

Microwave Digital Archive

IEEE Microwave Theory and Techniques Society

2002

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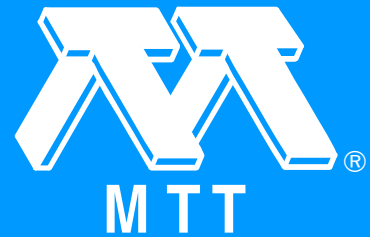
WELCOME:

The Microwave Theory and Techniques Society of the IEEE continues the task of archiving the IEEE Transactions on Microwave Theory and Techniques, and all other major publications including the IEEE Microwave and Wireless Components Letters (formerly called IEEE Microwave and Guided Wave Letters), as well as the digests of the IEEE International Microwave Symposium and the Radio Frequency Integrated Circuits conference. The 2002 annual Microwave Theory and Techniques CD-ROM archive is provided to keep everyone up-to-date with the latest publications.

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The section “Getting Started” in this Index tells you how to optimize the Acrobat Reader preferences to improve the readability of the document.



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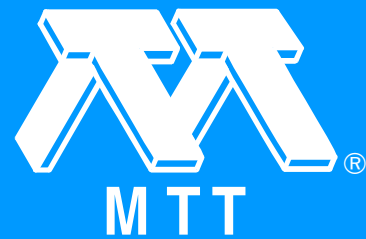
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If you find errors in the CD-ROM, e-mail a note to the current Editor of the Digital Archive project at Digital.Archive@mtt.org.

The 2002 CD-ROM archive was assembled from electronic files provided to us by Adam Philippidis at IEEE Headquarters. The material includes papers from the IEEE Transactions on Microwave Theory and Techniques edited by David Rutledge and his associated editors, and the IEEE Microwave and Wireless Components Letters edited by Samir El-Ghazaly and his associated editors.

Rob Hamilton edited the 2002 International Microwave Symposium (IMS) Digest. Joe Staudinger edited the Radio Frequency Integrated Circuits (RFIC) Digest. Aurea Taylor edited the IMS CD-ROM that included papers from both the IMS and the RFIC.



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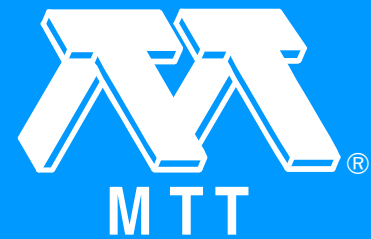


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Many people have contributed the CD-ROM archival effort. The Digital Archive project was initiated by Charlie Jackson and Roger Pollard. During my tenure as Editor, Charlie Jackson, Manfred Schindler, Karl Varian have provided constant help and support. I would also like to acknowledge the hard work of the reviewers of the journal disk. I hope that I have implemented their ideas and corrections and it is my only responsibility if any errors are still left unidentified. Last but not least, I want to acknowledge the enthusiastic support by the team at InControl Productions, Inc. Special thanks go to Barbara DiEdwardo for her assistance in producing the new journal disc.

Thank you and enjoy!

Luciano Boglione,
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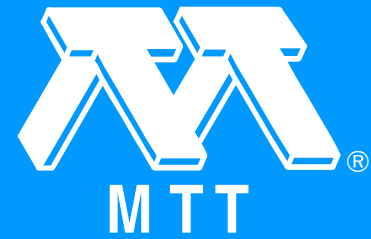


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ISBN: 0-7803-8147-5



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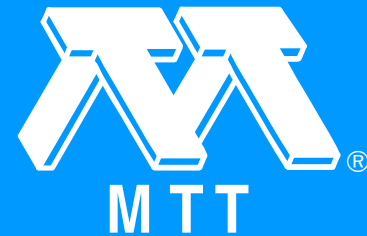
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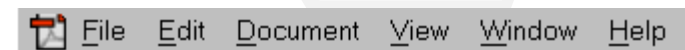
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The [README.TXT](#) file found on the root directory of this CD-ROM provides additional information.

In many instances, we refer to the “menu bar” and “tool bar”, shown here for reference.

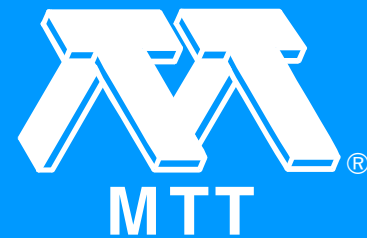
menu bar:



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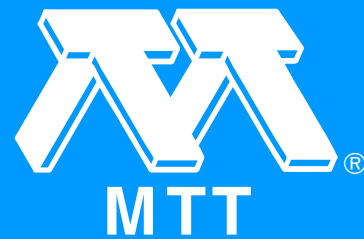
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RECOMMENDATIONS FOR OPTIMAL PERFORMANCE

In order to take full advantage of the performance capabilities of this collection, we recommend that you do the following:

1. To make navigation and searching easier, we strongly recommend changing the following Acrobat Search Preferences (found under Edit> Preferences > Search on the menu bar.) In the dialog box shown for Acrobat Search Preferences, make the following changes:
 - A. Select the “Document Information” option so that Title, Author, Keywords, and Subject fields are visible when specifying search criteria. If for some reason this preference option is not present on your system, check to see that you have the Search plug-in installed. The Search icon  will be present on the Acrobat tool bar if the function is properly installed. Specifics of the Search function are described later in this section.
 - B. Change “Show first 100 documents” to “Show first 1000 documents”. (Type in “1000” in the field provided.) This allows the maximum number of hits to be displayed during a search.

These settings will become your new default.



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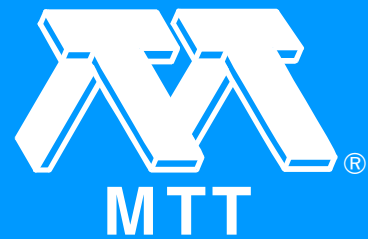
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USING BOOKMARKS

In addition to links, you can navigate through the Electronic Guide using Bookmarks. If they are not already visible, choose Window > Bookmarks from the menu bar or press the “Show/Hide Navigation Pane” button on the tool bar. A panel opens on the left side of the screen displaying Bookmarks in a hierarchy.

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Entries with lower level Bookmarks show a plus sign (+) when subordinate Bookmarks are hidden and a negative sign (-) when subordinate Bookmarks are visible. To view subordinate Bookmarks, click on the plus sign (+). To hide them, click on the negative sign (-). Dragging the right margin of the bookmark panel resizes it. Dragging the Bookmark tab moves the panel to a different location.



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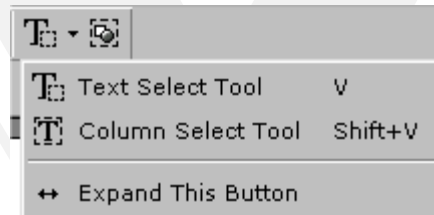
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SELECTING TEXT AND GRAPHICS

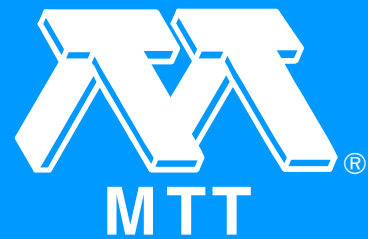
To select text or graphics, the appropriate select tool must be selected. The select tools share the same space on the tool bar.



To see more text selection tools you must click the arrow to the right of the Text Select Tool. A “flyout” menu will allow you to select the Column Select Tool.



See the Adobe Acrobat Reader 5.0 Guide (Help > Reader Help) for more information on these tools.



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NAVIGATION BUTTONS

Section Map

The current section is shown at the top of each page. The “path” to this section is shown at the right. Clicking these text buttons moves you to the start of that section.

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Click to go back to the previous page in the section.



(The Page Up and Page Down keys perform the same functions as the Next and Previous Page buttons.)

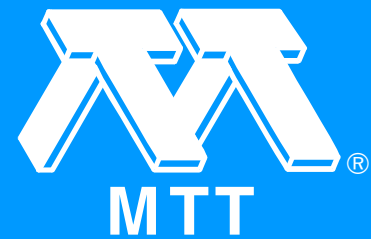
Fast Forward Pages

Click to advance (jump) multiple pages in the section.



Fast Back Pages

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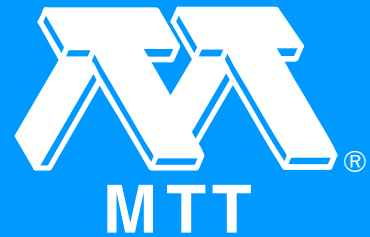


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Note to All users:

The “Return to Contents” is an Adobe Reader action of “Go Back Document.”

In search mode this action will take you to the previously viewed paper. Otherwise, this link will take you back to the Electronic Guide at the point from which you left.



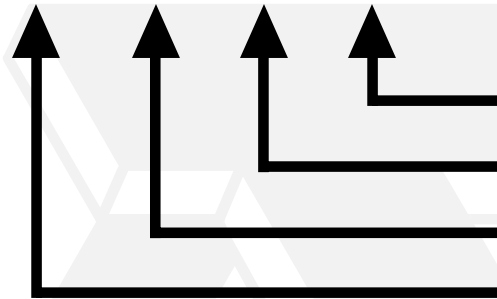
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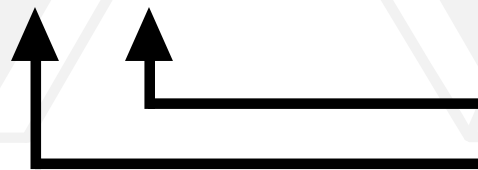
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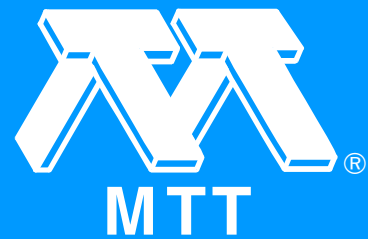
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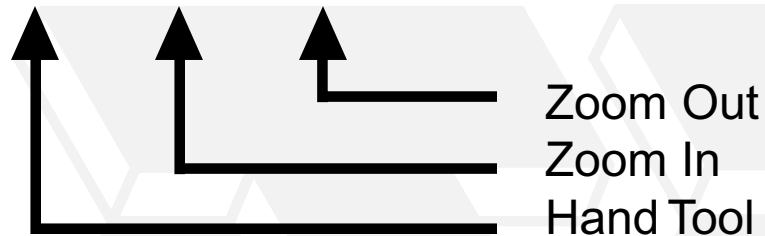


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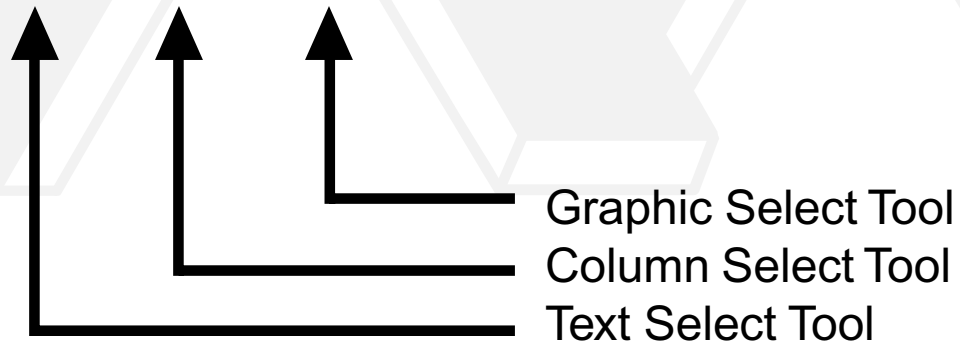
Zoom



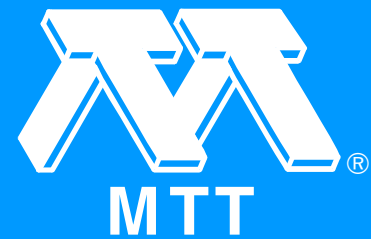
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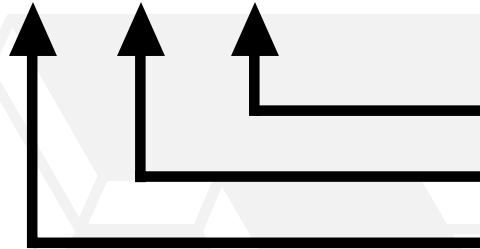


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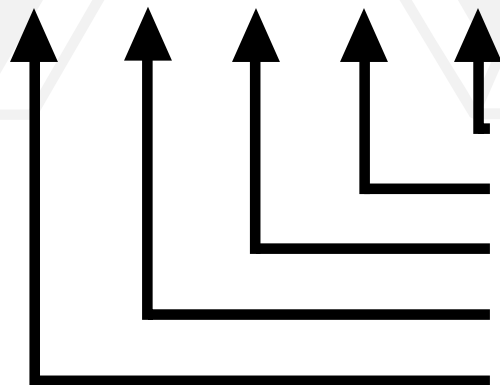
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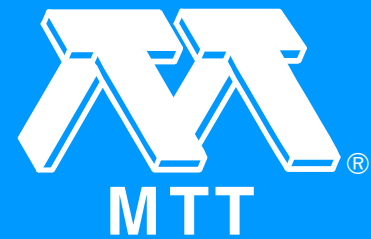
Fit Width
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Find/Search



Next Highlight (Hit)
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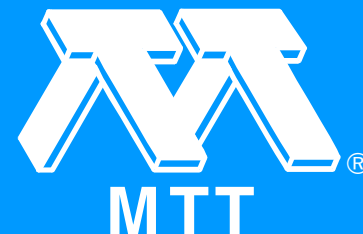
PERFORMING A “FIND”

Choosing Find opens a dialog box. Find scans linearly through the currently open Acrobat file from the cursor forward. If the Electronic Guide PDF is open, Find will scan the entire Electronic Guide for a match to your text. Type a text string in the field provided, check the appropriate options and press the “Find” button. Reader then highlights the first instance of the text string. To look at the next “hit”, click on the Find icon and press the “Find Again” button in the Acrobat Find window.

PERFORMING A “SEARCH”

Choosing the “Search” tool bar button or Search menu item (Edit > Search > Query), opens a dialog box from which you can access the more powerful full-text search engine (if you installed Acrobat Reader from this CD-ROM). Its dialog box is shown on the next page.

Typing a term in the text box at the top of the Search dialog box and pressing the “Search” button causes a full-text search of all words in the body of papers in the collection. If you have “Document



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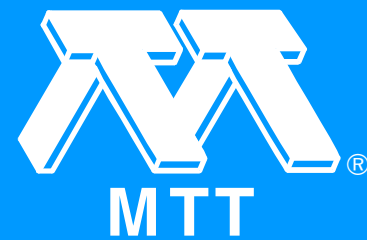
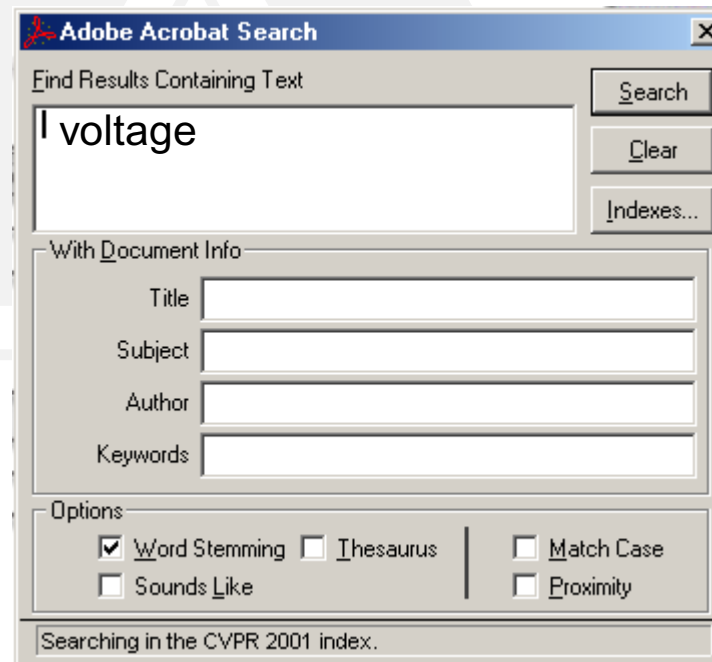


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Information” active in your Reader preferences, entering a term in one or more of the fixed fields (Title, Author, Subject or Keywords) will cause a search for hits in only those fields.

If you are not finding files you think should show in the results list, Acrobat may not be attached to the correct index file. To check, press the “Indexes...” button for a list of available indexes. If this collection is not listed, press the “Add...” button and look in the root directory of the CD-ROM for a file called “index.pdx”. Click on that file to add it to the list.

See the Reader Help (on Help menu) for more complete instructions on selecting appropriate options, constructing boolean queries, etc.



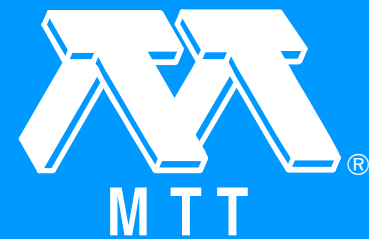
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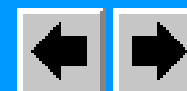


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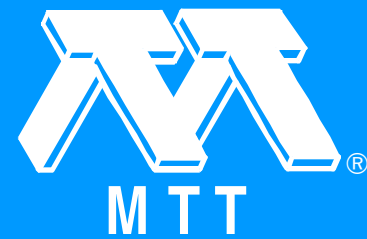


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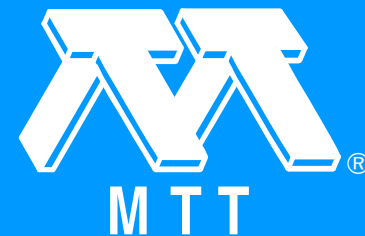
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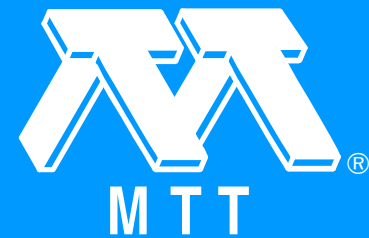
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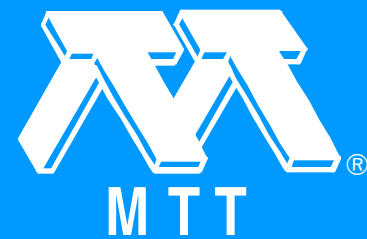
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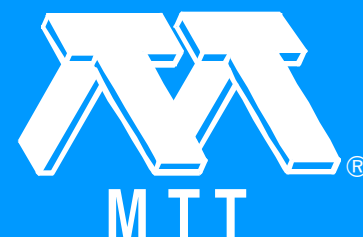
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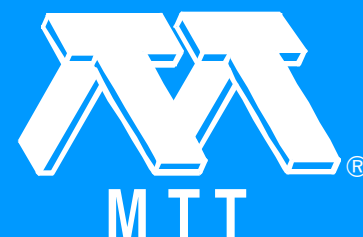
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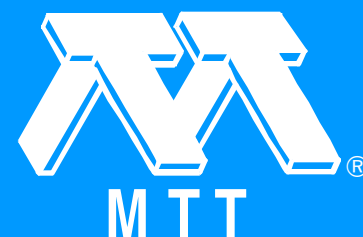
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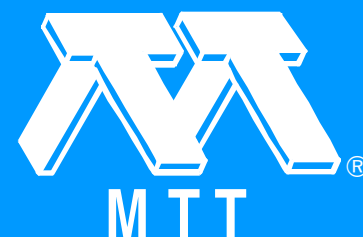
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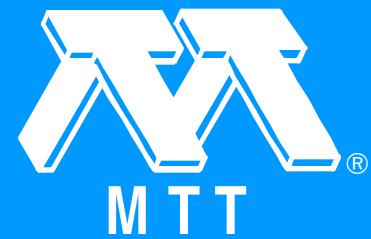
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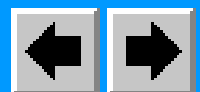
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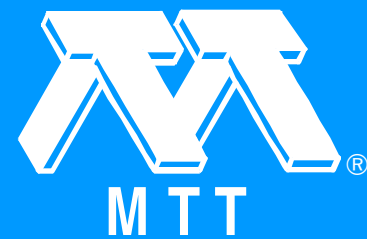
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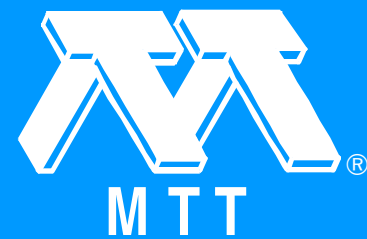
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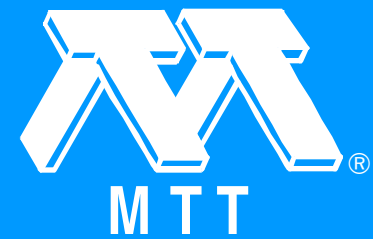
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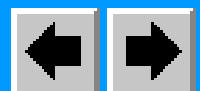


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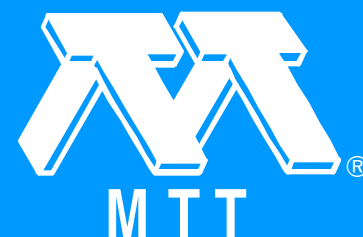
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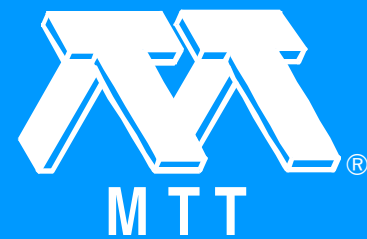
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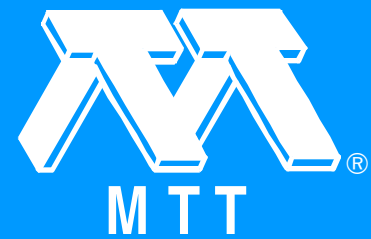
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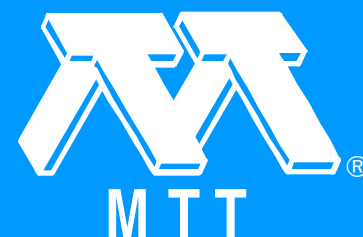
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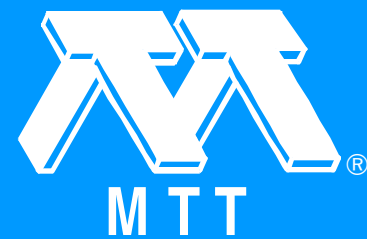
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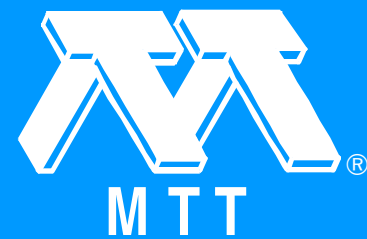
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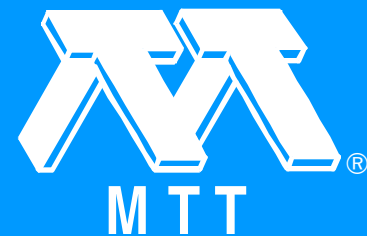
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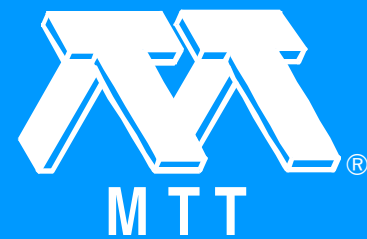
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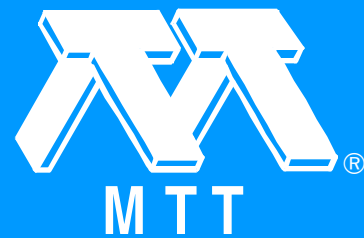
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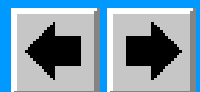
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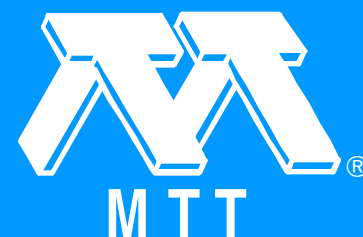
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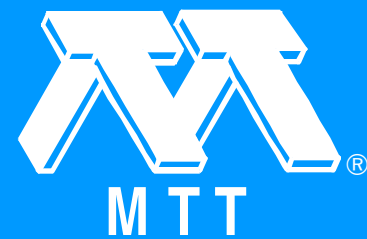
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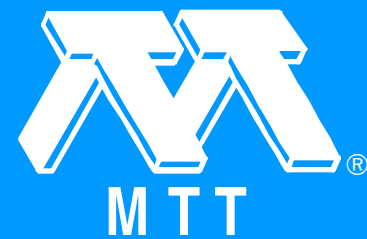
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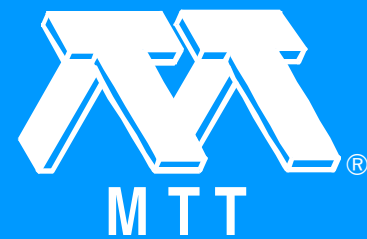
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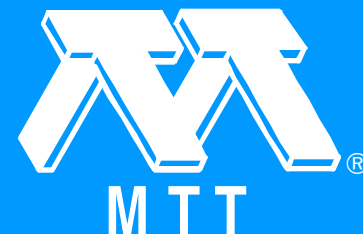
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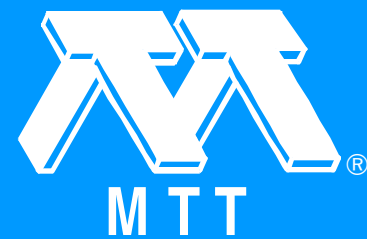
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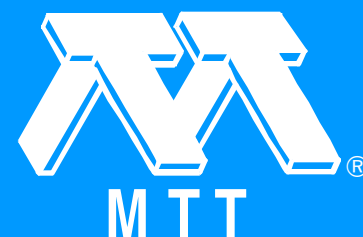
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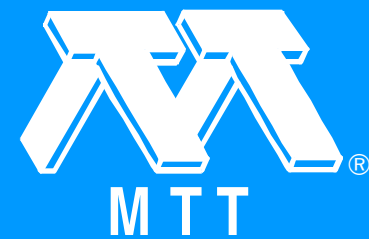
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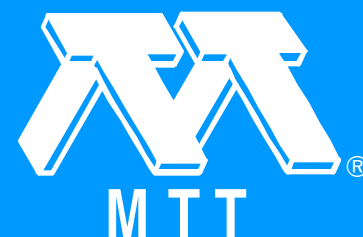
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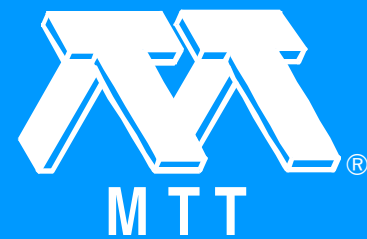
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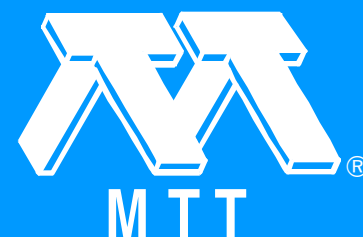
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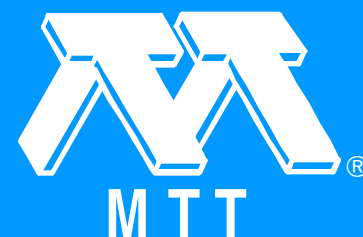
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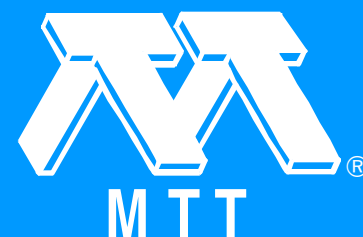
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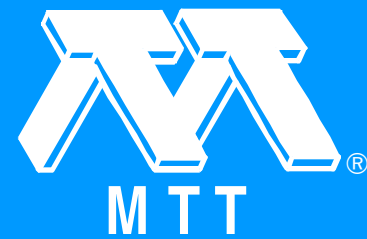
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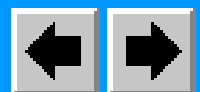
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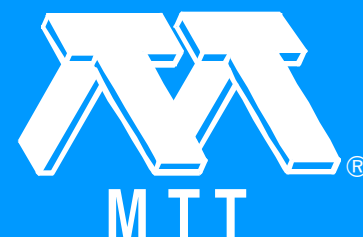
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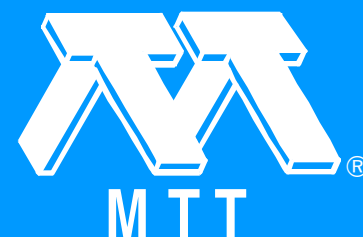
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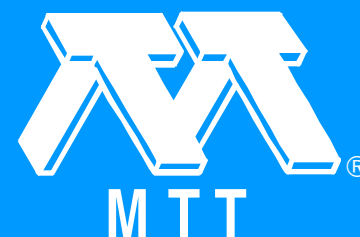
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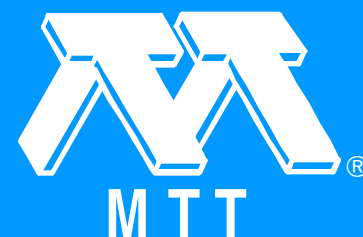
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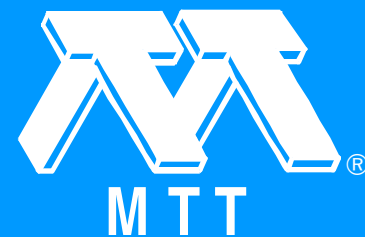
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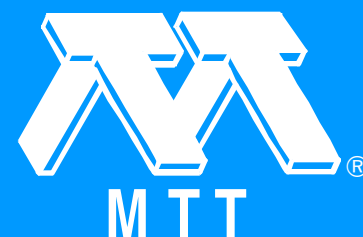
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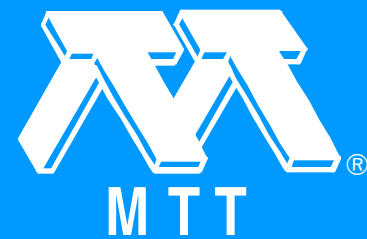
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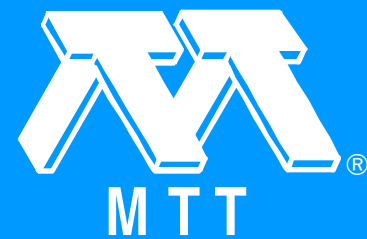
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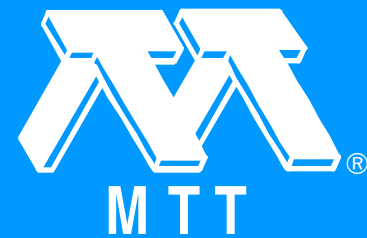
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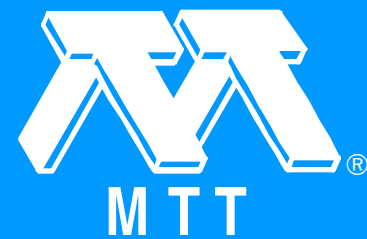
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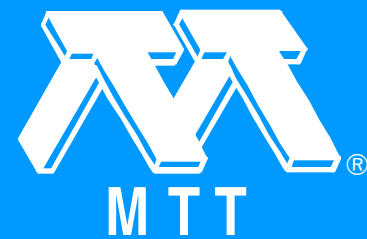
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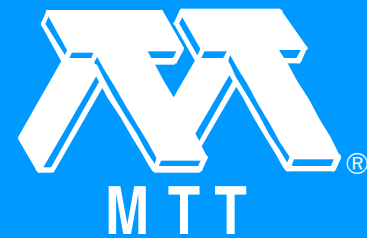
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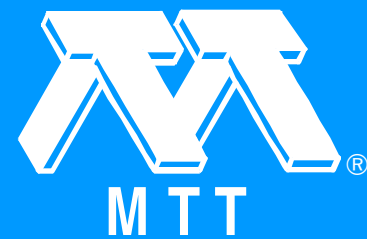
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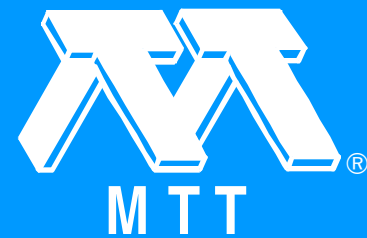
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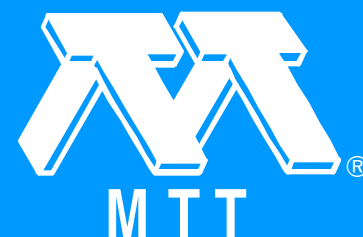
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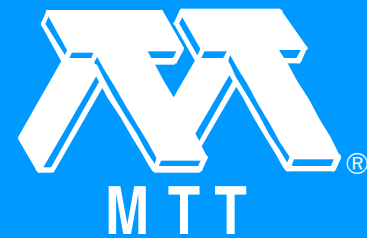
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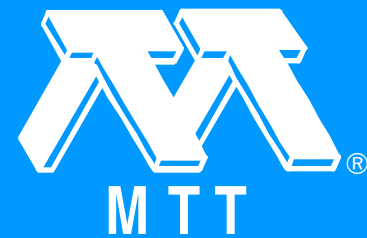
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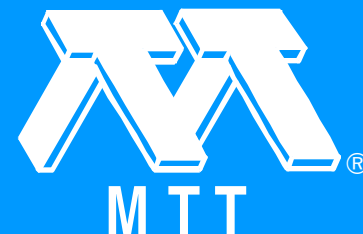
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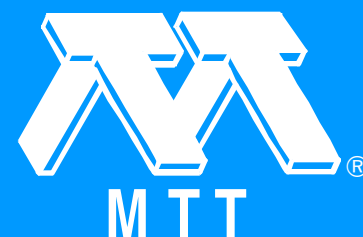
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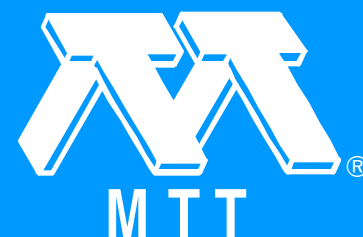
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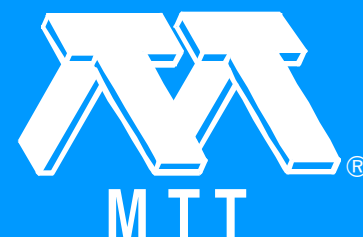
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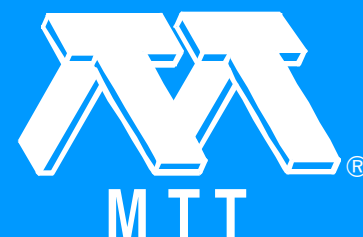
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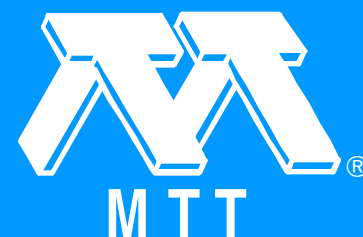
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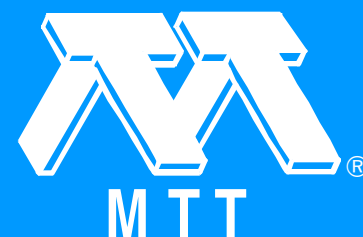
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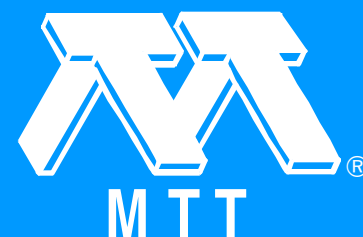
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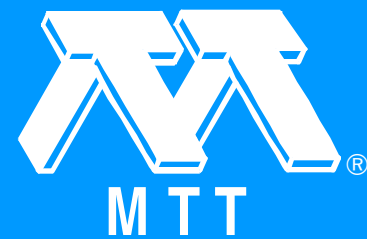
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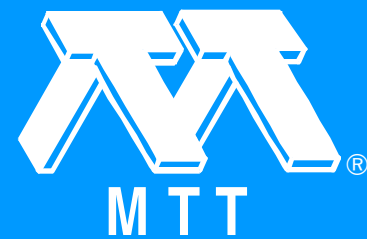
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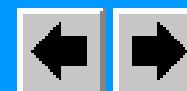


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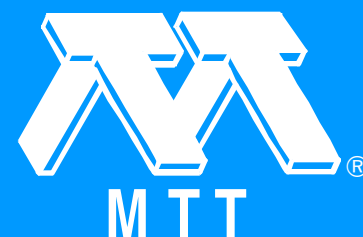
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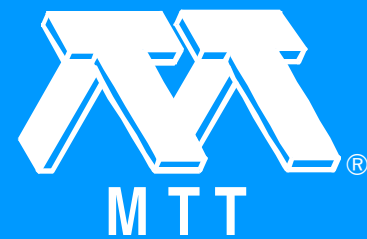
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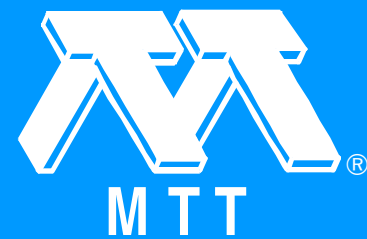
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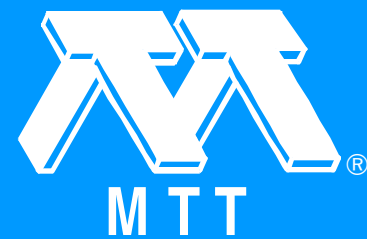
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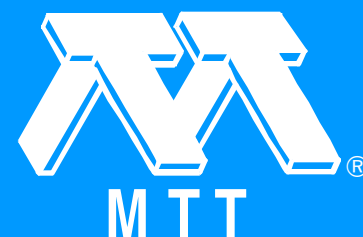
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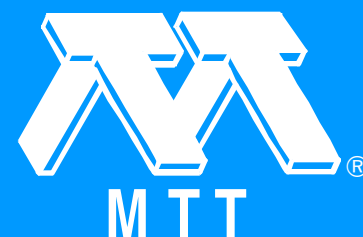
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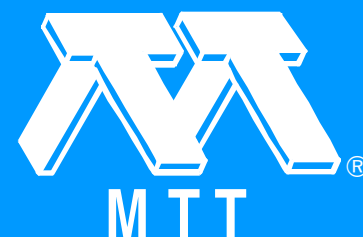
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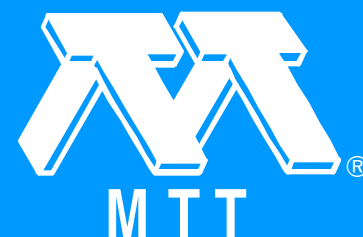
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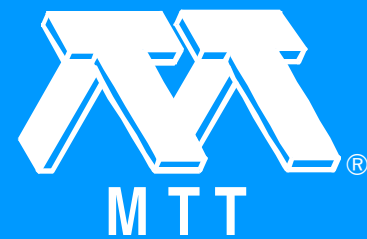
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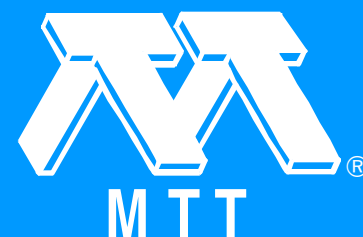
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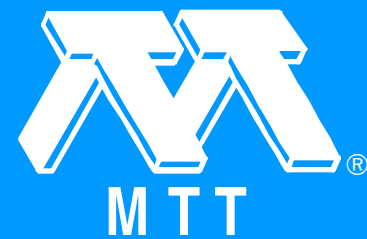
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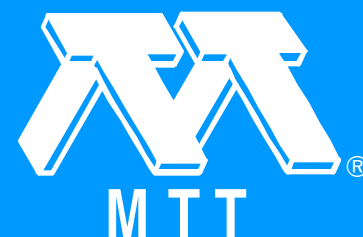
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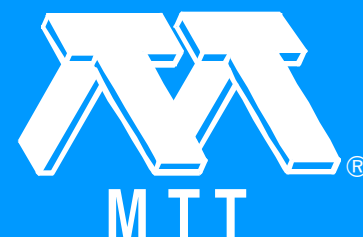
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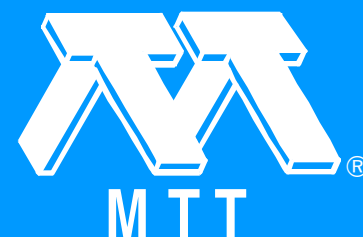
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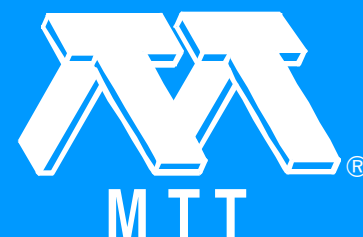
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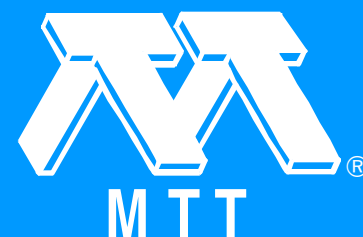
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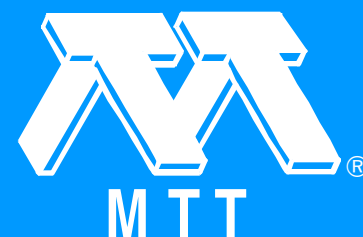
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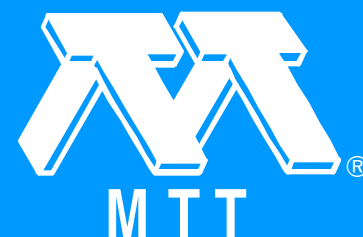
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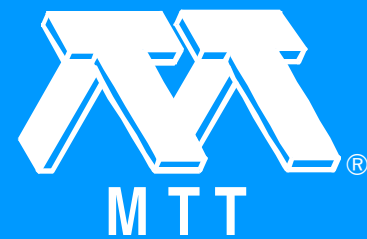
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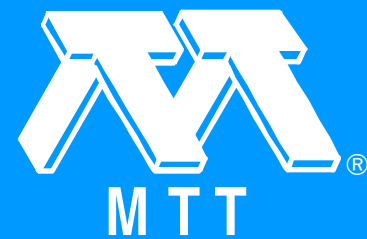
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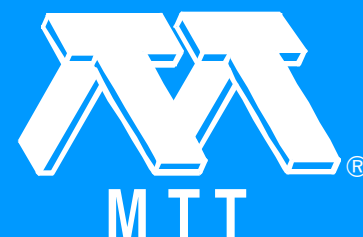
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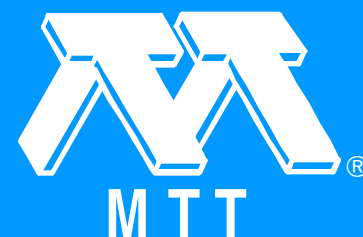
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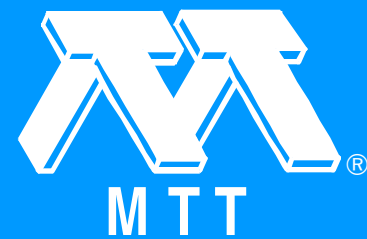
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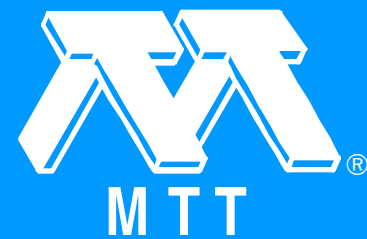
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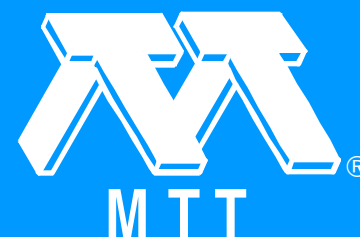
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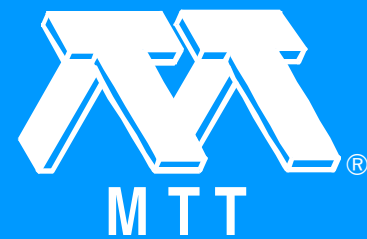
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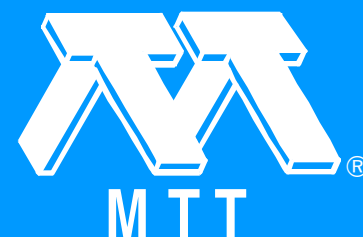
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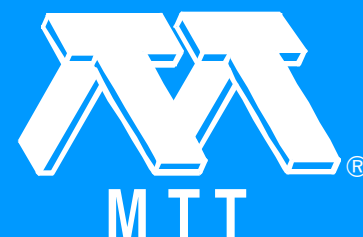
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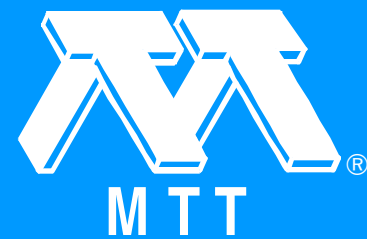
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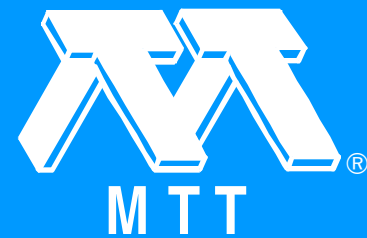
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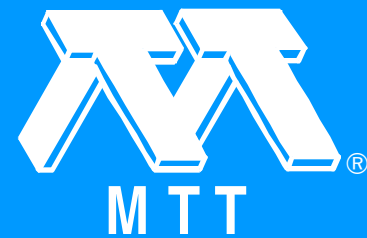
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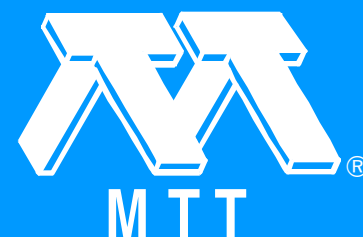
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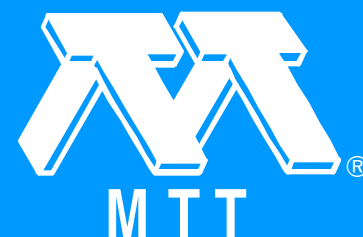
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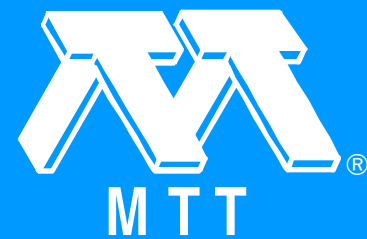
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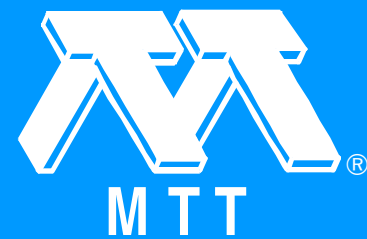
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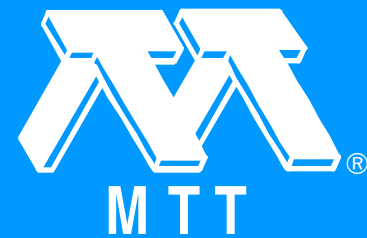
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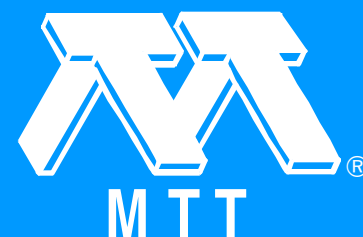
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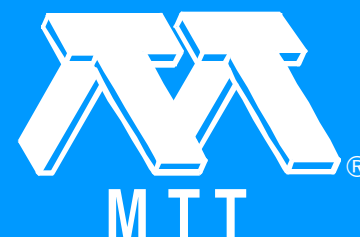
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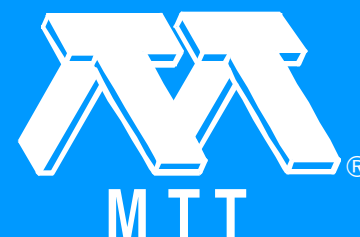
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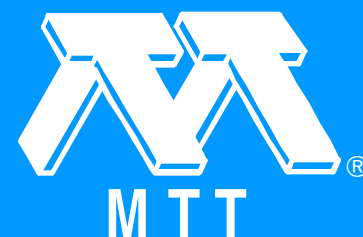
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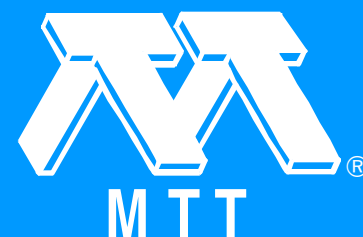
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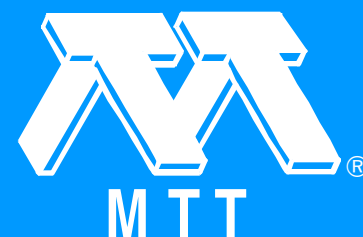
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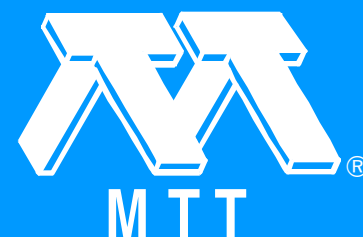
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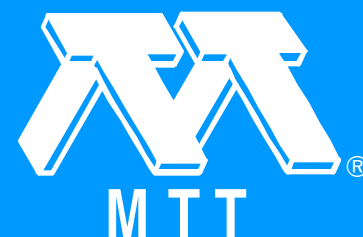
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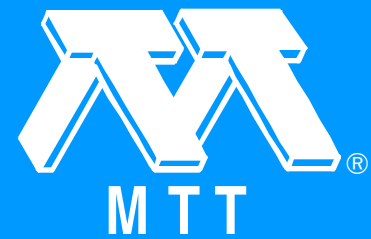
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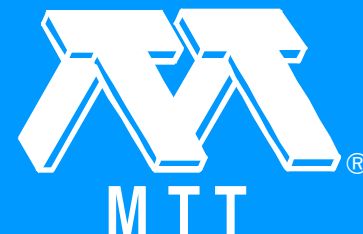
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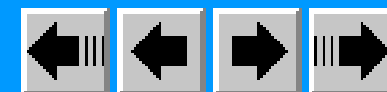
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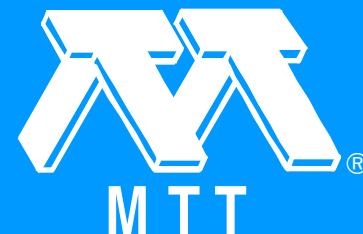
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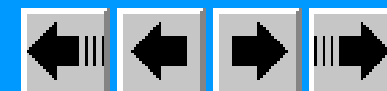
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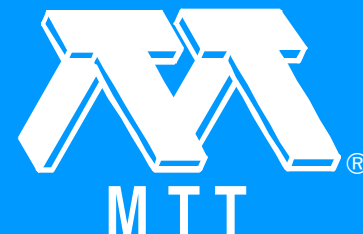
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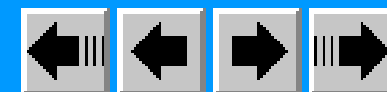
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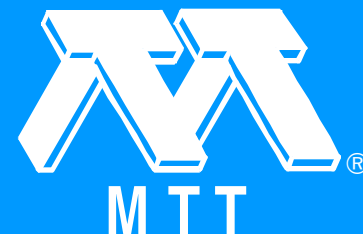
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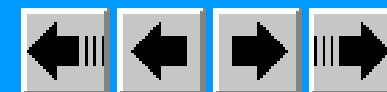
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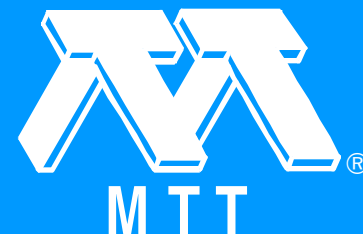
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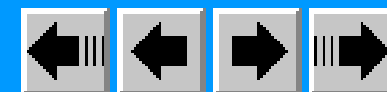
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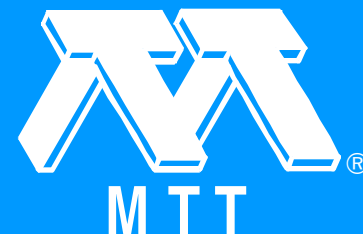
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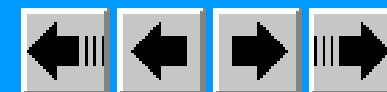
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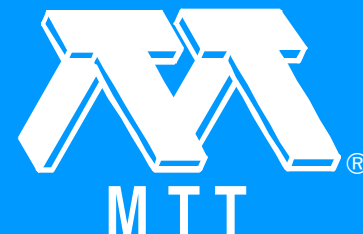
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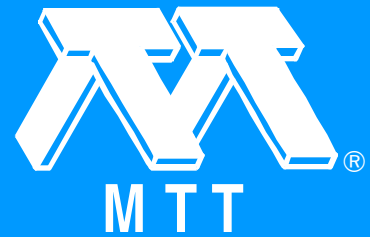


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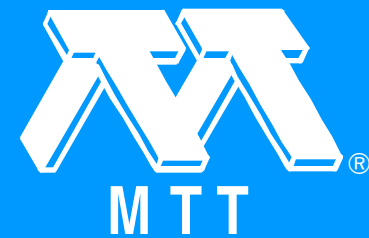
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"Table of Contents (Jan. 2002, Part I [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 0_1-0_2.



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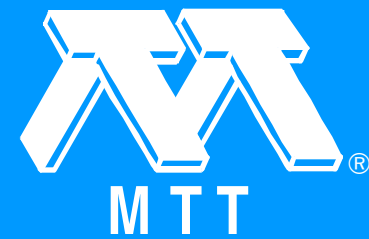
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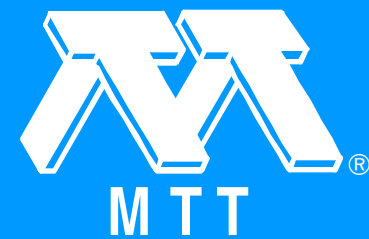
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Guest editors' overview (Jan. 2002, Part I [T-MTT])

H.E. Hernandez-Figueroa, P.H.P. De Carvalho, A.C. Bordonalli and F.J.S. Moreira. "Guest editors' overview (Jan. 2002, Part I [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 1-3.



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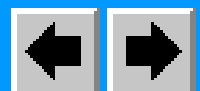
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GaN-based high electron-mobility transistors for microwave and RF control applications

N.V. Drozdovski and R.H. Caverly. "GaN-based high electron-mobility transistors for microwave and RF control applications." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 4-8.

Heterojunction FETs or high electron-mobility transistors (HEMTs) based on Al/sub x/Ga/sub 1-x/N/GaN are studied for their use as control components for high-power microwave and RF control devices (switches, phase-shifters, etc.). A linear operation model was developed for these components so that optimum transistor geometry and operation parameters may be determined for their use in control applications. The model was verified with experimental data taken on test HEMT devices. It was experimentally established that the HEMT resistance is low for voltages of +1.0 V, and that the capacitive reactance increases for de gate voltages below the threshold voltage of approximately -1.5 V.

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Design and fabrication of $\text{SiO}_2/\text{Si}_3\text{N}_4$ integrated-optics waveguides on silicon substrates

D.A.P. Bulla, B.-H.V. Borges, M.A. Romero, N.I. Morimoto and L.G. Neto. "Design and fabrication of $\text{SiO}_2/\text{Si}_3\text{N}_4$ integrated-optics waveguides on silicon substrates." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 9-12.

In this paper, the design and fabrication of silicon-based optical waveguides are revisited. The goal is to develop a novel design and deposition process to minimize leakage losses. Interface roughness and Si_3N_4 stoichiometry are examined. The optical loss is measured and contributions from scattering and absorption are determined.

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Security system for optical communication signals with fiber Bragg gratings

P. Torres, L.C.G. Valente and M.C.R. Carvalho. "Security system for optical communication signals with fiber Bragg gratings." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 13-16.

A security system for optical communication signals based on Bragg grating structures is presented in this paper. The technique can be implemented in different levels of sophistication with corresponding cost and technical difficulty. The technique is demonstrated in its simplest version with an array of two fiber Bragg gratings in each side of the optical link. The principle has been tested with a periodic pulse train of 1.4-GHz repetition rate. A simulation that allows the design of more sophisticated systems is also presented and show very good agreement with experimental results.



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A circuit-fed tile-approach configuration for millimeter-wave spatial power combining

M.A. Gouker, J.T. Delisle and S.M. Duffy. "A circuit-fed tile-approach configuration for millimeter-wave spatial power combining." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 17-21.

In this paper, a circuit-fed spatially combined transmitter array is described for operation at 44 GHz. The array contains 256 elements where each element consists of a monolithic-microwave integrated-circuit amplifier and a circularly polarized microstrip patch antenna. The array is constructed using 16-element tile-approach subarrays. Each subarray is a two RF-level (three-dimensional) multichip module containing integrated microstrip patch antennas. The basic construction of the transmitter array resembles tile-approach phased arrays; however, the implementation has been tailored for the power-combining application. The peak performance at 43.5 GHz is equivalent isotropic radiated power of 40.6 dBW (11570 W), effective transmitted power (P_{eff}) of 5.9 W, dc-to-RF efficiency of 7.3%, and system gain of 35 dB.

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A dynamic model for printed apertures in anisotropic stripline structures

J.C.D.S. Lacava, A.V.P. De la Torre and L. Cividanes. "A dynamic model for printed apertures in anisotropic stripline structures." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 22-26.

This paper presents a full-wave analysis method for printed apertures in anisotropic stripline structures. Both electric and magnetic anisotropy of the most general form are assumed. Working in the Fourier domain, closed-form expressions for the transformed electromagnetic fields are derived. Special attention is dedicated to the particular case of dielectrics with uniaxial anisotropy. In this case, spectral Green's functions in compact and closed form are obtained. Effects of the anisotropic ratio on the input impedance of a printed slot are presented.

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Theoretical investigation of compact microstrip resonators with stubs for patch antennas

V.A. Dmitriev and J.C.W.A. Costa. "Theoretical investigation of compact microstrip resonators with stubs for patch antennas." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 27-29.

The influence of the stubs on the resonance frequency and on the susceptance slope parameter of the disc resonator is investigated theoretically. It is shown that the stubs may significantly reduce the diameter of the resonator at the expense of bandwidth.

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Split-field and anisotropic-medium PML-FDTD implementations for inhomogeneous media

F.L. Teixeira, C.D. Moss, W.C. Chew and J.A. Kong. "Split-field and anisotropic-medium PML-FDTD implementations for inhomogeneous media." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 30-35.

In this paper, we present three-dimensional finite-difference time-domain (FDTD) algorithms for transient simulation of electromagnetic-wave propagation in arbitrary inhomogeneous media, which incorporate the perfectly matched layer (PML) absorbing boundary condition. We discuss the choice of constitutive parameters inside the PML layers to match the interior inhomogeneous media for planar interfaces and corner regions. We illustrate the method using both a split-field PML-FDTD formulation in Cartesian coordinates and an anisotropic medium (unsplit) PML-FDTD formulation in cylindrical coordinates.

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An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines

A. Casanueva and J.L. Garcia. "An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 36-40.

A full-wave electromagnetic technique is developed for the rapid and accurate calculation of dispersion characteristics in multiconductor and multilayer planar transmission lines. The proposed method is based on the Mrozowski and Przybyszewski algorithms. This powerful method calculates an approximate value of propagation constant at a desired frequency based on more accurate computations of the field distribution and propagation constant at a few selected frequency points. Comparison with previously accurate published data and numerical tests are first performed to confirm the accuracy of our procedure. Numerical results for several configurations are presented.

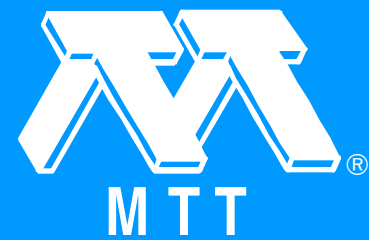
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Characteristics of rain fading on Ka-band satellite-earth links in a Pacific maritime climate

C. Amaya and D.V. Rogers. "Characteristics of rain fading on Ka-band satellite-earth links in a Pacific maritime climate." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 41-45.

Characteristics of rain-induced attenuation at Ka-band measured over a four-year period (1994-1997) with the advanced communications technology satellite (ACTS), Vancouver, BC, Canada, are reported. Event-based analyses of fading are performed and examples of the instantaneous 30/20-GHz frequency-scaling ratio are presented. Long-term cumulative statistics of rain rate as derived from rain-gauge measurements, along with annual attenuation statistics at 20 and 30 GHz, are provided. Finally, attenuation statistics are compared with the ITU-R model and aspects related to local climatic characteristics are considered, aiming to improve the predictions of attenuation due to rain.



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A generalized solution for diversity combining techniques in fading channels

C.R.C.M. da Silva and M.D. Yacoub. "A generalized solution for diversity combining techniques in fading channels." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 46-50.

This paper develops an exact and general formulation in order to investigate the performance of equal gain, selection/equal gain, and selection/maximal ratio combining techniques. The performance is examined in terms of both the reliability and mean signal-to-noise ratio at the combiner output. Although the solution presented here considers the Nakagami fading environment, the formulation is general and can be easily applied to any other fading channel.





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Monolithic transistor SPST switch for L-band

J.A. Torres and J.C. Freire. "Monolithic transistor SPST switch for L-band." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 51-56.

A comparison of single-pole single-throw switch topologies is presented in this paper. A three-MESFET monolithic GaAs switch was designed, for 2-GHz operation, fabricated and tested in three different bias conditions: $V_{\text{sub bias}} = 0$ (self-bias); $I_{\text{sub bias}} = 0$ (floating); and $V_{\text{sub bias}} \neq 0$, $I_{\text{sub bias}} \neq 0$ (biased). It will be shown that a floating configuration presents on-state lower insertion loss (IL) (~ 1.7 dB). However, the off-state isolation has the same order of magnitude in all three bias conditions (typically 50 dB). Comparing measurements and simulations, the best available nonlinear model for the floating bias operation was selected. Finally, several resonant topologies were studied and a new topology is proposed to increase the off-state isolation without degrading the on-state IL. The advantages and drawbacks of resonant topologies over nonresonant configurations are also discussed, taking into account technology constraints and operation frequency. A solution to reduce the inductor value is proposed.

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A new model for enhancement-mode power pHEMT

Ce-Jun Wei, Y.A. Tkachenko and D. Bartle. "A new model for enhancement-mode power pHEMT." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 57-61.

Optimum loading for a power enhancement-mode pseudomorphic high electron-mobility transistor (E-pHEMT) is determined by a systematic harmonic load-pull simulation. The simulation uses a modified Angelov-Parker model that can accurately predict DC, small-signal RF, and power performance of the devices. The optimum second harmonic loading for a 2-mm device is found to be open circuit and the optimum third harmonic is at the third quadrant, which is about $1/\text{spl ang}/210/\text{spl deg/}$. The measured versus modeled results show very good agreement and, therefore, verify the model. The simulation predicts that as high as 80% power-added efficiency can be achieved for E-pHEMT under optimum source and load termination with harmonic tuning.

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High-speed MSM/HEMT and p-i-n/HEMT monolithic photoreceivers

P. Fay, C. Caneau and I. Adesida. "High-speed MSM/HEMT and p-i-n/HEMT monolithic photoreceivers." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 62-67.

The performance of monolithically integrated metal-semiconductor-metal/high electron-mobility transistor (MSM/HEMT) and p-i-n/HEMT photoreceivers is reported. p-i-n/HEMT photoreceivers have been designed and fabricated, resulting in measured transimpedances of 700 Ω , an 8.3-GHz bandwidth, and measured sensitivities of -17.7 dBm at 10 Gb/s and -15.8 dBm at 12 Gb/s for a 2/3 - 1 pattern length pseudorandom bit sequence at a bit error rate of 10⁻⁹. Low-noise MSM-based photoreceivers have also been designed and fabricated, and frequency response, noise, and sensitivity measurements have been performed. Sensitivities of -16.9, -13.1, and -10.7 dBm were obtained at 5, 8, and 10 Gb/s, respectively. A direct comparison of p-i-n- and MSM-based photoreceivers is undertaken on photoreceivers with matched responsivity and bandwidth. Measurement and theoretical analysis of circuit and device noise indicates an anomalous sensitivity penalty in MSM-based receivers that arises due to intersymbol interference.

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Barrier enhancement mechanisms in heterodimensional contacts and their effect on current transport

A. Anwar and B. Nabet. "Barrier enhancement mechanisms in heterodimensional contacts and their effect on current transport." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 68-71.

It has been shown that, in a three-dimensional (3D) to two-dimensional (2D) contact system, the quantized nature of the energy of the 2D system imposes important changes on thermionic emission of carriers from a 3D metal to two-dimensional electron gas (2DEG). Interestingly, in actual devices, barrier heights higher than what is theorized based on the first confined state are measured. In this paper, we introduce an additional mechanism that explains barrier height enhancement in 3D-2D contacts, which is due to the repulsive Coulombic force that is exerted by the 2DEG on the thermionically emitted electrons. An analytical derivation of the barrier height due to this effect is given and total thermionic emission current is derived. These results are particularly important for design and understanding of device behavior for low-noise photodetectors in front end optical receivers. The electron cloud model presented for the reservoir of mobile charges that are free to move in response to charged particle or electromagnetic waves implies that any means of interaction that disturbs the equilibrium of the electron cloud have strong signature at the contact, as well as the temporal response of the induced disturbance. This can be effective for low-power-detection applications.

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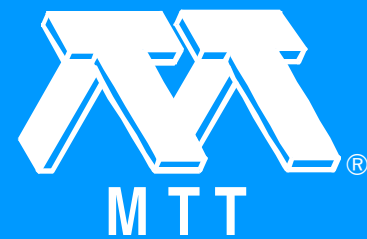
Scattering by FSS on anisotropic substrate for TE and TM excitation

A.L.P.S. Campos, A.G. d'Assuncao and L.M. de Mendonca. "Scattering by FSS on anisotropic substrate for TE and TM excitation." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 72-76.

The scattering of electromagnetic waves from frequency-selective surfaces (FSS) composed of rectangular conducting patches mounted on uniaxial dielectric anisotropic substrate is investigated by using a full-wave analysis. The moment method is used in combination with the spectral-domain immittance approach to determine reflection and transmission coefficients of the FSS structure as function of the geometry parameters and dielectric anisotropy. The analysis provides very accurate results compared to those presented by others and to those obtained by measurements.

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Carrier reuse with gain compression and feed-forward semiconductor optical amplifiers

E. Conforti, C.M. Gallep, S.H. Ho, A.C. Bordonalli and Sung-Mo Kang. "Carrier reuse with gain compression and feed-forward semiconductor optical amplifiers." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 77-81.

The results of two techniques for optical carrier regeneration and wavelength reuse using semiconductor optical amplifiers (SOAs) are presented in this paper. The main objective is to recover an optical carrier by erasing its amplitude modulation. The first technique employs gain compression of deeply saturated SOAs. The second technique uses a feed-forward approach, where a delayed current signal is injected into the SOA with the same shape of the incoming optical pulse. The second technique could be capable to recover the optical carrier with less than 3-dB noise. However, it was observed that the SOA gain recovery time limits the maximum usable bit rate. Theoretical simulation showed good agreement with experimental results.

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A novel gold-coated multimode fiber sensor

E. Fontana. "A novel gold-coated multimode fiber sensor." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 82-87.

A novel optical-fiber sensor is proposed for use in chemical analysis. The sensor probe is made of a gold-coated multimode optical fiber, configured to exhibit surface plasmon resonance (SPR) when immersed in a wet environment. The proposed detection strategy comprises measurement of the image pattern irradiated by the fiber under monochromatic illumination. A theoretical model is proposed to determine device performance. From computer simulations, it is shown that the proposed configuration and detection strategy allows reaching a 30-fold enhancement in sensitivity relative to that obtained in previous SPR-based versions of the device.

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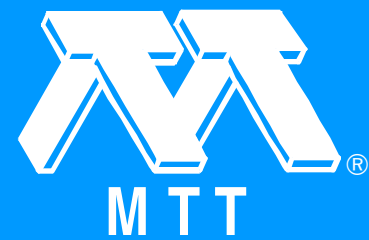
System impact of the physical length of unapodized chirped fiber Bragg gratings on dispersion compensation

M.L. Rocha, R. Kashyap, R.F. Souza, A. Paradisi, M.R.X. Barros and C. Coral. "System impact of the physical length of unapodized chirped fiber Bragg gratings on dispersion compensation." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 88-93.

It is shown, for the first time, how the group-delay ripple, due to a pair of identical unapodized dispersion compensating gratings, can be affected by a small change in the physical length of one of the gratings. It is theoretically and experimentally demonstrated that the ripple can be smoothed by a slight difference in length between the gratings. The pair are arranged in a four-port optical circulator in a cascading configuration. System simulations indicate that the performance of the unapodized gratings may be improved by using such a scheme. This has implications for dispersion compensation in high-speed long-haul transmission systems.

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Evolution of leaky modes on printed-circuit lines

F. Mesa, D.R. Jackson and M.J. Freire. "Evolution of leaky modes on printed-circuit lines." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 94-104.

The frequency evolution of dominant (quasi-TEM) and higher order modes on an open printed-circuit structure such as a microstrip is examined. Three different mode types are considered, including bound modes (BMs), leaky modes that leak into the surface wave of the background structure, and leaky modes that also leak into space. One of the fundamental goals is to establish the conditions under which one type of mode can transition into another type as the frequency changes. One important conclusion is that the dominant BM can never transition into a leaky mode for a microstrip structure with an isotropic substrate, but such a transition is possible for an anisotropic substrate, observed originally by Tsuji et al. and Shigesawa et al. However, higher order BMs can directly transition into leaky modes, as shown by Oliner and Michalski and Zheng. On other structures such as coplanar strips, where the bound dominant mode exhibits odd symmetry, a transition from a bound dominant mode to a leaky mode is possible, as shown by Shigesawa et al. and Tsui et al. In addition to examining the mathematical transitions that are possible, the physical continuation of modes is also investigated, by examining the frequency evolution of the currents excited by a practical source. It is concluded that there may be physical continuity between modes, even if there is no mathematical continuity.





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Analysis and optimization of a phase shifter controlled by a piezoelectric transducer

Tae-Yeoul Yun and Kai Chang. "Analysis and optimization of a phase shifter controlled by a piezoelectric transducer." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 105-111.

This paper introduces a method for analyzing and optimizing a phase shifter controlled by a piezoelectric transducer (PET). To analyze the multilayer microstrip structure of the PET-controlled phase shifter, new equivalent single-layer (ESL) equations for the phase shift and loss calculations are developed and confirmed with spectral-domain analysis (SDA) of the moment method. A parametric analysis is accomplished with ESL equations and SDA, and optimization guidelines are suggested. An optimized PET phase shifter is demonstrated to operate up to 40 GHz with a maximum total loss of 4 dB and phase shift of 480/spl deg/. Measured results agree very well with calculations showing substantially smaller control voltage, size, and dispersion, as compared to previously published data. This new analysis and optimization technique for the PET-controlled phase shifter should be useful in the design of phased-array antennas and tunable microwave circuits.

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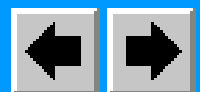
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Dyadic Green's function modifications for obtaining attenuation in microstrip transmission layered structures with complex media

C.M. Krowne. "Dyadic Green's function modifications for obtaining attenuation in microstrip transmission layered structures with complex media." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 112-122.

Rigorous derivation of the correction to the Green's function for a microstrip structure containing complex layered media is done for imperfect metallization. A hierarchy of formulas is found consistent with a full-wave electromagnetic code employing zero-thickness extent conductors for the guiding structure metal. At the top of the hierarchy are formulas that utilize new Green's functions of the structure, whereas at the bottom are formulas that are only dependent on the conductor geometry and material properties. Numerical examples are provided to show the sensitivity of the propagation constant attenuation to those elegantly simple formulas at the bottom of the hierarchy.

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Active microwave imaging. I. 2-D forward and inverse scattering methods

Qing Huo Liu, Zhong Qing Zhang, T.T. Wang, J.A. Bryan, G.A. Ybarra, L.W. Nolte and W.T. Joines. "Active microwave imaging. I. 2-D forward and inverse scattering methods." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 123-133.

Active microwave imaging (MWI) for the detection of breast tumors is an emerging technique to complement existing X-ray mammography. The potential advantages of MWI arise mainly from the high contrast of electrical properties between tumors and normal breast tissue. However, this high contrast also increases the difficulty of forming an accurate image because of increased multiple scattering. To address this issue, we develop fast forward methods based on the combination of the extended Born approximation, conjugate- and biconjugate-gradient methods, and the fast Fourier transform. We propose two nonlinear MWI algorithms to improve the resolution for the high-contrast media encountered in microwave breast-tumor detection. Numerical results show that our algorithms can accurately model and invert for the high-contrast media in breast tissue. The outcome of the inversion algorithms is a high-resolution digital image containing the physical properties of the tissue and potential tumors.





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On the effect of IF power nulls in Schottky diode harmonic mixers

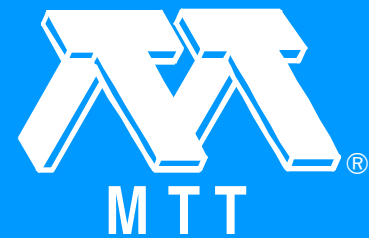
R. Feinaugle, H.-W. Hubers, H.P. Roser and J.L. Hesler. "On the effect of IF power nulls in Schottky diode harmonic mixers." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 134-142.

Experimental results reveal the existence of a null in the IF output power for certain bias voltage levels in single Schottky diode harmonic mixers at terahertz frequencies. This dramatic loss of IF power is due to a drastic increase of conversion loss and is governed by intrinsic diode parameters, as well as external parameters. For a second harmonic mixer, this is due to a competition of two mixing paths; one is the mixing of the RF with the doubled local oscillator (LO) frequency and the other a mixing of the RF with the LO to an LO sideband followed by a second mixing with the LO, both leading to the IF. In this paper, we present a systematic investigation of and some basic relations between these parameters and the depth and voltage levels where the conversion loss increases. Good agreement is obtained between a simple analysis and the experimental data on second and fourth harmonic mixers.

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Experimental confirmation of the dynamics of coupled-oscillator arrays and implications for angle-based modulation

R.J. Pogorzelski. "Experimental confirmation of the dynamics of coupled-oscillator arrays and implications for angle-based modulation." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 143-149.

This paper describes a set of experimental measurements designed to test the predictions of the continuum theoretical model concerning the dynamics of a linear array of mutually injection-locked voltage-controlled oscillators. The model indicates that the phase distribution evolves according to a diffusion process, the diffusion rate being determined by the inter-oscillator locking range. The theoretical predictions are confirmed by the experimental results. In addition, a discussion of computational predictions of the characteristics of the signal received in the far zone when such an oscillator array excites a linear array of radiating elements is included.

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A miniaturized MMIC analog phase shifter using two quarter-wave-length transmission lines

H. Hayashi, T. Nakagawa and K. Araki. "A miniaturized MMIC analog phase shifter using two quarter-wave-length transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 150-154.

This paper describes a miniaturized monolithic-microwave integrated-circuit (MMIC) analog phase shifter using two quarter-wave-length transmission lines. A conventional analog phase shifter employs an analog phase-shifter topology using a 3-dB 90/spl deg/ branch-line hybrid requiring four quarter-wave-length transmission lines. Thus, in the first stage of our study, we present a new analog phase-shifter topology using only two quarter-wave-length transmission lines. The phase shifter here has only one-half as many transmission lines as a conventional analog phase shifter using a 3-dB 90/spl deg/ branch-line hybrid, and the circuit can be miniaturized to less than one-fourth as compared to the conventional analog phase shifter. Furthermore, we show that the operating frequency range of the phase shifter is very wide and can obtain large phase variation with small capacitance variation. Next, an experimental Ku-band MMIC analog phase shifter is presented. A phase shift of more than 180/spl deg/ and an insertion loss of 3.6/spl plusmn/1.1 dB are obtained at the frequency range from 12 to 14 GHz. The chip size of the experimental MMIC phase shifter is less than 3.0 mm/sup 2/.

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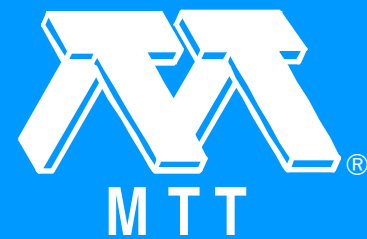
Method for the calculation of mutual coupling between discontinuities in planar circuits

B.L.A. Van Thielen and G.A.E. Vandenbosch. "Method for the calculation of mutual coupling between discontinuities in planar circuits." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 155-164.

In this paper, a fast method for the calculation of mutual coupling between discontinuities is described. The discontinuities must be small compared to the wavelength and compared to the distance between them. For most circuits, these assumptions are valid. Under these circumstances, the component's (discontinuity) radiation behavior can be accurately modeled by using adequately placed dipoles. This method uses far less unknowns than the method of moments. If the distances between the components become smaller or the components become bigger, then the accuracy can be improved by using more dipoles.

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Design considerations of engraved NRD guide for millimeter-wave integrated circuits

Y. Cassivi, D. Deslandes and K. Wu. "Design considerations of engraved NRD guide for millimeter-wave integrated circuits." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 165-171.

Practical construction of nonradiative dielectric (NRD) guide components such as filters, junctions, or hybrid planar NRD-guide circuits is rather difficult because of the tedious alignment and tolerance requirement of various separate NRD-guide elements. To overcome this hurdle, we present a new scheme called the engraved NRD guide (ENRD). This ENRD guide is an NRD guide whose outline is machined out of a single dielectric block, thereby eliminating the alignment constraint, and allowing a better precision for physical design, realization, and integrity of the overall circuit. Design considerations and procedures of the ENRD guide are studied and discussed in this paper, which suggest the predominance of gap dimension in obtaining a quasi-nonradiative condition with similar propagation properties as a normal NRD guide. It also shows that the amount of dielectric material left in support of the whole structure alignment could greatly affect the leakage level of the guide. An ENRD-guide 90/spl deg/ bend and filter were designed and measured. Investigation of the ENRD-guide filter leads to the characterization of an evanescent LSM/sub 10/ mode in the air gap region between the resonators necessary for reducing its insertion loss.

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A simple method to design wide-band electronically tunable combline filters

G. Torregrosa-Penalva, G. Lopez-Risueno and J.I. Alonso. "A simple method to design wide-band electronically tunable combline filters." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 172-177.

A new systematic approach for designing wide-band tunable combline filters is presented. New results on tunable combline filter theory are proposed and explicit design formulas, to obtain the filter design parameters from specifications, are included. These design parameters are: center frequency, resonator electrical length, instantaneous bandwidth, and tuning capacitance. The proposed design technique is used to construct an X-band wide-band microstrip tunable filter from 8 to 12 GHz with commercial GaAs FETs as tuning elements. Parasitic effects and simulation problems are also discussed.

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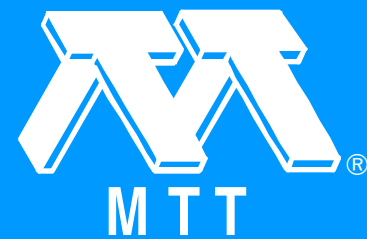
Compact monolithic integrated resistive mixers with low distortion for HIPERLAN

F. Ellinger, R. Vogt and W. Bachtold. "Compact monolithic integrated resistive mixers with low distortion for HIPERLAN." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 178-182.

Three ultra-compact low-cost mixers, using either a single enhancement, depletion, or deep-depletion FET are presented and compared. They are designed for HIPERLAN and 802.11a receivers with radio and intermediate frequencies around 5.2 and 0.95 GHz, respectively. An improved MESFET large-signal model has been used to allow efficient optimizations of the circuits. The fully integrated mixers have been fabricated using a commercial 0.6- μm GaAs MESFET process and require a total chip area of only 0.5 mm². With an ultra-low local-oscillator (LO) power of -10 dBm, the enhancement FET mixer achieves a -4.7 dBm 1-dB input compression point, a 12.6-dB conversion loss, and a 13-dB noise figure. At a low LO power of -2.5 dBm, excellent dynamic properties are obtained for the depletion FET mixer with 2.6-dBm 1-dB input compression point, 8.3-dB conversion loss, and 8.8-dB noise figure. State-of-the-art performances with 16-dBm 1-dB input compression point, 5.5-dB conversion loss, and 6.5-dB noise figure are reached for the deep depletion FET mixer at 10-dBm LO power.

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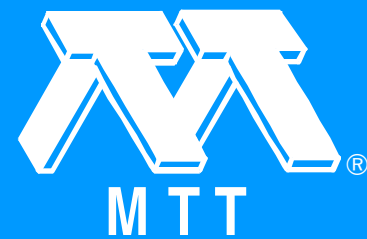
Investigation of the longitudinal multiconductor transmission line functions for symmetric coupled-microstrip systems

J.G. Nickel and J.E. Schutt-Aine. "Investigation of the longitudinal multiconductor transmission line functions for symmetric coupled-microstrip systems." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 183-190.

In inhomogeneous multiconductor transmission line (MTL) structures such as coupled microstrip, propagation is characterized by multiple quasi-TEM modes with distinct propagation constants. These "mode delays" cause the MTL functions to exhibit longitudinal behavior that superficially appears problematic in the context of passive lossless reciprocal systems. This paper presents a thorough investigation of the longitudinal MTL functions. Using MTL formulation and computer simulation, we explain the mathematics and physics of mode delays so that their effects are not misinterpreted or attributed to error in the numerical analysis of MTLs.

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Analysis of the coaxial helical-groove slow-wave structure

Guofen Yu, Wenxiang Wang, Yanyu Wei and Shenggang Liu. "Analysis of the coaxial helical-groove slow-wave structure." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 191-200.

A coaxial helical-groove structure is presented and analyzed in this paper. The dispersion equation and coupling impedance of the structure are given. Numerical calculations of the dispersion relation and coupling impedance with different structure dimensions are carried out. Calculated results indicate that the cold bandwidth of this structure can reach 60%, while the coupling impedance is more than 16 /spl Omega/. It is shown that the coaxial helical groove is a wide-band slow-wave structure with high-power capacity.

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Phase-locked-loop control of active microstrip patch antennas

J.W. Andrews and P.S. Hall. "Phase-locked-loop control of active microstrip patch antennas." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 201-206.

Active patch antennas are simple to fabricate, compact, and low cost, but have inherently poor phase noise and stability. In this paper, a phase-locked loop (PLL) integrated with a 4-GHz active patch antenna was investigated in order to reduce the phase noise and stabilize the frequency of the oscillator. Both these aims were realized by careful integration and optimization of the PLL parameters. Experimental results showed that a phase noise reduction in excess of 55 dB was achieved using this technique. A standalone voltage-controlled oscillator and passive patch technique can provide lower phase noise, but the active patch lends itself to effective integration. Measurement techniques were demonstrated to measure the phase noise and stability of the patch oscillator.

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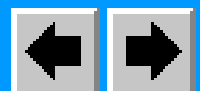
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Efficient optical control of millimeter waves in a slot line on semiconductor plasma substrate

S.K. Dana, H. Shimasaki and M. Tsutsumi. "Efficient optical control of millimeter waves in a slot line on semiconductor plasma substrate." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 207-210.

Efficient control of millimeter-waves in a slot line on an Si and GaAs substrate is discussed both theoretically and experimentally. The spectral-domain method is used to estimate the propagation and the attenuation constants in the slot line with the density of the optically induced plasma as a parameter. Experiments in the millimeter-wave range of 35-50 GHz are carried out using high-resistivity Si and GaAs wafers with the dimension of 15 mm/spl times/30 mm/spl times/600 /spl mu/m. The slot-width could be varied from 0.5 to 2 mm. The attenuation of millimeter waves by over 20 dB can be controlled by optical means using light-emitting diodes with 870 nm wavelength and 68 mW optical power. The experimental results agree considerably well with the theory. The response of millimeter waves with pulsed optical illumination is also examined using a high-power laser diode of 20 W optical power and a pulsewidth less than 100 ns. High-speed response due to optically induced plasma is confirmed for the slot line on GaAs substrate.

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A completely integrated 1.9-GHz receiver front-end with monolithic image-reject filter and VCO

J.W.M. Rogers, J.A. Macedo and C. Plett. "A completely integrated 1.9-GHz receiver front-end with monolithic image-reject filter and VCO." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 210-215.

A 1.9-GHz monolithic superheterodyne receiver front-end with 300-MHz IF on-chip tunable image-reject filter and voltage-controlled oscillator (VCO) is presented. Two versions of the receiver were fabricated on a 0.5- μm bipolar process and compared to a previously fabricated version with an off-chip VCO. The two versions are identical, except for the fact that the 2.2-GHz VCO was realized with and without ground-shielded inductors. The receiver that used ground-shielded inductors had a conversion gain of 25.6 dB, a noise figure of 4.5 dB, a third-order input intercept point (IIP3) of -19 dBm, an image rejection of 65 dB, and a phase noise of -103 dBc/Hz at 100-kHz offset. The receiver drew 32.5 mA from a 3-V supply and had a die area of 2.1 mm/spl times/1.7 mm. The local-oscillator-IF isolation improved compared to the previously fabricated front-end with an off-chip VCO.

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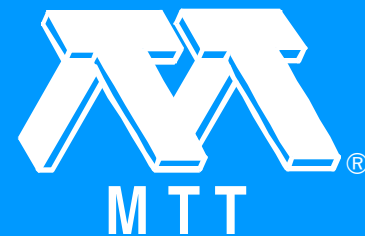


Abstracts

The summation-by-parts algorithm-a new efficient technique for the rapid calculation of certain series arising in shielded planar structures

J.R. Mosig and A. Alvarez Melcon. "The summation-by-parts algorithm-a new efficient technique for the rapid calculation of certain series arising in shielded planar structures." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 215-218.

This paper presents a new technique for the convergence acceleration of a large class of series often arising in electromagnetic problems. The technique is based on the recursive application of the integration-by-parts technique to discrete sequences, thus the given name of the "summation-by-parts" technique. It is shown that the new technique greatly enhances the convergence rate of the series treated, and very small relative errors are obtained by performing a few simple operations. The new technique is applied to the efficient numerical calculation of the Green's functions in a parallel-plate waveguide.



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Direct extraction of linear HBT-model parameters using nine analytical expression blocks

A. Ouslimani, J. Gaubert, H. Hafdallah, A. Birafane, P. Pouvil and H. Leier. "Direct extraction of linear HBT-model parameters using nine analytical expression blocks." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 218-221.

A method to determine the heterojunction bipolar transistor (HBT) equivalent-circuit elements without numerical optimizations is presented. It is based on the extraction of nine analytical expressions, which are referred to here as "blocks." The model elements are extracted using certain blocks for some of them and three nonlinear equations derived from a combination of four expression blocks for some others. The base and collector resistances can be determined at each bias point. The method is validated treating the on-wafer HBTs.

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A Z-transform-based absorbing boundary conditions for 3-D TLM-SCN method

Zhenhai Shao, Wei Hong and Hongwei Wu. "A Z-transform-based absorbing boundary conditions for 3-D TLM-SCN method." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 222-225.

In this paper, an efficient absorbing boundary condition (ABC) constructed in the Z-transform domain [i.e., Z-transform-based absorbing boundary conditions (Z-ABCs)] for the three-dimensional symmetrical condensed-node transmission-line matrix method is presented. Numerical results indicate that the Z-ABCs show better performance than the conventional Higdon's ABC in suppressing instability caused by spurious modes.

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General oscillator characterization using linear open-loop S-parameters (Comments)

L. Cascio. "General oscillator characterization using linear open-loop S-parameters (Comments)." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 226-227.

For original paper see *ibid.*, vol. 49, no. 6, p. 1094-1100 (2001). A general expression for the gain in terms of S-parameters, based on the physical concept of the input and output impedances of the self-terminated circuit, has been provided. This expression is mathematically equivalent to the one provided in terms of T-parameters in the aforementioned paper by Randall and Hock, and in the opinion of the commenter invalidates the S-parameter formulation provided by them in the paper. In reply, the authors state that Cascio's comments and S-parameter derivation touch on an important fundamental concept underlying the derivation described in their paper. They claim that their paper did not go into depth explaining some of the subtleties related to this, but they welcome the opportunity to do so now in this reply.

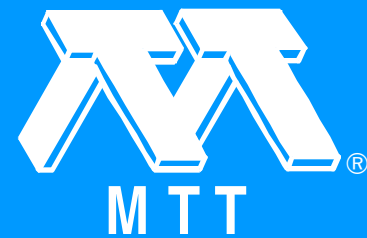
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Abstracts

General oscillator characterization using linear open-loop S-parameters (Authors' Reply)

M. Randall and T. Hock. "General oscillator characterization using linear open-loop S-parameters (Authors' Reply)." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 227-228.



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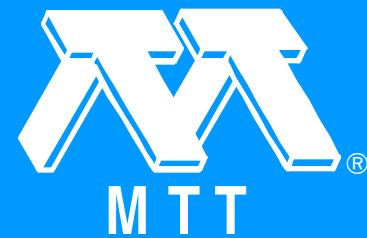
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Abstracts

Improvement of third-order intermodulation product of rf and microwave amplifiers by injection (Corrections)

C.S. Aitchison, M. Mbabele, M.R. Moazzam, D. Budimir and F. Ali. "Improvement of third-order intermodulation product of rf and microwave amplifiers by injection (Corrections)." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part I [T-MTT] (Mini-Special Issue on 1999 International Microwave and Optoelectronics Conference (IMOC'99))): 229-229.



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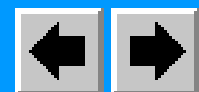
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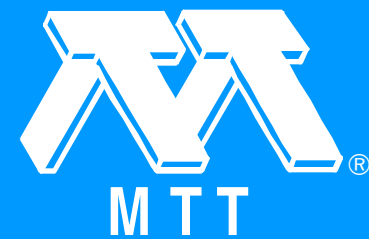
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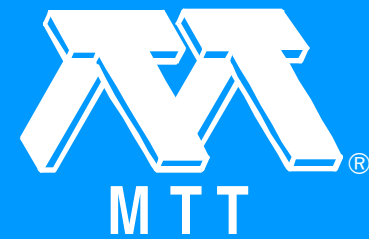
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Abstracts

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"Table of Contents (Jan. 2002, Part II [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 0_1-0_1.



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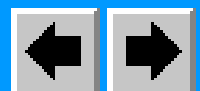
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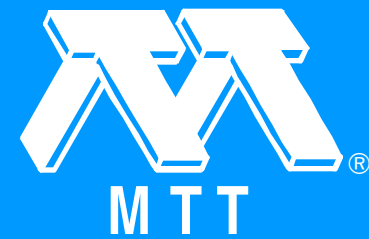
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Abstracts

Inside Cover (Jan. 2002, Part II [T-MTT])

"Inside Cover (Jan. 2002, Part II [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 0_2-0_3.



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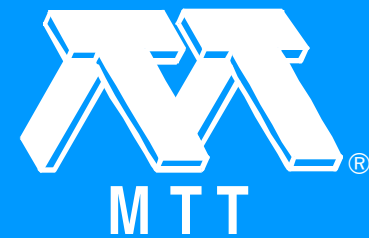
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Abstracts

Guest Editorial (Jan. 2002, Part II [T-MTT])

A. Hajimiri and T.H. Lee. "Guest Editorial (Jan. 2002, Part II [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 233-234.



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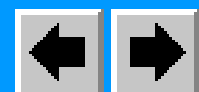
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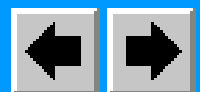
Subjects

The silicon radio decade

J. Sevenhans, F. Op't Eynde and P. Reusens. "The silicon radio decade." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 235-244.

During the 1990s, we witnessed a string of advances in silicon RF integration: from the introduction of the first integrated silicon bipolar radios for groupe special mobile (GSM) and digital European cordless telephone in the late 1980s toward full single-chip integration capabilities based on silicon-germanium BiCMOS technologies. Where RF design used to be a black art, it is becoming a "normal practice" today. In this paper, the authors look back on the past ten years of circuits, silicon technology, and system research with roots in standardization and a scope reaching from the early ideas to the final product success on the market and some perspective toward new concepts and systems.

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RF-SoC-expectations and required conditions

A. Matsuzawa. "RF-SoC-expectations and required conditions." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 245-253.

This paper discusses the expectations for the development of radio-frequency systems-on-chip (RF-SoCs) that integrate RF, analog, and digital circuits, and the conditions under which they can be realized. Future RF systems will be increasingly large and complex. However, high integration technology is expected to reduce the circuit size, number of components, and total system cost. Over the past few years, rapid progress of scaled CMOS technology and the introduction of SiGe technology have improved the performance of silicon RF devices and circuits to meet the requirements for conventional RF applications. The RF-SoC, which may be said to be the ultimate goal for RF systems, is expected to improve silicon RF devices even further. However, before this is possible, strict requirements for system perfection, continuous cost reduction, ease of function and specification change, and process portability issues must be resolved. Difficulty in lowering power consumption of RF and analog circuits and of reducing the size of passive components and analog transistors diminish the appeal of the RF-SoC. The RF-SoC in deep submicrometer technology may be an unreasonable solution for some application areas. System-in-package may be one way to address this issue.





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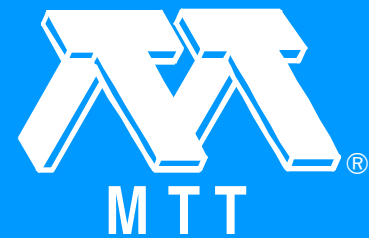
RF system concepts for highly integrated RFICs for W-CDMA mobile radio terminals

A. Springer, L. Maurer and R. Weigel. "RF system concepts for highly integrated RFICs for W-CDMA mobile radio terminals." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 254-267.

The standardization phase for third-generation wide-band CDMA systems like the universal mobile telecommunication system, which will add broad-band data to support video, Internet access, and other high-speed services for untethered devices is running toward its finalization. As is typical for mobile communication systems standardization, sufficient RF performance has been assumed and most efforts have been put to digital baseband issues. This is especially true for the mobile phone transceivers, the RF part of which is (although its baseband part is much more complex in terms of number of devices) still the bottleneck of the entire system. Meanwhile, in the RF concept engineering of today's commercial products, an accurate prediction of the needed RF performance by using RF system simulation is indispensable. This is, in particular, the case with third-generation wireless systems, which, from the RF design point-of-view, are quite different from second-generation time-division multiple access/frequency-division multiple-access systems due to the fact that the user signals are now separated in the code domain rather than in the time and/or frequency domain. The paper gives an insight of how to derive receiver requirements for third-generation mobiles in terms recognizable by microwave designers, reports on the system simulation-based design, and performance of silicon-based RF integrated circuits for mobile terminal use, and discusses some future technologies and techniques and their possible impact on portable wireless devices.

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5-GHz CMOS wireless LANs

T.H. Lee, H. Samavati and H.R. Rategh. "5-GHz CMOS wireless LANs." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 268-280.

This paper first provides an overview of some recently ratified wireless local-area network (WLAN) standards before describing an illustrative 5-GHz WLAN receiver implementation. The receiver, built in a standard 0.25- μm CMOS logic technology, exploits several recent developments, including lateral-flux capacitors, accumulation-mode varactors, injection-locked frequency dividers, and an image-reject low-noise amplifier. The receiver readily complies with the performance requirements of both IEEE 802.11a and ETSI HiperLAN. It exhibits a 7.2-dB noise figure, as well as an input-referred third-order intercept and 1-dB compression point of -7 and -18 dBm, respectively. Image rejection for this double conversion receiver exceeds 50 dB throughout the frequency band without using external filters. Leakage out of the RF port from the local oscillators is under -87 dBm, and all synthesizer spurs are below the -70-dBm noise floor of the instrumentation used to measure them. The receiver consumes 59 mW from a 1.8-V supply and occupies only 4 mm² of die area, in no small measure due to the use of fractal capacitors for ac coupling.

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Low-voltage low-power CMOS-RF transceiver design

M.S.J. Steyaert, B. De Muer, P. Leroux, M. Borremans and K. Mertens. "Low-voltage low-power CMOS-RF transceiver design." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 281-287.

Research over the last ten years has resulted in attempts toward single-chip CMOS RF circuits for Bluetooth, global positioning system, digital enhanced cordless telecommunications and cellular applications. An overview of the use of CMOS for low-cost integration of a high-end cellular RF transceiver front-end is presented. Some fundamental pitfalls and limitations of RF CMOS are discussed. To circumvent these obstacles, the choice of transceiver architecture, circuit topology design, and systematic optimization of the different transceiver blocks is necessary. Moreover, optimization of the transceiver as one single block by minimizing the number of power-hungry interface circuits is emphasized. As examples, a fully integrated cellular transceiver front-end, a low-power extremely low noise-figure low-noise amplifier, and a very efficient power amplifier are demonstrated.

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Concurrent multiband low-noise amplifiers-theory, design, and applications

H. Hashemi and A. Hajimiri. "Concurrent multiband low-noise amplifiers-theory, design, and applications." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 288-301.

The concept of concurrent multiband low-noise-amplifiers (LNAs) is introduced. A systematic way to design concurrent multiband integrated LNAs in general is developed. Applications of concurrent multiband LNAs in concurrent multiband receivers together with receiver architecture are discussed. Experimental results of a dual-band LNA implemented in a 0.35- μm CMOS technology as a demonstration of the concept and theory is presented.

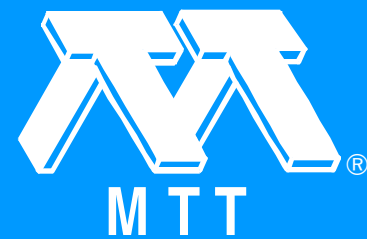
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Delta-sigma data conversion in wireless transceivers

I. Galton. "Delta-sigma data conversion in wireless transceivers." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 302-315.

High-performance analog-to-digital converters, digital-to-analog converters, and fractional-N frequency synthesizers based on delta-sigma (/spl utri//spl Sigma/) modulation - collectively referred to as /spl utri//spl Sigma/ data converters have contributed significantly to the high level of integration seen in recent commercial wireless handset transceivers. This paper presents a tutorial on /spl utri//spl Sigma/ data converters and their uses and implications with respect to wireless transceiver architectures.



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Distributed active transformer-a new power-combining and impedance-transformation technique

I. Aoki, S.D. Kee, D.B. Rutledge and A. Hajimiri. "Distributed active transformer-a new power-combining and impedance-transformation technique." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 316-331.

In this paper, we compare the performance of the newly introduced distributed active transformer (DAT) structure to that of conventional on-chip impedance-transformations methods. Their fundamental power-efficiency limitations in the design of high-power fully integrated amplifiers in standard silicon process technologies are analyzed. The DAT is demonstrated to be an efficient impedance-transformation and power-combining method, which combines several low-voltage push-pull amplifiers in series by magnetic coupling. To demonstrate the validity of the new concept, a 2.4-GHz 1.9-W 2-V fully integrated power-amplifier achieving a power-added efficiency of 41% with 50-/spl Omega/ input and output matching has been fabricated using 0.35-/spl mu/m CMOS transistors.

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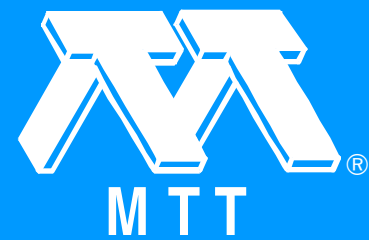
Differentially driven symmetric microstrip inductors

M. Danesh and J.R. Long. "Differentially driven symmetric microstrip inductors." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 332-341.

A differentially excited symmetric inductor that enhances inductor quality (Q) factor on silicon RFICs is presented. Compared with an equivalent single-ended configuration, experimental data demonstrate that the differential inductor offers a 50% greater Q factor and a broader range of operating frequencies. Predictions from full-wave simulations and a physics-based SPICE-compatible model are validated by experimental measurements on an inductor fabricated in a triple-level metal silicon technology. Application of the symmetric inductor to a cross-coupled oscillator improves output voltage swing and phase noise by 75% and 1.8 dB, respectively (for a given power consumption), while chip area is reduced by 35% compared to conventional inductor equivalents.

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An MOS transistor model for RF IC design valid in all regions of operation

C. Enz. "An MOS transistor model for RF IC design valid in all regions of operation." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 342-359.

This paper presents an overview of MOS transistor modeling for RF integrated circuit design. It starts with the description of a physical equivalent circuit that can easily be implemented as a SPICE subcircuit. The MOS transistor is divided into an intrinsic part, representing mainly the active part of the device, and an extrinsic part responsible for most of the parasitic elements. A complete charge-based model of the intrinsic part is presented. The main advantage of this new charge-based model is to provide a simple and coherent description of the DC, AC, nonquasi-static (NQS), and noise behavior of the intrinsic MOS that is valid in all regions of operation. It is based on the forward and reverse charges $q_{\text{sub } f}$ and $q_{\text{sub } r}$ defined as the mobile charge densities, evaluated at the source and at the drain. This intrinsic model also includes a new simplified NQS model that uses a bias and frequency normalization allowing one to describe the high-order frequency behavior with only two simple functions. The extrinsic model includes all the terminal access series resistances, and particularly the gate resistance, the overlap, and junction capacitances as well as a substrate network. The latter is required to account for the signal coupling occurring at RF from the drain to the source and the bulk, through the junction capacitances. The noise model is then presented, including the effect of the substrate resistances on the RF noise parameters. All the aspects of the model are validated for a 0.25- μm CMOS process.

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Modeling and analysis techniques for system-level architectural design of telecom front-ends

G.G.E. Gielen. "Modeling and analysis techniques for system-level architectural design of telecom front-ends." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 360-368.

An overview is presented of the challenges and design issues in the system-level design of mixed analog-digital telecom front-ends. The progress in very large scale integration technology allows the integration of complex systems on a chip, containing both analog and digital parts. In order to boost the design productivity and guarantee the optimality of such systems while meeting the time-to-market constraints, a systematic top-down design approach has to be followed with sufficient time and attention paid to system-level architectural design before proceeding to the detailed block or circuit design. This paper presents high-level system exploration tools that allow the analysis of architectural alternatives for the telecom front-end and to explore system tradeoffs such as finding the optimal analog-digital partitioning. This is illustrated with results from experimental tools. Finally, the crucial underlying technology for such high-level design will be described in detail: analog behavioral modeling, efficient high-level simulation methods, and analog power/area estimation.





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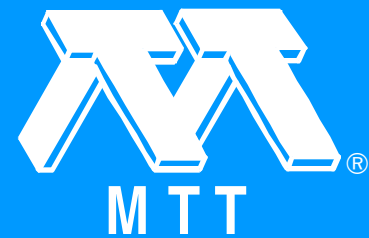
0.25-/spl mu/m BiCMOS receivers for normal and micro GSM900 and DCS 1800 base stations

P. Gould, Jenshan Lin, O. Boric-Lubecke, C. Zelle, Yung-Jinn Chen and Ran-Hong Yan. "0.25-/spl mu/m BiCMOS receivers for normal and micro GSM900 and DCS 1800 base stations." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 369-376.

This paper describes two integrated RF receivers with low noise and high linearity for GSM900 and DCS1800 base stations. The chips were fabricated using a 0.25-/spl mu/m BiCMOS process. This is the first silicon-integrated radio front-end that can be used to meet GSM normal and micro base-station specifications reported to date. Noise figure, gain, and output third-order intercept point are 2.1 dB, 25.8 dB, and 25.7 dBm for GSM900 and 3.3 dB, 21.3 dB, and 22.5 dBm for DCS1800, respectively.

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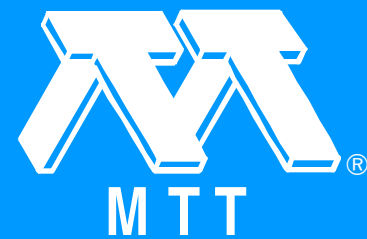
Substrate effects in monolithic RF transformers on silicon

K.T. Ng, B. Rejaei and J.N. Burghartz. "Substrate effects in monolithic RF transformers on silicon." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 377-383.

The effect of substrate RF losses on the characteristics of silicon-based integrated transformers is studied experimentally by using a substrate transfer technique. The maximum available gain is used to evaluate the quality of transformers similarly to that of active devices. The silicon substrate has a pronounced effect on the quality factor and mutual resistive coupling factor of the primary and secondary coils, thereby degrading the maximum available gain of the transformer. A highly structured patterned ground shield is shown to improve the maximum available gain of a transformer at high frequencies, while at low frequencies, it has little effect on the maximum available gain and even degrades the quality factors of the transformer coils. It is shown that the low-frequency degradation of the coil quality factors relates to local eddy currents in the patterned metal shield.

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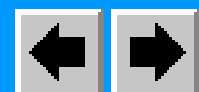
Subjects

A physical frequency-dependent compact model for RF integrated inductors

J. Sieiro, J.M. Lopez-Villegas, J. Cabanillas, J.A. Osorio and J. Samitier. "A physical frequency-dependent compact model for RF integrated inductors." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 384-392.

A frequency-dependent compact model for inductors in high ohmic substrates, which is based on an energy point-of-view, is developed. This approach enables the description of the most important coupling phenomena that take place inside the device. Magnetically induced losses are quite accurately calculated and coupling between electric and magnetic fields is given by means of a delay constant. The later coupling phenomenon provides a modified procedure for the computation of the fringing capacitance value, when the self-resonance frequency of the inductor is used as a fitting parameter. The model takes into account the width of every metal strip and the pitch between strips. This enables the description of optimized layout inductors. Data from experiments and electromagnetic simulators are presented to test the accuracy of the model.

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A study of parasitic effects of ESD protection on RF ICs

Ke Gong, Haigang Feng, Rouying Zhan and A.Z.H. Wang. "A study of parasitic effects of ESD protection on RF ICs." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 393-402.

This paper presents a comprehensive study on influences of on-chip electro-static discharge (ESD) protection structures on performance of the circuits being protected. Two novel compact low-parasitic ESD structures were designed for RF and mixed-signal (MS) integrated circuits. Parasitic models of the ESD structures are extracted. RF building-block circuits, including a low-power high-speed op amp and a fully integrated 2.4-GHz low-noise amplifier were designed in 0.18/0.35- μm technologies. Investigation of performance of these circuits under influences of the two new ESD protection structures and traditional MOS ESD protection device, in both copper and aluminum interconnects, demonstrated that significant circuit performance degradation (/spl sim/30%) occur when using NMOS ESD protection in Al technology, which recovered substantially (/spl sim/80%) when using low-parasitic ESD protection in Cu technology. This work indicates that the ESD-to-circuit influence is inevitable and substantial. Therefore, novel low-parasitic ESD protection solution is essential to maintaining both circuit functionality and ESD robustness in RF and MS applications.

Click on title for a complete paper.



A bond-wire inductor-MOS varactor VCO tunable from 1.8 to 2.4 GHz

F. Svelto and R. Castello. "A bond-wire inductor-MOS varactor VCO tunable from 1.8 to 2.4 GHz." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 403-407.

This paper presents a technique that optimizes LC-tank CMOS voltage-controlled oscillators (VCOs) by minimizing the product of phase noise and power consumption. Moreover, it shows that the minimum depends on the tank's quality factor Q , the device noise coefficient $/\text{spl } \gamma$, and the ratio between the maximum oscillation amplitude and supply voltage $/\text{spl } \alpha$. Prototypes, realized in a $0.35\text{-}\mu\text{m}$ process, show the following performances: -122.5 dBc/Hz at 600 kHz from a 1.9-GHz carrier, with 2-V supply voltage and 1-mA current consumption. The VCO can be tuned between 1.8-2.4 GHz, when the varactor control voltage is varied between 0-3.5 V. In the proposed realization, the tank is made of a metal-oxide-silicon varactor (operated between accumulation and deep depletion) and a bond-wire inductor, realized connecting two pads to a package frame lead to be compatible with the production environment.



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Interface Loss Mechanism of Millimeter-Wave Coplanar Waveguides on Silicon

W. Zhao, C. Schöllhorn and E. Kasper. "Interface Loss Mechanism of Millimeter-Wave Coplanar Waveguides on Silicon." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 407-410.

The interface loss mechanisms of coplanar waveguides (CPWs) on silicon with an SiO₂/sub 2/ isolation layer are investigated. The total losses of straight CPW lines of 7.5-mm length are measured between 45 MHz and 40 GHz and the interface contribution is extracted from that by its bias dependence. The interface losses depend on bias voltage and on the oxide quality. With an optimal bias voltage, the attenuation of a CPW with an unpatterned oxide layer always achieves a minimum. With bias between the flat-band voltage V_{FB} and threshold voltage V_T (depletion region), the interface losses are negligible. For high quality oxides (V_T around 0 V), very low attenuation was obtained without any bias.

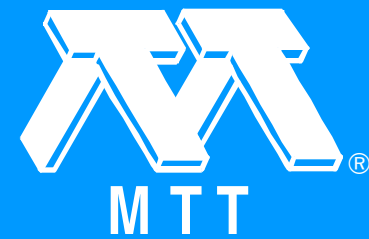
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Abstracts

Information for Authors (Jan. 2002, Part II [T-MTT])

"Information for Authors (Jan. 2002, Part II [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 0_4-0_4.



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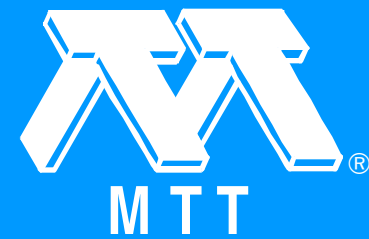
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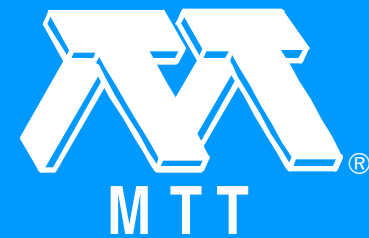
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"Inside Cover (Feb. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 0_3-0_4.



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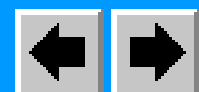
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Photo-injection p-i-n diode switch for high-power RF switching

E.W. Jacobs, D.W. Fogliatti, H. Nguyen, D.J. Albares, C.T. Chang and C.K. Sun. "Photo-injection p-i-n diode switch for high-power RF switching." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 413-419.

The high RF power-switching properties of the photo-injection p-i-n switch (PIPINS), an optically controlled RF switch, are investigated. Proper functioning of a PIPINS as a low insertion-loss RF switch requires that it operates as a photoconductor, where the photo-injected charge is much greater than the RF sweep out charge. Insertion loss using 650-mW optical power was <0.4 dB at RF (VHF-UHF) power in excess of 200 W, and devices successfully stand off 200-W incident RF power with the series isolation being determined by the device capacitance (e.g., 225 fF). PIPINS hot-switching measurements are reported for the first time, with output RF power up to 180 W at low duty cycle, rise times of 1 ps, and fall times for a series shunt switch of ~ 2.5 μ s. The RF power for hot switching a PIPINS is limited by a latch-on effect, which is dependent on a variety of parameters, including duty cycle and repetition period, consistent with thermally generated carriers contributing to the latch-on effect. The switching properties of PIPINS make them a candidate for high RF power applications such as reconfigurable antennas, where electromagnetic isolation of the switch and control lines are critical.





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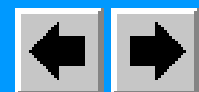
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An accurate on-wafer deembedding technique with application to HBT devices characterization

S. Bousnina, C. Falt, P. Mandeville, A.B. Kouki and F.M. Ghannouchi. "An accurate on-wafer deembedding technique with application to HBT devices characterization." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 420-424.

An accurate deembedding technique for on-wafer measurements of an active device's S-parameter is presented in this paper. This deembedding technique accounts in a systematic way for effect of all parasitic elements surrounding the device. These parasitic elements are modeled as a four-port network. Closed-form equations are derived for deembedding purposes of this four-port network. The proposed deembedding technique was used to extract small-signal model parameters of a $2/\text{spl times}/25 \text{ /spl mu/m}$ emitter GaInP/GaAs heterojunction bipolar transistor device, and excellent agreement between measured and model-simulated S-parameter was obtained up to 30 GHz.

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Millimeter-wave FET modeling using on-wafer measurements and EM simulation

A. Cidronali, G. Collodi, A. Santarelli, G. Vannini and G. Manes. "Millimeter-wave FET modeling using on-wafer measurements and EM simulation." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 425-432.

Electron device modeling is a challenging task at millimeter-wave frequencies. In particular, conventional approaches based on lumped equivalent circuits become inappropriate to describe complex distributed and coupling effects, which may strongly affect the transistor performance. In this paper, an empirical distributed FET model is adopted that can be identified on the basis of conventional S-parameter measurements and electromagnetic simulations of the device layout. The consistency of the proposed approach is confirmed by robust scaling properties, which enable millimeter-wave small-signal S-parameters to be predicted as a function of the device periphery and number of gate fingers. Moreover, it is shown how the model identified on the basis of standard S-parameter measurements up to 50 GHz can be efficiently exploited in order to obtain reasonably accurate small-signal prediction up to 110 GHz. Extensive experimental validation is presented for 0.2- μm pseudomorphic high electron-mobility transistors devices.

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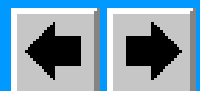
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A fast finite-element-based field optimizer using analytically calculated gradients

P. Harscher, S. Amari and R. Vahldieck. "A fast finite-element-based field optimizer using analytically calculated gradients." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 433-439.

A novel and efficient gradient-based optimization technique for the finite-element method (FEM) is described. In contrast to the standard approach in which finite differences are used to determine the gradient of a cost function, the new technique calculates the gradient analytically. This offers many advantages, the most prominent of which are that only a single FEM analysis is necessary to find the gradient and no mesh readjustment is required. Thus, computer resources like memory and CPU time are reduced significantly. The analytically calculated gradient is exact and singularities (as in the finite-difference technique) are eliminated.

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Complete location of poles for thick lossy grounded dielectric slab

Swee-Ann Teo, Mook-Seng Leong, Siou-Teck Chew and Ban-Leong Ooi. "Complete location of poles for thick lossy grounded dielectric slab." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 440-445.

In order to obtain accurate closed-form representations of the microstrip Green's functions, it is often necessary to find the locations of the proper and improper surface-wave poles. In this paper, we present an efficient and robust iterative algorithm based on contraction mapping, which can locate all the proper and improper solutions of the characteristic equations of the grounded dielectric slab. The dielectric may also be lossy.

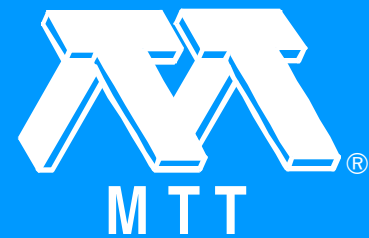
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New predistortion linearizer using low-frequency even-order intermodulation components

Youngoo Yang, Young Yun Woo and Bumman Kim. "New predistortion linearizer using low-frequency even-order intermodulation components." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 446-452.

We present two types of new predistortion linearizers using low-frequency even-order components. One adopts an in-phase and quadrature balanced modulator as a generator of the third-order intermodulation (IM3) and fifth-order intermodulation (IM5) components and the other adopts a double-balanced diode mixer. Both types are very compact and could independently control the amplitudes and phases of the intermodulation (IM) components. We have analyzed the delay mismatch effect of these predistortion circuits. The result shows that the IM5 components are twice as sensitive than the third ones. Two types of predistorters are implemented and tested at the International Mobile Telecommunications-2000 band. Two tone test results show that the IM3 cancellation is about 23-25 dB and the IM5 is cancelled by about 12-20 dB for both cases. The adjacent channel power ratio is improved by over 11 dB at the broad-band CDMA signal with a chip rate of 4.096 Mc/s, and this improvement is maintained through a broad range of output power level.



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Equivalent lumped elements G , L , C , and unloaded Q 's of closed- and open-loop ring resonators

Lung-Hwa Hsieh and Kai Chang. "Equivalent lumped elements G , L , C , and unloaded Q 's of closed- and open-loop ring resonators." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 453-460.

A transmission-line model is used to extract the equivalent lumped-element circuits for the closed- and open-loop ring resonators. The unloaded Q values of the ring resonators can be calculated from the equivalent lumped elements G , L , and C . Four different configurations of microstrip ring resonators fabricated on low and high dielectric-constant substrates are used to investigate the lumped elements and unloaded Q s. The largest difference between the measured and calculated unloaded Q is 5.7%, which is due to measurement uncertainties and accuracies of the calculation. These simple expressions introduce an easy method for analyzing ring resonators in filters and provide, for the first time, a means of predicting their unloaded Q .

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Direct extraction of FET noise models from noise figure measurements

M. Rudolph, R. Doerner, P. Heymann, L. Klapproth and G. Bock. "Direct extraction of FET noise models from noise figure measurements." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 461-464.

An algorithm is presented that allows for noniterative extraction of the parameters of the Pucel and Pospieszalski FET noise models directly from noise-figure measurements. Since the goal is to minimize the number of source-pull measurements, the number of different source admittances required as a minimum to determine the model parameters reliably is investigated. It turns out that, in the case of the Pospieszalski model, 50-/spl Omega/ measurements are sufficient, while in case of the Pucel model, three additional source impedances have to be taken into account. The results are verified by investigating MESFET and pseudomorphic high electron-mobility transistor devices.



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Novel modal analysis of a circular-to-rectangular waveguide T-junction and its application to design of circular waveguide dual-mode filters

Ke-Li Wu, Ming Yu and Apu Sivadas. "Novel modal analysis of a circular-to-rectangular waveguide T-junction and its application to design of circular waveguide dual-mode filters." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 465-473.

This paper describes a novel modal analysis of a circular-to-rectangular waveguide T-junction and its application to the design of circular waveguide dual-mode filters with a sidewall coupling iris. The analysis is based on the newly developed finite plane-wave series-expansion technique and the concept of the extended boundary condition. The combination of the two concepts greatly facilitates the modal analysis of complex boundary value problems and eliminates the numerical integration. The proposed modal analysis has been verified both by experiments and commercial software for a wide range of parameters. Design examples of I/O structures for a set of channel filters demonstrate the great value of the new modal analysis scheme in practical applications.

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Microwave properties of low-loss polymers at cryogenic temperatures

M.V. Jacob, J. Mazierska, K. Leong and J. Krupka. "Microwave properties of low-loss polymers at cryogenic temperatures." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 474-480.

Dielectric loss tangent and permittivity of polytetrafluoroethylene (Teflon), high-density (HD) polyethylene, and cross-linked polystyrene (Rexolite) were measured at temperature range from 28 to 84 K and frequency of approximately 18 GHz. The material properties were determined by measurements of the resonant frequency and the Q factor of a TE/sub 011/ mode cylindrical superconducting cavity containing a sample under test. It has been demonstrated that these materials exhibit very low losses at cryogenic temperatures (2×10^{-6} for Teflon, 5×10^{-5} for HD polyethylene and 1.1×10^{-4} for Rexolite). Due to low losses, these materials can be useful in construction of various high-Q factor microwave devices for operation at cryogenic temperatures.

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A compact CPW-based single-layer injection-locked active antenna for array applications

K.H.Y. Ip and G.V. Eleftheriades. "A compact CPW-based single-layer injection-locked active antenna for array applications." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 481-486.

A compact single-layer coplanar waveguide (CPW)-fed active patch antenna oscillator at 9.81 GHz is presented based on a commercially available GaAs FET, which is centered behind the patch for tight packing. The positive feedback for the oscillation is accomplished through twin-slot aperture coupling to the patch. This results in a design having its longest dimension equal to 26.6 mm at 9.81 GHz. A low-power injection signal is applied to stabilize the oscillation through parasitic coupling at the CPW side of the circuit. This parasitic coupling is achieved by electromagnetic coupling of the locking signal to the gate of the FET. The measured effective isotropic radiated power is 19.6 dBm, whereas the worse-case front-to-back ratio is about 15 dB with the cross-polarized fields better than -20 dB at broadside. The measured phase noise of the unlocked and locked signals are -63.28 and -107.5 dBc/Hz, respectively, at a 100-kHz offset away from the carrier. This compact design is ideally suited as a unit cell in injection-locked phased-array architectures.

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A high-power Ka-band quasi-optical amplifier array

S.C. Ortiz, J. Hubert, L. Mirth, E. Schlecht and A. Mortazawi. "A high-power Ka-band quasi-optical amplifier array." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 487-494.

Results for a high-power Ka-band quasi-optical amplifier array are presented in this paper. The amplifier consists of a 45-element double-sided active array with a hard-horn feed. Excess heat is removed via a metal carrier integrated into the array with liquid cooling at the periphery. Each unit cell of the array consists of transmitting and receiving patch antennas, driver and power amplifier monolithic microwave integrated circuits on input and output layers, and a through-plate coaxial transition, which connects the input and output layers. An estimated 25 W is radiated when the amplifier is used as an antenna feed, otherwise 13 W is collected into waveguide. Experimental results and construction details are discussed.



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Full-wave high-order FEM model for lossy anisotropic waveguides

P. Savi, I.-L. Gheorma and R.D. Graglia. "Full-wave high-order FEM model for lossy anisotropic waveguides." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 495-500.

Anisotropic lossy waveguides are analyzed by applying the finite-element method with higher order interpolatory vector elements. The problem is formulated in terms of the electric field only. The transverse vector component of the electric field is numerically represented by higher order curl-conforming interpolatory vector functions, whereas the longitudinal component of the field is represented by higher order scalar basis functions. Due to the better interpolatory capabilities of the expansion functions, the metallic and material losses are modeled with a higher precision with respect to that provided by the other available numerical models. Furthermore, the use of higher order elements permits the correct modeling of the discontinuity of the normal field component at the interfaces between different materials.

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Multiresolution time-domain (MRTD) adaptive schemes using arbitrary resolutions of wavelets

E.M. Tentzeris, A. Cangellaris, L.P.B. Katehi and J. Harvey. "Multiresolution time-domain (MRTD) adaptive schemes using arbitrary resolutions of wavelets." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 501-516.

A space- and time-adaptive two-dimensional multiresolution time-domain (MRTD) algorithm based on arbitrary resolutions of Battle-Lemarie wavelets is proposed. Analytic expressions for the finite-summation coefficients are derived and details concerning the modeling of hard boundaries, excitation, and field reconstruction are extensively discussed. Through the use of a combination of absolute and relative thresholding, a dynamically changing grid is developed with minimal computational requirements in comparison to the finite-difference time-domain technique. After the validation process, MRTD is used for the first time for the numerical optimization of complex RF structures such as evanescent-mode filters.

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High-gain meanderless slot arrays on electrically thick substrates at millimeter-wave frequencies

Meide Qiu, M. Simcoe and G.V. Eleftheriades. "High-gain meanderless slot arrays on electrically thick substrates at millimeter-wave frequencies." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 517-528.

Introduces new techniques and architectures for the implementation of linear slot arrays on electrically thick dielectric substrates at millimeter-wave frequencies. The slot arrays are fed by a coplanar waveguide series line and lead to high gain by utilizing the phase cancellation technique to reduce coupling to the dominant surface-wave mode. Unlike traditional designs, no meander lines are used in the proposed structures, easing their fabrication by eliminating the need for air bridges and leading to patterns with low cross-polarization and high gain. In addition, the option of including a backing ground reflector to render the patterns unidirectional is explored and implemented. In this latter case, it is shown that simultaneous reduction of the dominant surface-wave and TEM modes through phase cancellation can be achieved. The design of the proposed arrays is based on an intuitive transmission-line model, which enables the implementation of arrays with a gradual current taper and, thus, maximum gain. This study is verified experimentally around a nominal frequency of 27.8 GHz.

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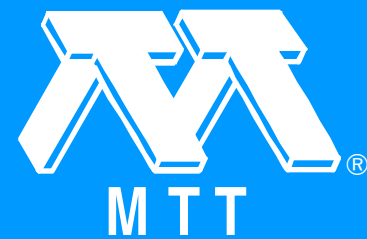
Direct parameter-extraction method for HBT small-signal model

S. Bousnina, P. Mandeville, A.B. Kouki, R. Surridge and F.M. Ghannouchi. "Direct parameter-extraction method for HBT small-signal model." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 529-536.

An accurate and broadband method for the direct extraction of heterojunction bipolar transistor (HBT) small-signal model parameters is presented in this paper. This method differs from previous ones by extracting the equivalent-circuit parameters without using special test structures or global numerical optimization techniques. The main advantage of this method is that a unique and physically meaningful set of intrinsic parameters is extracted from the measured S-parameters for the whole frequency range of operation. The extraction procedure uses a set of closed-form expressions derived without any approximation. An equivalent circuit for the HBT under a forward-bias condition is proposed for extraction of access resistances and parasitic inductances. An experimental validation on a GaInP/GaAs HBT device with a 2×10^5 μm^2 emitter was carried out, and excellent results were obtained up to 30 GHz. The calculated data-fitting residual error for three different bias points over 1-30 GHz was less than 2%.

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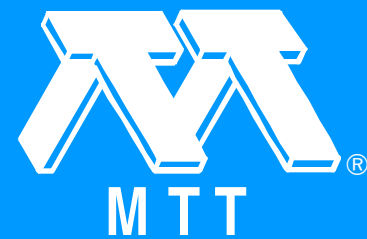
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Anisotropic permittivity and attenuation extraction from propagation constant measurements using an anisotropic full-wave Green's function solver for coplanar ferroelectric thin-film devices

C.M. Krowne, M. Daniel, S.W. Kirchoefer and J.A. Pond. "Anisotropic permittivity and attenuation extraction from propagation constant measurements using an anisotropic full-wave Green's function solver for coplanar ferroelectric thin-film devices." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 537-548.

In this paper, a full-wave spectral-domain integral-equation technique is used to study double substrate layer coplanar devices with the ferroelectric thin film adjacent to the conductor guiding interfacial surface. The Green's function is used in the anisotropic situation for anisotropic permittivities. In examining specific laboratory data, going from an unbiased static electric field to the biased case, the permittivity tensor is allowed to go from a unity tensor to a uniaxial one. Consistent with this permittivity tensor behavior, the attenuation trend with frequency and its amplitude is also found.





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Characterization of finite-ground CPW reactive series-connected elements for innovative design of uniplanar M(H)MICs

Lei Zhu and Ke Wu. "Characterization of finite-ground CPW reactive series-connected elements for innovative design of uniplanar M(H)MICs." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 549-557.

A variety of finite-ground coplanar waveguide (FGCPW) reactive series-connected capacitive and inductive elements are extensively studied and characterized as equivalent-circuit models that include complex parasitic effects caused by finite-ground widths. These models are developed by implementing a numerical calibration procedure called short-open calibration, which is used to extract characteristic parameters of the circuit model from full-wave method-of-moments calculations. The proposed model is generally described as an equivalent series admittance ($Y_{\text{sub } g/}$) or impedance ($Z_{\text{sub } g/}$) together with a pair of shunt admittances ($Y_{\text{sub } p/}$) for FGCPW series-connected structures. With the new scheme, the FGCPW elements of interest behave like lossless lumped elements at low-frequency range, consisting of a series capacitance or inductance, as well as two shunt capacitances. As frequency increases, however, $Y_{\text{sub } g/}$ and $Z_{\text{sub } g/}$ exhibit a frequency-related dispersion and also a lossy resonance behavior, which stand for some added inductive or capacitive coupling effect caused by the extent of finite-ground width. On the other hand, unbounded radiation effect, considered in this model, appears too strong to be ignored around resonance. Theoretical and experimental results that compare very well with each other are shown for interesting electrical behaviors of finite-ground structures. An innovative uniplanar three-stage bandstop filter is designed and measured on the basis of its simplified equivalent-circuit model.

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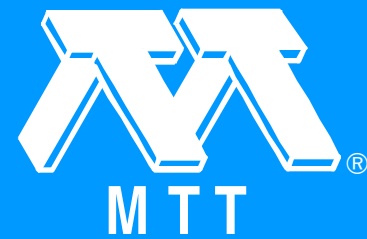


Abstracts

A new class of eigenfunction expansion methods for fast frequency-domain analysis of waveguides

P. Przybyszewski, J. Mielewski and M. Mrozowski. "A new class of eigenfunction expansion methods for fast frequency-domain analysis of waveguides." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 558-563.

This paper presents a new class of algorithms for a fast calculation of dispersion characteristics in inhomogeneously loaded strictly bidirectional waveguides. The algorithms use the method of moments to convert the wave equation to a matrix eigenvalue problem using, as a basis, a set of known solutions determined for a few selected points from the ω - β diagram. Depending on the choice of points for the basis and the testing functions, several algorithms are derived, each leading to extremely simple expressions for the calculation of the matrix elements.



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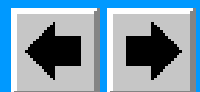
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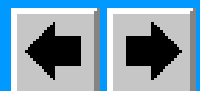
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Simple technique for measuring source reflection coefficient while characterizing active devices

G. Madonna and A. Ferrero. "Simple technique for measuring source reflection coefficient while characterizing active devices." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 564-569.

The measurement of the source reflection coefficient is fundamental for noise, as well as large-signal testing of microwave active devices. This paper describes a simple yet rigorous technique for fast and accurate determination of a source reflection coefficient when a load-source pull test set is used. The solution consists in measuring the waves at the device-under-test reference plane under two different bias conditions. We have proven that these measurements give enough information to compute the source reflection coefficient with accuracy suitable for most applications. Experimental results are presented and compared to data obtained with more conventional techniques.

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Full-wave analysis and modeling of multiconductor transmission lines via 2-D-FDTD and signal-processing techniques

Feng Liu, J.E. Schutt-Aine and Ji Chen. "Full-wave analysis and modeling of multiconductor transmission lines via 2-D-FDTD and signal-processing techniques." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 570-577.

The full-wave analysis of multiconductor transmission lines on an inhomogeneous medium is performed by using the two-dimensional finite-difference time-domain (FDTD) method. The FDTD data are analyzed by using signal-processing techniques. The use of high-resolution signal-processing techniques allows one to extract the dispersive characteristics and normal-mode parameters, which include decoupled modal impedances and current and voltage eigenvector matrices. A new algorithm for extracting frequency-dependent equivalent-circuit parameters is presented in this paper. Smaller CPU time and memory are required as compared to the three-dimensional FDTD case. Numerical results are presented to demonstrate the accuracy and efficiency of this method.

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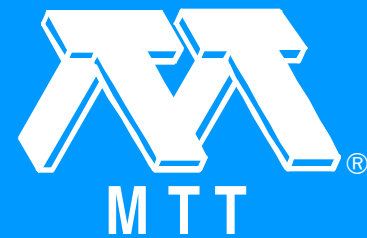


Abstracts

On the line-integral formulation of mode-matching technique

G. Figlia and G.G. Gentili. "On the line-integral formulation of mode-matching technique." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 578-580.

In this paper, a brief description of the line-integral formulation of mode matching is recalled, and the analysis is extended to the case of a TEM mode, normalization integrals, and degenerate eigenvalues.



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Improved automatic parameter extraction of InP-HBT small-signal equivalent circuits

B. Willen, M. Rohner, I. Schnyder and H. Jackel. "Improved automatic parameter extraction of InP-HBT small-signal equivalent circuits." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 580-583.

An improved automatic extraction technique for determination of the element values of an InP heterojunction-bipolar-transistor small-signal T-model is presented. Numerical optimization is shown to yield reproducible and physically relevant results when using a suitable figure-of-merit. The outcome of such an extraction is displayed for a range of operation points and the resulting bias dependencies of the element values is shown to be in good agreement with theoretical effects. The technique is further used to validate the quality of the extraction itself by showing a significant sensitivity to a deliberate error in the value of each element.

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Comments on representation of surface leaky waves on uniplanar transmission lines

J. Machac and J. Zehentner. "Comments on representation of surface leaky waves on uniplanar transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.2 (Feb. 2002 [T-MTT]): 583-585.

This paper compares partial waves approximating a surface leaky wave on a uniplanar transmission line with substrate surface waves supported by its substrate. It is shown that their field distributions and the propagation constants differ. These differences increase with rising leakage constant, and with the growing distance of the corresponding pole of the Green function from the real axis on the spectral variable complex plane. The reported findings are demonstrated on the slotline.

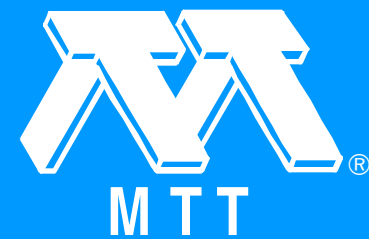
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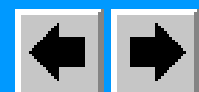
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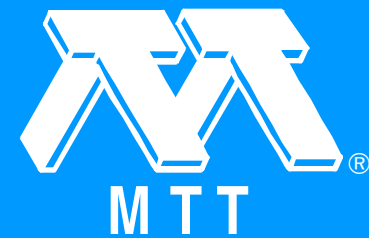
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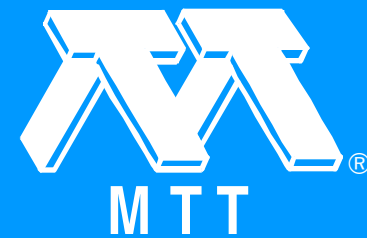
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"Inside Cover (Mar. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 0_3-0_4.



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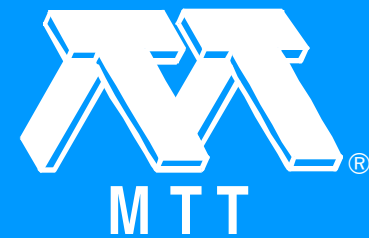
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Introduction (Mar. 2002 [T-MTT])

L. Young. "Introduction (Mar. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 592-593.



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Milestones of microwaves

H. Sobol and K. Tomiyasu. "Milestones of microwaves." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 594-611.

This paper presents a compilation of the important milestones in the development and applications of microwave technology from the time of Hertz until 1980. The years from 1980 to the present are not addressed since this period will be covered in depth in other papers of this Transactions. The primary technology areas addressed are electromagnetics, guided microwave structures, free-space propagation, power generation using tubes and solid-state devices, passive devices, microwave integrated circuits, ferrites, microwave acoustics, and microwave biological effects. The primary application areas are communications, radar, heating, and medical applications. Design techniques, measurements, and instrumentation are also discussed.

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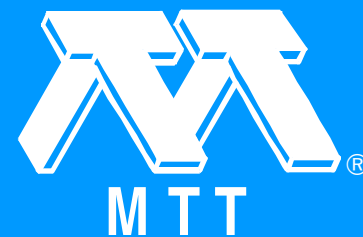


Abstracts

50 years of the IEEE Microwave Theory and Techniques Society

T.S. Saad and J.C. Wiltse. "50 years of the IEEE Microwave Theory and Techniques Society." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 612-624.

The early history of the IEEE Microwave Theory and Techniques Society (IEEE MTT-S) is summarized since its founding in 1952, and all administrative committee members and presidents are listed. Some of the more recent changes resulting from growth and multinational participation are described. Publications are discussed with editors listed for this Transactions, the IEEE Microwave and Wireless Components Letters, the IEEE Microwave Newsletter, and IEEE Microwave Magazine. The chronological evolution of the IEEE MTT-S's awards is presented, including a listing of all award winners. Distinguished lecturers and microwave symposia sites and chairpersons are also discussed. Early technology trends are described.



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Role of radar in microwaves

M. Skolnik. "Role of radar in microwaves." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 625-632.

Radar has been highly influenced by the technology of microwaves, and likewise the development of microwaves has been significantly affected by the needs of radar. This paper addresses the relation between the two. It begins by briefly describing the introduction of microwave radar in World War II that was a major factor in the Allies achieving success in air defense and antisubmarine warfare. Microwave radar developments during and after the war are reviewed, along with a listing of current military and civilian applications. The dependence of modern radar on digital processing (with clock rates at microwave frequencies), high-power transmitters, and sophisticated antennas is discussed. The paper concludes by mentioning possible future directions for radar, and briefly describes two examples of future radar system opportunities. These are the ubiquitous radar and high-power transportable millimeter-wave radar based on the gyrokystron amplifier. The message is that microwaves and radar have mutually benefited from one another and that radar still offers many opportunities for microwave engineers to demonstrate their ingenuity and creativity.

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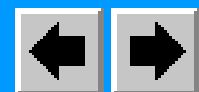
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Subjects

Electronic warfare systems

A.E. Spezio. "Electronic warfare systems." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 633-644.

Electronic warfare (EW) is an important capability that can advance desired military, diplomatic, and economic objectives or, conversely, impede undesired ones. In a military application, EW provides the means to counter, in all battle phases, hostile actions that involve the electromagnetic (EM) spectrum-from the beginning when enemy forces are mobilized for an attack, through to the final engagement. EW exploits the EM environment by sensing and analyzing an adversary's application of the spectrum and imposing appropriate countermeasures (CMs) to hostile spectrum use. EW sensors are one means by which the military gathers tactical intelligence from noncooperative forces. EW sensors, together with EW CMs, mitigate the effectiveness of an adversary's electrooptic/infrared, and radio frequency-controlled weapons. EW enhances the survivability of the host force through control and manipulation of the EM environment and denies or limits its use by an adversary. EM spectrum CMs to threat systems can be selectively applied on a time- and/or frequency-multiplexed basis so that host force use of the EM spectrum is uninhibited.

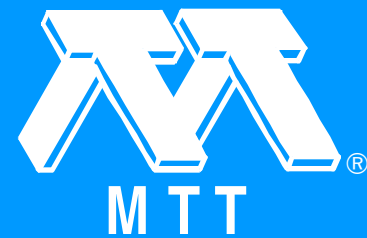


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The global positioning system

J.G. McNeff. "The global positioning system." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 645-652.

The paper provides a top-level perspective on how the global positioning system works, how its services are used, and delves into the most important technical and geo-political factors affecting its long-term availability in an international setting.



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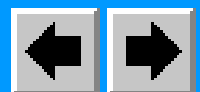
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Direct-sequence spread-spectrum communications for multipath channels

M.B. Pursley. "Direct-sequence spread-spectrum communications for multipath channels." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 653-661.

Direct-sequence spread spectrum has been adopted for many current and future cellular CDMA communication systems, and it is also used widely for military communication networks and systems. One of the motivations for employing direct-sequence spread spectrum is its ability to combat fading due to multipath propagation. The use of direct-sequence spread spectrum to resolve multipath signals is discussed and illustrated. The role of a rake receiver is described, and tradeoffs in the selection of the chip rate for the spread-spectrum system are discussed.

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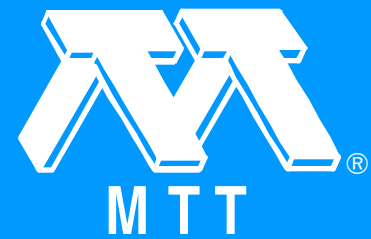


Abstracts

Propagation prediction models for wireless communication systems

M.F. Iskander and Zhengqing Yun. "Propagation prediction models for wireless communication systems." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 662-673.

A comprehensive review of the propagation prediction models for terrestrial wireless communication systems is presented in this paper. The classic empirical models are briefly described and the focus is placed on the application of ray-tracing techniques to the development of deterministic propagation models. Schemes to increase the computational efficiency and accuracy are discussed. Traditional statistical models are also briefly reviewed for completeness. New challenges to the propagation prediction are described and some new approaches for meeting these challenges are presented.



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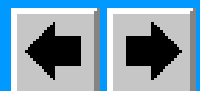
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Integrated automotive sensors

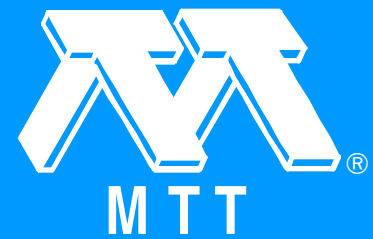
M.E. Russell, C.A. Drubin, A.S. Marinilli, W.G. Woodington and M.J. Del Checcolo. "Integrated automotive sensors." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 674-677.

Focuses on automotive applications and discusses the development of a suite of integrated radar and IR sensors that can be used to surround a vehicle (car, truck, boat, etc.). The primary function is to provide information to the vehicle systems and operator as enhancements to passenger and vehicle safety. It may also provide vehicle information (speed, location, destination, etc.) and integrate information (weather, road/traffic conditions, service/rest-area location, route details, etc.) from an intelligent vehicle highway system.

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Subjects

Phased arrays - part 1: theory and architectures

D. Parker and D.C. Zimmermann. "Phased arrays - part 1: theory and architectures." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 678-687.

An overview of electronically scanned array technology with a brief introduction of the basic theory and array architectures are presented. Implementations, current state-of-the-art, and future trends are briefly reviewed in Part II of this paper.

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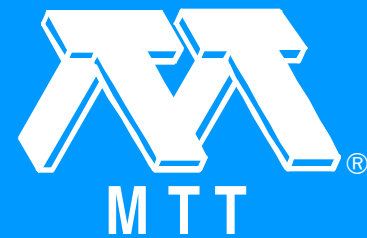


Abstracts

Phased arrays-part II: implementations, applications, and future trends

D. Parker and D.C. Zimmermann. "Phased arrays-part II: implementations, applications, and future trends." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 688-698.

In part I of this paper, we presented the basic architectures and theory for passive and active phased arrays. Here, we review array implementation, state-of-the-art applications, and identify future trends in phased-array technology.



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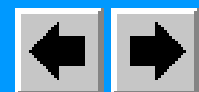
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Digital microwave receiver technology

J.B.Y. Tsui and J.P. Stephens, Sr.. "Digital microwave receiver technology." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 699-705.

This paper reports the impact of digital signal processing on microwave receiver technology. The majority of modern receiver designs are based on digital technology. Wide-and narrow-band receivers are presented. The wide-band receivers cover approximately 1-GHz instantaneous bandwidth and are used to intercept radar pulses. Current narrow-band receivers cover up to 50-MHz instantaneous bandwidth and are primarily used for receiving communication signals. Two approaches for wide-band receiver design are discussed. One is the conventional digital receiver. The other one is called the monobit receiver, which has slightly inferior performance in some respects, but can be built on a single chip. Narrow-band receivers are best implemented in software because they can more adapt to changes. Two types of receivers are discussed. One is the software Global Positioning System receiver. The other one is called a transform-domain communication system. The object of this system is to avoid interference in a hostile communication environment.

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Dielectric materials, devices, and circuits

S.J. Fiedziuszko, I.C. Hunter, T. Itoh, Y. Kobayashi, T. Nishikawa, S.N. Stitzer and K. Wakino. "Dielectric materials, devices, and circuits." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 706-720.

Dielectric materials are continuing to play a very important role in the microwave communication systems. These materials are key in realization of low-loss temperature-stable resonators and filters for satellite and broadcasting equipment, and in many other microwave devices. High dielectric-constant materials are critical to the miniaturization of wireless systems, both for the terminals and base-stations, as well as for handsets. In this paper, a sequential evolution of the dielectric materials applications in microwave devices will be reviewed. This includes dielectric waveguides, low-loss temperature-stable ceramic materials, dielectric resonators, and filters. The recent advances in the multilayer circuit modules, dielectric antennas, and ferroelectrics are also described.

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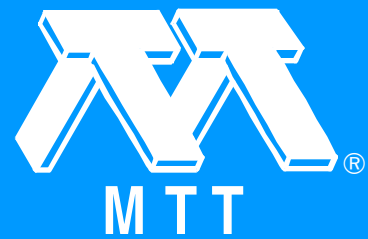


Abstracts

Ferrite devices and materials

J.D. Adam, L.E. Davis, G.F. Dionne, E.F. Schloemann and S.N. Stitzer. "Ferrite devices and materials." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 721-737.

The development and current status of microwave ferrite technology is reviewed in this paper. An introduction to the physics and fundamentals of key ferrite devices is provided, followed by a historical account of the development of ferrimagnetic spinel and garnet (YIG) materials. Key ferrite components, i.e., circulators and isolators, phase shifters, tunable filters, and nonlinear devices are also discussed separately.



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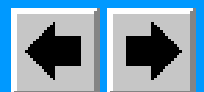
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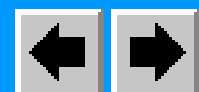
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Microwave acoustic materials, devices, and applications

R. Weigel, D.P. Morgan, J.M. Owens, A. Ballato, K.M. Lakin, K. Hashimoto and C.C.W. Ruppel. "Microwave acoustic materials, devices, and applications." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 738-749.

This paper surveys applications of acoustic waves in microwave devices. After a general and historical introduction to bulk acoustic waves (BAWs), surface acoustic waves (SAWs), practical wave types, and acoustoelectric transducers, a review is given of technologically important materials for microwave acoustic applications. Following this, we discuss BAW and SAW microwave devices and their technologies. Specifically reviewed are thin-film resonators and filters, transversal filters, and filters for correlative analog signal processing. Finally, an overview of the most important microwave applications is given, along with manufacturing and packaging issues.

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Microwave superconductivity

R.R. Mansour. "Microwave superconductivity." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 750-759.

This paper provides an overview of the microwave applications of high-temperature superconductor (HTS) technology. The main characteristics of HTS materials are outlined, highlighting the differences between superconductors and normal conductors. This paper presents recent progress in the development of HTS filters, multiplexers, cryogenic receivers, delay lines, and antennas. A brief summary of cryocooler technology and cryopackaging requirements is presented. The benefits of using HTS technology in wireless and satellite systems are also discussed. The intent of this paper is to provide perspective to newcomers in the field and to empower the potential end-users with current status and performance capabilities of HTS microwave devices.

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Microwave solid-state active devices

G.I. Haddad and R.J. Trew. "Microwave solid-state active devices." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 760-779.

Solid-state devices have had a major impact on the development of microwave and millimeter-wave systems. Starting with development work dating back to the 1940s, a variety of two- and three-terminal device structures have been proposed, fabricated, and found their way into commercial and military applications. These devices have resulted in the realization of numerous systems that would not otherwise be possible. The device development effort has been closely linked to advances in semiconductor materials growth and processing technology. Many of the advanced device concepts can only be implemented with the advent of advanced materials growth technology, such as molecular-beam epitaxy, and fine-line lithography techniques, such as electron-beam lithography. Advanced materials technology has also provided the ability to fabricate heterostructures that permit the advantages of multiple material layers to be optimized for device applications. High-performance diodes and transistors are now available for use from UHF into the millimeter-wave spectrum, approaching terahertz frequencies. The development, operating principles, and state-of-the-art of various diode and transistor structures are reviewed.

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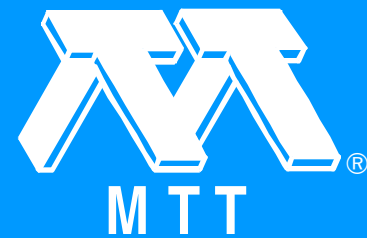


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The early history of the high electron mobility transistor (HEMT)

T. Mimura. "The early history of the high electron mobility transistor (HEMT)." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 780-782.

The early history of the high electron mobility transistor illustrates the way in which a new device idea occurs and is developed towards commercialization. The events which took place in our laboratory are described in this paper.

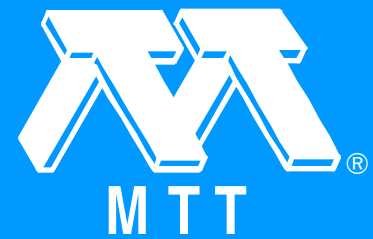


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Design of microwave filters

R. Levy, R.V. Snyder and G. Matthaei. "Design of microwave filters." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 783-793.

A survey of the major techniques used in the design of microwave filters is presented in this paper. It is shown that the basis for much fundamental microwave filter theory lies in the realm of lumped-element filters, which indeed are actually used directly for many applications at microwave frequencies as high as 18 GHz. Many types of microwave filters are discussed with the object of pointing out the most useful references, especially for a newcomer to the field.

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Microwave filters-applications and technology

I.C. Hunter, L. Billonet, B. Jarry and P. Guillon. "Microwave filters-applications and technology." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 794-805.

This paper describes the development of microwave filter technology from an applications perspective. Military applications required wide-band and tunable devices for electronic support measures receivers, which led to the development of highly selective wide-band waveguide filters, coaxial resonator and suspended-substrate multiplexers, and electronically tunable filters. The satellite communications industry created demand for low-mass narrow-band low-loss filters with severe specifications on amplitude selectivity and phase linearity. These requirements resulted in the development of dual-mode waveguide and dielectric-resonator filters, and advances in the design of contiguous multiplexers. Cellular communications base-stations demanded low-loss high power-handling selective filters with small physical size, capable of being manufactured in tens of thousands at a reasonable cost. These demands led to advances in coaxial resonator, dielectric resonator, and superconducting filters, and also to methods of cost-reduction, including computer-aided alignment. Cellular radio handsets have required the manufacture of hundreds of millions of extremely small very low-cost filters, still with reasonably low loss and high selectivity. This has driven significant advances in integrated ceramic, surface, and bulk acoustic-wave active filters and filters using micromachined electromechanical systems.



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Low-noise amplifiers-then and now

J.J. Whelehan. "Low-noise amplifiers-then and now." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 806-813.

The evolution in the performance of low-noise amplifiers (LNAs) has been dynamic over the past years. From the early LNAs that were complex, large, and heavy, to the present day InP high electron-mobility transistors that have virtually transformed the industry by their performance and extension into frequency bands that were not even considered in the past. This paper summarizes the transformation that has occurred in the LNA field, viewing where they were in the past, and where they are now.

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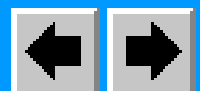
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Power amplifiers and transmitters for RF and microwave

F.H. Raab, P. Asbeck, S. Cripps, P.B. Kenington, Z.B. Popovic, N. Potheary, J.F. Sevic and N.O. Sokal. "Power amplifiers and transmitters for RF and microwave." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 814-826.

The generation of RF/microwave power is required not only in wireless communications, but also in applications such as jamming, imaging, RF heating, and miniature dc/dc converters. Each application has its own unique requirements for frequency, bandwidth, load, power, efficiency, linearity, and cost. RF power is generated by a wide variety of techniques, implementations, and active devices. Power amplifiers are incorporated into transmitters in a similarly wide variety of architectures, including linear, Kalm, envelope tracking, outphasing, and Doherty. Linearity can be improved through techniques such as feedback, feedforward, and predistortion.

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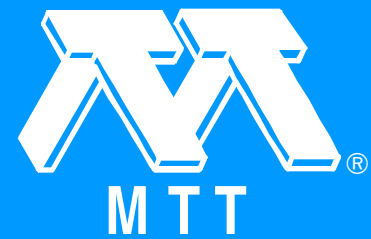


Abstracts

Transmit/receive modules

B.A. Kopp, M. Borkowski and G. Jerinic. "Transmit/receive modules." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 827-834.

This paper begins with a discussion of the microwave functions performed by transmit/receive (T/R) modules for phased-array antenna applications. The paper then addresses performance and cost aspects of semiconductor, packaging, and assembly technologies associated with T/R modules.



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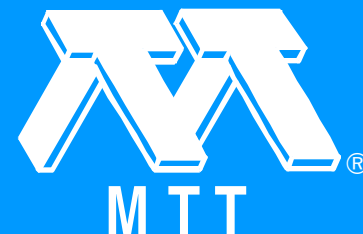


Abstracts

Vacuum electronics

R.K. Parker, R.H. Abrams, Jr., B.G. Danly and B. Levush. "Vacuum electronics." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 835-845.

This paper explores the recent history and diversity of this remarkable technology, with emphasis on recent advances in the more traditional device types (traveling-wave tube and klystron), as well as more recent innovations such as the microwave power module, inductive output amplifier, fast-wave devices, ultrahigh-power sources, and RF vacuum microelectronics. These advances can be credited to a combination of device innovation, enhanced understanding gained through improved modeling and design, the introduction of superior materials and sub-assembly components and the development of advanced vacuum processing and manufacturing techniques.



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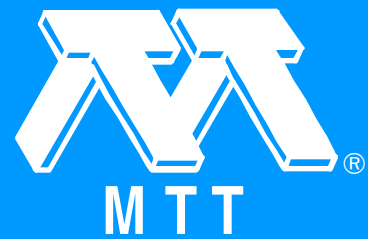


Abstracts

Microwave and millimeter-wave integrated circuits

E.C. Niehenke, R.A. Pucel and I.J. Bahl. "Microwave and millimeter-wave integrated circuits." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 846-857.

This historical review is divided into three sections: microwave integrated circuits (MICs), monolithic microwave integrated circuits (MMICs), and MIC and millimeter-wave integrated-circuit applications.



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MEMS and Si micromachined circuits for high-frequency applications

L.P.B. Katehi, J.F. Harvey and E. Brown. "MEMS and Si micromachined circuits for high-frequency applications." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 858-866.

RF micromachining and microelectromechanical structure (MEMS) technology promise to provide an innovative approach in the development of effective and low-cost circuits and systems. This technology is expected to have significant application in the development of low-cost antenna arrays and reconfigurable apertures, due to its potential to support novel systems architectures. This paper presents a brief history and the state-of-the-art in the development of RF MEMS devices, with primary emphasis on switches and Si-micromachined circuit components for use in high-performance high-density on-wafer packaged circuits.

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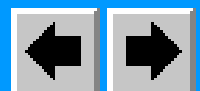
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50 years development of the microwave mixer for heterodyne reception

T.H. Oxley. "50 years development of the microwave mixer for heterodyne reception." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 867-876.

A brief technical historical review of mixer development, in its application as the frequency down-converter for the microwave and millimeter-wave heterodyne receiver, provides the background to discussion of mixer design, technology, and performance characteristics. In general terms, today's mixers designs are based on the 1970s principles, but technology progress in the solid-state frequency-mixing element and associated integrated circuits has been significant, with exploitation of the monolithic potential. Performance advancements have mainly been in the increased frequency capabilities of the planar Schottky barrier diode mixer, broad application of the three terminal devices, and balun implementation.

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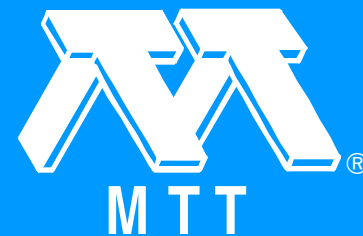


Abstracts

Microwave photonics

A.J. Seeds. "Microwave photonics." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 877-887.

The low-loss wide-bandwidth capability of optoelectronic systems makes them attractive for the transmission and processing of microwave signals, while the development of high-capacity optical communication systems has required the use of microwave techniques in optical transmitters and receivers. These two strands have led to the development of the research area of microwave photonics. This paper describes the development of microwave photonic devices, describes their systems applications, and suggests likely areas for future development.



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HF, VHF, and UHF systems and technology

F.H. Raab, R. Caverly, R. Campbell, M. Eron, J.B. Hecht, A. Mediano, D.P. Myer and J.L.B. Walker. "HF, VHF, and UHF systems and technology." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 888-899.

A wide variety of unique systems and components inhabits the HF, VHF, and UHF bands. Many communication systems (ionospheric, meteor-burst, and troposcatter) provide beyond-line-of-sight coverage and operate independently of external infrastructure. Broadcasting and over-the-horizon radar also operate in these bands. Magnetic-resonance imaging uses HF/VHF signals to see the interior of a human body, and RF heating is used in a variety of medical and industrial applications. Receivers typically employ a mix of analog and digital-signal-processing techniques. Systems for these frequencies make use of RF-power MOSFETs, p-i-n diodes, and ferrite-loaded transmission-line transformers.

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Digital signal processing - up to microwave frequencies

P. Asbeck, I. Galton, Keh-Chung Wang, J.F. Jensen, A.K. Oki and C.T.M. Chang. "Digital signal processing - up to microwave frequencies." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 900-909.

Digital logic integrated circuits are advancing toward ever higher speeds of operation. Clock frequencies already exceed 1 GHz in some Si CMOS-based consumer products, and even higher speeds are attainable in specialized technologies, such as those based on GaAs, InP, and SiGe bipolar and field-effect transistors. Digital approaches may be used to carry out a variety of functions important in microwave systems, including signal generation, filtering, and frequency conversion. The digital implementation provides a variety of potential benefits, including lack of sensitivity to aging and component inaccuracies, flexibility, and programmability. The dynamic range and degree of nonlinearity can be specified by design. Signal storage and memory functions are easily accomplished. Single-chip integration of digital and microwave systems are also facilitated. The application of digital techniques in domains previously considered to be analog is an important ongoing technology thrust, which may be expected to accelerate. This paper reviews the prospects of digital techniques for microwave systems, and briefly describes the state-of-technology and future possibilities.

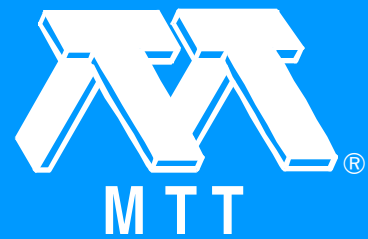


Abstracts

Terahertz technology

P.H. Siegel. "Terahertz technology." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 910-928.

Terahertz technology applications, sensors, and sources are briefly reviewed. Emphasis is placed on the less familiar components, instruments, or subsystems. Science drivers, some historical background, and future trends are also discussed.



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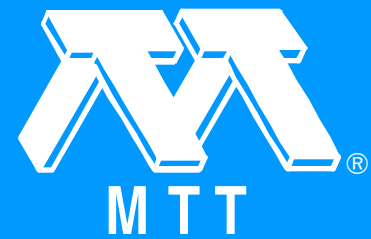


Abstracts

Quasi-optical and spatial power combining

M.P. DeLisio and R.A. York. "Quasi-optical and spatial power combining." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 929-936.

Quasi-optical power-combining techniques have been developed to address fundamental limitations in solid-state devices and circuits. These techniques have been applied to oscillators, amplifiers, frequency-conversion components, and control circuits. This paper surveys progress in the development of quasi-optical array systems operating in the microwave and millimeter-wave regime, focusing primarily on the progress in power amplifiers.



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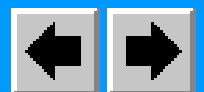
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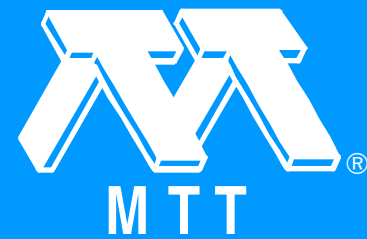


Abstracts

Active integrated antennas

K. Chang, R.A. York, P.S. Hall and T. Itoh. "Active integrated antennas." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 937-944.

This paper provide a review of the active integrated antenna (AIA) technologies. After a brief introduction on the definition and some historical remarks, the paper concentrates on the research effort on the past decades or so. The AIAs are reviewed in its various functions. First, an oscillator-type AIA is presented, followed by very interesting aspects of coupled oscillator arrays for phase control. Use of an AIA concept for efficient RF front ends is described with examples on high-power amplifier AIAs. Next, a phase-conjugation-based retrodirective array is reviewed. Finally, AIA systems for receiving, transmitting, and duplexing are reviewed.



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Microwave underground propagation and detection

L. Carin, J. Sichina and J.F. Harvey. "Microwave underground propagation and detection." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 945-952.

The detection of buried targets has been a problem of significant interest for decades, with microwave-based sensing constituting an important tool. In this paper, we review the basic issues that characterize microwave-based subsurface sensing. Issues considered include the use of microwaves in the context of an airborne synthetic aperture radar, as well for radars deployed close to the air-soil interface. Rough-surface induced clutter is also discussed. Particular examples are presented for detection of land mines and unexploded ordnance.

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Biological effects of radiofrequency/microwave radiation

E.R. Adair and R.C. Petersen. "Biological effects of radiofrequency/microwave radiation." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 953-962.

Over the past 50 years, significant advances have been made in the characterization of radiofrequency/microwave (RF/MW) fields (3 kHz-300 GHz) and energy absorption, as well as in the quantification of biological responses of organisms exposed to this kind of electromagnetic energy. The known biological effects and hazards have been demonstrated to be largely thermal in nature. This paper reviews key developments in experimental and theoretical dosimetry, as well as confirmed biological effects that have formed the basis of ever more sophisticated human-exposure standards generated through the IEEE consensus process. It also suggests some potential benefits to mankind of systems based on the thermogenic character of RF/MW energy absorption.

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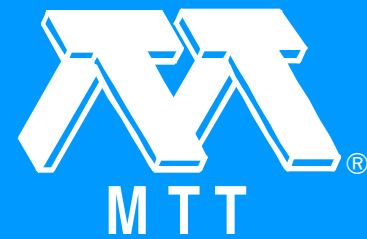


Abstracts

Applications of RF/microwaves in medicine

A. Rosen, M.A. Stuchly and A. Vander Vorst. "Applications of RF/microwaves in medicine." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 963-974.

Medical applications of RF/microwaves are highlighted in this paper. The emphasis is placed on newer emerging diagnostic and therapeutic applications, such as microwave breast cancer detection, and treatment with localized high power used in ablation of the heart, and liver, benign prostate hypertrophy, angioplasty, and others. A very brief outline of biological effects of RF/microwaves and associated issues is given as background to the applications.



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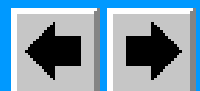
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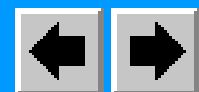
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Microwave power applications

J.M. Osepchuk. "Microwave power applications." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 975-985.

The field of microwave power applications is little recognized within the publications of the IEEE, yet it represents the most universal connection of microwave technology to the everyday life of people worldwide through the microwave oven. The technology of efficient low-cost microwave power sources has progressed not only to permit the economic feasibility of the microwave oven, but also a growing myriad of other commercial and industrial applications. The most successful of these is in the food industry for meat tempering and cooking. Other successful applications include plasma discharge devices for UV curing and lighting. In the future, applications to comfort heating of man and animals and various microwave power transmissions are foreseen. Problems of hazard perception and interference are now recognized as potential impediments to accelerated progress. The resolution of these problems requires cooperation between various parties, including the power application industries and the wireless communication industries.

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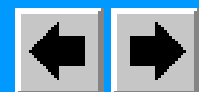
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Microwave instrumentation for radio astronomy

J.C. Webber and M.W. Pospieszalski. "Microwave instrumentation for radio astronomy." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 986-995.

Radio astronomy is a branch of science that allows observation of natural radio signals from cosmic sources. Microwave techniques are employed in large radio telescope systems in diverse ways. Starting with early vacuum tube receivers at meter wavelengths, low-noise receivers have pushed the leading edge of technology, culminating in present-day receivers employing HFET amplifiers, superconducting tunnel junctions, and other advanced receiving elements. We discuss the principles of such devices, modern receivers, and modern radio telescope systems both operational and under development.

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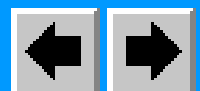
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Computer-aided design of RF and microwave circuits and systems

M.B. Steer, J.W. Bandler and C.M. Snowden. "Computer-aided design of RF and microwave circuits and systems." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 996-1005.

The history of RF and microwave computer-aided engineering is documented in the annals of the IEEE Microwave Theory and Techniques Society. The era began with elaborate analytically based models of microwave components and simple computer-aided techniques to cascade, cascode, and otherwise connect linear component models to obtain the responses of linear microwave circuits. Development has become rapid with computer-oriented microwave practices addressing complex geometries and with the ability to globally model and optimize large circuits. The pursuit of accurate models of active devices and of passive components continues to be a key activity.

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Microwave and RF education-past, present, and future

K.C. Gupta, T. Itoh and A.A. Oliner. "Microwave and RF education-past, present, and future." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1006-1014.

This paper is an overview of how microwave and RF education has changed over the years and where it is heading. The history of microwave and RF education, and the key events that influenced its development, are summarized. These events include the need for short-wavelength radar during World War II, the invention of printed transmission lines in the 1950s, the emergence of microwave integrated circuits and solid-state devices during the 1960s, the growing availability of computers and the development of numerical methods during the 1970s, and the availability of microwave circuit simulators and field simulators in the 1980s and 1990s, respectively. The likely impact of recent advances in Internet technology for the distribution of multimedia information is then described. The paper concludes by pointing out the outstanding challenges for the education and continuing education of microwave and RF engineers.

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Technology-based electromagnetic education

M.F. Iskander. "Technology-based electromagnetic education." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1015-1020.

In this paper, we briefly review the various roles of technology in stimulating interest and deepening understanding of abstract and highly mathematical subjects such as electromagnetics (EM). The general advantages of using technology in offering Web-based courses and professional training are described and examples of the ongoing activities in this area are summarized. Focus, however, is placed on the development and effective use of multimedia assets in the modern teaching of fundamental EM and more advanced microwave courses. Development and use of interactive components such as virtual laboratories, virtual instruments, simulation software, animation, and virtual participation in practical applications are described. The new "Conceptual Learning of Engineering" project is also described, and examples demonstrating the various ongoing activities are presented.

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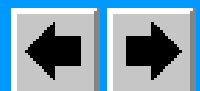
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Electromagnetic units and equations

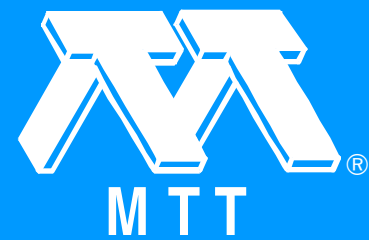
L. Young. "Electromagnetic units and equations." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1021-1027.

Different systems of units are often used in electrical engineering and in physics, causing difficulties when the need arises to convert from one system of units to another. This can be a problem in certain areas of electromagnetism, as in microwave engineering when dealing with magnetic materials and devices, or with electromagnetic-wave propagation. It arises, for example, when converting between units or equations of the (rationalized, unsymmetrical) meter, kilogram, second, and ampere system and the (nonrationalized symmetrical) Gaussian system often used in physics. This paper solves the problem by means of Gedanken ("in-the-mind") experiments. You are invited to join "Alice in Wonderland," where anything is possible and every experiment has a happy outcome.

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The role of government support for research in U.S. academic institutions

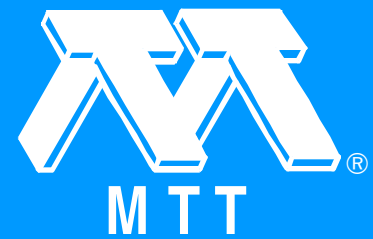
R.J. Trew, J.W. Mink and U. Varshney. "The role of government support for research in U.S. academic institutions." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1028-1033.

The U.S. government provides support funds for academic research in engineering through a variety of agencies. The majority of the funds for academic research is provided through the U.S. Department of Defense (DoD) and the National Science Foundation (NSF). Together these two U.S. government agencies, provide about /spl Bscr/ in total research funding annually to U.S. universities. Support funds for academic microwave-oriented research provided by these two agencies have proved instrumental in development of a strong academic base that has provided the intellectual energy resulting in the development of the U.S. communications, radar, remote sensing, and wireless industries. The history of U.S. government support for basic research is discussed, along with the organization of the DoD and NSF funding offices. Research funding distributions and trends are also discussed.

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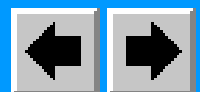
Microwave industry outlook - overview

P. Staecker. "Microwave industry outlook - overview." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1034-1036.

This paper reviews the influences that will shape the future of the microwave industry covering such topics as defense, engineering education, future of microwaves, healthcare, history of microwaves, technology roadmaps and telecommunications.



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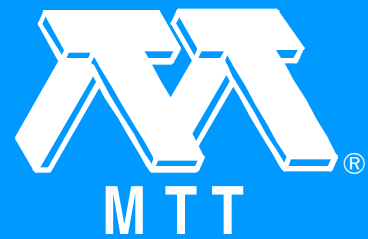


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Microwave industry outlook - microwaves for telecommunication systems

H. Sobol. "Microwave industry outlook - microwaves for telecommunication systems." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1037-1038.

This paper addresses future directions of microwave technology in telecommunication systems. Terrestrial mobile and fixed wireless access and transmission systems and satellite systems are discussed.



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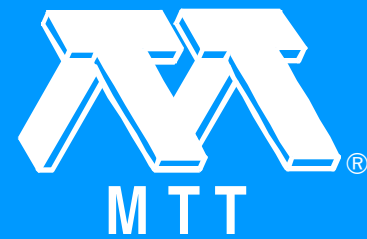


Abstracts

Microwave industry outlook - defense applications

D. Parker. "Microwave industry outlook - defense applications." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1039-1041.

Microwaves will play a vital role in future defense systems. They will enable the integration and interdependent operation of military ground, surface, air, missile, and space-based radar and communication systems for enhanced overall defense effectiveness. Microwave component, subsystem, and systems engineers will find new challenges in meeting the requirements for extremely high data rates and very low cost that are critical to the development of these systems of systems. The need for multidisciplined microwave engineers will provide new opportunities in the future.



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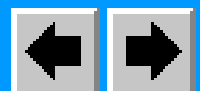
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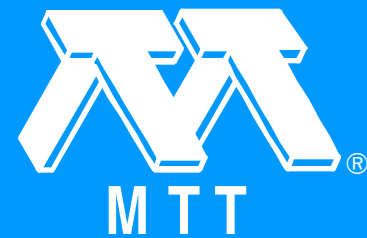


Abstracts

Microwave industry outlook - who will develop the wireless communication products of the 21st century?

L. Besser. "Microwave industry outlook - who will develop the wireless communication products of the 21st century?." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1042-1043.

The growing demand for wireless professionals is not matched by the preparation of RF and microwave engineers. A joint action of industry and academia, possibly coordinated by the IEEE, is needed to prevent serious engineering manpower shortage in the future.



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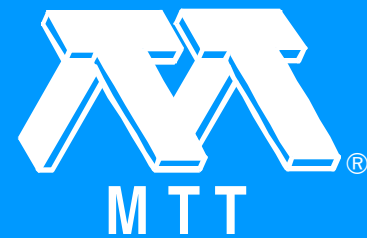


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Microwave industry outlook - wireless communications in healthcare

J. Schepps and A. Rosen. "Microwave industry outlook - wireless communications in healthcare." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1044-1045.

Concomitant advances in communications and medical technology have led to increasing deployment of telemedicine systems and services around the world. The goals of these systems are to increase the accessibility of professional caregivers, increase the quality of care to patients, and to increase the focus on preventative medicine through early intervention, all while reducing the overall cost of healthcare. Current pilot programs are beginning to show that these goals are achievable, warranting continued investment in telemedicine technologies.



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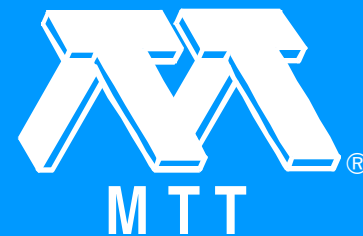


Abstracts

Microwaves in the asia-pacific region

E. Yamashita, T.S. Bird, Zhenghe Feng, B. Bhat, M. Akaike, Jung-Woong Ra, Mook Seng Leong, M. Krairiksh and Song Tsueng Peng. "Microwaves in the asia-pacific region." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1046-1055.

Infrastructure elements to produce microwave engineers and to promote microwave research and development in the Asia-Pacific region are described by active professors and researchers in this area as a multiauthor forum. The content of each description focuses mainly on the role of present-day universities, government, and industry.



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Microwaves in Europe

R. Sorrentino, T. Oxley, G. Salmer, A.V. Vorst, L.P. Ligthart, P. Russer, G. Gerosa, G. Pelosi, J.B. Andersen, A.V. Raisanen, E. Kollberg, J. Modelski, O.G. Vendik, I.B. Vendik, T. Berceli, M. Salazar-Palma, J. Costa Freire, N. Uzunoglu and A. Madjar. "Microwaves in Europe." 2002 Transactions on Microwave Theory and Techniques 50.3 (Mar. 2002 [T-MTT] (50th Anniversary Issue)): 1056-1072.

An overview of microwave activities and infrastructures in Europe is presented. The material is organized in 17 sections, each devoted to a country or group of countries and prepared by an internationally renowned microwave expert. In general, each section contains some history of microwaves in the region, and highlights some microwave activities in association with research centers, laboratories and institutions, industry, education, and national conferences.

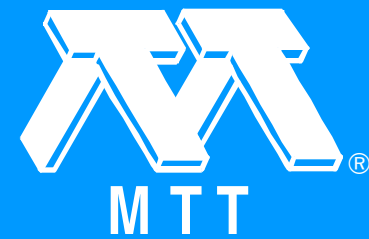
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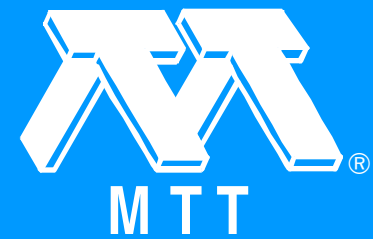
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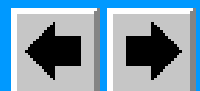
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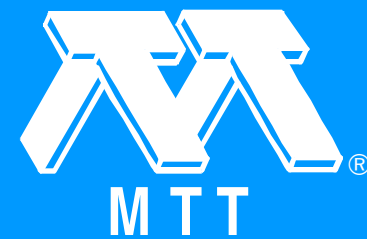
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Abstracts

Inside Cover (Apr. 2002 [T-MTT])

"Inside Cover (Apr. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 0_3-0_4.



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Full-wave design and optimization of circular waveguide polarizers with elliptical irises

G. Bertin, B. Piovano, L. Accatino and M. Mongiardo. "Full-wave design and optimization of circular waveguide polarizers with elliptical irises." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1077-1083.

We describe the design and optimization of a new polarizer structure realized in circular waveguide with insertion of elliptical irises. The device is compact, showing a considerable reduction in size and weight when compared to previously known realizations. It requires manufacturing by milling techniques only and, since it is composed entirely by waveguides with separable cross sections, it is also well suited for electromagnetic modeling. Measured and theoretical results for a polarizer with a 90/spl deg//spl plusmn/1/spl deg/ differential phase shift and a return loss better than 35 dB for both polarizations over the operating frequency band confirm the validity of the proposed design.



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Large-signal modeling and characterization of high-current effects in InGaP/GaAs HBTs

M.S. Shirokov, S.V. Cherepko, Xiaohang Du, J.C.M. Kwang and D.A. Teeter. "Large-signal modeling and characterization of high-current effects in InGaP/GaAs HBTs." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1084-1094.

High-current effects in InGaP/GaAs heterojunction bipolar transistors (HBTs) were modeled and characterized. In addition to the self-heating effect, high currents were found to degrade large-signal performance mainly through Kirk and quasi-saturation effects. New formalisms in terms of base transit time and base-collector diffusion capacitance were used to modify the conventional Gummel-Poon model. This new model was verified against large-signal characteristics measured at 2 GHz. The validity of the new model for HBTs of different emitter geometry was also explored.

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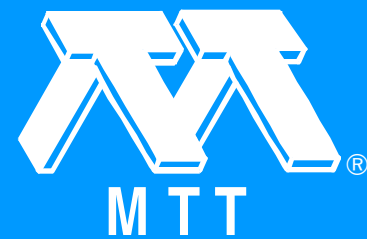
Attenuation characteristics in confocal annular elliptic waveguides and resonators

J.C. Gutierrez-Vega, R.M. Rodriguez-Dagnino and S. Chavez-Cerda. "Attenuation characteristics in confocal annular elliptic waveguides and resonators." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1095-1100.

The perturbation method is used to obtain the attenuation constant and Q-factor of several TEM, TE, and TM modes in confocal annular elliptic waveguides (CAE-Ws) and confocal annular elliptic resonators (CAE-Rs). Normalized attenuation and Q-factor charts are given for a variety of possible combinations of the focal distance and the eccentricities. Comparisons between the first higher mode in a CAE-W and a coaxial waveguide with the same cutoff frequency and cross-sectional propagating area reveals a lower attenuation in elliptic geometry. Consequently, the Q-factor in a CAE-R is 20%-40% greater than a Q factor for a coaxial resonator with the same volume and resonant frequency.

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A high-power and high-gain X-band Si/SiGe/Si heterojunction bipolar transistor

Zhenqiang Ma, S. Mohammadi, P. Bhattacharya, L.P.B. Katehi, S.A. Alterovitz and G.E. Ponchak. "A high-power and high-gain X-band Si/SiGe/Si heterojunction bipolar transistor." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1101-1108.

A double mesa-type Si/SiGe/Si (n-p-n) heterojunction bipolar transistor (HBT) with record output power and power gain at X-band (8.4 GHz) is demonstrated. The device exhibits collector breakdown voltage BV/sub CBO/ of more than 24 V and a maximum oscillation frequency f/sub max/ of 37 GHz. Under continuous-wave operation and class-AB biasing conditions, 24.2-dBm (263-mW) RF output power with concurrent gain of 6.9 dB is measured at the peak power-added efficiency (28.1%) from a single ten-emitter fingers (780-/spl mu/m/sup 2/ emitter area) common-base HBT. The maximum RF output power achieved is as high as 26.3 dBm (430 mW in saturation) and the maximum collector efficiency is 36.9%. The low collector doping concentration together with the device layout result in negligible thermal effects across the transistor and greatly simplifies the large-signal modeling. The conventional Gummel-Poon model yields good agreement between the modeled and the measured de characteristics and small-signal S-parameters. The accuracy of the model is further validated with the measured power performance of the SiGe power HBT at X-band. These results set a benchmark for power performance for SiGe-based HBTs and indicate promise for their implementation in efficient X-band power-amplifier circuits.

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A fast noise and Z-parameter transformations between common emitter and common base InP DHBT

Yong Zhong Xiong, Geok-Ing Ng, Hong Wang, Chee Leong Tan and J.S. Fu. "A fast noise and Z-parameter transformations between common emitter and common base InP DHBT." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1109-1113.

A new approach has been developed that uses only a simple set of formulas to transform noise and Z-parameters between common emitter and common base configurations. This technique is based on the typical T-model of InP double-heterojunction bipolar transistor and calculated results agree with the experimental results, demonstrating that this approach is useful for many broad-band low-noise communication circuit designs.

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Wide-band equal-ripple filters in nonuniform transmission lines

Da-Chiang Chang and Ching-Wen Hsue. "Wide-band equal-ripple filters in nonuniform transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1114-1119.

In this paper, a novel method to realize equal-ripple filters over microwave frequencies is presented. All networks are implemented by using cascade serial and shunt transmission-line sections having the same electrical length. The transfer functions of such networks are formulated in the Z domain. In particular, it can be shown that some shunt components are able to contribute zeros locating on the unit circle if the components are open circuited. Due to the feature of transfer-function zeros locating on the unit circle, we may use an optimization procedure to implement equal-ripple filters. Both low-pass and bandpass filters are realized in the form of microstrip lines and their frequency responses are measured to validate this novel method.

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Analysis of balanced active doubler for broad-band operation - the frequency-tuning concept

B. Piernas, K. Nishikawa, T. Nagagawa, H. Hayashi and K. Araki. "Analysis of balanced active doubler for broad-band operation - the frequency-tuning concept." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1120-1126.

A comprehensive analysis of an active balanced frequency doubler is described and proposed as a new concept: tuning the center frequency at which the doubler exhibits its highest performance to extend the usable bandwidth of the device. The concept is validated using a fabricated V-band pseudomorphic high electron-mobility transistor frequency doubler. For this device, a substantial improvement in the usable bandwidth (more than double) is achieved, demonstrating that the proposed concept is particularly suitable for the realization of high spectral purity and widely tunable V-band frequency sources.

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Device-level simulation of wave propagation along metal-insulator-semiconductor interconnects

Gaofeng Wang, R.W. Dutton and C.S. Rafferty. "Device-level simulation of wave propagation along metal-insulator-semiconductor interconnects." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1127-1136.

A device-level simulation is presented for studying wave propagation along metal-insulator-semiconductor interconnects. A set of nonlinear equations is first formulated by combining the motion equations of charged carriers and Maxwell's equations. The set of nonlinear equations is then transformed into the frequency domain, which leads to sets of nonlinear equations for the fundamental mode and its harmonics. Finally, the sets of nonlinear equations in the frequency domain are discretized using the finite-element method and solved using Newton's iterations. Special numerical enhancements are implemented to speed up the computational convergence and handle the boundary layer nature of the problem under study. This device-level simulation provides knowledge on field-carrier interactions, semiconductor substrate loss, and nonlinearity, as well as slow-wave and screening effects of charged carriers. This device-level simulation scheme enables a rigorous full-wave study of nonlinearity effects that arise from semiconductor substrates. Numerical examples for some practical material and geometrical parameters are included to illustrate capabilities and efficiency of the proposed device-level simulation scheme.





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Computer-aided diagnosis and tuning of cascaded coupled resonators filters

Heng-Tung Hsu, Hui-Wen Yao, K.A. Zaki and A.E. Atia. "Computer-aided diagnosis and tuning of cascaded coupled resonators filters." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1137-1145.

A model for the determination of the individual resonant frequencies and inter-resonator couplings of a system consisting of cascaded coupled resonators is presented. Measuring or computing the phase of the reflection coefficient of short-circuit terminated networks synthesizes all the inter-resonator couplings and resonant frequencies. The loading effect on the last resonator due to the unknown position of the short-circuit reference plane is accurately accounted for by a systematic method. A deterministic finite steps tuning method based on the model is developed. The method is proven successful experimentally and the noniterative nature of the method makes fully automatic tuning of filters possible.

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Asymmetric ring-hybrid phase shifters and attenuators

Hee-Ran Ahn and I. Wolff. "Asymmetric ring-hybrid phase shifters and attenuators." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1146-1155.

A new structure of asymmetric ring-hybrid phase shifters and attenuators is presented. Each consists of an asymmetric ring hybrid and reflecting terminations, and it does not have any additional 90/spl deg/ phase delay line for utilizing symmetric reflecting terminations that conventional phase shifters use. To analyze these asymmetric ring-hybrid phase shifters, normalized impedance ratios $NI_{\text{sub } b/}$ and $NI_{\text{sub } d/}$ are introduced, and the possibilities to reduce the size of the reflecting terminations are presented. Using the new structure of the asymmetric ring-hybrid phase shifters, asymmetric ring-hybrid attenuators are synthesized. To analyze the attenuators, normalized resistance ratios $NR_{\text{sub } Lb/}$ and $NR_{\text{sub } Ld/}$ are introduced, so that the resistances in the reflection terminations can arbitrarily be determined. On the basis of the derived new structures, a uniplanar asymmetric ring-hybrid -135/spl deg/ phase shifter and a microstrip asymmetric 4-dB attenuator with 45/spl deg/ phase shift have been fabricated and measured. They show good agreement between measured and simulated results and they may be used for impedance transformers besides their original functions.



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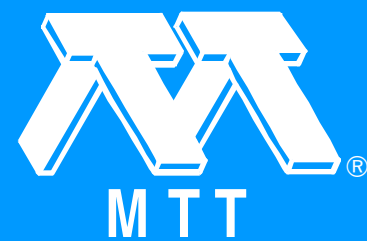
Analysis of the numerical dispersion of the 2D alternating-direction implicit FDTD method

An Ping Zhao. "Analysis of the numerical dispersion of the 2D alternating-direction implicit FDTD method." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1156-1164.

The numerical dispersion property of the two-dimensional alternating-direction implicit finite-difference time-domain (2D ADI FDTD) method is studied. First, we notice that the original 2D ADI FDTD method can be divided into two sub-ADI FDTD methods: either the x-directional 2D ADI FDTD method or the y-directional 2D ADI FDTD method; and secondly, the numerical dispersion relations are derived for both the ADI FDTD methods. Finally, the numerical dispersion errors caused by the two ADI FDTD methods are investigated. Numerical results indicate that the numerical dispersion error of the ADI FDTD methods depends highly on the selected time step and the shape and mesh resolution of the unit cell. It is also found that, to ensure the numerical dispersion error within certain accuracy, the maximum time steps allowed to be used in the two ADI FDTD methods are different and they can be numerically determined.

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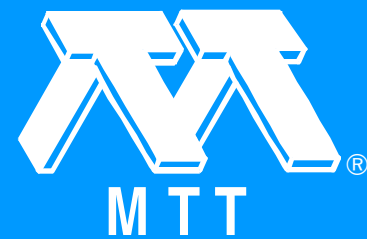
Subjects

Application of the SSOR preconditioned CG algorithm to the vector FEM for 3D full-wave analysis of electromagnetic-field boundary-value problems

*Ru-Shan Chen, Edward Kai-Ning Yung, C.H. Chan, Dao Xiang Wang and Da Gang Fang.
"Application of the SSOR preconditioned CG algorithm to the vector FEM for 3D full-wave analysis of electromagnetic-field boundary-value problems." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1165-1172.*

The symmetric successive overrelaxation (SSOR) preconditioning scheme is applied to the conjugate-gradient (CG) method for solving a large system of linear equations resulting from the use of edge-based finite-element method (FEM). For this scheme, there is no additional computing time required to construct the preconditioning matrix and it contains more global information of the coefficient matrix when compared with those of the banded-matrix preconditioning scheme. The efficient implementation of this preconditioned CG (PCG) algorithm is described in details for complex coefficient matrix. With SSOR as the preconditioner and its efficient implementation in the CG algorithm, this PCG approach can reach convergence in five times CPU time shorter than CG for several typical structures. By comparison with other preconditioned techniques, these results demonstrate that SSOR preconditioning strategy is especially effective for CG iterative method when an edge FEM is applied to solve large-scale time-harmonic electromagnetic-field problems.





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Single-MMIC four-channel transmitter module for multichannel RF/optical subcarrier multiplexed communications applications

Sangwoo Han, N. Lal, Chang Ho Lee, B. Matinpour, J. Laskar and D.J. Blumenthal. "Single-MMIC four-channel transmitter module for multichannel RF/optical subcarrier multiplexed communications applications." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1173-1179.

Presents a compact single monolithic microwave integrated circuit (MMIC) transmitter module for four-channel RF/optical subcarrier multiplexed (OSCM) communication applications. The developed module consists of one fully monolithic four-channel OSCM transmitter integrated circuit (IC) and four coupled-line filters. The MMIC is designed and implemented in a commercial 0.6- μm GaAs MESFET process and five-stage coupled-line filters are fabricated for each of the four channels on the module board. The module design and bit-error-rate performance are considered. This is the first fully monolithic IC transmitter module for OSCM communications applications.

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A genetic algorithm for the evaluation of material parameters of compound multilayered structures

T. Zwick, J. Haala and W. Wiesbeck. "A genetic algorithm for the evaluation of material parameters of compound multilayered structures." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1180-1187.

Presents a new method to obtain the material parameters of each single layer in a multilayered structure. The compound structure has to be measured over frequency or for different incidence angles in the microwave frequency range. The genetic algorithm for parameter extraction from the reflection or transmission measurement data is based on a simplified evolution strategy. In this paper, the evolution optimization is described briefly and is verified by measurements performed in the frequency range from 115 to 145 GHz. The parameters obtained by the algorithm show good agreement with reference values gained by other researchers.

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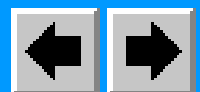
Subjects

A novel drain current I-V model for MESFET

Ban-Leong Ooi, J.Y. Ma and M.S. Leong. "A novel drain current I-V model for MESFET." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1188-1192.

The conventional approach for modeling the dc I-V characteristics of a MESFET transistor usually adopts the hyperbolic tangent dependence on V_{ds} . On the contrary, our new empirical model describes the device drain current as a polynomial of effective gate-source voltage V_{eff} . The derived model is capable of accurately modelling the subthreshold effect and the device current-voltage behavior at different operating regions, in particular, the device operation around the pinchoff region. Measured and modeled results of a 0.5- μm gatelength MESFET device are compared and good agreement has been obtained. Comparisons between the proposed model, Curtice model, Chalmers model, and Parker model are also made in this paper. In addition, a single-stage class-AB amplifier was built with a commercial high-power MESFET transistor to verify the new model.

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An accurate photonic capacitance model for GaAs MESFETs

C. Navarro, J.-M. Zamanillo, A.M. Sanchez, A.T. Puente, J.L. Garcia, M. Lomer and J.M. Lopez-Higuera. "An accurate photonic capacitance model for GaAs MESFETs." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1193-1197.

A new set of pseudoempirical equations is presented in order to simulate the optical and bias dependencies of GaAs MESFET junction capacitances, which is valid for the whole I-V plane. The variations induced in the small-signal equivalent circuit by the optical illumination are extracted from on-wafer scattering parameter measurements. New linear and quasi-logarithmic variations versus the incident optical power are shown for gate-drain and gate-source (C_{gd} and C_{gs}) capacitances. Furthermore, experimental results are in very good agreement with the simulated values for a wide range of optical power and bias conditions. Large signal MESFET models show a better fit with measured S-parameters than those previously published, leading to a greater degree of confidence in the design of photonic monolithic microwave integrated circuits.

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Electromagnetic scattering by metallic holes and its applications in microwave circuit design

A. Zeid and H. Baudrand. "Electromagnetic scattering by metallic holes and its applications in microwave circuit design." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1198-1206.

The problem of arbitrarily incident plane-wave scattering from rod structures of thick conducting plates arranged with two-dimensional (2D) periodicity has been examined. The square approximation as well as truncated-square approximation of circular cross sections is used in this study. The impedance of cascaded screens and the reflection coefficient is calculated using the multimodal variational method for both TE- and TM-polarized incident electric field. The 2D periodic structure of holes described in this paper can be used for the purpose of designing new guiding microwave structures. A transverse resonance method is applied to solve this problem. The convergence behavior of the technique has also been examined. The numerical results of the reflection coefficient, surface impedance, and dispersion curves are presented.

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Field-extracted lumped-element models of coplanar stripline circuits and discontinuities for accurate radiofrequency design and optimization

Lei Zhu and Ke Wu. "Field-extracted lumped-element models of coplanar stripline circuits and discontinuities for accurate radiofrequency design and optimization." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1207-1215.

Presents original lumped-element models of a large variety of coplanar stripline (CPS) circuits and discontinuities for accurate design and optimization of radiofrequency integrated circuits. These circuit models are extracted by applying a recently proposed deembedding technique called short-open calibration to calibrate the calculated field parameters obtained from the full-wave method of moments (MoM). It is realized by defining the two calibration standards, i.e., short and open elements, to evaluate and remove the error terms existing in the deterministic MoM algorithm, such as the approximation of port discontinuity and inconsistency of two-dimensional and three-dimensional characterizations of CPS external lines. In contrast to the static models, these field-extracted models can account for all the physical effects subject to the core area of CPS discontinuity, including frequency dispersion, high-order modes, and radiation loss. With this scheme, several CPS circuits and discontinuities are investigated over a wide frequency range to formulate their lumped-element models.

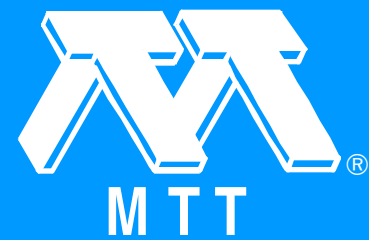
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A dual-plane comb-line filter having plural attenuation poles

T. Kitamura, Y. Horii, M. Geshiro and S. Sawa. "A dual-plane comb-line filter having plural attenuation poles." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1216-1219.

In this paper, a dual-plane comb-line filter having plural attenuation poles is proposed. We investigate the filtering characteristics from both experiments and numerical simulations by means of the finite-difference time-domain method. It is shown that this filter has attenuation poles just above, as well as below the passband and that intersections between the curves of input susceptance of the even and odd modes agree with the attenuation-pole frequencies. Furthermore, it is demonstrated that, by changing the position of the metal pin, which connects two resonators, we can change the input susceptance of the odd mode alone and, hence, regulate the attenuation-pole frequencies.



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A new hybrid mode-matching/numerical method for the analysis of arbitrarily shaped inductive obstacles and discontinuities in rectangular waveguides

H. Esteban, S. Cogollos, V.E. Boria, A.S. Blas and M. Ferrando. "A new hybrid mode-matching/numerical method for the analysis of arbitrarily shaped inductive obstacles and discontinuities in rectangular waveguides." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1219-1224.

A new and efficient hybrid mode-matching method is presented for the analysis of arbitrarily shaped inductive obstacles and/or discontinuities in a rectangular waveguide. The irregular region with obstacles and/or discontinuities is characterized using a full-wave hybrid spectral/numerical open-space technique expanding the fields in cylindrical wave functions. Next, a full-wave mode-matching procedure is used to match the cylindrical wave functions to guided modes in all ports and a generalized scattering matrix for the structure is finally obtained. The obstacles can be metallic or dielectric with complex permittivities and arbitrary geometries. The structure presents an arbitrary number of ports, each one with different orientation and dimensions. The accuracy of the method is validated comparing with results for several complex problems found in the literature. CPU times are also included to show the efficiency of the new method.



A balanced FET FMCW radar transceiver with improved AM noise performance

C. Fager, K. Yhland and H. Zirath. "A balanced FET FMCW radar transceiver with improved AM noise performance." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1224-1227.

A balanced FET frequency-modulated continuous-wave radar transceiver designed to suppress AM noise is presented. The transceiver utilizes the same device for output power amplification as for down-conversion of the received signal, thereby avoiding the need for separation of these signals. This makes the transceiver suitable for integration in monolithic-microwave integrated-circuit technology. A test circuit operating at 10 GHz was designed. The AM noise suppression is characterized, as well as output power and noise performance. Comparison with an unbalanced transceiver using the same principle of operation shows an improvement of 20 dB in AM noise performance. The output power is 14 dBm at 7-dBm input power.



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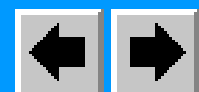
Subjects

A microwave gyro amplifier with a ferroelectric cathode

M. Einat, E. Jerby and G. Rosenman. "A microwave gyro amplifier with a ferroelectric cathode." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1227-1230.

A ferroelectric cathode is employed for the first time as the electron-beam source in a microwave amplifier tube. A PLZT 12/65/35 ferroelectric ceramic with a high dielectric constant ($\epsilon_r \approx 4000$) is used in a form of a hollow cathode. The tube is operated in poor vacuum conditions (2×10^{-5} Torr) at room temperature, in a mechanism of a cyclotron-resonance maser amplifier. The device operates near the waveguide cutoff frequency at 6927 MHz. A 22-dB electronic gain and a 25-W output power are measured in this experiment.

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A novel tap input coupling structure for a narrow bandpass filter using TM/sub 010/ mode of a microstrip circular-disk resonator

K.S.K. Yeo and M.J. Lancaster. "A novel tap input coupling structure for a narrow bandpass filter using TM/sub 010/ mode of a microstrip circular-disk resonator." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1230-1232.

This paper discusses a new method to couple into the TM/sub 010/ mode of a microstrip circular-disk resonator. This method can achieve reasonably strong input coupling, which is useful for narrow-band filters with fractional bandwidths of approximately 0.5% and above. A comparison between this newly proposed input coupling structure and the conventional gap input coupling structure will be addressed. A decision threshold for using either the tap input or the conventional gap-coupled input is also explained. Experimental results of a filter fabricated using this novel input coupling structure is also presented.

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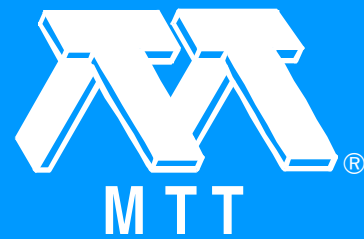


Abstracts

The H_{constant} mode in free-space and conical waveguides

J. Van Bladel. "The H_{constant} mode in free-space and conical waveguides." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1233-1237.

H_{constant} is one of the Neumann eigenfunctions used to expand the axial H component in a cylindrical waveguide. It cannot be omitted, lest erroneous results are obtained in, for example, aperture coupling with the exterior region. This paper investigates whether the same situation holds for a conical waveguide, and extends the analysis to free space, which may be considered as a radial waveguide.



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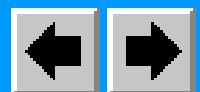
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Six-port self-calibration based on active loads synthesis

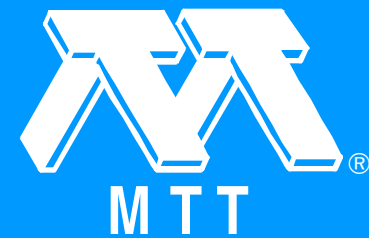
T. Yakabe, F.M. Ghannouchi, E.E. Eid, K. Fujii and H. Yabe. "Six-port self-calibration based on active loads synthesis." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1237-1239.

An automatic method for self-calibrating six-port reflectometers is reported in this paper. It is based on the use of an active impedance synthesis system. This self-calibration method allows a completely autonomous operation, reduces measurement errors caused by the frequent connecting and disconnecting of calibration standards, and is suitable for low and high frequencies, where sliding shorts are difficult to manufacture. In addition, it simplifies operation of six-port reflectometers to nonspecialized users. The experimented impedance synthesis presented relies on an in-phase and quadrature vector modulator, and the entire system is computer controlled.

Abstracts

Information for Authors (Apr. 2002 [T-MTT])

"Information for Authors (Apr. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 0_5-0_5.



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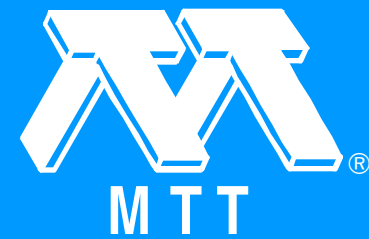
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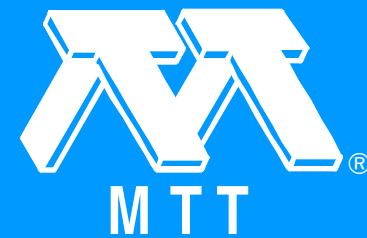
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Inside Cover (May 2002 [T-MTT])

"Inside Cover (May 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 0_3-0_4.



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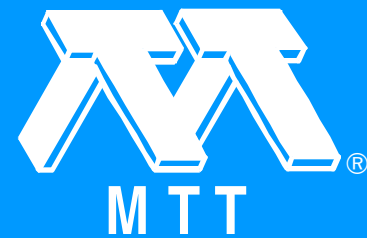


Abstracts

An improved thin-wire model for FDTD

R.M. Makinen, J.S. Juntunen and M.A. Kivikoski. "An improved thin-wire model for FDTD." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1245-1255.

An improved thin-wire model for the finite-difference time-domain method is proposed. The new model can be used to accurately model straight wire sections connected to other metal structures. In addition, the model includes the effect of charge accumulation at wire end caps. The end-cap model is based on conservation of charge and Coulomb's law. Using the end-cap model, unconnected wires such as wire antennas are also accurately modeled. The results indicate a significant improvement in predicting the resonance frequency of a dipole antenna.



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Numerical analysis of dielectric-rod waveguides with deep corrugation

H. Kubo and M. Tahara. "Numerical analysis of dielectric-rod waveguides with deep corrugation." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1256-1263.

Dielectric-rod waveguides with deep surface corrugation is analyzed by using the finite-difference time-domain method. In order to mitigate the load in numerical calculation and to analyze a wide region, the method is formulated in two-dimensional form. It is shown that disks located in a line function as a waveguide of low loss in a frequency region. The procedure of deciding the propagation constant from the analyzed field is presented. The complex propagation constant is obtained and the dependence of the amount of radiation on the corrugation amplitude is discussed.



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An efficient method for electromagnetic characterization of 2-D geometries in stratified media

M.I. Aksun, F. Caliskan and L. Gurel. "An efficient method for electromagnetic characterization of 2-D geometries in stratified media." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1264-1274.

A numerically efficient technique, based on the spectral-domain method of moments (MoM) in conjunction with the generalized pencil-of-functions (GPOF) method, is developed for the characterization of two-dimensional geometries in multilayer planar media. This approach provides an analytic expression for all the entries of the MoM matrix, explicitly including the indexes of the basis and testing functions provided that the Galerkin's MoM is employed. This feature facilitates an efficient modification of the geometry without the necessity of recalculating the additional elements in the MoM matrix. To assess the efficiency of the approach, the results and the matrix fill times are compared to those obtained with two other efficient methods, namely, the spatial-domain MoM in conjunction with the closed-form Green's functions, and a fast Fourier transform algorithm to evaluate the MoM matrix entries. Among these, the spectral-domain MoM using the GPOF algorithm is the most efficient approach for printed multilayer geometries.

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Analytical description of metal loss in finite-difference transmission-line analysis

M. Kunze and W. Heinrich. "Analytical description of metal loss in finite-difference transmission-line analysis." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1275-1279.

A new approximate approach to include metallic loss of planar transmission lines in the finite-difference frequency-domain analysis is presented. From the two-dimensional field behavior in the vicinity and inside of nonideal metallic layers, analytical approximations are obtained and incorporated into the algorithm. This approach leads to considerable savings in computational efforts. The same mesh size as in the lossless case can be used at an acceptable accuracy level and skin depth does not need to be resolved. Furthermore, preprocessing can be automated. The benefits of the new method are demonstrated for typical monolithic microwave integrated circuit coplanar waveguides.

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Calculated and measured characteristics of a microstrip line fabricated on a Y-type hexaferrite substrate

Hoton How, Xu Zuo, E. Hokanson, L.C. Kempel and C. Vittoria. "Calculated and measured characteristics of a microstrip line fabricated on a Y-type hexaferrite substrate." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1280-1288.

Numerical calculations have been applied to a microstrip line fabricated on a Y-type hexaferrite substrate using the Green's function technique. The formulation allows the ferrite substrate to be magnetized along an arbitrary direction. Current potentials have been used to construct the Galerkin elements and the resultant calculational scheme is applicable even when ferrimagnetic resonance is approached. Calculations compared reasonably well with measurements.

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Coplanar stripline resonators modeling and applications to filters

Young-Ho Suh and Kai Chang. "Coplanar stripline resonators modeling and applications to filters." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1289-1296.

This paper presents coplanar stripline (CPS) resonators and their practical implementations to filters. Five types of CPS resonator are built using open and short-ended strips. Lumped-element equivalent circuits are presented for each resonator. Their performances are investigated and compared in terms of Q factor or bandwidth. Two types of bandpass filter are developed with the resonators. The bandpass filters have low-passband insertion losses and wide-stopband suppression bandwidths. Lumped-element equivalent circuits are presented for the bandpass filters. A wide-band CPS-to-microstrip transition is developed for the measurements. The back-to-back transition has an insertion loss of less than 3 dB and a return loss of better than 10 dB for the frequency range from 1.3 to 13.3 GHz (1:10.2).



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Improvement to the PML boundary condition in the FEM using mesh compression

A. Mitchell, D.M. Kokotoff and M.W. Austin. "Improvement to the PML boundary condition in the FEM using mesh compression." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1297-1302.

Numerical errors encountered when using the perfectly matched layer (PML) absorbing boundary condition with the finite-element method are investigated to discover more efficient implementation schemes. Closed-form expressions for the numerical reflection at an interface between two general biaxial materials are applied to the special case of a PML boundary. Expressions for an anisotropically compressed mesh are then derived, revealing that reflections can be greatly reduced through increasing mesh density only where it is required. Significant improvements over previously reported PML boundaries are demonstrated.

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Piezoelectric-transducer-controlled tunable microwave circuits

Tae-Yeoul Yun and Kai Chang. "Piezoelectric-transducer-controlled tunable microwave circuits." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1303-1310.

This paper introduces a new method to tune microwave circuits of phase shifters, filters, resonators, and oscillators, controlled by a piezoelectric transducer (PET) with computational and experimental results. An optimized PET-controlled phase shifter is demonstrated to operate up to 40 GHz with a maximum total loss of 4 dB and phase shift of 480/spl deg/. PET-controlled tunable bandpass filter, ring resonator, and one-dimensional photonic-bandgap resonator show a very wide tuning bandwidth of 17.5%-28.5% near 10 GHz with little performance degradation. A new PET-controlled or voltage-controlled dielectric-resonator oscillator (DRO) is demonstrated with a tuning bandwidth of 3.7% at the center frequency of 11.78 GHz. The tuning bandwidth is slightly less than that of a mechanical tuning using a micrometer-head-controlled tunable DRO with a tuning bandwidth of 4.7%. The new tuning method should have many applications in monolithic and hybrid microwave integrated circuits.



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Extraction of a nonlinear AC FET model using small-signal S-parameters

J.H.K. Vuolevi and T. Rahkonen. "Extraction of a nonlinear AC FET model using small-signal S-parameters." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1311-1315.

The nonlinearities of an RF FET can be obtained by a set of small-signal circuit elements extracted over a range of terminal voltages and temperatures. This study used pulsed S-parameter measurements on a 3 /spl times/ 3 DC-bias-point grid at two different temperatures to obtain electrical and electrothermal nonlinearity coefficients up to the third order. The extracted nonlinear AC model can be used in a Volterra analysis to gain an insight into the distortion mechanisms. The measurement results were in good agreement with the calculated third-order intermodulation values.

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Phase-noise analysis of MEMS-based circuits and phase shifters

G.M. Rebeiz. "Phase-noise analysis of MEMS-based circuits and phase shifters." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1316-1323.

The effect of Brownian, acceleration, acoustic, and power-supply noise on MEMS based circuits has been calculated for MEMS.-based circuits (phase shifters, delay circuits). The calculations are done for capacitive shunt MEMS switches and metal-to-metal contact series MEMS switches. It is found that these effects result in both an amplitude and phase noise, with the phase noise being around 100/spl times/ larger than the amplitude noise. The phase noise due to Brownian motion is negligible for MEMS switches with $k / \text{spl sime/ } 1.0 \text{ N/m}$, $g / \text{sub } 0 / > 2 / \text{spl mu/m}$, $Q > 0.5$, and $f / \text{sub } 0 / / \text{spl sime/ } 50 \text{ kHz}$. The effect of acceleration and acoustic noise is negligible for a total acceleration noise of 10 g or less and a total acoustic noise of 74-dB sound pressure level. The power-supply noise depends on the bias conditions of the MEMS element, but is negligible for MEMS switches with a bias voltage of 0 V and a total noise voltage of 0.1 V or less. It is also found that metal-to-metal contact series switches result in much less phase noise than standard capacitive shunt switches. The phase noise increases rapidly for low spring-constant bridges ($k = 0.24 \text{ N/m}$), low-height bridges, and bridges with a large mechanical damping ($Q < 0.3$). Also, varactor-based designs result in 30-40 dB more phase noise than switch-based circuits. This paper proves that microwave passive circuits built using MEMS switches (with a proper mechanical design) can be used in most commercial and military applications without any phase-noise penalty.

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Evanescent-mode ridged waveguide bandpass filters with improved performance

A. Kirilenko, L. Rud, V. Tkachenko and D. Kulik. "Evanescent-mode ridged waveguide bandpass filters with improved performance." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1324-1327.

New types of evanescent-mode bandpass filters based on the ridged waveguide sections are considered. Insertion of additional inductive strips between the ridge sections enables one to reduce the longitudinal filter size, increase the cross section of the ridged waveguide housing, and achieve a sufficient improvement of stopband characteristics. Results of designing the millimeter-wave filters and comparison with the measured data are presented.

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Trefftz finite elements for electromagnetics

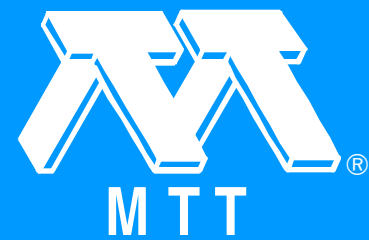
Y.O. Shlepnev. "Trefftz finite elements for electromagnetics." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1328-1339.

It is shown that the method of minimum autonomous blocks (MAB) of Nikol'skii and Nikol'skaia can be reformulated as the Trefftz finite-element method. Solutions of Maxwell's equations in form of plane waves are used to represent fields inside a finite element. Their projections on a set of basis functions on the surface of the element are used to obtain a descriptor of the element in form of an admittance matrix. It is shown that a point-matching projection procedure gives the frequency-domain transmission-line-matrix formulation and Galerkin-type projection leads to the MAB formulation. Admittance matrix representation of the descriptors of the elements makes it possible to use a finite-element-type global matrix assembling procedure and a sparse matrix solver.

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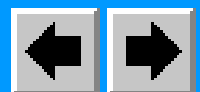
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Dual-mode quasi-elliptic-function bandpass filters using ring resonators with enhanced-coupling tuning stubs

Lung-Hwa Hsieh and Kai Chang. "Dual-mode quasi-elliptic-function bandpass filters using ring resonators with enhanced-coupling tuning stubs." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1340-1345.

A novel microwave dual-mode quasi-elliptic-function bandpass filter structure has been designed and fabricated. The filter uses L-shaped coupling arms for enhanced coupling and dual-mode excitation. The effects of varying the length of tuning stubs and gap size between tuning stubs and ring resonator have been studied. Filters using multiple cascaded ring resonators with high rejection band are presented. The new filters have been verified by simulation and measurement with good agreement.

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Modeling microwave and hybrid heating processes including heat radiation effects

J. Haala and W. Wiesbeck. "Modeling microwave and hybrid heating processes including heat radiation effects." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1346-1354.

This paper presents an efficient simulation tool for conventional, microwave, and combined heating. Two heat-transfer mechanisms are included: conductive and radiant heat transfer. The conductive heat transfer is modeled by a finite-difference algorithm. A modeling technique for radiant heat transfer in nonuniform grids has been developed and is here presented for the first time. For the radiant heat transfer a finite-difference scheme is not applicable, as radiation from a material surface; is not bounded to the immediate vicinity, as is conductive heat transfer. Therefore, ray optical methods are used. Rays connecting mutually visible surfaces are obtained by a new fast method. Necessary, but acceptable simplifications allow fast computations. The algorithms are integrated conveniently together with an electromagnetic finite-difference time-domain program to one simulation tool. Representative simulations are presented for an oven heated conventionally, by microwaves, and by a combination of both.

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Multioctave spatial power combining in oversized coaxial waveguide

Pengcheng Jia, Lee-Yin Chen, A. Alexanian and R.A. York. "Multioctave spatial power combining in oversized coaxial waveguide." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1355-1360.

We describe a multioctave power-combiner structure using finline arrays in an oversized coaxial waveguide. The spectral-domain method (SDM) is used to compute the propagation constant in this structure, and is verified with HFSS simulations. The SDM method is then employed to synthesize broad-band tapered impedance transformers in finline for coupling energy to and from a set of monolithic microwave integrated circuit (MMIC) amplifiers. A modular assembly is described using a sectoral tray architecture. The concept is demonstrated for a 32-MMIC system using low-power traveling-wave amplifier MMICs, providing a 3-dB bandwidth of 13 GHz (3-16 GHz). An output combining loss of 1 dB is estimated from the small-signal measurements, suggesting a combining efficiency of $\sim 75\%$ for 32 MMICs.



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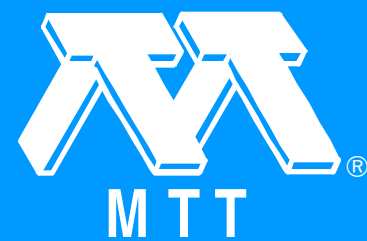
Investigation of mode coupling due to ohmic wall losses in overmoded uniform and varying-radius circular waveguides by the method of cross sections

J. Shafii and R.J. Vernon. "Investigation of mode coupling due to ohmic wall losses in overmoded uniform and varying-radius circular waveguides by the method of cross sections." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1361-1369.

The effect of ohmic wall losses on mode coupling in overmoded varying-radius circular waveguides is investigated. Mode coupling and multimode propagation in uniform lossy-wall circular waveguides is also discussed. The expressions for the coupling coefficients are given by line integrals of the power-normalized fields of the normal modes along the boundary of the waveguide cross section. Numerical results are presented for the case of propagation of an HE/sub 11/-like mode excitation in a uniform smooth lossy-wall circular waveguide.

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Characteristic impedance and propagation of the first higher order microstrip mode in frequency and time domain

Shyue-Dar Chen and C.-K.C. Tzuang. "Characteristic impedance and propagation of the first higher order microstrip mode in frequency and time domain." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1370-1379.

This paper experimentally and theoretically confirms the validity of the definition proposed by Das (1996) for computing the complex characteristic impedance of the first higher order (EH/sub 1/) microstrip mode. The normalized complex propagation constant and complex characteristic impedance of the microstrip obtained by the rigorous full-wave integral-equation method are also presented. To better understand the circuit behavior of the leaky mode at the respective frequencies, the results are analyzed in both frequency and transformed steepest descent plane. A differential time-domain reflectometry (TDR) experiment shows that the experimental results are in excellent agreement with the time-domain plots obtained theoretically by the inverse discrete Fourier transform of the transmission line modeled by the dispersive characteristic. The propagation characteristics of the echoed signals in the time domain, which are reflected from the open end of the leaky line, are analyzed in detail using the corresponding group velocity of the EH/sub 1/ mode. The time-to-frequency conversion of the measured TDR data reveals that the reflection, leaky, and propagation zones coexist simultaneously for the EH, mode propagation. The conversion also accurately assesses the attenuation constant of the EH, mode if the attenuation is not too high. The Fourier transform of the TDR responses also simultaneously yields the input reflection coefficient (S_{11}) and the complex characteristic impedance. The complex characteristic impedance extracted from the TDR responses also agrees closely with the theoretical data.

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An efficient method to determine Green's functions of a two-dimensional photonic crystal excited by a line source - the phased-array method

C. Caloz, A.K. Skrivervik and F.E. Gardiol. "An efficient method to determine Green's functions of a two-dimensional photonic crystal excited by a line source - the phased-array method." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1380-1391.

A novel and efficient method to determine Green's functions in photonic crystals (PCs), i.e., the phased-array method (PAM), is presented. The PAM is a combination of the plane-wave method and the array-scanning method, which is both more flexible and computationally faster than the eigenmodes expansion method. A complete derivation of the electric- and magnetic-field Green's functions associated, respectively, with an infinite electric and magnetic current line exciting a two-dimensional PC is given. Although the developments are presented only for a line source, the PAM can be extended to a dipole source. Thus, the PAM represents a promising method for the analysis of printed-circuit elements or antennas on PC materials. Numerical results for the Green's functions are shown for different positions of the source and a discussion about radiation patterns, asymptotic behaviors, and convergence characteristics is proposed.





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Narrow-band matching networks for quasi-TEM coupled microstrip lines

J.G. Nickel, M.D. Hampson, H.-Y.R. Chung and J.E. Schutt-Aine. "Narrow-band matching networks for quasi-TEM coupled microstrip lines." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1392-1399.

For coupled-line systems, "matching" involves entire impedance matrix networks and necessarily involves multiple propagating modes. This paper presents the synthesis of several matching strategies for symmetric coupled-line microstrip structures mismatched with several types of simple passive terminations. Detailed multiconductor transmission-line analysis provides the basis for procedures to optimize the parameters of several matching networks (stubs, reactances, transformers) that yield significant line and mode reflection reduction resulting from the mismatches. Measurement of synthesized structures verifies the reflection reduction and power savings.

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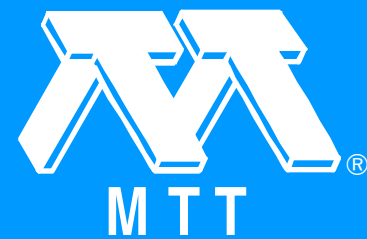
Frequency stabilization of power-combining grid oscillator arrays

Wenzhang Wang and L.W. Pearson. "Frequency stabilization of power-combining grid oscillator arrays." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1400-1407.

In this paper, we report the results of phase locking of grid oscillator arrays. First, a voltage-controlled grid oscillator array with a center frequency of 4.7 GHz and with a 300-MHz electric tuning range was locked to a frequency synthesizer through a phase-locked loop. Second, a 4 /spl times/ 4 and a 6 /spl times/ 6 grid oscillator arrays were locked by way of the injection locking. In both methods, a simple loop antenna mounted on the reflection mirror was used for taking/injecting signals from/to the array. Results show that the phase noise performance is improved significantly in the locked oscillator arrays.

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Generation of a wide-band electromagnetic response through a Laguerre expansion using early-time and low-frequency data

T.K. Sarkar and Jinhwan Koh. "Generation of a wide-band electromagnetic response through a Laguerre expansion using early-time and low-frequency data." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1408-1416.

The objective of this paper is to generate a wide-band and temporal response for three-dimensional conducting structures. This is accomplished through the use of a hybrid method that involves generation of early-time and low-frequency information for the electromagnetic structure of interest. These two, early-time and low-frequency information, are mutually complementary and contain all the necessary information for an ultrawide-band response for a sufficient record length. The time-domain response is modeled as a Laguerre series expansion. The frequency-domain response is also expressed in an analytic form using the same expansion coefficients used in modeling of the time-domain response. The data in both the domains is used to solve for the polynomial coefficients in a data-fitting procedure. Once the polynomial coefficients are known, the available data is simultaneously extrapolated in both domains. This approach is attractive because expansions with a few terms give good extrapolation in both time and frequency domains. The computation involved is minimal with this method.

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Properties of guided modes on open structures near the cutoff region using a new version of complex effective dielectric constant

Xiang-yin Zeng, Shan-jia Xu, Ke Wu and Kwai-Man Luk. "Properties of guided modes on open structures near the cutoff region using a new version of complex effective dielectric constant." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1417-1424.

Radiation region for open guiding structures is known to be further divided into antenna- and reactive-mode regions, and there is no clear cutoff point defined between the two regions. For a leaky-wave antenna, it is crucial that the antenna is designed to operate in the antenna-mode region so as to increase radiation efficiency, whereas in integrated circuits, the leakage should be suppressed to avoid unwanted coupling among circuits. Therefore, a reasonable definition of the two above-mentioned mode regions is necessary. In this paper, we propose a simple, but good alternative to define these two regions by means of a new version of complex effective dielectric constant, where the complex nature is due to leakage rather than dielectric or metal losses, as is customary. With the new approach, the reactive-mode region is found to be consistent with the conventional concept, and our results are similar to those in the literature. The present technique, however, helps in a better understanding of the results in a much easier way. Furthermore, we find for the first time that the attenuation constant in the deep reactive-mode region can be divided into two separate parts, one is due to the cutoff effect, while the other is caused by the leakage effect. Simple closed-form expressions are derived to determine the two kinds of effects. One can, therefore, gain some insight into the leakage effect in the reactive-mode region. A nonradiative-guide leaky-wave antenna is then investigated as a showcase and low radiation efficiency is observed in the reactive-mode region.

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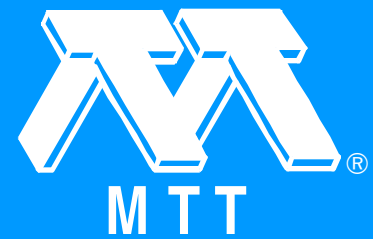
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Spatial optical beam-forming network for receiving-mode multibeam array antenna - proposal and experiment

O. Shibata, K. Inagaki, Y. Karasawa and Y. Mizuguchi. "Spatial optical beam-forming network for receiving-mode multibeam array antenna - proposal and experiment." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1425-1430.

This paper proposes an array antenna for multibeam reception with a beam-forming network (BFN) that uses spatial optical signal processing and also presents experimental results. In this antenna, signals received at individual antenna elements are converted to optical signals, and are optically divided from the directions of signal arrival by means of optical spatial Fourier transformation, and then the optical signals are reconverted into microwave signals at the BFN. In this BFN, to maintain optical path-length conditions, an optical integrated circuit is employed. We have experimentally investigated the optical signal processing performances of the BFN for multibeam reception. The experimental results show that optical beam direction is changed according to the signal arrival direction of an array antenna. Two multiple RF signals with different phase distributions are separated. The sidelobe level of the optical signal is reduced when amplitude distributions of optical signals are Chebyshev distributions. We also present the signal transmission behavior of this BFN. The measured carrier-to-noise-ratio degradation of this BFN is 2 dB at BER=10/sup -6/ when 118.125-Mb/s QPSK modulated signal is input into the BFN.





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New wide-band DC-block cymbal bandpass filter

B. Strassner and K. Chang. "New wide-band DC-block cymbal bandpass filter." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1431-1432.

A new low-loss dc-blocking parallel-cascaded bandpass filter is presented. The filter is much easier to use and fabricate, more compact, and simpler to design than the conventional end- or parallel-coupled line filters. The filter has a wide passband with a 2:1 voltage standing-wave ratio bandwidth of around 10% and an insertion loss of 0.5 dB at 10 GHz. Simulated results agree very well with experimental results.

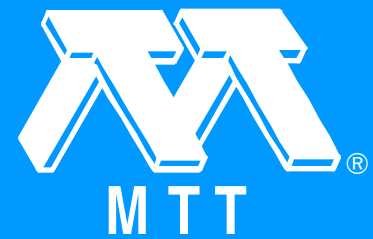
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A novel common-gate mixer for wireless applications

B.M. Frank, A.P. Freundorfer and Y.M.M. Antar. "A novel common-gate mixer for wireless applications." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1433-1435.

In this paper, a balanced 27 GHz common-gate downconvert mixer is presented. The common-gate configuration allows 0.8 μm MESFETs to be used at frequencies in excess of those practical for the common-source configuration. Measurements indicate a conversion loss of 10.7 dB at an input RF frequency of 27 GHz and local-oscillator power of 7.4 dBm, with a third-order intercept at -5.3-dBm output power. This performance is in the range of reported mixers at this frequency, even though most use higher tolerance and more expensive processes.



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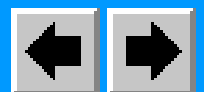
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Analytical evaluation of the MoM matrix elements for the capacitance of a charged plate

Jen-Tsai Kuo and Ke-Ying Su. "Analytical evaluation of the MoM matrix elements for the capacitance of a charged plate." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1435-1436.

Closed-form expression is derived for the fourfold integral involved in the evaluation of the capacitance of a charged plate using the Galerkin's procedure in the method of moments. The dimensions of each rectangular subsection for discretizing the conducting plate can be arbitrary. The calculated solutions converge faster than the point-matching results, as expected.

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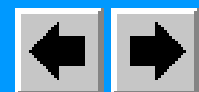
[Subjects](#)

High-power squeeze-type phase shifter at W-band

M.E. Hill, R.S. Callin, M. Seidel and D.H. Whittum. "High-power squeeze-type phase shifter at W-band." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1437-1441.

We describe the design, fabrication, and bench study of a millimeter-wave phase shifter employed as a high-power recirculator for a traveling-wave resonator circuit. The oxygen-free electronic-grade copper phase shifter was prepared by electrodischarge machining. Measured phase-shifter characteristics are presented and compared with theory. The phase shifter was employed in a traveling-wave circuit at 91.4 GHz with a circulating power of 0.2 MW and subjected to fields greater than 10 MV/m without evidence of breakdown.

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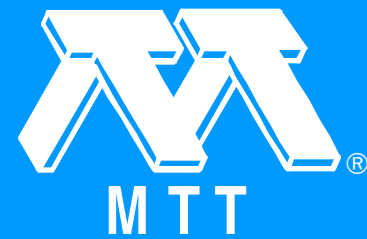


Abstracts

An inverse scattering technique for microwave imaging of binary objects

I.T. Rekanos and T.D. Tsiboukis. "An inverse scattering technique for microwave imaging of binary objects." 2002 Transactions on Microwave Theory and Techniques 50.5 (May 2002 [T-MTT]): 1439-1441.

In this paper, an inverse scattering method for detecting the location and estimating the shape of two-dimensional homogeneous scattering is presented. It is assumed that the permittivity and conductivity of the scatterer are given. Thus, the method concentrates on reconstructing the domain occupied by the scatterer. The inversion is based on scattered electric far-field measurements and is carried out by a combined finite- element-nonlinear optimization technique. The computational burden is reduced by use of the adjoint-state-vector methodology. Finally, the proposed method is applied to both penetrable and impenetrable scatterers.



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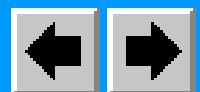
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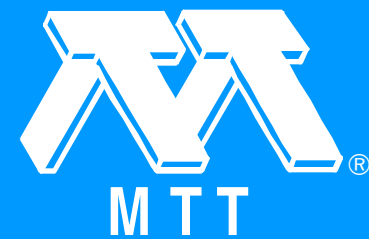
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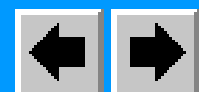
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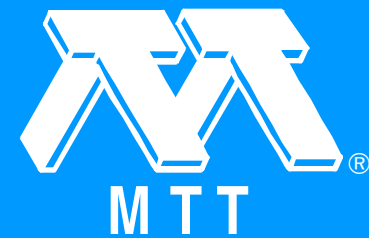
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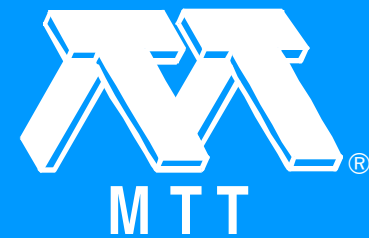
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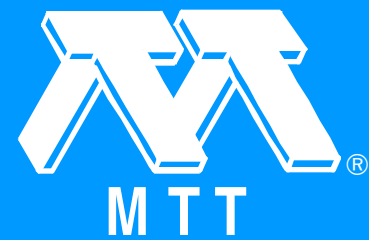
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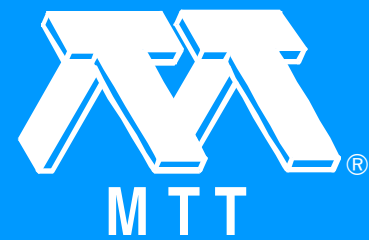
Simple and efficient full-wave modeling of electromagnetic coupling in realistic RF multilayer PCB layouts

M.R. Abdul-Gaffoor, H.K. Smith, A.A. Kishk and A.W. Glisson. "Simple and efficient full-wave modeling of electromagnetic coupling in realistic RF multilayer PCB layouts." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1445-1457.

A simple method to model a printed circuit board (PCB) that takes advantage of the unique features found in PCBs is proposed. This method is capable of analyzing coupling between any nets in the entire multilayer PCB. Using the equivalence principle, the PCB is modeled as a cascade of parallel-plate waveguides with half-space regions residing above and below the PCB. Instead of formulating the problem in terms of electric currents in the horizontal metal layers, it is formulated using equivalent magnetic currents in the nonmetallic regions of layer interfaces. The equivalent magnetic currents at the dielectric interfaces are expressed in terms of the Rao-Wilton-Glisson (RWG) basis functions. The electric currents flowing on the vias inside dielectric layers are assumed constant in the vertical direction. These vertical electric currents radiate TEM modes in the parallel-plate environment. Integral equations based on simple parallel-plate and free-space Green's functions enforcing the boundary conditions are set up and solved using the method of moments (MoM). The equivalent magnetic currents in each layer interact with currents in the adjacent layers only, thereby resulting in a "chained-block-banded" matrix. Excitation is provided through ports defined at each pair of pads, or between a pad and nearby ground. These ports are located only on the top and the bottom layers of the PCB where the circuit components and integrated-circuit pins are mounted. Two different localized excitation schemes, one with a current loop injection and the other with a strip current excitation, are proposed. This formulation requires the computation of the MoM matrix only once per frequency for any number of ports. Further, the solution for only those unknown equivalent magnetic currents around the port regions is required to obtain the N-port impedance parameter characterization of the PCB. Consequently, a memory-efficient block matrix solution process can be used to solve problems of large size for a given memory. Simple and realistic examples are given to illustrate the applicability of this approach.

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Millimeter-wave remote self-heterodyne system for extremely stable and low-cost broad-band signal transmission

Y. Shoji, K. Hamaguchi and H. Ogawa. "Millimeter-wave remote self-heterodyne system for extremely stable and low-cost broad-band signal transmission." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1458-1468.

We have developed a millimeter-wave remote self-heterodyne transmission system that enables extremely stable and low-cost broad-band transmission in the millimeter-wave band. The system was applied to a 60-GHz-band transmission system for the first time. The transmitter of the developed system transmits RF modulated signals and a local oscillation signal simultaneously, and the receiver detects these signals by using a square-law-type detection technique, thus creating a very stable and low phase-noise millimeter-wave transmission link without the use of an expensive and more advanced frequency-stabilization technology. Since the receiver no longer requires a millimeter-wave oscillator for frequency conversion, the devices used in this system can be miniaturized and the cost of the system can be reduced. This paper discusses the performance of the developed system in terms of its phase-noise degradation and carrier-to-noise power ratio (CNR). We also discuss the optimal transmitter design to obtain the maximum CNR. Using our miniaturized monolithic millimeter-wave integrated-circuit-based 60-GHz-band experimental system, we demonstrate that our millimeter-wave transmission link is completely free of phase-noise and frequency-offset degradation due to the use of a millimeterwave local oscillator. We show that equal transmission-power distribution between the RF signal and local carrier gives the maximum CNR under the transmission-power-limited conditions. Also, we demonstrate that QPSK-modulated satellite broadcast multichannel video signals with a 300-MHz bandwidth, in total, can be successfully transferred over a distance of 8 m.

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Efficient and accurate modeling of planar anisotropic microwave structures by the method of lines

R. Pregla. "Efficient and accurate modeling of planar anisotropic microwave structures by the method of lines." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1469-1479.

A new algorithm for the analysis of planar microwave structures with anisotropic substrates is proposed and substantiated. This algorithm is based on generalized transmission-line (GTL) equations, which are developed here for numerical algorithms. For the purpose of analysis, two different modal matrices for the discretized transverse electric and magnetic fields are calculated. Furthermore, impedance/admittance transformation formulas are developed with the help of the GTL equations for longitudinal sections and general junctions. Crossed discretization lines are used in the latter case. The materials are assumed to be biaxial or specific anisotropic. Special algorithms are developed for junctions consisting of more than two waveguides in the cross section and for bends. The proposed algorithm is verified by numerical results.

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On the performance of low-noise low-DC-power-consumption cryogenic amplifiers

L. Angelov, N. Wadefalk, J. Stenarson, E.L. Kollberg, P. Starski and H. Zirath. "On the performance of low-noise low-DC-power-consumption cryogenic amplifiers." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1480-1486.

The performance of broad-band low-noise low-dc-power-consumption cryogenic amplifiers have been studied in detail with emphasis on minimizing the power consumption and optimizing the amplifier performance at cryogenic temperature. A general approach is presented for the modeling and amplifier design, which helps in minimizing the power consumption and optimizing the performance of the amplifier. A noise temperature below 9 K and 22-dB gain was experimentally obtained in the frequency range of 4-8 GHz with a total power consumption of 4 mW with commercial GaAs transistors.

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Coupled-mode design of ferrite-loaded coupled-microstrip-lines section

J. Mazur, M. Mazur and J. Michalski. "Coupled-mode design of ferrite-loaded coupled-microstrip-lines section." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1487-1494.

A coupled-mode approach is applied to a microstrip circulator with a distributed section of axially magnetized ferrite coupled lines (FCLs). The equivalent model of the FCL junction is found, which includes gyromagnetic interaction between propagated and evanescent isotropic modes. On the basis of the coupling process, the ferrite modes in the FCL are defined. From the decomposition of these modes, the waves in each line of the structure are determined. The mode matching is applied at the junction ports, which allows one to obtain the scattering matrix of the microstrip FCL. Validity of the approach is verified by checking the scattering parameters of the FCL section and comparing the numerical results with available measurements. The proposed model gives the properties with regards to the impedance matching and ferrite section dimensions, which can help the design of the FCL nonreciprocal devices. As an example, the S-parameters of an FCL circulator are presented.

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The characteristics of microwave melting of frozen packed beds using a rectangular waveguide

P. Ratanadecho, K. Aoki and M. Akahori. "The characteristics of microwave melting of frozen packed beds using a rectangular waveguide." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1495-1502.

The melting of frozen packed beds by a microwave with a rectangular waveguide has been investigated numerically and experimentally. It was performed for the two different layers, which consist of frozen and unfrozen layers. This paper focuses on the prediction of the temperature field, as well as the microwave energy absorbed, and the melting front within the layered packed beds. Based on the combined model of the Maxwell and heat transport equations, the results show that the direction of melting against the incident microwave strongly depends on the structural layered packed beds because of the difference in the dielectric properties between water and ice.

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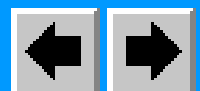
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A simple and analytical parameter-extraction method of a microwave MOSFET

Ickjin Kwon, Minkyu Je, Kwyro Lee and Hyungcheol Shin. "A simple and analytical parameter-extraction method of a microwave MOSFET." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1503-1509.

A simple and accurate parameter-extraction method of a high-frequency small-signal MOSFET model including the substrate-related parameters and nonreciprocal capacitors is proposed. Direct extraction of each parameter using a linear regression approach is performed by Y-parameter analysis on the proposed equivalent circuit of the MOSFET for high-frequency operation. The extracted results are physically meaningful and good agreement has been obtained between the simulation results of the equivalent circuit and measured data without any optimization. Also, the extracted parameters, such as $g_{\text{sub } m/}$ and $g_{\text{sub } ds/}$, match very well with those obtained by DC measurement.

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Full-wave analysis of a wide class of microstrip resonators fabricated on magnetized ferrites with arbitrarily oriented bias magnetic field

G. Leon, R.R. Boix and F. Medina. "Full-wave analysis of a wide class of microstrip resonators fabricated on magnetized ferrites with arbitrarily oriented bias magnetic field." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1510-1519.

A numerical code has been developed for the full-wave determination of the resonant frequencies and quality factors of microstrip patches with right-angle corners of arbitrary shape in the case in which the substrate of the patches is a magnetized ferrite with arbitrarily oriented bias magnetic field. The code is based on the solution of an electric-field integral equation by means of Galerkin's method in the spectral domain. The evaluation of the infinite integrals arising from the application of the numerical method is efficiently carried out by means of a technique based on the interpolation of the spectral dyadic Green's function. The numerical results obtained indicate that microstrip patches fabricated on ferrite substrates present cutoff frequency regions in which resonances cannot occur owing to the excitation of magnetostatic modes. The limits of these cutoff regions are shown to be dependent on the orientation and the magnitude of the bias magnetic field, on the shape of the patches, and even on the nature of every particular resonant mode. The numerical results also show that the resonant frequencies of microstrip patches on magnetized ferrites can always be tuned over a wide frequency range provided the orientation of the bias magnetic field is suitably chosen.

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Impedance matching for complex loads through nonuniform transmission lines

Gaobiao Xiao and K. Yashiro. "Impedance matching for complex loads through nonuniform transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1520-1525.

A numerical method for designing nonuniform transmission lines (NTLs) to match complex loads is presented. This method is based on solving an inverse problem derived from the telegrapher's equation. The matched NTLs are expected to have bandpass characteristics covering the sampling frequency points. A numerical algorithm is provided and verified by examples.

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Phase retrieval of gyrotron beams based on irradiance moments

J.P. Anderson, M.A. Shapiro, R.J. Temkin and D.R. Denison. "Phase retrieval of gyrotron beams based on irradiance moments." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1526-1535.

We present the formulation of the moment method applied to the determination of phase profiles of microwave beams from known amplitudes. While traditional approaches to this problem employ an iterative error-reduction algorithm, the irradiance moment technique calculates a two-dimensional polynomial phasefront based on the moments of weighted intensity measurements. This novel formulation has the very important advantage of quantifying measurement error, thus allowing for its possible reduction. The validity of the irradiance moment approach is tested and confirmed by examining a simple case of an ideal Gaussian beam with and without measurement errors. The effectiveness of this approach is further demonstrated by applying intensity measurements from cold-test gyrotron data to produce a phasefront solution calculated via the irradiance moment technique. The accuracy of these results is shown to be comparable with that obtained from the previously developed iteration method.

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A revision of cascade synthesis theory covering cross-coupled filters

N. Yildirim, O.A. Sen, Y. Sen, M. Karaaslan and D. Pelz. "A revision of cascade synthesis theory covering cross-coupled filters." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1536-1543.

The classical zero-shifting technique is generalized to cover extraction of complex transmission zeros (TZs) in the form of fourth-order LC sections whereby the j/ω - and $1/\omega$ -axis TZs appear as special cases. Using this approach, bandpass filters can be synthesized in direct coupled resonator forms by pole placement instead of designing them through low-pass prototypes. By using circuit transformations, the resulting direct coupled resonator filter circuits can then be transformed into a variety of cross-coupled forms like a fully cross-coupled form or cascaded N-tuplet form. It is shown that one or more finite j/ω -axis, $1/\omega$ -axis, or complex TZs can be extracted as direct coupled resonator circuit blocks, which can be converted into cross-coupled triplets, quadruplets, or other N-tuplets of resonators. In particular, it is shown that a cascaded quadruplet section can be used to realize a complex TZ quadruplet $S_{ij} = \pm \sigma_{ij} / (j\omega + \sigma_{ij})$, as well as two pairs of j/ω -axis TZs, $S_{ij} = \pm j\omega_{ij} / (j\omega + \omega_{ij})$, and $S_{kl} = \pm j\omega_{kl} / (j\omega + \omega_{kl})$.



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Intermodulation analysis of dual-gate FET mixers

Junghyun Kim and Youngwoo Kwon. "Intermodulation analysis of dual-gate FET mixers." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1544-1555.

A detailed intermodulation analysis of dual-gate FET (DG-FET) mixers is presented. The analysis method is based on a large-signal/small-signal analysis using time-varying Volterra-series methods. The analysis program allows one to probe the internal nodes of DG-FETs to evaluate the nonlinear current components. Therefore, it helps physical understanding of intermodulation distortion (IMD) mechanisms in DG-FET mixers. The program was used to identify the major sources of IMD generation. It was found from the analysis that the nonlinearities due to the output conductance (G_{d3} and G_{d2}) of the lower common-source FET were most responsible for IMD generation. The impact of the upper common-gate FET on IMD generation was also found to be nonnegligible, especially at high local oscillator (LO) power levels. The analysis also predicted the presence of MM "sweet spots" using bias optimization, which was experimentally proved by the fabricated mixers at X- and Ka-bands. The optimized X-band hybrid mixer showed measured intermodulation characteristics (OIP_3 /spl sim/13.6 dBm) comparable to those of the resistive mixers (OIP_3 /spl sim/15.3 dBm) with low LO and dc power conditions.

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New closed-form Green's functions for microstrip structures - theory and results

Yuehe Ge and K.P. Esselle. "New closed-form Green's functions for microstrip structures - theory and results." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1556-1560.

This paper presents an efficient technique to evaluate the Green's functions of single-layer and multilayer structures. Using the generalized pencil of function method, a Green's function in the spectral domain is accurately approximated by a short series of exponentials, which represent images in spatial domain. New compact closed-form spatial-domain Green's functions are found from these images using several semi-infinite integrals of Bessel functions. With the numerical integration of the Sommerfeld integrals avoided, this method has the advantages of speed and simplicity over numerical techniques, and it leads to closed-form expressions for the method-of-moments matrix coefficients. Numerical examples are given and compared with those from numerical integration.

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RF electro-thermal modeling of LDMOSFETs for power-amplifier design

S. Akhtar, P. Roblin, Sunyoung Lee, Xiaohui Ding, Shuang Yu, J. Kasick and J. Strahler. "RF electro-thermal modeling of LDMOSFETs for power-amplifier design." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1561-1570.

A new approach for the electro-thermal modeling of LDMOSFETs for power-amplifier design that bypasses pulsed-IVs and pulsed-RF measurements is presented in this paper. The existence of low-frequency dispersion in LDMOSFETs is demonstrated by comparing pulsed IVs with iso-thermal IVs. The modeling technique uses iso-thermal IV and microwave measurements to obtain the temperature dependence of small-signal parameters. Optimized tensor-product B-splines, which distribute knots to minimize fitting errors, are used to represent the small-signal parameters and extract the large-signal model as a function of voltages and temperature. The model is implemented on ADS and is verified by simulating and measuring the power harmonics and IMD large-signal performance of a power amplifier. The impact on the model of temperature-dependent drain and gate charge is investigated. The presented model is found to compare well and, in some cases, exceed the existing MET model for LDMOSFETs.



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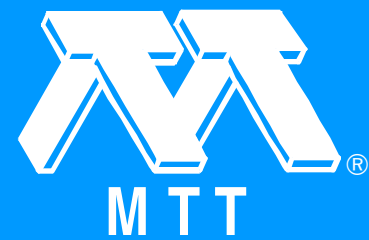
On the use of vias in conductor-backed coplanar circuits

W.H. Haydl. "On the use of vias in conductor-backed coplanar circuits." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1571-1577.

Ground planes of conductor-backed coplanar waveguides (CBCPWs) behave like overmoded patch antennas supporting parallel-plate modes and show numerous resonances. For typical monolithic-microwave integrated-circuit chip sizes, these unwanted resonance frequencies lie within the microwave and millimeter-wave frequency region. Due to this feedback mechanism, today's coplanar millimeter-wave amplifiers operating up to 250 GHz require special packaging techniques for stable operation. The use of vias is one method of suppressing parallel-plate modes. The effect of via-holes within a ground plane and the effect of an open or a shorted ground-plane periphery on the parallel-plate modes of CBCPWs were investigated in depth up to 200 GHz for quartz and GaAs substrates. It is shown that the placement of the vias within the coplanar-waveguide structure is crucial for the suppression of parallel-plate modes. If properly placed, vias are an effective means to suppress these unwanted modes over a chosen frequency range.

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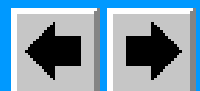
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Subjects

Multiple image technique (MIT) and anisotropic perfectly matched layer (APML) in implementation of MRTD scheme for boundary truncations of microwave structures

Qunsheng Cao, Yinchao Chen and R. Mittra. "Multiple image technique (MIT) and anisotropic perfectly matched layer (APML) in implementation of MRTD scheme for boundary truncations of microwave structures." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1578-1589.

This paper presents an adjustable multiple image technique (MIT) and an anisotropic perfectly matched layer (APML) employed in the context of multiresolution time-domain (MRTD) scheme for the truncation of the computational boundary, with the MIT used for perfect electrically conducting (PEC) shields and the APML for open structures. We begin by presenting a systematic formulation for developing the constitutive relations and update equations in the transform domain of the MRTD, when considering both the original and image regions. We then illustrate the applications of the above techniques by analyzing a two-layer dielectric-loaded cavity, printed circuit enclosed by a PEC, as well as open transmission lines. Although, in principle, one can employ a large number of images to ensure the accuracy of the MRTD computation, in practice, it is useful, from the point-of-view of computational efficiency, to develop a criterion that determines the number of requisite images. While its formulation may appear to be lengthy, the MIT is based on physical concepts that are fairly well suited for computer programming.





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Power-amplifier characterization using a two-tone measurement technique

C.J. Clark, C.P. Silva, A.A. Moulthrop and M.S. Muha. "Power-amplifier characterization using a two-tone measurement technique." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1590-1602.

An accurate nonlinear model is necessary to optimize the tradeoff between efficiency and linearity in power amplifiers. Gain compression (AM/AM) and amplitude-phase (AM/PM) distortion are the two primary model inputs used to characterize the nonlinearity. The amplifier's AM/AM and AM/PM characteristics are typically measured statically using a vector network analyzer. Since the input is typically a modulated signal, it is desirable to characterize the amplifier dynamically. This paper describes and demonstrates a dynamic AM/AM and AM/PM measurement and modeling technique involving a spectrum analyzer and two-tone input signals. A complete analysis of the measurement technique is presented, along with the data processing needed for the identification of a new three-box model. The test configuration and procedure are presented with special precautions to minimize measurement error. Results for a solid-state amplifier are used to accurately predict intermodulation distortion, while those for a traveling-wave tube amplifier show good agreement with that obtained dynamically using a 16 quadrature-amplitude-modulation signal.

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Artificial-line-division distributed ICs with 0.1-/spl mu/m-gate-length GaAs MESFET and three-dimensional transmission lines

S. Kimura, Y. Imai, S. Yamaguchi, K. Onodera and H. Kikuchi. "Artificial-line-division distributed ICs with 0.1-/spl mu/m-gate-length GaAs MESFET and three-dimensional transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1603-1608.

0.1-/spl mu/m-gate-length GaAs MESFET distributed baseband integrated circuits (ICs) that utilize an artificial-line-division technique and three-dimensional transmission lines are described. The technique reduces return loss of the distributed circuits at high frequencies, and four-layer transmission-line structure reduces parasitic impedance caused by the IC pattern shape and is suitable for the flip-chip bonding module format. A gate-line-division distributed baseband amplifier IC achieved input return loss of less than -13 dB and gain of 11.7 dB in the 0-56 GHz band. A source-line-division distributed level-shift IC achieved output return loss of less than -9.6 dB at high frequencies and insertion loss of 2.7 dB in the 0-79 GHz band. Both results better the performance of all reported GaAs MESFET distributed ICs.

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Excitation of a parallel-plate dielectric waveguide using a coaxial probe-basic characteristics and experiments

G.K.C. Kwan and N.K. Das. "Excitation of a parallel-plate dielectric waveguide using a coaxial probe-basic characteristics and experiments." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1609-1620.

In this paper, we study the basic characteristics of a probe excitation to a parallel-plate dielectric waveguide (PPDW), and present design data and experimental results. A coaxial probe has been used in microstrip lines and rectangular waveguides. The present study shows that it is also an effective method to excite/couple a PPDW, thus facilitating the introduction of a new class of PPDW technology in microwave/millimeter-wave integrated circuits. We use here a spectral-domain analysis for analytical modeling of the probe transition, where the probe is approximated by a current strip of an equivalent width. Applying the method of image, the structure is transformed to an infinite-long thin strip inside a dielectric slab, which reduces the transition analysis into a simpler planar geometry. Basic characteristics of the probe excitation, and a complete design data for the radiation loss, excitation efficiency, and input impedance for various transition parameters are computed. Prototype design experiments were conducted, which show that quite efficient excitation can be achieved using; the probe, with insertion loss as low as 0.1 dB. This is contrary to some misconceptions that a probe transition to the fundamental PPDW mode is quite inefficient due to parallel-plate mode radiation.

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Scattering and absorption by thin metal wires in rectangular waveguide-FDTD simulation and physical experiments

M. Bingle, D.B. Davidson and J.H. Cloete. "Scattering and absorption by thin metal wires in rectangular waveguide-FDTD simulation and physical experiments." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1621-1627.

The high-frequency internal impedance model of a round ohmic conductor is incorporated into the subcell thin-wire formulation of the finite-difference time-domain method to model the microwave properties of metal wires. For magnetic metals, such as steel, an effective conductivity is introduced to account for the increase in ohmic loss due to the high-frequency permeability. Physical experiments with half-wave resonant copper- and steel-wire inclusions, supported by a dielectric slab in a standard S-band rectangular waveguide, support the formulation.

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Efficient electromagnetic modeling of three-dimensional multilayer microstrip antennas and circuits

Feng Ling, Jian Liu and Jian-Ming Jin. "Efficient electromagnetic modeling of three-dimensional multilayer microstrip antennas and circuits." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1628-1635.

An efficient method-of-moments (MoM) solution is presented for analysis of multilayer microstrip antennas and circuits. The required multilayer Green's functions are evaluated by the discrete complex image method (DCIM), with the guided-mode contribution extracted recursively using a multilevel contour integral in the complex ρ -plane. An interpolation scheme is employed to further reduce the computer time for calculating the Green's functions in the three-dimensional (3-D) space. Higher order interpolatory basis functions defined on curvilinear triangular patches are used to provide necessary flexibility and accuracy for the discretization of arbitrary shapes and to offer a better convergence than lower order basis functions. The combination of the improved DCIM and the higher order basis functions results in an efficient and accurate MoM analysis for 3-D multilayer microstrip structures.

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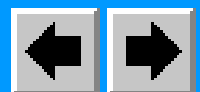
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Radiation and leakage characteristics of transverse slot in NRD-guide operating in LSE/sub 00/ mode

Xiang-yin Zeng, Kwai-Man Luk and Shan-jia Xu. "Radiation and leakage characteristics of transverse slot in NRD-guide operating in LSE/sub 00/ mode." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1636-1639.

Characteristics of a transverse slot in the upper plate of a nonradiative dielectric guide operating in the dominant LSE/sub 00/ mode have been analyzed. A fundamental radiation phenomenon due to the open property of the guiding structure is observed theoretically. It is found that the propagation direction of the leakage covers the whole angular spectrum in the plane parallel to the metallic plates. An explanation to its physical existence is given. A simple, but efficient method is developed to determine its angular power density. Numerical computation shows that the leakage is substantially high when the slot is near resonance.

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Modification of Marcatili's method for the calculation of anisotropic rectangular dielectric waveguides

S.N. Dudorov, D.V. Lioubtchenko and A.V. Raisanen. "Modification of Marcatili's method for the calculation of anisotropic rectangular dielectric waveguides." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1640-1642.

Marcatili's method for the calculation of rectangular dielectric rod waveguides has been modified for uniaxial anisotropic dielectric materials. The averaging method without guessing the field distribution has been used to derive the equations. Experimental results for an anisotropic sapphire waveguide show a good agreement with those calculated using the approach developed here.

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Microwave I-Q vector modulator using a simple technique for compensation of FET parasitics

M. Chongcheawchamnan, S. Bunnjaweht, D. Kpogla, D. Lee and I.D. Robertson. "Microwave I-Q vector modulator using a simple technique for compensation of FET parasitics." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1642-1646.

The analysis and design of an improved technique for the realization of vector modulators using analog reflection-type circuits are presented. The analysis focuses on the detrimental effect that the parasitic elements of the FET variable-resistance elements have on the 360/spl deg/ phase and amplitude control. It is shown that a simple circuit technique can be used to compensate for the parasitic effects and achieve a near-ideal constellation. Compared with the balanced structure, the proposed technique leads to a much smaller circuit area and does not require additional complementary control signals. This makes it better suited to commercial wireless applications where low cost is paramount. Simulation and experimental results for an L-band prototype are presented.

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W-band micromachined circuit combining networks

K.J. Herrick and L.P.B. Katehi. "W-band micromachined circuit combining networks." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1647-1651.

In circuit-combining networks, low-loss interconnecting transmission lines are pivotal in reducing excess loss. Micromachined finite ground coplanar waveguides are used in this study as low-loss interconnects showing significant improvements in line loss while maintaining 50- Ω characteristic impedance. Wilkinson power dividers, reactive tee junctions, and right-angle bends are combined with micromachined interconnects in 1:2, 1:4, and 1:8 power-dividing networks and show measured loss reduction of 0.3-1.0 dB depending on circuit type and size from 85 to 95 GHz.

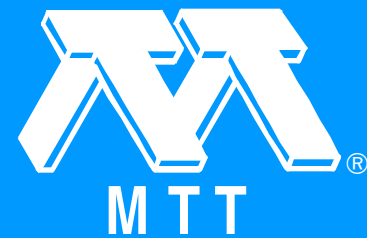
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Abstracts

Numerical analysis of complicated waveguide circuits on the basis of generalized scattering matrices and domain product technique (Corrections)

V.P. Chumachenko and V.P. Pyankov. "Numerical analysis of complicated waveguide circuits on the basis of generalized scattering matrices and domain product technique (Corrections)." 2002 Transactions on Microwave Theory and Techniques 50.6 (Jun. 2002 [T-MTT]): 1652-1652.



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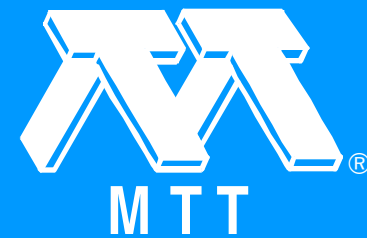
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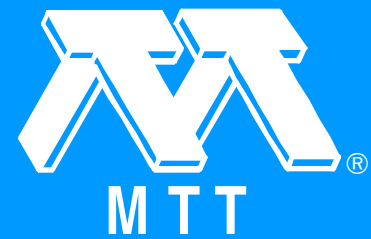
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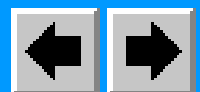
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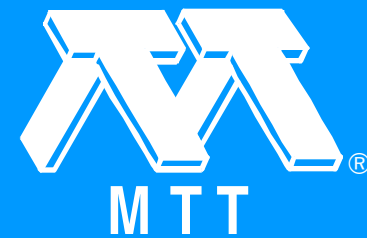
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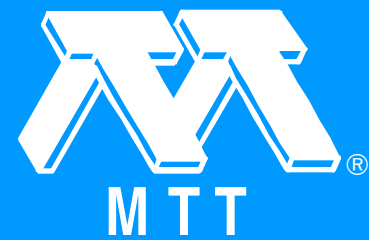
Stopband performance improvement of rectangular waveguide filters using stepped-impedance resonators

M. Morelli, I. Hunter, R. Parry and V. Postoyalko. "Stopband performance improvement of rectangular waveguide filters using stepped-impedance resonators." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1657-1664.

Rectangular waveguide stepped-impedance resonators (SIRs) are analyzed and employed in the design of an X-band filter with center frequency $f_{0/10} = 10$ GHz and a bandwidth of 100 MHz. An attenuation of 80 dB is held up to 23.1 GHz and, compared to standard uniform-impedance-resonator filters, a reduction in length of 55 % is achieved at the expense of an increased insertion loss from 0.6 to 1.5 dB. The second resonance of the fundamental TE_{10/10} mode can be controlled by adjusting the length and impedance ratio of each resonator. A design procedure that takes into account step discontinuities is described and applied to the design of a number of SIR filters. Finally, the presented theory is supported with experimental results.

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Conductivity measurements at the interface between the sintered conductor and dielectric substrate at microwave frequencies

A. Nakayama, Y. Terashi, H. Uchimura and A. Fukuura. "Conductivity measurements at the interface between the sintered conductor and dielectric substrate at microwave frequencies." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1665-1674.

A novel measuring technique of the effective conductivity at microwave frequencies for both the sintered conductor surface and the interface between conductor and dielectric materials was developed. In the measurement, a dielectric rod resonator is placed between two dielectric plates, one side of which is coated with a sintered conductor. For measuring the surface conductivity, the dielectric rod is sandwiched by the conductor side of the plates. On the other hand, for measuring the interface conductivity, the dielectric rod is sandwiched by the dielectric side of the plates. By the configuration, only interface conductivity contributes to the conducting loss of the resonator, thus allowing the measurement of the interface conductivity. Using the new technique, the frequency dependence of both the surface and interface conductivity of a sintered copper, formed on a glass ceramic substrate by the co-firing technique, was investigated in the frequency range from 11 to 34 GHz. It was confirmed that the values of interface conductivity of the sintered copper were smaller than the values of the surface conductivity.

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Noise model of InP-InGaAs SHBTs for RF circuit design

A. Huber, D. Huber, C. Bergamaschi, T. Morf and H. Jackel. "Noise model of InP-InGaAs SHBTs for RF circuit design." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1675-1682.

A scalable small-signal and noise model of InP-InGaAs single heterojunction bipolar transistors was developed. Effects which become important at higher frequencies such as the correlation between base and collector current noise and frequency-dependent base current noise are taken into account. We will show that these effects are significant at frequencies higher than 40 GHz and can no longer be neglected. Our model also includes the effects of the different emission coefficients of the base and collector currents. Using this improved model, a direct-coupled, lumped broad-band amplifier was designed. We completely characterized the fabricated circuit with respect to small-signal, noise, and linearity behavior. A -3-dB bandwidth of 50 GHz with a dc gain of 9.8 dB and a gain-peaking of only 1.2 dB were achieved. All these values agree very well with the simulation results. The noise figure is 7.5 dB over a large frequency range. In the frequency range from 2 to 50 GHz, the third-order intercept point IP/sub 3/ and 1-dB compression point at the output have values from 17 to 10 dBm and 3 to 0 dBm, respectively.



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Novel configurations of planar multilayer magic-T using microstrip-slotline transitions

Jeong Phill Kim and Wee Sang Park. "Novel configurations of planar multilayer magic-T using microstrip-slotline transitions." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1683-1688.

Novel configurations of microwave planar magic-T suitable for microwave integrated circuits (MICs) and monolithic MICs are described. They consist of microstrip and slotline T-junctions coupled by microstrip-slotline transitions. Since via-hole processing is not encountered, they are especially applicable to multilayer MICs. Derived equivalent network models are used efficiently for the design of the corresponding multilayer microstrip magic-T. Measured data and numerical simulations showing good amplitude and phase characteristics over an octave operating bandwidth validate the proposed configurations of planar magic-T.

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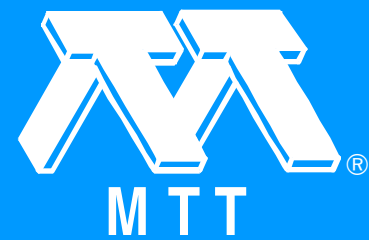
FDTD modeling of wave propagation in dispersive media by using the Mobius transformation technique

J.A. Pereda, A. Vegas and A. Prieto. "FDTD modeling of wave propagation in dispersive media by using the Mobius transformation technique." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1689-1695.

This paper introduces a technique for finite-difference time-domain modeling of wave propagation in general Mth-order dispersive media. Ohm's law in the Laplace domain with an Mth-order rational model for the complex conductivity is considered as a constitutive relation. In order to discretize this model, the complex conductivity is mapped onto the Z-transform domain by means of the Mobius transformation. This leads finally to a set of difference equations that is consistent with Yee's scheme. The resulting formulation is explicit, it has a second-order accuracy, and the need for additional storage variables is minimal. The numerical stability problem is discussed and the numerical dispersion equation for Mth-order media is given.

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Convergence behavior and acceleration of the Berenger and leaky modes series composing the 2-D Green's function for the microstrip substrate

H. Rogier and D. De Zutter. "Convergence behavior and acceleration of the Berenger and leaky modes series composing the 2-D Green's function for the microstrip substrate." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1696-1704.

The Green's functions $G_{\text{sub } A}$ and $G_{\text{sub } V}$ are calculated for a two-dimensional microstrip substrate by placing the substrate into a closed perfectly-matched-layer waveguide and by performing a modal expansion in Berenger and leaky modes. It is shown that each series composing $G_{\text{sub } A}$ and $G_{\text{sub } V}$ has a particular convergence behavior when considering small lateral distances between the excitation and the observation points. It is then demonstrated that, by applying the Shanks transform to accelerate each series separately, a more efficient calculation for the Green's functions can be obtained than by direct computation of the series. The theory is illustrated by means of a representative example.

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Methods for measurement and simulation of weak substrate coupling in high-speed bipolar ICs

W. Steiner, M. Pfost, H.-M. Rein, A. Sturmer and A. Schuppen. "Methods for measurement and simulation of weak substrate coupling in high-speed bipolar ICs." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1705-1713.

On-wafer measurements of very weak substrate coupling in high-speed integrated circuits (ICs) at high frequencies suffer from the direct crosstalk between the input and output RF probes. Two alternative methods to reduce this effect are presented and compared. The first one is based on an advanced deembedding method that eliminates the crosstalk between the RF probes after measurement. The second method utilizes an on-chip broad-band amplifier between the input probe and the substrate test structure. Thus, for a given signal amplitude at the output probe, the amplitude of the input signal can be reduced, resulting in less distortion of the output signal by the crosstalk via the probes. Both methods are compared and verified by measurements up to about 20 GHz even at substrate coupling impedances as high as 0.5 M/spl Omega/ (corresponding to -80 dB in a 50-/spl Omega/ system). For this, several substrate test structures (some with the 20-GHz on-chip amplifier) have been designed and fabricated in an SiGe bipolar production technology with 20-/spl Omega/cm substrate resistivity. The measurement results agree well with simulation results using our substrate simulator SUSI. As a consequence, the inflexible, expensive, and time-consuming way to determine substrate coupling experimentally is no longer required in future IC designs-not even at very weak coupling and high frequencies. In this work, however, the proposed measuring methods had to be applied to verify the suitability of substrate simulation (with SUSI) under extreme conditions.



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Analysis of nonlinear behavior of power HBTs

Woonyun Kim, Sanghoon Kang, Kyungho Lee, Minchul Chung, Jongchan Kang and Bumman Kim. "Analysis of nonlinear behavior of power HBTs." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1714-1722.

To accurately understand the linear characteristics of a heterojunction bipolar transistor (HBT), we developed an analytical nonlinear HBT model using Volterra-series analysis. The model considers four nonlinear components: r_{π} , C_{diff} , C_{depl} , and g_m . It shows that nonlinearities of r_{π} and C_{diff} are almost completely canceled by g_m nonlinearity at all frequencies. The residual g_m nonlinearity is highly degenerated by input circuit impedances. Therefore, r_{π} , C_{diff} , C_{depl} , and g_m nonlinearities generate less harmonics than C_{bc} nonlinearity. If C_{bc} is linearized, g_m is the main nonlinear source of HBT, and C_{depl} becomes very important at a high frequency. The degeneration resistor R_E is more effective than R_B for reducing g_m nonlinearity. This analysis also shows the dependency of the third-order intermodulation (IM3) on the terminations of the source second harmonic impedances. The IM3 of HBT is significantly reduced by setting the second harmonic impedances of $Z_{S,2} = 0$ and $Z_{S,2}/\omega_2 = 0$.

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Effects of particle shape on the effective permittivity of composite materials with measurements for lattices of cubes

K.W. Whites and Feng Wu. "Effects of particle shape on the effective permittivity of composite materials with measurements for lattices of cubes." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1723-1729.

The effects of inclusion shape on the quasi-static effective permittivity of a two-phase periodic composite material are discussed in this paper. The lattice is formed from complex-shaped conducting inclusions suspended in a host medium. The effective permittivity is computed using an accurate moment-method-based technique. Numerical results are presented for a variety of particle shapes including circular, square, and "rounded square" cylinders (two dimensional) as well as lattices of spheres and cubes (three dimensional). It was found that among these shapes, lattices of square cylinders and cubes produced nearly the minimal polarization per unit volume possible (a/spl grave/ la Maxwell/Maxwell Garnett). It appears that the strong mutual interaction between edges and corners of these particles is responsible for this effect. That is, it was observed that the mutual interaction between square cylinders and cubes caused a decrease in their dipole moments and, hence, the effective permittivity, which is opposite to the usual expectation from mutual interaction between circular cylinders and spheres. Experimental verification of this effect is provided by quasi-static conductivity measurements.

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Dispersion analysis of multilayer cylindrical transmission lines containing magnetized ferrite substrates

N. Dib and A. Omar. "Dispersion analysis of multilayer cylindrical transmission lines containing magnetized ferrite substrates." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1730-1736.

Recently, there has been a growing interest in using cylindrical transmission lines that contain magnetized ferrite material in a variety of applications. In this paper, the finite-difference time-domain (FDTD) method (in cylindrical coordinates) and the spectral-domain analysis (SDA) are used to calculate the propagation characteristics of cylindrical transmission lines that contain magnetized ferrite material. The magnetization can be either in the longitudinal or azimuthal directions. Specifically, the cylindrical microstrip line, and the cylindrical coplanar waveguide printed on magnetized ferrite substrate are analyzed. Both the FDTD and SDA results are in very good agreement. In addition, the results are compared to those of planar structures by taking the radius of the substrate to be large enough such that the curvature effect is negligible.

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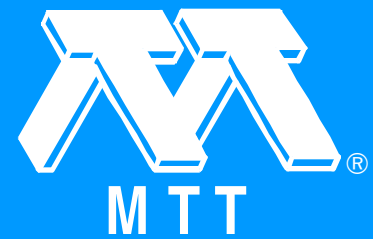
Multifrequency radiometric determination of temperature profiles in a lossy homogeneous phantom using a dual-mode antenna with integral water bolus

S. Jacobsen and P.R. Stauffer. "Multifrequency radiometric determination of temperature profiles in a lossy homogeneous phantom using a dual-mode antenna with integral water bolus." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1737-1746.

In the treatment of cancer, microwave hyperthermia has been established as an efficient adjunctive procedure to radiation therapy and chemotherapy. Wider acceptance of this method awaits schemes to measure volumetric temperatures noninvasively in human tissue for control of the heating process. This effort describes the design and performance of a new microstrip applicator intended for homogeneous heating of superficial tissue while at the same time monitoring temperature of the underlying tissue by noninvasive radiometric sensing of black-body radiation from the heated volume. Radiometric capabilities are assessed in terms of accuracy of up to six measured brightness temperatures applied in an inversion algorithm from which one-dimensional depth temperature profiles are generated. Based on radiometric signals recorded over the 1-4-GHz range, the temperature accuracy determined from statistical analysis of 200 realizations of the process is better than $\pm 0.2^\circ\text{C}$ to a depth of 5 cm in phantom. Aperture heating uniformity is assessed with electric field scans in a homogeneous muscle phantom. As long as sufficiently thin (< 5 mm) water boli are used, SAR distributions at 1-cm depth in phantom extends effectively just outside the aperture perimeter, making this microstrip antenna an excellent building block element of larger multi-antenna array applicators.

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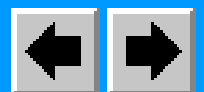
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Unified model for collector charge in heterojunction bipolar transistors

M. Rudolph, R. Doerner, K. Beilenhoff and P. Heymann. "Unified model for collector charge in heterojunction bipolar transistors." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1747-1751.

The base-collector capacitance and the collector transit-time in GaAs-based heterojunction bipolar transistors depend not only on base-collector voltage, but also on collector current. This has to be taken into account in a large-signal model. However, since collector transit-time and capacitance are both caused by the charge stored in the collector space-charge region, it is not possible to model them independently of each other. This paper investigates the interrelation between collector capacitance and transit-time due to transcapacitance effects, and presents an analytical unified description for both quantities, that is derived from measurement-extracted small-signal equivalent circuits. The model is verified by comparison of simulation and measurement data.

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Scattering analysis by the multiresolution time-domain method using compactly supported wavelet systems

T. Dogaru and L. Carin. "Scattering analysis by the multiresolution time-domain method using compactly supported wavelet systems." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1752-1760.

We present a formulation of the multiresolution time-domain (MRTD) algorithm using scaling and one-level wavelet basis functions, for orthonormal Daubechies and biorthogonal Cohen-Daubechies-Feauveau (CDF) wavelet families. We address the issue of the analytic calculation of the MRTD coefficients. This allows us to point out the similarities and the differences between the MRTD schemes based on the aforementioned wavelet systems and to compare their performances in terms of dispersion error and computational efficiency. The remainder of the paper is dedicated to the implementation of the CDF-MRTD method for scattering problems. We discuss the approximations made in implementing material inhomogeneities and validate the method by numerical examples.

Click on title for a complete paper.



Imaging of biomedical data using a multiplicative regularized contrast source inversion method

A. Abubakar, P.M. van den Berg and J.J. Mallorqui. "Imaging of biomedical data using a multiplicative regularized contrast source inversion method." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1761-1771.

In this paper, the recently developed multiplicative regularized contrast source inversion method is applied to microwave biomedical applications. The inversion method is fully iterative and avoids solving any forward problem in each iterative step. In this way, the inverse scattering problem can efficiently be solved. Moreover, the recently developed multiplicative regularizer allows us to apply the method blindly to experimental data. We demonstrate inversion from experimental data collected by a 2.33-GHz circular microwave scanner using a two-dimensional (2-D) TM polarization measurement setup. Further some results of a feasibility study of the present inversion method to the 2-D TE polarization and the full-vectorial three-dimensional measurement will be presented as well.

Retrodirective array augmentation for electronic RCS modification

V.F. Fusco and Bee Yen Toh. "Retrodirective array augmentation for electronic RCS modification." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1772-1778.

In this paper, an active Pon type retrodirective array (RDA) is augmented with a passive array in order to provide electronic modification of the transmit function of the combination in response to the influence of an external interrogating signal. By the use of a single phase shifter and level setting control, it will be shown that different types of broadcast mode can be initiated. The first of these is the self-tracking capability normally associated with a Pon heterodyne RDA.

Broadside radiation production associated with a conventional in-phase fed passive array operating in transmission mode is also demonstrated. Additionally, new modes of operation which include the use of the configuration are described: 1) as a radiation nulling device; 2) its use as a sidelobe suppressor; and 3) as a beamwidth control device.

Accurate synthesis of inline prototype filters using cascaded triplet and quadruplet sections

G. Macchiarella. "Accurate synthesis of inline prototype filters using cascaded triplet and quadruplet sections." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1779-1783.

A general method for designing low-pass prototype networks with cascade inline topology is presented. The generalized Chebyshev characteristic is imposed, allowing an equiripple response in the passband and transmission zeros arbitrarily displaced in the complex plane (symmetry with respect to the imaginary axis is, however, required). A computationally efficient method is employed for evaluating reflection and transmission polynomials, given the transmission zeros; then, the synthesis of a starting coupling matrix is performed using one of the methods available in the literature. The desired inline topology is then assembled by cascading elementary building blocks (triplets and/or quadruplets), following specific rules which assure the feasibility of the structure; finally, the synthesis is performed by applying a multiple similarity transform to the starting coupling matrix (the set of rotation angles is determined by means of an efficient and fast optimization procedure). Examples are reported which validate the proposed synthesis procedure.



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A high-efficiency dual-frequency rectenna for 2.45- and 5.8-GHz wireless power transmission

Young-Ho Suh and Kai Chang. "A high-efficiency dual-frequency rectenna for 2.45- and 5.8-GHz wireless power transmission." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1784-1789.

A dual-frequency printed dipole rectenna has been developed for the wireless power transmission at 2.45- and 5.8-GHz (industrial-scientific-medical bands). For operating at dual band, a new uniplanar printed dipole antenna is developed using a coupling method. A GaAs Schottky barrier diode analysis is performed, and a proper device requirement is discussed to have high RF-to-dc conversion efficiencies at both frequencies. A novel coplanar stripline (CPS) low-pass filter integrated with two additional open-ended T-strip CPS bandstop filters effectively block higher order harmonics generated from the diode. The measured conversion efficiencies achieved at free space are 84.4 and 82.7% at 2.45 and 5.8 GHz, respectively.

Click on title for a complete paper.



Broad-banding technique for in-phase hybrid ring equal power divider

Ban-Leong Ooi, W. Palei and M.S. Leong. "Broad-banding technique for in-phase hybrid ring equal power divider." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1790-1794.

A broad-banding technique for in-phase equal power divider is described. Detailed comparisons between the proposed variants of power dividers and the conventional in-phase power divider are also performed. Based on the 15-dB input and output return losses criteria, it is noted that a maximum impedance bandwidth of 44.3% for an amplitude error of ± 0.9 dB and a phase error of ± 1.8 deg/ can be achieved, for the first time, for divider with length more than $3\lambda/2$ ring impedance transformer. A systematic design technique that relaxes some of the conventional constraint in in-phase hybrid ring equal power divider design, is also described.



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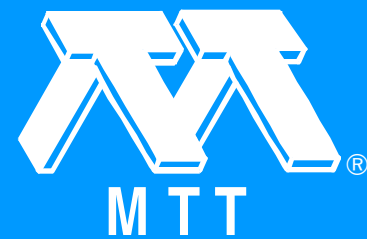
Slow-wave bandpass filters using ring or stepped-impedance hairpin resonators

Lung-Hwa Hsieh and Kai Chang. "Slow-wave bandpass filters using ring or stepped-impedance hairpin resonators." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1795-1800.

This paper proposes a new class of slow-wave bandpass filters that uses a microstrip line periodically loaded with microstrip ring or stepped-impedance hairpin resonators. The new slow-wave periodic structures utilize the parallel and series resonance characteristics of the resonators to construct a bandpass filter. Unlike conventional slow-wave filters, the proposed bandpass filters are designed to produce a narrow passband at the fundamental mode of the resonators. The new filters provide lower insertion loss than that of parallel- or cross-coupled ring and stepped-impedance hairpin bandpass filters. The calculated frequency responses of the filters agree well with experiments.

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Theoretical and experimental study of amplifier linearization based on harmonic and baseband signal injection technique

Chun-Wah Fan and K.-K.M. Cheng. "Theoretical and experimental study of amplifier linearization based on harmonic and baseband signal injection technique." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1801-1806.

This paper presents a novel linearization scheme for RF amplifiers based on simultaneous harmonic and baseband signal injection. In this method, second-order frequency components generated by predistortion circuits are fed to the input of the main amplifier to mix with the fundamental signal for third-order intermodulation distortion (IMD) cancellation. A general and rigorous analytical formulation of baseband, harmonic, and the proposed injection techniques is presented, and from these derived expressions, the optimum conditions for IMD suppression are developed. The result also reveals the practical limitation of the proposed method subject to gain and phase error associated with the RF and baseband circuitry. For comparison purposes, an amplifying system is constructed for the experimental investigation of second-order signal injection approach. Both two-tone and digitally modulated waveforms are employed in these measurements.

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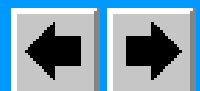
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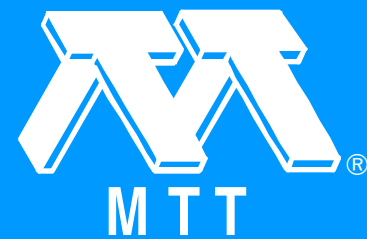
Eye pattern evaluation in high-speed digital systems analysis by using MTL modeling

G. Antonini, J.L. Drewniak, A. Orlandi and V. Ricchiuti. "Eye pattern evaluation in high-speed digital systems analysis by using MTL modeling." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1807-1815.

A method for simulating the eye pattern of high-speed digital signals propagated on printed circuit boards using multiconductor transmission-line modeling is proposed in this paper. The approach takes into account the frequency-dependent properties of the dielectric materials of the board and of the conductors. The validation is performed by comparing the modeling with measurements taken from the literature, and directly performed on test boards specially design for this study.

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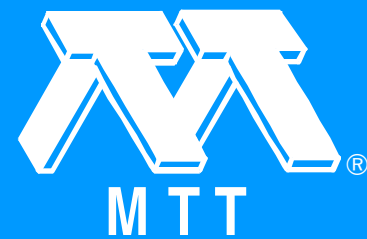
On-board accurate calibration of dual-channel radiometers using internal and external references

I. Corbella, A.J. Gasiewski, M. Klein, V. Leuski, A.J. Francavilla and J.R. Piepmeier. "On-board accurate calibration of dual-channel radiometers using internal and external references." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1816-1820.

This paper presents a method for combining internal noise injection and external reference standard looks to accurately calibrate an airborne dual-channel radiometer. The method allows real-time estimation of the correct values of the radiometer gains and offsets, even for nontemperature-stabilized radiometers and with minimum loss of measurement time spent in external load measurement. Crosstalk and leakage introduced by the noise injection circuitry is also taken into account, thus providing high gain and offset estimation accuracy. The method was implemented on a National Oceanic and Atmospheric Administration airborne instrument, the Polarimetric Scanning Radiometer, which was used to obtain an extensive set of radiometric measurements over oceanic convection during CAMEX3 in August-September 1998.

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Novel TE/sub 10/spl delta// rectangular-waveguide-type resonators and their bandpass filter applications

Hee Yong Hwang and Sang-Won Yun. "Novel TE/sub 10/spl delta// rectangular-waveguide-type resonators and their bandpass filter applications." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1821-1831.

New dielectric-filled rectangular-waveguide-type TE/sub 10/spl delta// resonators are presented. A dielectric-filled rectangular waveguide section (WGS) has inductive impedance at the open-end faces. Using this property and the frequency dependency of the wave impedance of the WGS, we calculated the resonant frequency and the slope parameter of the waveguide-type resonators. The resonant frequency depends strongly on the width of the WGS and loosely on the height and the length. The calculated resonant frequencies agree well with measured data. One of the proposed bandpass filters shows highly reduced spurious up to three times the center frequency. Quality factors of the resonator and effects of a housing are also discussed.

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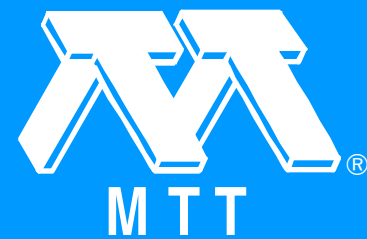
Analysis of the AO-FDPC optical heterodyne technique for microwave time delay and phased array beamsteering applications

W.D. Jemison. "Analysis of the AO-FDPC optical heterodyne technique for microwave time delay and phased array beamsteering applications." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1832-1843.

This paper presents a theoretical analysis of the application of the acousto-optic frequency-dependent phase compensated (AO-FDPC) optical heterodyne technique for microwave time delay applications and phased array beamsteering. A primary goal of the paper is to resolve open questions that have been associated with this interesting and highly referenced technique. The work presented here quantifies, for the first time, the fundamental time delay performance bounds of this technique in terms of the parameters associated with the AO-FDPC acousto-optic (AO) cell and the signal bandwidth. The theory presented in this paper is used to interpret previously reported experimental results that have been subject to debate. Much of the theoretical approach is general and may, therefore, be modified to address the design of new FDPC approaches. Finally, the wide-band beamsteering performance that can be achieved with this technique is quantified in terms of the AO cell parameters and phased array specifications.

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A compact 2-D full-wave finite-difference frequency-domain method for general guided wave structures

Yong-Jiu Zhao, Ke-Li Wu and K.-K.M. Cheng. "A compact 2-D full-wave finite-difference frequency-domain method for general guided wave structures." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1844-1848.

A compact two-dimensional (2-D) full-wave finite-difference frequency-domain method is proposed for the analysis of dispersion characteristics of a general guided wave structure. Because the longitudinal field components are eliminated in the proposed method, only four transverse field components are involved in the final resulting eigen equation. This feature considerably reduces the required CPU time as compared to the existing approaches by which six field components are comprised. Additionally, unlike other 2-D finite-difference schemes that determine the eigenfrequency for a given propagation constant, the new method finds the propagation constant β for a given k_0 (frequency). The new method has been verified by examining the computed results of a number of typical guided wave structures with the published results. Very good agreement is achieved.

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A new method for the design of a quasi-optical mode converter with a special reflector

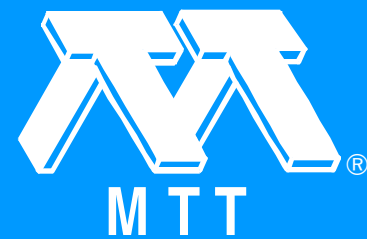
Shiwen Yang, Soon Hie Tan and Hongfu Li. "A new method for the design of a quasi-optical mode converter with a special reflector." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1849-1852.

This paper presents a new method for the design of a special reflector for quasi-optical mode converters, using the combination of vector diffraction theory and geometrical optics. The reflector is formed in a piecewise manner, according to a base reflector shape chosen previously. Each piece of reflector cell is adjusted separately. A numerical example is carried out for the quasioptical mode conversion of a circular waveguide TE/sub 52/ mode at 35 GHz, and the calculated results show that the output Gaussian wave beam waist radius is only less than twice the wavelength.

On the evaluation of modal coupling coefficients by contour integrals

M. Bozzi, G. Conciauro and L. Perregrini. "On the evaluation of modal coupling coefficients by contour integrals." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1853-1855.

The coupling coefficients between two waveguide modes or between a waveguide and a Floquet mode can be written in terms of line integrals on the boundary of the smaller waveguide. However, some of these integrals give rise to indeterminate forms when the cutoff frequencies of the two modes coincide, thus making these expressions useless from a numerical point of view. In this paper, alternative line-integral expressions are derived, which remove the indeterminacy and are applicable also when the cutoff frequencies are very close or even coincident.



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Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro-dependence on physical, physiological, and genetic factors (Comments)

J.M. Osepchuk and R.C. Petersen. "Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro-dependence on physical, physiological, and genetic factors (Comments)." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1856-1856.

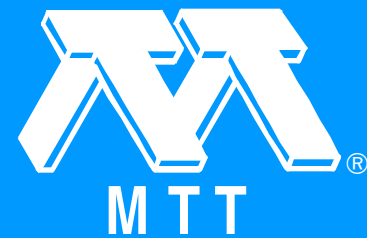
As long-time workers on development of microwave safe-exposure standards, we are keenly aware of the deficient quality in many of the papers in the bioeffect literature, particularly those relating to microwave artifacts. In the November 2000 issue of this Transactions there are many good papers but there are also papers displaying deficiencies. We are not able to review all such deficiencies, but we restrict our comments here to the above paper [see *ibid.*, vol. 44, no. 11, p. 2172-9, 2000], which makes the extraordinary claim of a significant microwave bioeffect at an incident power density of 10^{-19} W/cm², well below that of thermal noise in a bandwidth of practical significance.



Abstracts

Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro-dependence on physical, physiological, and genetic factors (Authors' Reply)

I.Y. Belyaev, E.D. Alipov and V.L. Ushakov. "Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro-dependence on physical, physiological, and genetic factors (Authors' Reply)." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 1856-1858.



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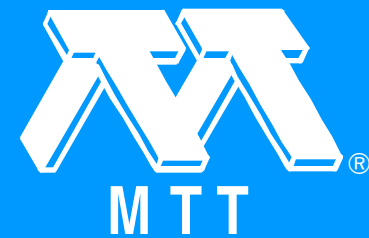
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"Information for Authors (Jul. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.7 (Jul. 2002 [T-MTT]): 0_5-0_5.



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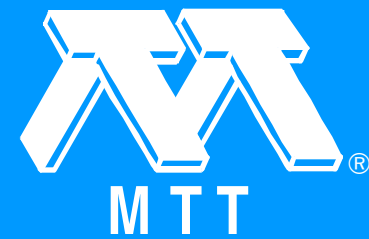
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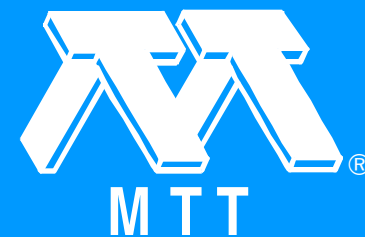
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Inside Cover (Aug. 2002 [T-MTT])

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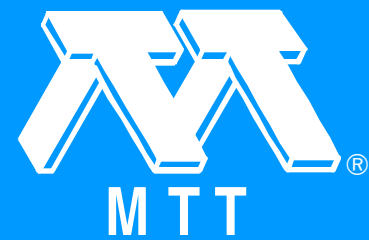
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Short-open calibration technique for field theory-based parameter extraction of lumped elements of planar integrated circuits

Lei Zhu and Ke Wu. "Short-open calibration technique for field theory-based parameter extraction of lumped elements of planar integrated circuits." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1861-1869.

A generalized short-open calibration (SOC) technique is developed toward complete field theory-based deembedding and lumped-element extraction of equivalent-circuit models for planar integrated circuits from admittance-type method of moments (MoM) simulations. With reference to the modal expansion modeling of a rectangular waveguide discontinuity, our investigation at first is to show the physical reason why there exist two aspects of numerical error in a deterministic MoM regarding a microstrip step discontinuity as the showcase in this study. In this SOC scheme, the identified two error sources are put together as a single error term or box for each feed line and then characterized by defining and evaluating two self-consistent calibration standards in the MoM, namely, short and open elements. As such, the core circuit model of the step discontinuity is effectively extracted by removing out two error terms. Subsequently, geometry- and frequency-dependent characteristics of the SOC technique are studied and discussed to demonstrate its effectiveness and accurateness as compared with the conventional transmission-line deembedding technique. After a series of validations by static analysis and measured results, the SOC scheme is used to model symmetrical and asymmetrical microstrip step discontinuities in terms of their equivalent dynamic circuit model over a wide frequency range.

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5.8-GHz circularly polarized rectifying antenna for wireless microwave power transmission

B. Strassner and Kai Chang. "5.8-GHz circularly polarized rectifying antenna for wireless microwave power transmission." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1870-1876.

This paper reports a new circularly polarized (CP) high-gain high-efficiency rectifying antenna (rectenna). The CP rectenna can be rotated and still maintain a constant dc output voltage. The high-gain antenna has an advantage of reducing the total number of rectenna elements to cover a fixed area. The rectenna is etched on Rogers Duroid 5870 substrate with $\epsilon_r = 2.33$ and 10 mil thickness. A high-gain dual-rhombic-loop antenna and a reflecting plane are used to achieve a CP antenna gain of 10.7 dB and a 2:1 voltage standing-wave ratio bandwidth of 10%. The rectenna's pattern has an elliptical cross section with orthogonal beamwidths of 40° and 60°. The rectenna circuit has a coplanar stripline band-reject filter that suppresses the re-radiated harmonics by 20 dB. A highly efficient Schottky diode is used for RF-to-dc conversion with an efficiency of approximately 80% for an input power level of 100 mW and a load resistance of 250 Ω .

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A reconfigurable leaky-wave/patch microstrip aperture for phased-array applications

J. Sor, Chin-Chang Chang, Yongxi Qian and T. Itoh. "A reconfigurable leaky-wave/patch microstrip aperture for phased-array applications." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1877-1884.

A novel reconfigurable leaky-wave/patch microstrip aperture is introduced and characterized. The structure consists of a long leaky-wave microstrip antenna that has been segmented into several smaller patch antennas. The multimode structure can be reconfigured into a patch antenna anywhere along the aperture of the leaky-wave antenna with two degrees of freedom. p-i-n-diode switches are utilized to switch between the different aperture configurations. The structure's unique field profile is utilized to minimize insertion loss in the leaky-wave mode and also to maximize isolation between the different aperture ports. Radiation patterns demonstrate excellent radiation characteristics consistent with standard leaky-wave and patch-antenna patterns. The reconfigurable leaky-wave/patch concept is applied to realize some unique multimode array configurations offering wide scan coverage and enhanced flexibility over traditional phased-array systems.

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A tunable all-pass MMIC active phase shifter

D. Viveiros, Jr., D. Consonni and A.K. Jastrzebski. "A tunable all-pass MMIC active phase shifter." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1885-1889.

This paper describes a novel structure for a monolithic-microwave integrated-circuit active phase shifter based on a bridge all-pass network. The design procedure has been developed, leading to a fixed-frequency circuit with large tunable phase variation, associated to a low-gain ripple, and requiring nearly no design optimization. Simulated results predicted an analog tunable 180/spl deg/ phase variation, at 5-GHz operation frequency. The circuit was implemented using GEC-Marconi pseudomorphic high electron-mobility transistor H40 technology, and measured results validated the proposed design method and circuit structure.

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Separation of the nonlinear source-pull from the nonlinear system behavior

P. Crama, Y. Rolain, W. Van Moer and J. Schoukens. "Separation of the nonlinear source-pull from the nonlinear system behavior." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1890-1894.

In this paper, we describe a measurement technique to identify a nonlinear system in the presence of nonlinear source-pull. Models identified with continuous-wave measurement data are not generalizable when nonlinear source-pull is present. This is demonstrated on measured data and compared with the performance of the proposed technique. The method is based on two-tone signals with very close frequencies that excite the system at the fundamental and harmonic frequencies. By varying the phase relation between the beat components, the system's nonlinear behavior is separated from the nonlinear source-pull. Note that such excitations can be generated using commercially available synthesizers with single-sideband in-phase-quadrature modulation options.



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2-D analysis of leakage in printed-circuit lines using discrete complex-images technique

J. Bernal, F. Mesa and F. Medina. "2-D analysis of leakage in printed-circuit lines using discrete complex-images technique." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1895-1900.

The mixed-potential integral equation is combined with the discrete complex-images technique to analyze the complete spectrum of multilayered printed transmission lines. A relevant contribution of the present two-dimensional approach is its ability to study both the bound and leaky regimes in a very simple, systematic, and efficient way. Since the analysis is carried out in the spatial domain, this method makes it possible to analyze the leakage phenomenon for structures with nonzero-thickness conductors. Efficient quasi-analytical techniques are employed to solve the integral equation.

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Accuracy control in the optimization of microwave devices by finite-element methods

M.M. Gavrilovic and J.P. Webb. "Accuracy control in the optimization of microwave devices by finite-element methods." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1901-1911.

Automatically optimizing the design of a microwave device can be prohibitively time-consuming when a numerical electromagnetic-field analysis is necessary at each iteration. However, the time taken for the field analysis depends on the accuracy required, and in the early stage of the optimization relatively inaccurate solutions are adequate. This idea is exploited in a scheme that combines a quasi-Newton constrained optimizer with a two-dimensional p-adaptive finite-element method for finding scattering parameters. The scheme has been tested on three H-plane rectangular waveguide devices: a T-junction, a miter bend with a dielectric column, and a two-cavity iris-coupled filter. Time savings of more than an order of magnitude were obtained, compared to the standard approach of requiring equally high accuracy throughout the optimization.

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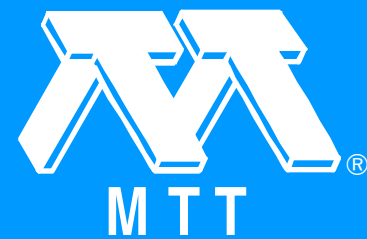
Improved analysis of nonreciprocal remanence ferrite phase shifter in grooved waveguide

Wenquan Che, E.K.-N. Yung, Suibing Chen and Junding Wen. "Improved analysis of nonreciprocal remanence ferrite phase shifter in grooved waveguide." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1912-1918.

In this paper, the nodal finite-element method is used to analyze the differential phase shift of a nonreciprocal remanence ferrite phase shifter in a grooved waveguide. Instead of the former twin-slab model, an improved analytical model is adopted, where the effect of every part of a ferrite toroid on the differential phase shift has been considered. This analysis may replace the correcting factor with good agreement with the experimental data. Furthermore, this analysis is employed to investigate the effect of corner chamfering on the figure-of-merit (differential phase shift per decibel insertion loss) of a ferrite phase shifter. The numerical results are found to agree with the experiments in the literatures.

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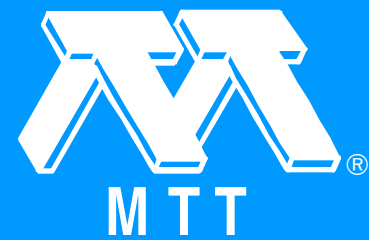
A novel amplifying antenna array using patch-antenna couplers-design and measurement

Chih-Hung Tsai, Y.A. Yang, Shyh-Jong Chung and Kai Chang. "A novel amplifying antenna array using patch-antenna couplers-design and measurement." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1919-1926.

This paper proposes a novel amplifying antenna array using the patch-antenna coupler formed by placing one or two open-ended microstrip lines (coupled lines) near and along the nonradiating edge(s) of a patch antenna. An X-band five-element array with broadside 25-dB Chebyshev radiation is demonstrated. When the input signal is fed to the center element, with most of the power radiating from the antenna, part of it is tapped to the coupled lines, amplified by an FET amplifier, and fed to the next antenna element. This process is repeated after all the antenna elements are fed with suitable power. The amplitude distribution of the fields radiated from the antennas is controlled by the coupling coefficient from the patch to the coupled line, which, in turn, is governed by the coupling length and gap between the patch and line. The measured return loss of the designed five-element array is -27 dB at the center frequency of 10 GHz with 2% 10-dB bandwidth. The radiation pattern possesses a transmitting gain of 15.9 dB, a half-power beamwidth of 17/spl deg/, and a sidelobe level of -22 dB.

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Small-signal and temperature noise model for MOSFETs

A. Pascht, M. Grozing, D. Wiegner and M. Berroth. "Small-signal and temperature noise model for MOSFETs." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1927-1934.

The present CMOS technology provides n-channel MOSFETs with a transit frequency beyond 30 GHz, which are attractive for RF integrated circuits, e.g., low-noise amplifiers. This paper presents an improved deembedding procedure for extraction of parasitic elements of MOSFETs. The extraction determines the intrinsic elements of the small-signal equivalent circuit. As a result, a new method to determine the gate capacitance is presented. This deembedding procedure is based on an analytical solution of the equations and facilitates the determination of the elements at any specific frequency. Moreover, a temperature noise model is presented, which is based on the small-signal equivalent circuit with an analytical description of the channel noise. This enables a complete noise modeling of all four noise parameters and the determination of the dominant noise sources. Finally, the noise-figure measurements are compared with the simulation results.

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Analysis of the propagation of leaky magnetostatic modes in normally magnetized microstrip and slot lines

R. Marques, R. Rafii-El-Idrissi, F. Mesa and F. Medina. "Analysis of the propagation of leaky magnetostatic modes in normally magnetized microstrip and slot lines." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1935-1941.

The propagation of leaky forward magnetostatic (MS) volume waves along ferrite-loaded microstrip and slot lines is analyzed. This phenomenon is studied by means of a numerical approach based on the residue calculus technique because of its good numerical convergence and stability. The proposed method allows for a quick and accurate computation of the phase and attenuation constants of the leaky MS modes. A comparative analysis between both microstrip lines and slot lines is carried out, and some new physical effects, such as MS resonances in the radiation loss, are reported. The advantages of the proposed method of analysis over other numerical methods, such as Galerkin's or moment methods, are also discussed.

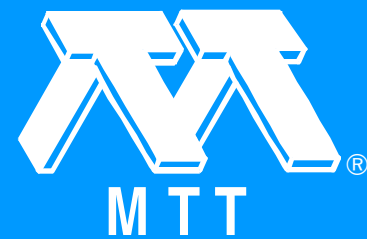
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High-Q factor three-dimensional inductors

B. Piernas, K. Nishikawa, K. Kamogawa, T. Nakagawa and K. Araki. "High-Q factor three-dimensional inductors." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1942-1949.

In this paper, the great flexibility of three-dimensional (3-D) monolithic-microwave integrated-circuit technology is used to improve the performance of on-chip inductors. A novel topology for high-Q factor spiral inductor that can be implemented in a single or multilevel configuration is proposed. Several inductors were fabricated on either silicon substrate ($\rho = 30 \text{ } \Omega \cdot \text{cm}$) or semi-insulating gallium-arsenide substrate demonstrating, more particularly, for GaAs technology, the interest of the multilevel configuration. A 1.38-nH double-level 3-D inductor formed on an Si substrate exhibits a very high peak Q factor of 52.8 at 13.6 GHz and a self-resonant frequency as high as 24.7 GHz. Our 4.9-nH double-level GaAs 3-D inductor achieves a peak Q factor of 35.9 at 4.7 GHz and a self-resonant frequency of 8 GHz. For each technology, the performance limits of the proposed inductors in terms of quality factor are discussed. Guidelines for the optimum design of 3-D inductors are provided for Si and GaAs technologies.



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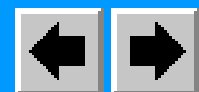
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Construction of solutions to electromagnetic problems in terms of two collinear vector potentials

N.K. Georgieva. "Construction of solutions to electromagnetic problems in terms of two collinear vector potentials." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1950-1959.

In this paper, the construction of solutions to transient electromagnetic (EM) problems in terms of two collinear vector potentials (VPs) is subjected to a careful theoretical study and numerical verification. The analysis concerns a general isotropic medium that can be inhomogeneous, lossy, and may contain sources. It is also assumed that the medium has instantaneous response, i.e., its EM properties are frequency independent. First, the completeness of the solution in terms of the two VPs in homogeneous and inhomogeneous media is addressed. Second, the behavior of the VPs at interfaces and edges is considered. Finally, a number of simple, but relevant numerical tests are performed to verify the theoretical model. This paper is part of the effort to establish the theoretical background of a novel efficient approach to the analysis of transient EM propagation based on the VPs.

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Synthesis of coupled-resonators group-delay equalizers

Heng-Tung Hsu, Hui-Wen Yao, K.A. Zaki and A.E. Atia. "Synthesis of coupled-resonators group-delay equalizers." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1960-1968.

A systematic synthesis and design procedure for coupled-resonators cavity group-delay equalizers is presented. The procedure consists of solving the approximation problem by optimization and performing cascade synthesis. The error function for the optimization is computed from the given filter's group delay and the zeros and poles of the input impedance of the equalizer. Convergence of the optimization is fast and insensitive to the initial guess even when the number of resonators is large. Two examples, together with experimental results, are presented; comparisons between the externally equalized and self-equalized filters are made. The effect of the isolation of the cascading devices (circulator or 3-dB hybrid) on the ripple of the final group-delay response is also extensively investigated. The good agreement between the theoretical simulation and the experimental results demonstrates the powerful nature and effectiveness of the proposed design procedure.

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Adaptive synthesis and design of resonator filters with source/load-multiresonator coupling

S. Amari, U. Rosenberg and J. Bornemann. "Adaptive synthesis and design of resonator filters with source/load-multiresonator coupling." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1969-1978.

The paper presents a universal and comprehensive synthesis technique of coupled resonator filters with source/load-multiresonator coupling. The approach is based on repeated analyses of a circuit with the desired topology; no similarity transformation is needed. Restrictions imposed by the implementation on the coupling coefficients such as signs and orders of magnitudes are straightforwardly handled within this technique. The technique is then used to synthesize and design filters with full or almost full coupling matrices by selecting, among the infinite number of solutions, the matrix that corresponds to the actual implementation. In such cases, analytical techniques and those based on similarity transformations cannot be used since they provide no mechanism to constrain individual coupling coefficients in order to discriminate between two full coupling matrices, which are both solutions to the synthesis problem. Using the technique described in this paper, a filter designer can extract the coupling matrix of a filter of arbitrary order and topology while enforcing relevant constraints. There is no need to master all the different existing similarity-transformation-based techniques and the topologies to which they are applicable. For the first time, detailed investigations of parasitic coupling effects, for either compensation or utilization, are made possible. The method is applied to the synthesis of a variety of filters, some of which are then designed and built and their response measured.

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Out-of-band emissions of digital transmissions using Kahn EER technique

D. Rudolph. "Out-of-band emissions of digital transmissions using Kahn EER technique." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1979-1983.

The Kahn envelope elimination and restoration (EER) technique allows for linear RF power amplification by combining nonlinear, but efficient, RF and AF power amplifiers (PAs). In order to use the EER technique for digital signals, a coordinate transform from the original Cartesian in-phase and quadrature mode into a polar mode has to take place, yielding an envelope (or amplitude) and a PM RF signal. This coordinate transform is extremely nonlinear and thereby broadens the spectra of the original signals. In the final PA stage, both signals are recombined. However, since this recombination process is imperfect, out-of-band (OOB) emissions come up, also known as adjacent channel power or spectral regrowth. In this paper, the impact of the broadening of the amplitude and phase signals on OOB emissions is investigated with respect to imperfect restoration due to signal delays and limited bandwidth of the amplitude path. It is shown that the amount of OOB emissions can significantly be reduced if the modulation scheme shows a "hole" at the origin in its vector diagram.

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Hierarchical multilevel potential preconditioner for fast finite-element analysis of microwave devices

Yu Zhu and A.C. Cangellaris. "Hierarchical multilevel potential preconditioner for fast finite-element analysis of microwave devices." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1984-1989.

A robust hierarchical multilevel preconditioning technique is presented for the fast finite-element analysis of microwave devices. The proposed preconditioner is based on a hierarchical multilevel scheme for the vector-scalar potential finite-element formulation of electromagnetic problems. Numerical experiments from the application of the new preconditioner to the finite-element analysis of microwave devices are used to demonstrate its superior numerical convergence and efficient memory usage.

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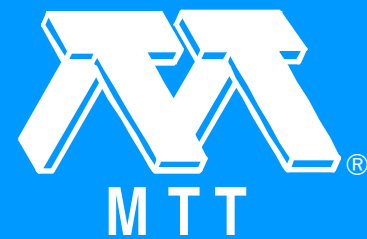
Converting baluns into broad-band impedance-transforming 180/spl deg/ hybrids

Kian Sen Ang and Yoke Choy Leong. "Converting baluns into broad-band impedance-transforming 180/spl deg/ hybrids." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1990-1995.

A technique for converting baluns into 180/spl deg/ hybrids by adding an in-phase power splitter is presented in this paper. Incorporating the broad-band antiphase and in-phase power splitting characteristics of the balun and power splitter results in a 180/spl deg/ hybrid with broad-band characteristics. This technique also provides a means of achieving perfect matching and output isolation for three-port lossless baluns. Applying this technique to a Marchand balun will result in a broad-band impedance-transforming 180/spl deg/ hybrid. Simple design equations based on the scattering matrix are presented. These theoretical results are validated by an experimental 180/spl deg/ hybrid using a coupled line Marchand balun. It achieves amplitude balance of 0.5 dB and phase balance of less than 5/spl deg/ from 1.2 to 3.2 GHz.

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Electric-magnetic-electric slow-wave microstrip line and bandpass filter of compressed size

Ching-Kuo Wu, Hsien-Shun Wu and Ching-Kuang Cliver Tzuang. "Electric-magnetic-electric slow-wave microstrip line and bandpass filter of compressed size." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 1996-2004.

This paper presents a novel integrated microstrip low-loss slow-wave line. The new microstrip replaces the conventional metal strip by composite metals paralleling the electric surface and magnetic surface (MS). The MS made of an array of coupled inductors shows a high-impedance state in the stopband, below which the propagation properties can be well controlled by varying the dimensions of the electric surface and MS. The dispersion curves obtained by matrix-pencil analyses closely correspond to those obtained by scattering-parameter extraction. Theoretical results, as confirmed experimentally, indicate that an increase of over 60% in the slow-wave factor can be achieved without sacrificing propagation losses, using the proposed structure. This electric-magnetic-electric (EME) microstrip is insensitive to the alignment position of the periodical structure, and can be constructed using conventional printed-circuit-board fabrication processes and integrated with other microwave components in a multilayered circuit. A compact EME bandpass filter (BPF) with suppressed harmonic responses is presented. The length of the filter is reduced by 26%, and the measured insertion loss and fractional bandwidth is comparable to that of a conventional microstrip BPF on the same substrate.

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Radiation from a microstrip amplifier

Tzyy-Sheng Horng and Sung-Mao Wu. "Radiation from a microstrip amplifier." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2005-2010.

A full-wave method is presented to investigate radiation from a microstrip amplifier. The spectral-domain dyadic Green's function, which takes into account both radiation and surface waves, is used to formulate an integral equation. The method of moments is then employed to find the current densities in microstrips and, subsequently, the scattering parameters of the amplifier. The radiated space and surface waves that are launched from the amplifier can be further expressed in terms of the dyadic Green's function and current densities. To verify the numerical results of scattering parameters and far-field radiation patterns, a UHF-band microstrip amplifier matching with single stubs has been implemented and measured. The comparison between simulation and measurement shows excellent agreement.

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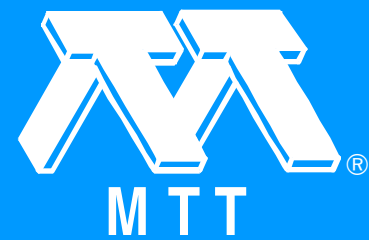
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A novel algorithm based on the domain-decomposition method for the full-wave analysis of 3-D electromagnetic problems

Lei Yin, Jie Wang and Wei Hong. "A novel algorithm based on the domain-decomposition method for the full-wave analysis of 3-D electromagnetic problems." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2011-2017.

A novel technique based on the domain-decomposition method and frequency-domain finite-difference method is presented for the full-wave analysis of three-dimensional electromagnetic problems. In this method, the original domain is decomposed into sub-domains, Maxwell's equations are then solved in each sub-domain independently, and the global solution is achieved finally by an iterative procedure. It greatly reduces the computational complexity and the memory requirement compared with the conventional finite-difference method and method of moments, etc. To reduce CPU time, some techniques, such as the relaxation iterative algorithm, overlapped domain decomposition, and multimesh resolution are also investigated and adopted to accelerate the algorithm. The validity of this algorithm is verified by numerical examples, including the analysis of a multilayered aperture-coupled patch antenna, the scattering characteristic analysis of conducting pillars, and the S-parameters extraction of the air-bridge discontinuity.





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Analysis of transient interaction of electromagnetic pulse with an air layer in a dielectric medium using wavelet-based implicit TDIE formulation

Y. Shifman and Y. Leviatan. "Analysis of transient interaction of electromagnetic pulse with an air layer in a dielectric medium using wavelet-based implicit TDIE formulation." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2018-2022.

The interaction of transient electromagnetic pulse with an air layer in a dielectric medium is formulated in terms of a time-domain integral equation and solved numerically via the method of moments. Previous related works pointed to the inherent inadequacy of the marching-on-in-time method in this case, but suggested no remedy. This paper explains why an implicit modeling scheme would work effectively in this case. It is also noted that the use of an implicit scheme would normally involve a solution of a very large and dense matrix equation. To alleviate this drawback of the implicit scheme, the use of a wavelet-based impedance-matrix-compression technique, which has facilitated in the very recent past solutions of time-domain problems with greater efficiency, is described.

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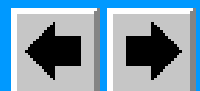
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Investigation of static and quasi-static fields inherent to the pulsed FDTD method

R. Pontalti, J. Nadobny, P. Wust, A. Vaccari and D. Sullivan. "Investigation of static and quasi-static fields inherent to the pulsed FDTD method." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2022-2025.

Demonstrates that trailing dc offsets, which can affect E- or H-fields in finite-difference time-domain simulations, are physically correct static solutions of Maxwell's equations instead of being numerically induced artifacts. It is shown that they are present on the grid when sources are used, which generates nondecaying charges. Static solutions are investigated by exciting electric and magnetic dipoles models with suitable waveforms.

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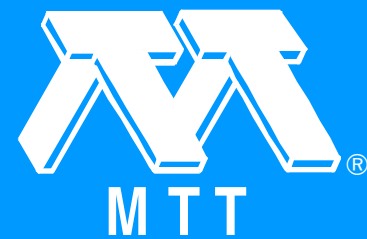


Abstracts

An improved algorithm of constructing potentials from Cauchy data and its application in synthesis of nonuniform transmission lines

G. Xiao and K. Yashiro. "An improved algorithm of constructing potentials from Cauchy data and its application in synthesis of nonuniform transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2025-2028.

It is required to construct a potential function from Cauchy data in the synthesis of arbitrarily terminated nonuniform transmission lines. An improved algorithm for this problem is discussed in this paper. With the proposed algorithm, not only is computation time reduced, but the possible divergence of the potential function that sometimes occur when adopting the successive approximation method is also avoided. It has been applied successfully to designs of nonuniform transmission-line filters or tapers through solving inverse problems.



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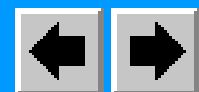
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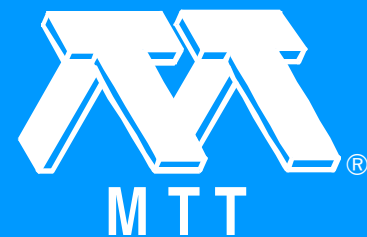
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The reentrant wide-band directional filter

A. Petrovich Gorbachev. "The reentrant wide-band directional filter." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2028-2031.

A new type of a wide-band microwave filter is described and named the reentrant directional filter, in which resonance occurs in the form of a traveling wave rather than in the conventional form of a standing wave. This device is the network, which has the constant input impedance and is manufactured as the directional coupler's free construction. An analysis of the reentrant directional filter shows it to have advantages in the case of wide-bands when compared to previously used directional filters. This filter finds application in multiplexers, as well as in matched bandpass (band-stop) filters by using planar multilayer transmission-line technology. Experimental results verify the theoretical approach.

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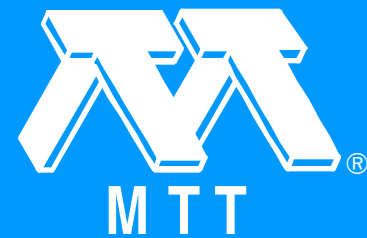


Abstracts

Biological effects of radio-frequency/microwave radiation (Comments)

R.W.P. King. "Biological effects of radio-frequency/microwave radiation (Comments)." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2032-2032.

The original paper [see *ibid.*, vol. 48, p. 1537-43, Sept. 2000] is important in that it summarizes 50 years of research on the thermal effects of microwave radiation in the human body and the penetration of a plane-wave incident on a planar surface of that body. The author would like to see the above paper supplemented with at least a reference to the possible biological effects of the axial electric current and electric field induced in the human body near its resonant length.



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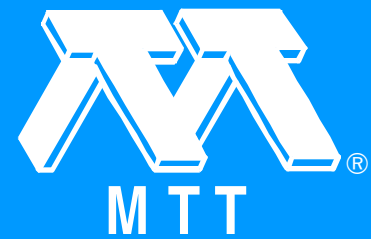
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Biological effects of radio-frequency/microwave radiation (Authors' Reply)

E.R. Adair and R.C. Petersen. "Biological effects of radio-frequency/microwave radiation (Authors' Reply)." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2032-2033.



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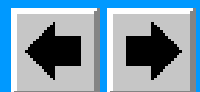
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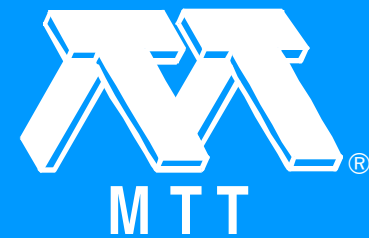
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Abstracts

Microwaves in Europe (Corrections)

G. Gerosa, G. Pelosi and R. Sorrentino. "Microwaves in Europe (Corrections)." 2002 Transactions on Microwave Theory and Techniques 50.8 (Aug. 2002 [T-MTT]): 2033-2033.



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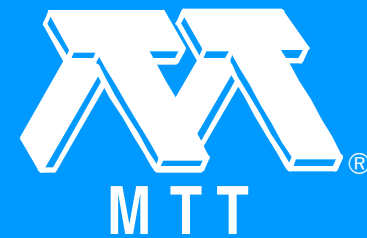
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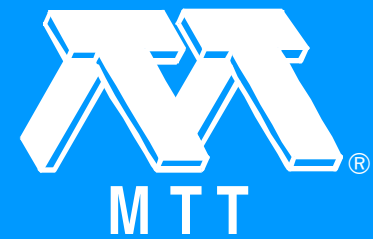
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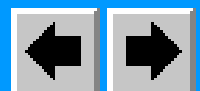
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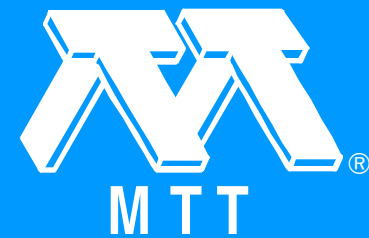
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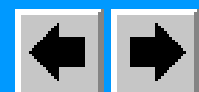
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A design of the novel coupled-line bandpass filter using defected ground structure with wide stopband performance

Jun-Seok Park, Jun-Sik Yun and Dal Ahn. "A design of the novel coupled-line bandpass filter using defected ground structure with wide stopband performance." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2037-2043.

In this paper, a novel three-pole coupled-line bandpass filter with a microstrip configuration is presented. Presented bandpass filters use defected ground structure (DGS) sections to simultaneously realize a resonator and an inverter. The proposed coupled-line bandpass filter provides compact size with low insertion-loss characteristic. Furthermore, a DGS shape for a microstrip line is newly proposed. The proposed DGS unit structure has a resonance characteristic in some frequency band. The proposed coupled-line filter can provide attenuation poles for wide stopband characteristic due to resonance characteristic of DGS. The equivalent circuit for the proposed DGS unit section is described. The equivalent-circuit parameters for DGS are extracted by using a three-dimensional finite-element-method calculation and simple circuit analysis method. A design method for the proposed coupled-line filter is derived based on coupled-line filter theory and the equivalent circuit of the DGS. The experimental results show excellent agreements with theoretical simulation results.

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Hybrid circuit-full-wave computer-aided design of a manifold multiplexers without tuning elements

L. Accatino and M. Mongiardo. "Hybrid circuit-full-wave computer-aided design of a manifold multiplexers without tuning elements." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2044-2047.

A hybrid procedure is introduced for computer-aided design (CAD) of manifold multiplexers without tuning elements. The procedure is based on: (1) a standard initial design with a simple network prototype; (2) a hybrid optimization with the multiplexer manifold rigorously described by a full-wave model and filters still described in terms of their network prototype; and (3) a final full-wave optimization of the entire structure. The proposed approach drastically reduces computer time while making it feasible to perform a very accurate full-wave optimization which in turn allows the avoidance of using tuning elements. An example illustrates and validates the CAD procedure.

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Evolutionary generation of microwave line-segment circuits by genetic algorithms

T. Nishino and T. Itoh. "Evolutionary generation of microwave line-segment circuits by genetic algorithms." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2048-2055.

Evolutionary generation of microwave line-segment circuits is presented in this paper. Topology and dimensions of line-segment circuits are expressed by sets of parameters, which describe the way of structural growth of line-segment circuits. The sets of parameters are then optimized by genetic algorithms (GAs) to satisfy specifications. Using line segments, we can obtain not only small components for limited space applications, but also large components for wide-band frequency specifications without increasing computational complexity. In the GA process, to reduce computation time, a circuit is decomposed into lines and discontinuous elements. The S-parameters are then synthesized to obtain the response of the circuit. Three filters and a power divider are designed and tested. The results have validated our proposing procedure.

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RF and IF ports matching circuit synthesis for a simultaneous conjugate-matched mixer using quasi-linear analysis

Yew Hui Liew and Jurianto Joe. "RF and IF ports matching circuit synthesis for a simultaneous conjugate-matched mixer using quasi-linear analysis." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2056-2062.

A quasi-linear two-port approach between RF and IF ports to design a simultaneous conjugate-matched mixer is presented in this paper. Conventionally, mixer design is treated as a nonlinear three-port device problem. Nonetheless, with the exception of the large-signal local oscillator (LO) that exists at the LO port, the input RF and output IF signals that exist at the RF and IF ports, respectively, are small signals. Consequently, mixers can be approximated as bilateral quasi-linear two-port circuits with a time-variant transfer function between the RF and IF ports, in which the LO port of the mixer is treated as part of the two-port network. With this approximation, it can be shown mathematically that the optimum source and load matching networks required for attaining simultaneous conjugate match at the RF and IF ports are actually time invariant, thus implying that it is possible to synthesize these optimum impedance values. This proposed mixer design technique, together with the equations derived, are verified with block-diagram simulation and experimental measurements of two 2.4-GHz RF/420-MHz IF double-balanced diode mixers.

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A vertically integrated micromachined filter

L. Harle and L.P.B. Katehi. "A vertically integrated micromachined filter." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2063-2068.

A 10-GHz filter constructed of slot-coupled micromachined cavities in silicon is presented. The novel character of the filter lies in its structure, which consists of a microstrip feed to cavities via slot apertures and three vertically stacked slot-coupled cavities. The cavities are essentially reduced-height waveguide resonators. The measured results are presented and compared to a finite-element-method model. The simulated model has a bandwidth of 4% with an insertion loss of 0.9 dB at 10.02 GHz. The measured filter yields a 3.7% bandwidth with a deembedded insertion loss of 2.0 dB at 10.01 GHz. Various loss mechanisms are examined to explain the difference between simulated and measured insertion loss.

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Low-loss compact Butler matrix for a microstrip antenna

M. Bona, L. Manholm, J.P. Starski and B. Svensson. "Low-loss compact Butler matrix for a microstrip antenna." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2069-2075.

This paper presents the design and realization of a double four-port Butler matrix to feed a four-column array antenna with two orthogonally polarized signals (to obtain polarization diversity). The main goals of this study are the reduction of the size and the losses of the network. In order to meet those requirements, a bi-layer structure, the suspended stripline, has been adopted to support the circuit. Moreover, the complete network has been integrated in a single unit. The double four-port Butler matrix has been etched on both sides of the suspended substrate to solve the problem of the cross between the lines. The broadside suspended 3-dB directional coupler has been chosen for the design of the 3-dB hybrid coupler. In order to change the side of the suspended substrate, contactless transitions have been used. The network is designed to work within the range of frequencies of the GSM-900-MHz standard: band 880 MHz-960 MHz, center frequency $f_{0/2} = 920$ MHz. Measured losses for a 4/spl times/4 Butler matrix are 0.3 dB.



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Probe-tone S-parameter measurements

J. Martens and P. Kapetanac. "Probe-tone S-parameter measurements." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2076-2082.

The measurement of device behavior under complex actual operating conditions is an increasingly important measurement problem. In particular, it can be difficult to accurately measure gain and some reflection coefficients of a power amplifier operating under a realistic modulated signal drive. A small-signal measurement alone of a power amplifier is generally incorrect since the device-under-test will not be biased correctly. A fully modulated measurement, however, may require very dedicated equipment, long measurement times for adequate stability, and special calibration techniques. The methodology discussed here, i.e., the use of S-parameter probe signals in addition to power signals, will allow self-consistent S-parameter measurement under these conditions with full (traceable) vector calibrations and reduced uncertainties. In some sense, the small probe signal is used to quantify nonlinearities introduced by the modulated signal. In addition, the measurement has the flexibility to perform frequency-domain profiling to elucidate the behavior that may be experienced by interfering signals.

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Measurement of a filter using a power detector

N. Vasudev and O.M. Collins. "Measurement of a filter using a power detector." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2083-2089.

This paper presents experimental results on the measurement of the magnitude and phase response of RF and baseband signal paths made with a power detector. The frequency response is obtained by measuring the magnitude and phase of the output of the power detector when the forward path is excited by a pair of tones. This technique provides a means for making vector measurements using a scalar detector. Instruments, like network analyzers, commonly use a mixer and sinusoidal source to downconvert the signal for digitization and measurement. The downconversion in this paper is performed using a power detector and an extra tone in the excitation signal itself, drastically reducing hardware complexity. Important applications of this technique include the characterization of the digital-to-antenna path of a software radio and the equalization of the antialiasing filter in a wide-band arbitrary waveform generator. Three examples of measurement, one at low frequency and two others at radio frequencies, show that the errors in the measured response are comparable to those obtained using conventional network analyzers.

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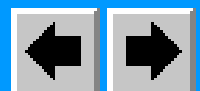
Subjects

A comprehensive explanation of distortion sideband asymmetries

N. Borges de Carvalho and J.C. Pedro. "A comprehensive explanation of distortion sideband asymmetries." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2090-2101.

This paper presents a comprehensive study of intermodulation-distortion response asymmetries often observed in microwave nonlinear systems subject to a two-tone or multitone test. The reasons for the different amplitudes of the two adjacent tones are first investigated under small- and large-signal regimes, using a general circuit with frequency-dependent embedding impedances and resistive and reactive nonlinearities. It is shown that this intriguing phenomenon can be mainly attributed to the terminating impedances at the baseband or difference frequencies. Multitone behavior is also addressed and its main differences from the two-tone case explained. Those theoretical conclusions are then extrapolated for real circuits and validated by measured results obtained from microwave power amplifiers of two different technologies, i.e., a GaAs MESFET and an Si bipolar junction transistor.

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An optimized parallel admittance matrix approach using the adjacence-graph recursive-thresholding technique

A. Esposito, F. Malucelli and L. Tarricone. "An optimized parallel admittance matrix approach using the adjacence-graph recursive-thresholding technique." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2102-2107.

The admittance method is an accurate approach for the analysis of electromagnetic circuits. Unfortunately, until now it has suffered from two main limitations, i.e., its high numerical complexity and its lack of robustness, due to the risk of numerical ill conditioning in a linear system representing the core of the approach. In a previous paper, both drawbacks have been solved, using a strategy based on the system partitioning into many independent and well-conditioned reduced-size subsystems, thanks to the exploitation of the matrix adjacence graph properties. In this paper, we demonstrate that the use of this strategy paves the way to a natural, straightforward, and low-cost migration on distributed platforms, with a consequent substantial reduction in computer times. Furthermore, the use of suitable optimization strategies proposed here allows an optimum partitioning of the system in order to maximize the parallel efficiency.

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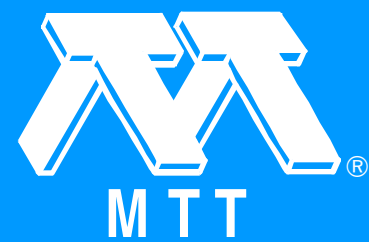
A fast reduced-order model for the full-wave FEM analysis of lossy inhomogeneous anisotropic waveguides

F. Bertazzi, O.A. Peverini, M. Goano, G. Ghione, R. Orta and R. Tascone. "A fast reduced-order model for the full-wave FEM analysis of lossy inhomogeneous anisotropic waveguides." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2108-2114.

The evaluation of the frequency response of waveguiding structures by means of the full-wave finite-element method requires solving a large generalized eigenvalue problem for each frequency. This paper describes a novel approach, based on the singular-value decomposition, which drastically reduces the order of the eigenvalue problem. By inspection of the singular values, the accuracy level of the procedure may be controlled. The technique is applied to the analysis of open and closed waveguides with arbitrary cross section, lossy conductors, and anisotropic dielectric layers, by means of vector elements of generic order; higher order elements are shown to allow the accurate evaluation of fields inside lossy conductors with fewer unknowns, besides exactly modeling normal field discontinuities at material interfaces. Examples of application of the reduced-order technique are shown concerning both non-TEM and quasi-TEM structures.

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Precise measurements of the Q factor of dielectric resonators in the transmission mode-accounting for noise, crosstalk, delay of uncalibrated lines, coupling loss, and coupling reactance

K. Leong and J. Mazierska. "Precise measurements of the Q factor of dielectric resonators in the transmission mode-accounting for noise, crosstalk, delay of uncalibrated lines, coupling loss, and coupling reactance." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2115-2127.

Accurate measurements of the unloaded Q /sub 0/ factor of microwave resonators are necessary in many microwave applications. The most accurate values of Q /sub 0/ can be obtained by Q -circle fits from multifrequency S -parameter data. Practical measurement systems cause S -parameters of the resonators to be distorted from the circular ideal shape, rotated, and shifted from the origin resulting in errors in the Q -factor values. A novel Q -factor measurement method has been developed based on equations derived for resonators working in the transmission mode and fractional linear circle-fitting techniques. The transmission-mode Q -factor (TMQF) technique removes measurement effects of noise, noncalibrated measurement cables, connectors, coupling structures, crosstalk between the coupling loops, and impedance mismatch from the measurement data. The TMQF is especially useful in cryogenic measurements of high-temperature superconducting thin films and dielectrics since these measurements are typically done in the transmission mode and contain cables and connectors that are difficult to calibrate. The accuracy of the TMQF is better than 1% for practical measurement ranges and the method is applicable to a wide range of coupling. The range of Q factors measurable is from $10^{3/}$ up to $10^{7/}$.





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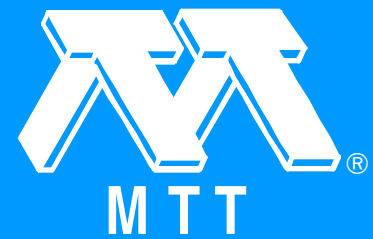
Automatic measurement of complex tensorial permeability of magnetized materials in a wide microwave frequency range

P. Queffelec, S. Mallegol and M. LeFloc'h. "Automatic measurement of complex tensorial permeability of magnetized materials in a wide microwave frequency range." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2128-2134.

This paper describes a microwave measurement technique enabling the automatic and broadband determination of the complex permeability tensor components μ and κ of magnetized materials. The method is applicable to ferrites, as well as magnetic composite materials. The measurement cell is composed of a nonreciprocal strip transmission line partly filled with the sample that is to be characterized. The data-processing program based on a quasi-static approach is valid whatever the magnetization state of the material is from the total demagnetization state to the saturation. The scattering matrix of the cell is measured in a wide frequency range (130 MHz-6 GHz) with a network analyzer setup. The stripline is set in the air gap of an electromagnet to magnetize the material. The electromagnetic parameters of the sample under test are deduced from the scattering matrix using analytical relations. General equations for μ and κ are proposed. Some measurements of magnetized ferrites are reported and compared with values predicted by Polder's relations to validate the technique in the saturation state. To our knowledge, this is the first noniterative measurement method giving μ and κ simultaneously in a wide range of frequency.

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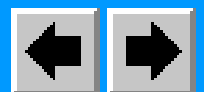
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Calibration of millimeter-wave polarimeters using a thin dielectric sheet

C.W. O'Dell, D.S. Swetz and P.T. Timbie. "Calibration of millimeter-wave polarimeters using a thin dielectric sheet." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2135-2141.

We present the theory and application of a novel calibration system for millimeter and microwave polarimeters. The technique is a simple extension of the conventional wire-grid approach, but employs a thin dielectric sheet rather than a grid. The primary advantage of this approach is to obtain a calibration signal that is only slightly polarized, which can be beneficial for certain applications such as astronomical radiometers that measure very low levels of polarization, or systems with a small dynamic range. We compare this approach with other calibration techniques and discuss its successful use in the calibration of the polarization observations of large angular regions experiment, designed to measure polarization in cosmic microwave background radiation.

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Efficient evaluation of reaction integrals in the EFIE analysis of planar layered structures with uniaxial anisotropy

F. Mesa, G. Plaza and F. Medina. "Efficient evaluation of reaction integrals in the EFIE analysis of planar layered structures with uniaxial anisotropy." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2142-2146.

This paper presents an efficient implementation of the electric-field integral-equation (EFIE) method to deal with planar anisotropic layered printed structures. A convenient treatment of the kernel of the integral equation gives rise to reaction integrals that only involve quasi-singularities and $R/\sup -1/-$ -type singularities. When the well-known Rao-Wilton-Glisson triangular basis functions are used in conjunction with the Galerkin's method, closed-form expressions are found for the singular parts of the self-reaction integrals, as well as for the inner convolution integrals of the remaining singular/quasi-singular reaction integrals. Thus, the present procedure sets the EFIE method as a competitive alternative to other formulations.

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A new class of multisection 180/spl deg/ hybrids based on cascadable hybrid-ring couplers

Kian Sen Ang, Yoke Choy Leong and Chee How Lee. "A new class of multisection 180/spl deg/ hybrids based on cascadable hybrid-ring couplers." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2147-2152.

A new class of multisection 180/spl deg/ hybrids is presented in this paper. It is based on the hybrid-ring coupler that has been reconfigured such that multiple sections can be conveniently cascaded together. The main limitations of the conventional hybrid-ring coupler are its limited bandwidth, large size, and the impracticably high-impedance levels required for large power-split ratios. These limitations are readily overcome using the multisection cascadable 180/spl deg/ hybrids. Simple design equations based on the scattering matrix and experimental verifications of the theoretical results for two-section 180/spl deg/ hybrids are presented.

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Design of an interdigital hairpin bandpass filter utilizing a model of coupled slots

A.N. Deleniv, M.S. Gashinova, I.B. Vendik and A. Eriksson. "Design of an interdigital hairpin bandpass filter utilizing a model of coupled slots." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2153-2158.

A design methodology of an interdigital hairpin filter based on a full-wave model of coupled slots is developed and discussed. It is applied to design a five-pole bandpass filter centered at 1.7 GHz; with 1.75% relative bandwidth. A low level of in-band insertion loss is achieved using high-temperature superconductor electrodes. Experimental data are presented and compared with the simulated response. A model of coupled slots embedded in a layered lossy media is developed on the basis of the spectral-domain approach. The multiport admittance (impedance) matrix of the coupled slots is formulated using the E-H duality principle. It is successfully applied in the design of the filter.

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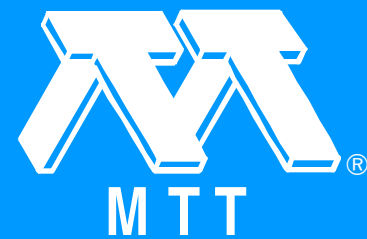
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Some aspects of stability and numerical dissipation of the finite-difference time-domain (FDTD) technique including passive and active lumped elements

W. Thiel and L.P.B. Katehi. "Some aspects of stability and numerical dissipation of the finite-difference time-domain (FDTD) technique including passive and active lumped elements." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2159-2165.

This paper presents a stability analysis of the extended finite-difference time-domain method including passive and active devices. An explicit, implicit, and semi-implicit incorporation of lumped elements is investigated and the eigenvalues of the resulting discrete system are discussed. With the underlying assumption that the domain is homogeneously loaded with lumped elements, stability criteria are derived on the basis of a resistance, a conductance, and an inductance. Applying a fully implicit method, a parasitic resistance can be observed when reactive devices are included. For an inductance, this numerical dissipation is characterized in detail and an equivalent circuit is given. As an example, the impact on the quality (Q) factor of a cavity loaded with an inductance is shown and compared to the theoretical derivation.





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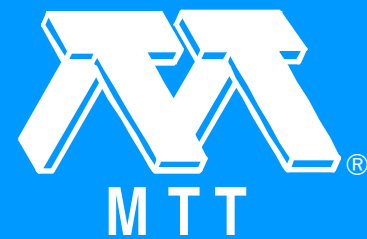
Wide-scan spherical-lens antennas for automotive radars

B. Schoenlinner, Xidong Wu, J.P. Ebling, G.V. Eleftheriades and G.M. Rebeiz. "Wide-scan spherical-lens antennas for automotive radars." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2166-2175.

A new approach to wide scan-angle antennas at millimeter-wave frequencies is introduced with special focus on ease of manufacturing and reliability. The system is composed of planar feed antennas (tapered-slot antennas), which are positioned around a homogeneous spherical Teflon lens. Beam scanning can be achieved by switching between the antenna elements. The spherical-lens system is analyzed through a combined ray-optics/diffraction method. It is found that a maximum efficiency of 50%-55% can be achieved using Teflon, Rexolite, or quartz lenses. The efficiency includes taper, spillover, and reflection loss. Calculations also indicate that the maximum lens diameter is $30-40 \lambda$, which results in a maximum directivity of 39.5-42 dB. Measurements done on a single-element feed and a 5-cm Teflon lens agree very well with theory and result in a 3-dB beamwidth of 5.5° and better than -20-dB sidelobe levels at 77 GHz. Absolute gain measurements show a system efficiency of 46%-48% (including dielectric loss). A 23- and 33-element antenna array with a scan angle of $\pm 90^\circ$ and a -3.5- and -6-dB crossover, respectively, in the far-field patterns was also demonstrated. The 23-element array resulted in virtually no gain loss over the entire 90° scan angle. This represents, to our knowledge, the first wide scan-angle antenna at millimeter-wave frequencies.

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Theory and design of an ultra-linear square-law approximated LDMOS power amplifier in class-AB operation

M.P. van der Heijden, H.C. de Graaff, L.C.N. de Vreede, J.R. Gajadharsing and J.N. Burghartz. "Theory and design of an ultra-linear square-law approximated LDMOS power amplifier in class-AB operation." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2176-2184.

This paper describes a power amplifier, employing parallel-connected laterally diffused metal-oxide semiconductor (LDMOS) devices with optimized channel widths and bias offsets to approximate ideal square-law behavior of the overall transconductance in class-AB operation. The proposed method results in a significant linearity improvement over a large dynamic range in comparison to a conventional amplifier in class-A or class-AB operation. Measurements demonstrate an improvement of 20 dB in third-order intermodulation distortion and 10 dB in adjacent channel power ratio for wide-band code-division multiple access at 12-dB output power backoff from the 1-dB gain compression point. Consequently, this amplifier can be operated more toward the compression region with better linearity and drain efficiency compared to a conventional LDMOS power-amplifier design.

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On the fast approximation of Green's functions in MPIE formulations for planar layered media

N.V. Shuley, R.R. Boix, F. Medina and M. Horno. "On the fast approximation of Green's functions in MPIE formulations for planar layered media." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2185-2192.

The numerical implementation of the complex image approach for the Green's function of a mixed-potential integral-equation formulation is examined and is found to be limited to low values of κ_0/ρ (in this context $\kappa_0/\rho = 2\pi/\rho\lambda_0$, where ρ is the distance between the source and the field points of the Green's function and λ_0 is the free space wavelength). This is a clear limitation for problems of large dimension or high frequency where this limit is easily exceeded. This paper examines the various strategies and proposes a hybrid method whereby most of the above problems can be avoided. An efficient integral method that is valid for large κ_0/ρ is combined with the complex image method in order to take advantage of the relative merits of both schemes. It is found that a wide overlapping region exists between the two techniques allowing a very efficient and consistent approach for accurately calculating the Green's functions. In this paper, the method developed for the computation of the Green's function is used for planar structures containing both lossless and lossy media.



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A 23.8-GHz SOI CMOS tuned amplifier

B.A. Floyd, L. Shi, Yuan Taur, I. Lagnado and K.K. O. "A 23.8-GHz SOI CMOS tuned amplifier." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2193-2196.

A 23.8-GHz tuned amplifier is demonstrated in a partially scaled 0.1- μm silicon-on-insulator CMOS technology. The fully integrated three-stage amplifier employs a common-gate, source-follower, and cascode with on-chip spiral inductors and MOS capacitors. The gain is 7.3 dB, while input and output reflection coefficients are -45 and -9.4 dB, respectively. Positive gain is exhibited beyond 26 GHz. The amplifier draws 53 mA from a 1.5-V supply. The measured on-wafer noise figure is 10 dB, while the input-referred third-order intercept point is -7.8 dBm. The results demonstrate that 0.1- μm CMOS technology may be used for 20-GHz RF applications and suggest even higher operating frequencies and better performance for further scaled technologies.

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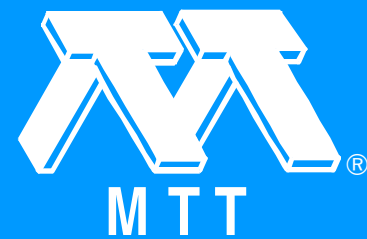
Effect of conductive perturber diameter on nonresonant measurement of interaction impedance for helical slow-wave structures

Sun-Shin Jung, A.V. Soukhov and Gun-Sik Park. "Effect of conductive perturber diameter on nonresonant measurement of interaction impedance for helical slow-wave structures." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2196-2198.

The measurement accuracy of the interaction impedance for a helical slow-wave structure (SWS) using the nonresonant perturbation method has been studied using conductive wire perturbers with different diameters. Data obtained by the measurement were compared with a rigorous numerical analysis. It is shown that the measured values of the interaction impedance for the helical SWS converge to those obtained by using a three-dimensional finite-element computational method when the diameter of the perturber is reduced to less than 10% of the helix diameter.

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A 7.5-GHz super regenerative detector

N.B. Buchanan, V.F. Fusco and J.A.C. Stewart. "A 7.5-GHz super regenerative detector." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2198-2202.

In this paper, simulated and measured results are presented for a microwave-integrated-circuit super regenerative detector operating at 7.5 GHz and brief comparisons made to a monolithic-microwave integrated-circuit super regenerative detector operating at 34 GHz. The sensitivity of the 7.5-GHz detector was measured at -83-dBm (AM, 1 kHz, 100 % mod) RF signal for 12 dB (signal + noise + distortion)/(noise + distortion). Simulation results show that, to produce a sensitive super regenerative detector, a high rate of change in loop gain of the oscillator circuit with respect to the gate bias (quenching) voltage and a high maximum loop gain at the point of detection is required. It has also been shown, by simulation and measurement, that the detection frequency of the super regenerative detector is lower than the normal free-running oscillation frequency.

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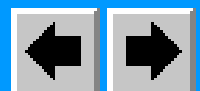
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An improved prediction of series resistance in spiral inductor modeling with eddy-current effect

Ban-Leong Ooi, Dao-Xian Xu, Pang-Shyan Kooi and Fu-jiang Lin. "An improved prediction of series resistance in spiral inductor modeling with eddy-current effect." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2202-2206.

Based on an earlier study by Kuhn and Ibrahim (see IEEE J. Trans. Microwave Theory Tech., vol. 49, no. 1, p. 31-38, 2001) on current crowding, an improved expression incorporating the skin effect for the prediction of series resistance in spiral inductor modeling has been derived. A modified model for the spiral inductor, which accounts for the eddy-current effect, is thus proposed. Relatively good agreements between the measured data and the results generated from the model are obtained.

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Multilayer and anisotropic planar compact PBG structures for microstrip applications

C. Caloz and T. Itoh. "Multilayer and anisotropic planar compact PBG structures for microstrip applications." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2206-2208.

Two novel microstrip planar photonic-bandgap (PBG) structures are presented, i.e., a multilayer PBG and an anisotropic PBG. The multilayer PBG, constituted of uniplanar compact (UC) PBGs stacked up below the line, produces huge gaps ($> 140\%$) through the suppression of parasitic transmission peaks and can achieve a two-fold size reduction with respect to UC-PBGs. The anisotropic PBG is a uniplanar structure exhibiting a propagation direction and an attenuation direction (AD) in a working range of the order of 35%, deep/sharp gaps broader than 65% in the AD, an excellent insensitivity to the line position and an extreme compact size of the order of $\lambda/2$ by $\lambda/7$.

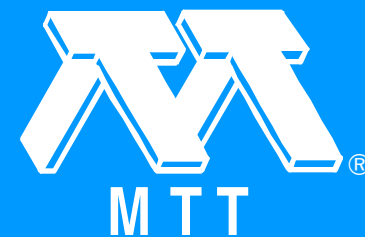
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Abstracts

Microwave power applications (Corrections)

J.M. Osepchuk. "Microwave power applications (Corrections)." 2002 Transactions on Microwave Theory and Techniques 50.9 (Sep. 2002 [T-MTT]): 2209-2209.



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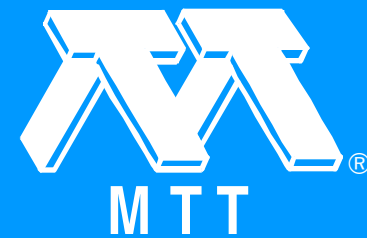
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Abstracts

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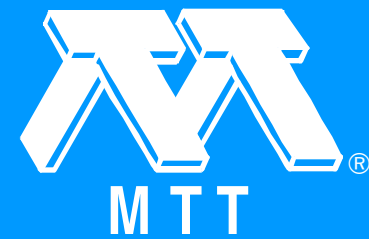
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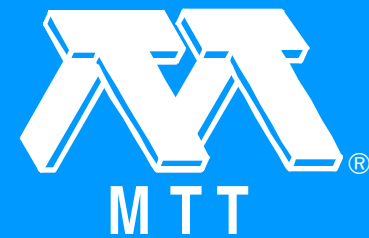
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Abstracts

Inside Cover (Oct. 2002 [T-MTT])

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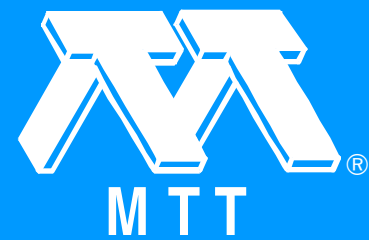
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Characterization of the complex permittivity of brain tissues up to 50 GHz utilizing a two-port microstrip test fixture

M.-R. Tofighi and A.S. Daryoush. "Characterization of the complex permittivity of brain tissues up to 50 GHz utilizing a two-port microstrip test fixture." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2217-2225.

Broad-band complex-permittivity values of biological tissues above 20 GHz obtained from direct measurements have not been reported in the literature. This paper presents for the first time the measurement results of complex permittivity of brain grey and white matters from 15 to 50 GHz utilizing a two-port microstrip test fixture. Test fixture S-parameters are simulated employing the finite-element method. To apply the data obtained from the simulation in complex-permittivity extraction, an efficient procedure, using the linear least square technique, is introduced to fit the modeling results to a rational function of complex permittivity, which is similar to the transfer function for a linear system. This fitting procedure is computationally more efficient than the previously developed fitting methods. Measurements are performed on slices of brain sample using a calibrated network analyzer utilizing custom designed through-reflect-line (TRL) calibration standards. The measurements are corrected for the residual errors observed in the measurement results due to the lack of performance repeatability of coaxial-to-microstrip launchers utilized in the TRL calibration standards. Finally, the measured results for brain matters are fitted to a single term Cole-Cole relation representing the dispersion characteristics of white and grey matters up to 50 GHz.

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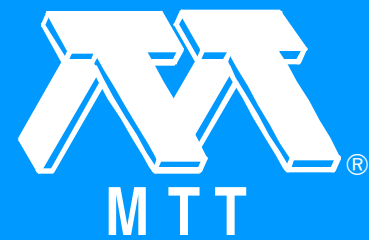
An unconditionally stable extended (USE) finite-element time-domain solution of active nonlinear microwave circuits using perfectly matched layers

Hsiao-Ping Tsai, Yuanxun Wang and T. Itoh. "An unconditionally stable extended (USE) finite-element time-domain solution of active nonlinear microwave circuits using perfectly matched layers." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2226-2232.

This paper proposes an extension of the unconditionally stable finite-element time-domain (FETD) method for the global electromagnetic analysis of active microwave circuits. This formulation has two advantages. First, the time-step size is no longer governed by the spatial discretization of the mesh, but rather by the Nyquist sampling criterion. Second, the implementation of the truncation by the perfectly matched layers (PML) is straightforward. An anisotropic PML absorbing material is presented for the truncation of FETD lattices. Reflection less than -50 dB is obtained numerically over the entire propagation bandwidth in waveguide and microstrip line. A benchmark test on a microwave amplifier indicates that this extended FETD algorithm is not only superior to finite-difference time-domain-based algorithm in mesh flexibility and simulation accuracy, but also reduces computation time dramatically.

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Accurate modeling of lossy nonuniform transmission lines by using differential quadrature methods

Qinwei Xu and P. Mazumder. "Accurate modeling of lossy nonuniform transmission lines by using differential quadrature methods." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2233-2246.

This paper discusses an efficient numerical approximation technique, called the differential quadrature method (DQM), which has been adapted to model lossy uniform and nonuniform transmission lines. The DQM can quickly compute the derivative of a function at any point within its bounded domain by estimating a weighted linear sum of values of the function at a small set of points belonging to the domain. Using the DQM, the frequency-domain Telegrapher's partial differential equations for transmission lines can be discretized into a set of easily solvable algebraic equations. DQM reduces interconnects into multiport models whose port voltages and currents are related by rational formulas in the frequency domain. Although the rationalization process in DQM is comparable with the Pade approximation of asymptotic waveform evaluation (AWE) applied to transmission lines, the derivation mechanisms in these two disparate methods are significantly different. Unlike AWE, which employs a complex moment-matching process to obtain rational approximation, the DQM requires no approximation of transcendental functions, thereby avoiding the process of moment generation and moment matching. Due to global sampling of points in the DQM approximation, it requires far fewer grid points in order to build accurate discrete models than other numerical methods do. The DQM-based time-domain model can be readily integrated in a circuit simulator like SPICE. Unlike the commercial simulators, which cannot directly handle nonuniform transmission lines, the DQMs model nonuniform transmission lines by using the same procedure as model uniform lines at the same computational cost. Numerical experiments show that DQM-based modeling leads to high accuracy, as well as high efficiency. For both uniform and nonuniform multiconductor transmission lines, the proposed DQM technique is thrice faster than a commercial HSPICE simulator.

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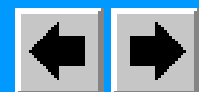
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An innovative semianalytical technique for ceramic evaluation at microwave frequencies

A.E. Fathy, V.A. Pendrick, B.D. Geller, S.M. Perlow, E.S. Tormey, A. Prabhu and S. Tani. "An innovative semianalytical technique for ceramic evaluation at microwave frequencies." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2247-2252.

We have developed an innovative semianalytical technique for various substrate material characterization. The developed technique is a measurement procedure and data-reduction formulation that takes into consideration the radiation loss in a resonant structure, allowing for a more effective means of dielectric- and conductor-loss determination for a microstrip ring resonator and its substrate material. We separate dielectric and conductor loss precisely, evaluate the contribution of each term in the overall loss performance, and analytically predict the error in their respective predicted value.

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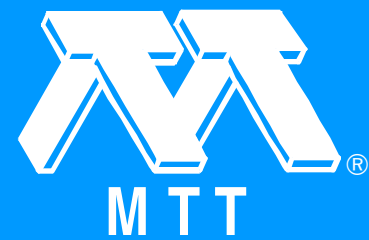
Convolution-based global simulation technique for millimeter-wave photodetector and photomixer circuits

D.B. Ameen and G.B. Tait. "Convolution-based global simulation technique for millimeter-wave photodetector and photomixer circuits." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2253-2258.

A fast convolution-based time-domain approach to global photonic-circuit simulation is presented that incorporates a physical device model in the complete detector or mixer circuit. The device used in the demonstration of this technique is a GaAs metal-semiconductor-metal (MSM) photodetector that offers a high response speed for the detection and generation of millimeter waves. Global simulation greatly increases the accuracy in evaluating the complete circuit performance because it accounts for the effects of the millimeter-wave embedding circuit. Device and circuit performance are assessed by calculating optical responsivity and bandwidth. Device-only simulations using GaAs MSMs are compared with global simulations that illustrate the strong interdependence between device and external circuit.

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A circuital approach to evaluating the electromagnetic field on rectangular apertures backed by rectangular cavities

R. Azaro, S. Caorsi, M. Donelli and G.L. Gragnani. "A circuital approach to evaluating the electromagnetic field on rectangular apertures backed by rectangular cavities." 2002 *Transactions on Microwave Theory and Techniques* 50.10 (Oct. 2002 [T-MTT]): 2259-2266.

In this paper, the problem of evaluating the electromagnetic field on rectangular apertures backed by rectangular cavities is investigated. The electromagnetic-field distribution is derived by using a circuital model of an aperture and suitable forcing terms introduced into the equations related to the aperture model. The effects of a rectangular cavity on the aperture-field distribution are assessed by considering the rectangular cavity as a load impedance. The impedance value is obtained by modeling the rectangular cavity as a length of rectangular waveguide back-ended by a short. The distribution of the electromagnetic field on the aperture is used as an exciting source to evaluate, through a modal expansion, the electromagnetic field inside the cavity. Numerical simulations are in a good agreement with both other theoretical models and experimental data.

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Investigation of integration paths in the spectral-domain analysis of leaky modes on printed circuit lines

F. Mesa and D.R. Jackson. "Investigation of integration paths in the spectral-domain analysis of leaky modes on printed circuit lines." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2267-2275.

The different integration paths that may arise in the spectral-domain analysis of leaky modes on open printed-circuit transmission lines such as microstrip are investigated. There are an infinite number of paths in the complex plane that may be used to construct leaky-mode solutions. Not all of the paths are valid mathematically. Among the mathematically valid ones, a certain subset correspond to paths that yield "physically valid" solutions. When tracking leaky-wave solutions as frequency changes, it is found that the propagation constants of the leaky modes may go through nonphysical "growing" regions where the attenuation constant is negative. These nonphysical regions may appear between physically valid frequency regions, implying that the leaky modes should be tracked in all frequency regions, including the nonphysical growing ones, in order to obtain the complete frequency dispersion behavior of the leaky mode. The migration of the leaky modes into these nonphysical growing regions gives rise to unconventional integration paths never seen before. Such paths must be used if the dispersion behavior of the leaky modes is to be plotted for all frequencies.





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Measurement-based closed-form modeling of surface-mounted RF components

K. Naishadham and T. Durak. "Measurement-based closed-form modeling of surface-mounted RF components." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2276-2286.

An understanding of the parasitic and packaging effects of passive surface-mounted devices (SMDs), including characterization of the pertinent interconnects, is required for developing robust equivalent-circuit models that are useful in RF and microwave computer-aided design. In this paper, we develop a procedure for modeling SMD inductors and capacitors, which incorporates the nonideal behavior associated with frequency dispersion, board layout, component parasitics, and device packaging. The equivalent-circuit parameters are extracted in closed-form from accurate in-situ measurement of the component's S-parameters, without the necessity for cumbersome optimization procedures normally followed in RF equivalent-circuit synthesis.

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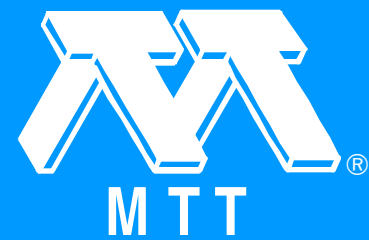
Resonant frequency and Q factor of axisymmetric composite microwave cavities

A.A. Kishk, D. Kajfez and S. Chebolu. "Resonant frequency and Q factor of axisymmetric composite microwave cavities." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2287-2293.

Resonant frequency and unloaded Q factor of composite microwave cavities are computed using surface integral equations for axisymmetric objects. The equivalence principle is used to formulate the problem so that the unbounded space Green's function can be utilized. The numerical results are verified experimentally for many samples of conducting cavities and dielectric resonators inside conducting cavities. Also, cases with a sector of the rotational cavity are considered by introducing a conducting corner. The method allows the computation of the stored energy in each dielectric region and the unloaded Q factor.

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TLM-based modal-extraction approach for the investigation of discontinuities in the rectangular waveguide and the NRD

B. Ghosh, N.R.S. Simons, L. Shafai, A. Ittipiboon and A. Petosa. "TLM-based modal-extraction approach for the investigation of discontinuities in the rectangular waveguide and the NRD." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2294-2304.

This paper describes the development of a rigorous transmission-line matrix-based modal-extraction approach to analyze discontinuities in guided-wave structures in general, with particular attention to the nonradiative dielectric waveguide (NRD). The motivation for this paper arose from the need to ascertain the admittance of a slot in the ground plane of an NRD without relying on experimental data. These data enabled one to design an NRD-based slot array following the methodology of Malherbe (1984), Malherbe et al. (1984), and Ghosh et al. (1997). Previous work in this area relied on placing observation points sufficiently remote from the discontinuity in order to ensure the decay of scattered evanescent modes to appreciably low levels. The method discussed here obviates this requirement and allows the evaluation of generalized scattering-matrix coefficients arbitrarily close to the discontinuity, thus significantly reducing the computational overhead. Results pertaining to discontinuities in the NRD and the rectangular waveguide have been presented and shown to give good agreement with those in the literature and with measurements. The perfectly matched layer has been used as an absorbing boundary condition in our simulations. Finally, the results have been verified using the power-conservation and Poynting's theorems.

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A reduced-size silicon micromachined high-Q resonator at 5.7 GHz

C.A. Tavernier, R.M. Henderson and J. Papapolymerou. "A reduced-size silicon micromachined high-Q resonator at 5.7 GHz." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2305-2314.

This paper depicts the progress toward a novel high-quality-factor miniaturized resonator operating in the 5.6-5.8-GHz range. The design of the resonator is based on a micromachined cavity loaded with a high dielectric-constant material. Energy is coupled into the cavity from input and output microstrip lines via slots. Quality factors up to 640 are demonstrated on silicon planar structures with a volume of 177 mm³. Further size reduction yields a volume of 24.5 mm³ and quality factors ranging from 152 to 197, while keeping the resonator integration ability. Bonding techniques and the dielectric loss of the loading material are proven to be the limiting factors in achieving higher quality factors.

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Straightforward and accurate nonlinear device model parameter-estimation method based on vectorial large-signal measurements

D.M.M.-P. Schreurs, J. Verspecht, S. Vandenberghe and E. Vandamme. "Straightforward and accurate nonlinear device model parameter-estimation method based on vectorial large-signal measurements." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2315-2319.

To model nonlinear device behavior at microwave frequencies, accurate large-signal models are required. However, the standard procedure to estimate model parameters is often cumbersome, as it involves several measurement systems (DC, vector network analyzer, etc.). Therefore, we propose a new nonlinear modeling technique, which reduces the complexity of the model generation tremendously and only requires full two-port vectorial large-signal measurements. This paper reports on the results obtained with this new modeling technique applied to both empirical and artificial-neural-network device models. Experimental results are given for high electron-mobility transistors and MOSFETs. We also show that realistic signal excitations can easily be included in the optimization process.





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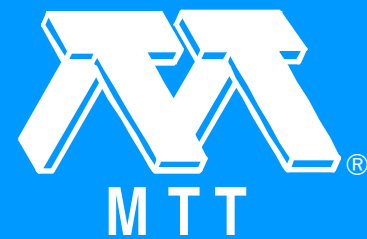
A comprehensive study of discontinuities in chirowaveguides

T.X. Wu and D.L. Jaggard. "A comprehensive study of discontinuities in chirowaveguides." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2320-2330.

We provide a comprehensive study of two- and three-dimensional discontinuities in chirowaveguides. The multimode coupled-mode method is an effective numerical approach to analyze this problem. After obtaining the coupled-mode equations, we diagonalize the coupling matrix to obtain a multimode scattering matrix rather than the usual two-mode approximation. We calculate the scattering properties of coaxial waveguides partially filled with lossy chiral media. Excellent agreement is observed between our results and those obtained by the mode-matching method. We also compare our results in the achiral case for dielectric material partially filled rectangular waveguide with experimental data and results obtained by the mode-matching method. Excellent agreement is again found. Based on our analysis, numerical and analytical results are displayed to provide physical insight into the problem. First, we discuss the effects of the chirality admittance on scattering properties and find that the sensitivity of the scattering parameters to chirality admittance increases as the chirality admittance increases. Second, we find the dielectric constant has a great influence on the scattering parameters. Third, we find the relative influence of height and width of chiral obstacles in rectangular waveguides.

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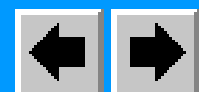
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Robust finite-element solution of lossy and unbounded electromagnetic eigenvalue problems

Yu Zhu and A.C. Cangellaris. "Robust finite-element solution of lossy and unbounded electromagnetic eigenvalue problems." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2331-2338.

An efficient algorithm is presented for the finite-element solution of electromagnetic eigenvalue problems associated with lossy and unbounded structures. The algorithm is based on the $E/\sqrt{\epsilon}$ - $B/\sqrt{\mu}$ formulation of the finite-element approximation of the electromagnetic equations. The special relationship between the vector bases used for the expansion of the electric field vector $E/\sqrt{\epsilon}$ and the magnetic flux density vector $B/\sqrt{\mu}$ is used to reduce the computational complexity of the proposed formulation. The occurrence of spurious DC modes is avoided through the careful selection of divergence-free initial vectors in the Lanczos-Arnoldi-based iterative schemes used by the proposed algorithm. The resultant algorithm is only marginally more expensive than standard finite-element-based algorithms used for electromagnetic eigenvalue problems involving lossless structures. Numerical experiments from the application of the proposed algorithm to the eigenvalue analysis of both lossless and lossy cavities are used to demonstrate its accuracy, computational efficiency, and robustness.

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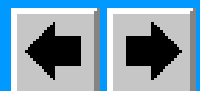
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Conformal-mapping design tools for coaxial couplers with complex cross section

V. Teppati, M. Goano and A. Ferrero. "Conformal-mapping design tools for coaxial couplers with complex cross section." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2339-2345.

Numerical conformal mapping is exploited as a simple, accurate, and efficient tool for the analysis and design of coaxial waveguides and couplers of complex cross section. An implementation based on the Schwarz-Christoffel Toolbox, a public-domain MATLAB package, is applied to slotted coaxial cables and to symmetrical coaxial couplers, with circular or polygonal inner conductors and external shields. The effect of metallic diaphragms of arbitrary thickness, partially separating the inner conductors, is also easily taken into account. The proposed technique is validated against the results of the finite-element method, showing excellent agreement at a fraction of the computational cost, and is also extended to the case of nonsymmetrical couplers, providing the designer with important additional degrees of freedom.

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A finite-element procedure based on a boundary-value approach for the evaluation of the electromagnetic exposure in biological phantoms

S. Caorsi, E. Bermani and A. Massa. "A finite-element procedure based on a boundary-value approach for the evaluation of the electromagnetic exposure in biological phantoms." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2346-2352.

In this paper, a finite-element method, based on a boundary-value approach, for the evaluation of the electric-field distribution in exposed biological phantoms is presented. Starting from the measurement of the electric field around the phantom, the field prediction is obtained by solving a boundary-value problem. This allows to avoid the description of the electromagnetic source and to estimate of the electric-field distribution also when the illuminating source is unknown or when its numerical model is not available. In order to show the effectiveness of the proposed approach, some numerical results, concerning a two-dimensional geometry, are provided. Firstly, the accuracy and validity of the electromagnetic prediction are assessed by comparing numerical with reference solutions (analytically computed). In order to demonstrate the efficiency, robustness, and capability of this technique, different measurement strategies, noisy environments, and errors in the data acquisition are then taken into account.

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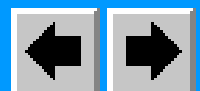
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Analytical comparison between time- and frequency-domain techniques for phase-noise analysis

A. Suarez, S. Sancho, S. Ver Hoeye and J. Portilla. "Analytical comparison between time- and frequency-domain techniques for phase-noise analysis." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2353-2361.

In the literature, different techniques have been presented for the phase-noise analysis of free-running oscillator circuits. In order to give some insight into the relationships existing between them, an analytical comparison is carried out in this paper between three different approaches. Two of them are time-domain approaches, based on Floquet's theory and the impulse sensitivity function, respectively, and the third one is the carrier modulation approach, in frequency domain. The application of Floquet's theory enables the calculation of periodic sensitivity functions to the noise perturbations. Here, the possibility to determine these functions through harmonic balance is demonstrated. This allows applying the whole stochastic characterization of phase noise, obtained from time-domain analysis, to circuits simulated through harmonic balance. For illustration, calculations in a cubic-nonlinearity oscillator are presented.



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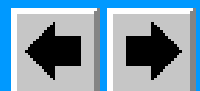
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Performance of a planar filter using a 0/spl deg/ feed structure

Chih-Ming Tsai, Sheng-Yuan Lee and Chin-Chuan Tsai. "Performance of a planar filter using a 0/spl deg/ feed structure." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2362-2367.

The advantage of using a 0/spl deg/ feed structure in filter design is that two extra transmission zeros are created in the stopband while the passband response remains unchanged. This feed structure is analyzed by using transmission matrices. A new lumped-circuit model for a coupled resonator filter is then proposed to take into account the effects of this feed structure. Finally, the feed structure is applied to the design of a cross-coupled filter. All the theoretical analysis and design procedures have been successfully verified by experiment results.

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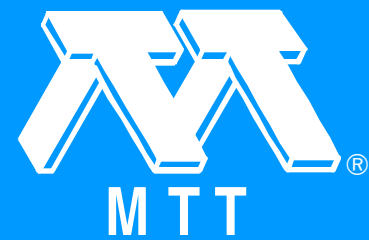
Analysis of a ridge waveguide using overlapping T-blocks

Y.H. Cho and H.J. Eom. "Analysis of a ridge waveguide using overlapping T-blocks." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2368-2373.

A T-block (TB) approach is proposed to analyze the dispersion relation of a ridge waveguide. The field representations of a TB are obtained with the Green's function and mode-matching technique. Rigorous, yet simple dispersion equations for symmetric and asymmetric ridge waveguides are presented using a superposition of overlapping TBs. The rapid convergence characteristics of the dispersion equation are illustrated in terms of the cutoff wavenumbers. A closed-form dispersion relation, based on a dominant-mode approximation, is shown to be accurate for most practical applications such as couplers, filters, and polarizer designs.

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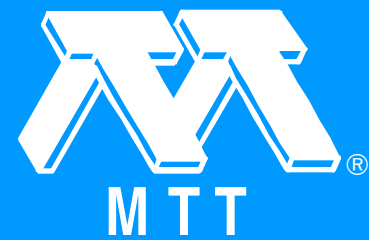
Coplanar-waveguide-based terahertz hot-electron-bolometer mixers improved embedding circuit description

P. Focardi, A. Neto and W.R. McGrath. "Coplanar-waveguide-based terahertz hot-electron-bolometer mixers improved embedding circuit description." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2374-2383.

Series-fed coplanar-waveguide embedding circuits have been recently developed for terahertz mixers using, in particular, superconducting devices as sensors. Although these mixers show promising performance, they usually also show a considerable downward shift in the resonating frequency when compared with calculations using simplified models. This effect is basically caused by parasitics due to the extremely small details (in terms of wavelength) of the device and to the connection of the remaining circuitry (i.e., RF filter). In this paper, we present an improved equivalent-network model of such devices that agrees with measured results. We first propose a method to calculate the characteristic impedance and propagation constant of the coplanar waveguide, etched between two semi-infinite media, which connect the receiving slot antennas to the superconducting device. In the formulation, we take into account, for the first time, the radiation power leakage. We then describe the procedure to calculate the reactances due to the detailed geometry of the mixer device and circuit and we correct the input impedance, calculated with a commonly used simplified network. Finally, by comparing our results with a complete set of measured data, for seven mixers in the range between 500 GHz-3 THz, we analyze the features of our model and propose further improvements. Useful guidelines for designing terahertz mixer circuits are also given.

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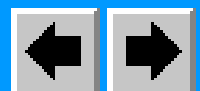
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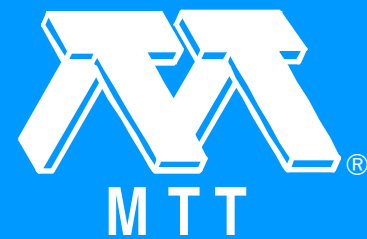
A low-cost fabrication technique for symmetrical and asymmetrical layer-by-layer photonic crystals at submillimeter-wave frequencies

R. Gonzalo, B. Martinez, C.M. Mann, H. Pellemans, P.H. Bolivar and P. de Maagt. "A low-cost fabrication technique for symmetrical and asymmetrical layer-by-layer photonic crystals at submillimeter-wave frequencies." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2384-2392.

This paper presents a rapid, versatile, and practical technique for the manufacture of layer-by-layer photonic crystals in the millimeter- and submillimeter-wave regions. Mechanical machining is used to derive a rugged layer-by-layer structure from high-resistivity silicon wafers. Unlike traditional anisotropic etching techniques, this method does not rely on any particular crystal orientation of the substrate and allows greater flexibility in the photonic crystal design. Automatic alignment of alternating layers is achieved via careful placement of the separation cuts. Using this ability, two configurations of photonic crystals are realized and their RF characteristics are measured and presented. Firstly, a symmetrical photonic crystal is studied as an initial demonstration of the technique. This is followed by an asymmetrical example, where a different frequency response is observed for the two orthogonal polarizations of the incident radiation. Two measurement techniques are used to characterize the photonic crystals and the merits of each are discussed. Theoretical predictions are seen to agree well with the measured behavior.

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W-band investigation of material parameters, SAR distribution, and thermal response in human tissue

F. Gustrau and A. Bahr. "W-band investigation of material parameters, SAR distribution, and thermal response in human tissue." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2393-2400.

This investigation is divided into three parts. First, the W-band dielectric properties of different biological tissues are determined. Then, the electromagnetic field in the human eye and skin is simulated for plane-wave exposure. An analytical method is used to investigate the specific absorption rate (SAR) inside a layered model of the human skin between 3-100 GHz. Furthermore, the SAR inside a detailed model of the human eye is investigated numerically by the finite-difference time-domain method for a frequency of 77 GHz. Maximum local SAR values of 27.2 W/kg in skin tissue and 45.1 W/kg in eye tissue are found for 77 GHz and an incident power density of 1 mW/cm². In the third part of the investigation, the temperature changes of superficial tissue caused by millimeter-wave irradiation are measured by a thermal infrared imaging system. The exposure setup is based on a horn antenna with a Gunn oscillator operating at 15.8-dBm output power. The measurements showed a maximum temperature increase of 0.7/spl deg/C for a power density of 10 mW/cm² and less than 0.1/spl deg/C for 1 mW/cm², both in human skin (in vivo), as well as in porcine eye (in vitro). The comparison of the temperature measurements with a thermal bio-heat-transfer simulation of a layered skin model showed a good agreement.





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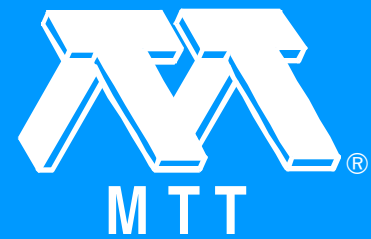
A three-dimensional unconditionally stable ADI-FDTD method in the cylindrical coordinate system

Chenghao Yuan and Zhizhang Chen. "A three-dimensional unconditionally stable ADI-FDTD method in the cylindrical coordinate system." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2401-2405.

An unconditionally stable finite-difference time-domain (FDTD) method in a cylindrical coordinate system is presented in this paper. The alternating-direction-implicit (ADI) method is applied, leading to a cylindrical ADI-FDTD scheme where the time step is no longer restricted by the stability condition, but by the modeling accuracy. In contrast to the conventional ADI method, in which the alternation is applied in each coordinate direction, the ADI scheme here performs alternations in mixed coordinates so that only two alternations in solution matching are required at each time step in the three-dimensional formulation. Different from its counterpart in the Cartesian coordinate system, the cylindrical ADI-FDTD includes an additional special treatment along the vertical axis of the cylindrical coordinates to overcome singularity. A theoretical proof of the unconditional stability is shown and numerical results are presented to demonstrate the effectiveness of the cylindrical algorithm in solving electromagnetic-field problems.

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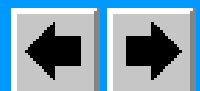
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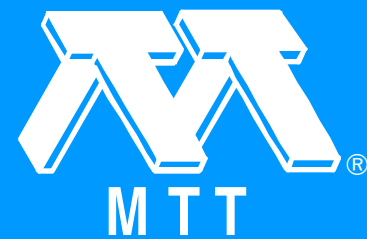
Hybrid planar NRD-guide magic-tee junction

Y. Cassivi and Ke Wu. "Hybrid planar NRD-guide magic-tee junction." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2405-2408.

A new magic-tee circuit is proposed and developed, which is based on the hybrid integration technology of a planar and nonradiative dielectric (NRD) guide. The magic-tee junction combines an NRD-guide T-junction with a microstrip T-junction. Furthermore, LSM/sub 10/-mode radiators are introduced in the magic-tee circuit to reduce its resonance problem. Measured results show that an isolation of 20 dB can easily be achieved between the sum and difference ports.

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An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines (Comments)

M. Mrozowski. "An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines (Comments)." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2409-2410.

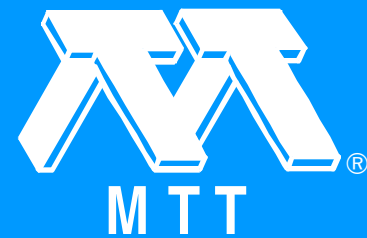
For original paper see A. Casanueva and J.L. Garcia, *ibid.*, vol.50, no.1, p.36-40 (2002). The original authors applied a technique developed by the commenter to calculate dispersion characteristics of multistrip transmission lines. The novelty of the work lay in the technique for solving the resulting eigenvalue problem. Casanueva and Garcia treated the problem as a system of homogeneous equations and advocate solving it by using singular value decomposition (SVD) combined with the search of minimum on the complex β plane. The commenter clarifies an apparent misunderstanding as to the numerical treatment of the eigenvalue problem. In reply, Casanueva and Garcia agree with the general outline and accept that the numerical technique suggested by Mrozowski is more orthodox than the one they used. They conclude by stressing that Mrozowski's proposed algorithms are valid for planar transmission lines when both the spectral-domain approach and the singular-value-decomposition technique have been implemented to obtain an accurate set of basic functions.



Abstracts

An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines (Authors' Reply)

A. Casanueva and J.L. Garcia. "An innovative fast powerful method for tackling electromagnetic eigenvalue problems for multistrip transmission lines (Authors' Reply)." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2410-2411.



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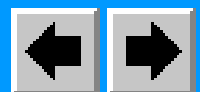
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Rigorous modeling of packaged Schottky diodes by the nonlinear lumped network (NL/sup 2/N)-FDTD approach (Comments)

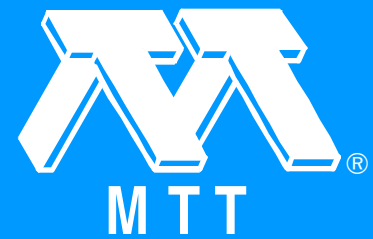
O. El Mrabet and M. Essaaidi. "Rigorous modeling of packaged Schottky diodes by the nonlinear lumped network (NL/sup 2/N)-FDTD approach (Comments)." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2411-2411.

For original paper see G. Emili et al., *ibid.*, vol.48, no.12, p.2277-82 (2000). The commenters point out several errors in equations and parameters presented in the original paper, that should be corrected to allow an accurate implementation of the model proposed for packaged Schottky diodes using a nonlinear lumped-network finite-difference time-domain (FDTD) approach. In reply, the original authors accept that there are three errors in their work, but stress that the results presented are not affected at all by the errors, which are simply relational.

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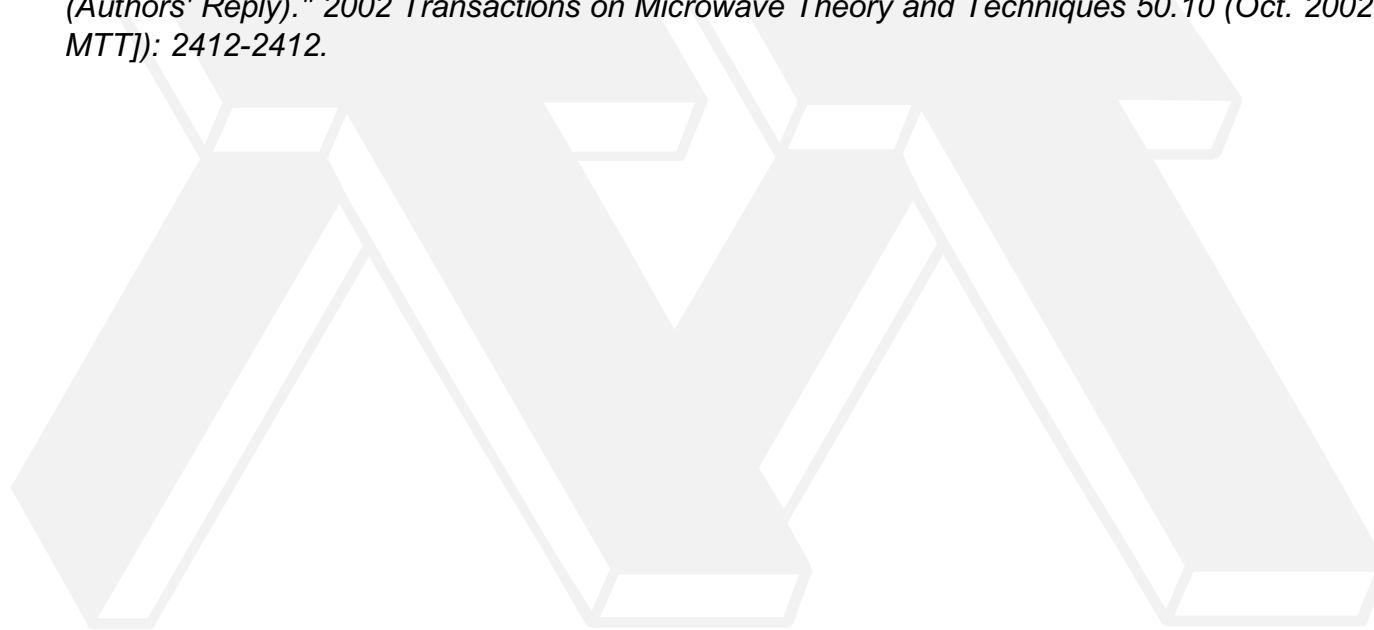
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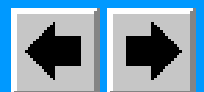
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Rigorous modeling of packaged Schottky diodes by the nonlinear lumped network (NL/sup 2/N)-FDTD approach (Authors' Reply)

G. Emili, F. Alimenti, P. Mezzanotte, L. Roselli and R. Sorrentino. "Rigorous modeling of packaged Schottky diodes by the nonlinear lumped network (NL/sup 2/N)-FDTD approach (Authors' Reply)." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2412-2412.



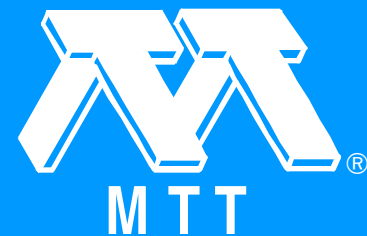
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Abstracts

Accurate circuit model of interdigital capacitor and its application to design of new quasi-lumped miniaturized filters with suppression of harmonic resonance (Corrections)

Lei Zhu and Ke Wu. "Accurate circuit model of interdigital capacitor and its application to design of new quasi-lumped miniaturized filters with suppression of harmonic resonance (Corrections)." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2412-2413.



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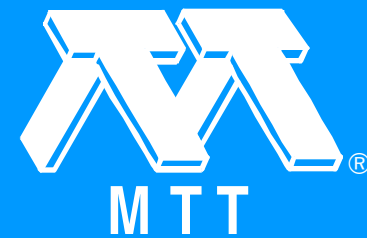
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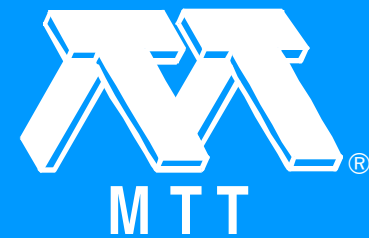
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Abstracts

Table of Contents (Nov. 2002 [T-MTT])

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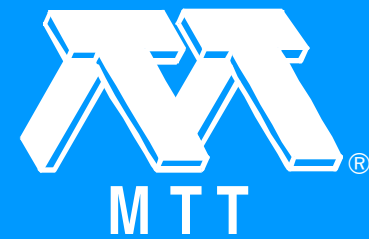
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Inside Cover (Nov. 2002 [T-MTT])

"Inside Cover (Nov. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 0_3-0_4.



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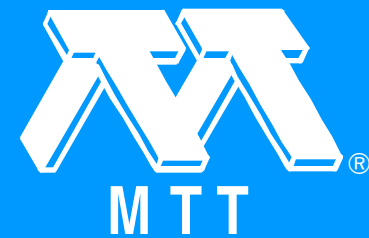
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Abstracts

Guest editorial (Nov. 2002 [T-MTT])

S. Lloyd. "Guest editorial (Nov. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2421-2421.



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Direct conversion radio for digital mobile phones- design issues, status, and trends

A. Loke and F. Ali. "Direct conversion radio for digital mobile phones-design issues, status, and trends." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2422-2435.

Applications of direct frequency-conversion techniques have been rapidly getting attention of radio designers worldwide. This paper focuses on bringing out key implementation challenges of direct conversion receivers and transmitters targeted for different second- and third-generation mobile phone standards like global system for mobile communication, code division multiple access (cdmaOne and CDMA 2000), and wide-band code division multiple access. Techniques and tradeoffs to arrive at optimal implementation are highlighted. Some of the commercially available application-specific integrated circuits that are based on direct conversion architecture and their salient features are summarized.

Click on title for a complete paper.



Ka-band direct digital receiver

S.O. Tatu, E. Moldovan, G. Brehm, Ke Wu and R.G. Bosisio. "Ka-band direct digital receiver." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2436-2442.

A new direct-conversion wideband (26-28.5 GHz) six-port receiver is proposed for mass-market wireless communications. This six-port receiver is designed to operate without the need for precise power reading and the use of a digital signal processor that is usually required in other receivers. The proposed receiver architecture is chosen to satisfy requirements of hardware receivers used in high-speed QPSK communications. The receiver contains a receiver front-end, QPSK demodulator, and carrier recovery module. A reverse modulation loop was used to provide a rapid carrier recovery. The maximum bit rate is determined solely by the limiting speed of the baseband module. This new hardware receiver is proposed as a robust, rugged, low-cost receiver for use in wide Ka-band wireless mass-market QPSK communications such as local multipoint distribution system services, which is a prime example of communication equipment requiring such receivers. Bit-error-rate results are presented versus the noise and reference signal phase shift.



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A transmit/receive IF chip set for WCDMA mobiles in 0.35 μm CMOS

U. Dasgupta, Wooi Gan Yeoh, Chun Geik Tan, Sheng Jau Wong, H. Mori, R. Singh and M. Itoh.
"A transmit/receive IF chip set for WCDMA mobiles in 0.35 μm CMOS." 2002
Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2443-2452.

An implementation of the IF section of WCDMA mobile transceivers with a set of two chips fabricated in an inexpensive 0.35- μm two-poly three-metal CMOS process is presented. The transmit/receive chip set integrates quadrature modulators and demodulators, wide dynamic range automatic gain control (AGC) amplifiers, with linear-in-decibel gain control, and associated circuitry. This paper describes the problems encountered and the solutions envisaged to meet stringent specifications, with process and temperature variations, thus overcoming the limitations of CMOS devices, while operating at frequencies in the range of 100 MHz-1 GHz. Detailed measurement results corroborating successful application of the new techniques are reported. A receive AGC dynamic range of 73 dB with linearity error of less than ± 2 dB and spread of less than 5 dB for a temperature range of -30°C to $+85^\circ\text{C}$ in the gain control characteristic has been measured. The modulator measurement shows a carrier suppression of 35 dB and sideband/third harmonic suppression of over 46 dB. The core die area of each chip is 1.5 mm^2 .

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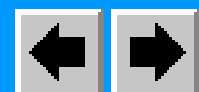
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Hot-carrier and soft-breakdown effects on VCO performance (Nov. 2002 [T-MTT])

Enjun Xiao, J.S. Yuan and Hong Yang. "Hot-carrier and soft-breakdown effects on VCO performance (Nov. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2453-2458.

This paper systematically investigates the hot-carrier- and soft-breakdown-induced performance degradation in a CMOS voltage-controlled oscillator (VCO) used in phase-locked-loop frequency synthesizers. After deriving the closed-form equations to predict phase noise and VCO gain, we relate VCO RF performance such as phase noise, tuning range, and gain of VCO subject to electrical stress. The circuit degradations predicted by analytical model equations are verified by SpectraRF simulation using parameters extracted from the experimental data of 0.16 μm CMOS technology. BERT simulation results give VCO performance degradations versus operation time.

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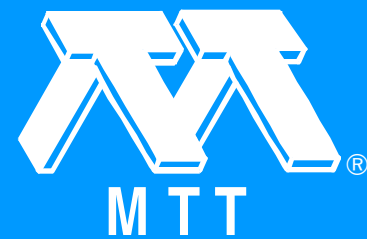
A new "active" predistorter with high gain and programmable gain and phase characteristics using cascode-FET structures

Junghyun Kim, Moon-Suk Jeon, Jaehak Lee and Youngwoo Kwon. "A new "active" predistorter with high gain and programmable gain and phase characteristics using cascode-FET structures." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2459-2466.

A MMIC-compatible miniaturized "active" predistorter using cascode FET structures is presented. The predistorter has added functionality of gain, as well as programmable gain and phase variation characteristics, which are required to compensate or the nonlinear distortion of a wide range of power amplifiers (PAs). Thanks to the inherent gain of the predistorter, a need for an additional buffer amplifier is eliminated. Furthermore, it can eventually replace the first-stage amplifier in the multistage PAs, making this approach well suited to MMIC implementation. A simple analysis is performed to understand the phase variation mechanisms in the proposed predistorter and to identify the dominant sources of phase variation. To demonstrate the general usefulness of this predistorter, the cascode predistorter was applied to linearize watt-level MMIC amplifiers for CDMA handset applications, as well as 30 W high power amplifiers for base-station applications. Adjacent channel power ratio (ACPR) improvement of 3-5 dB was achieved with off-chip predistorter when applied to 0.9 W monolithic amplifiers. The predistorter was also integrated with a 1.6 W MMIC PA on a single chip, replacing the first-stage transistor of the amplifier.

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Modeling and characterization of SiGe HBT low-frequency noise figures-of-merit for RFIC applications

Jin Tang, Guofu Niu, Zhenrong Jin, J.D. Cressler, Shiming Zhang, A.J. Joseph and D.L. Hareme. "Modeling and characterization of SiGe HBT low-frequency noise figures-of-merit for RFIC applications." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2467-2473.

We present the first systematic experimental and modeling results of noise corner frequency ($f_{sub C}$) and noise corner frequency to cutoff frequency ratio ($f_{sub C}/f_{sub T}$) for SiGe heterojunction bipolar transistors (HBTs) in a commercial SiGe RF technology. The $f_{sub C}$ and $f_{sub C}/f_{sub T}$ ratio are investigated as a function of operating collector current density, SiGe profile, breakdown voltage, and transistor geometry. We demonstrate that both the $f_{sub C}$ and $f_{sub C}/f_{sub T}$ ratio can be significantly reduced by careful SiGe profile optimization. A comparison of the $f_{sub C}$ and $f_{sub C}/f_{sub T}$ ratio for high breakdown and standard breakdown voltage devices is made. Geometrical scaling data show that the SiGe HBT with $A_{sub E}=0.5/\mu\text{m}^2$ times $2.5/\mu\text{m}^2$ has the lowest $f_{sub C}$ and $f_{sub C}/f_{sub T}$ ratio compared to other device geometries. An $f_{sub C}$ reduction of nearly 50% can be achieved by choosing this device as the unit cell in RF integrated-circuit design.

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Nonlinear analysis of GaN MESFETs with Volterra series using large-signal models including trapping effects

S.S. Islam and A.F.M. Anwar. "Nonlinear analysis of GaN MESFETs with Volterra series using large-signal models including trapping effects." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2474-2479.

Nonlinearities in GaN MESFETs are reported using a large-signal physics-based model. The model accounts for the observed current collapse to determine the frequency dispersion of output resistance and transconductance. Calculated $f_{\text{sub T}}$ and $f_{\text{sub max}}$ of a $0.8 \mu\text{m}/\text{spl times}/150 \mu\text{m}/\text{spl mu/m}$ GaN MESFET are 6.5 and 13 GHz, respectively, which are in close agreement with their measured values of 6 and 14 GHz, respectively. A Volterra-series technique is used to calculate size and frequency-dependent nonlinearities. For a $1.5 \mu\text{m}/\text{spl mu/m}/\text{spl times}/150 \mu\text{m}/\text{spl mu/m}$ FET operating at 1 GHz, the 1 dB compression point and output-referred third-order intercept point are 16.3 and 22.2 dBm, respectively. At the same frequency, the corresponding quantities are 19.6 and 30.5 dBm for a $0.6 \mu\text{m}/\text{spl mu/m}/\text{spl times}/150 \mu\text{m}/\text{spl mu/m}$ FET. Similar improvements in third-order intermodulation for shorter gatelength devices are observed.

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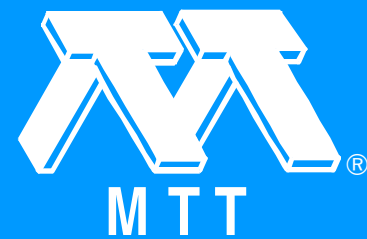
Generalized reaction and unrestricted variational formulation of cavity resonators. I. basic theory

A.M. Shams-Zadeh-Amiri, S. Safavi-Naeini, S.K. Chaudhuri and R. Sabry. "Generalized reaction and unrestricted variational formulation of cavity resonators. I. basic theory." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2480-2490.

Based on the reciprocity theorem, the reaction concept in electromagnetic theory is generalized to the cases where both surface electric and magnetic currents overlap across boundaries, i.e., neither the E-field, nor H-field meets the continuity conditions. An improved systematic method is then developed to obtain unrestricted variational expressions in a cavity resonator for which the tangential components of the trial fields can be discontinuous across its interior boundaries.

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Generalized reaction and unrestricted variational formulation of cavity resonators. II. Nonorthogonal and free-boundary mode-matching method

A.M. Shams-Zadeh-Amiri, S. Safavi-Naeini, S.K. Chaudhuri and R. Sabry. "Generalized reaction and unrestricted variational formulation of cavity resonators. II. Nonorthogonal and free-boundary mode-matching method." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2491-2498.

For pt. I see *ibid.*, vol. 50, no. 11, p. 2480-90 (2002). This paper addresses a systematic method whereby the conventional mode-matching method is generalized to the cases where the set of modes used for the field expansion within a cavity resonator are relaxed to be orthogonal or satisfy any specific boundary conditions. It is shown that this approach is based on the unrestricted variational formulation of a cavity resonator. Reciprocity theorem and generalized reaction are the mathematical foundations of this new formulation. We have shown that the conventional mode-matching method is a special case of this generalized formulation and indeed is variational in nature. More precisely, we have proven that, if the field distribution obtained based on the conventional mode-matching method is used as a trial one in some variational formulas, the resonant frequency will be the same as the one obtained by the mode-matching method.

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DC, RF, and microwave noise performances of AlGaN/GaN HEMTs on sapphire substrates

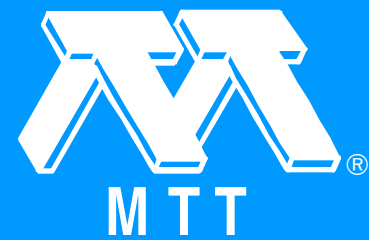
W. Lu, V. Kumar, R. Schwindt, E. Piner and I. Adesida. "DC, RF, and microwave noise performances of AlGaN/GaN HEMTs on sapphire substrates." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2499-2504.

High-performance AlGaN/GaN high electron-mobility transistors with 0.18- μm gate length have been fabricated on a sapphire substrate. The devices exhibited an extrinsic transconductance of 212 mS/mm, a unity current gain cutoff frequency ($f_{\text{sub T}}$) of 101 GHz, and a maximum oscillation frequency ($f_{\text{sub MAX}}$) of 140 GHz. At $V_{\text{ds}}=4$ V and $I_{\text{ds}}=39.4$ mA/mm, the devices exhibited a minimum noise figure ($\text{NF}_{\text{sub min}}$) of 0.48 dB and an associated gain (G_a) of 11.16 dB at 12 GHz. Also, at a fixed drain bias of 4 V with the drain current swept, the lowest NF_{min} of 0.48 dB at 12 GHz was obtained at $I_{\text{ds}}=40$ mA/mm, and a peak G_a of 11.71 dB at 12 GHz was obtained at $I_{\text{ds}}=60$ mA/mm. With the drain current held at 40 mA/mm and drain bias swept, the $\text{NF}_{\text{sub min}}$, increased almost linearly with the increase of drain bias. Meanwhile, the G_a values decreased linearly with the increase of drain bias. At a fixed bias condition ($V_{\text{ds}}=4$ V and $I_{\text{ds}}=40$ mA/mm), the $\text{NF}_{\text{sub min}}$ values at 12 GHz increased from 0.32 dB at -55°C to 2.78 dB at 200°C . To our knowledge, these data represent the highest $f_{\text{sub T}}$ and $f_{\text{sub MAX}}$, and the best microwave noise performance of any GaN-based FETs on sapphire substrates ever reported.

A distortion control technique for achieving high power efficiency in an HPA array

T. Kaho, Y. Nakasuga, H. Okazaki, K. Araki and K. Horikawa. "A distortion control technique for achieving high power efficiency in an HPA array." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2505-2512.

This paper proposes a new technique for reducing the intermodulation (IM) distortion products in a high-power amplifier (HPA) array. The proposed technique dissolves the relations between carriers and IMs by applying IM phase control. As a result, IMs are distributed to all the output ports in the array, and the carrier power to intermodulation power ratio (C/IM) of the HPA array can be increased. The improvement in C/IM is as high as $10\log N$ dB, where N is the number of HPAs. Newly developed even-order distortion implemented intermodulation distortion controllers (EODICs) are used to achieve the IM phase control. A test carried out using a four-parallel HPA array with EODICs confirms that the technique noticeably improves C/IM and demonstrates its validity.



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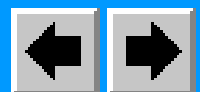
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A new termination condition for the application of the TLM method to discontinuity problems in closed homogeneous waveguide

L. Pierantoni, C. Tomassoni and T. Rozzi. "A new termination condition for the application of the TLM method to discontinuity problems in closed homogeneous waveguide." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2513-2518.

In this paper, we propose exact transmission-line matrix (TLM) boundary conditions for closed homogeneous waveguides. This approach is based on applying mode matching at the absorbing boundaries to the time-domain TLM algorithm. The absorbing condition in the time domain is achieved by the convolution of the modal characteristic impedances following inverse Fourier transform. The method is demonstrated for thick inductive irises in rectangular waveguide, showing excellent wide-band match of the fundamental mode, as well as of higher order modes excited by the discontinuity.

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Analysis and application of new quasi-network characteristics of nonuniform mesh in FDTD simulation

Yan Zhang, Ben-Qing Gao, Wu Ren, Zheng-Hui Xue and Wei-Ming Li. "Analysis and application of new quasi-network characteristics of nonuniform mesh in FDTD simulation." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2519-2526.

The equation of computing the reflection coefficient between two meshes of different sizes is derived. Using the equation, quasi-network characteristics of nonuniform mesh for the finite-difference time-domain technique is found and analyzed. The so-called mesh network (MN) here is a kind of structure composed of the sections of mesh in cascade. The cell sizes of these sections change regularly. By means of choosing the number of mesh sections, length of each section, and cell sizes, some novel network characteristics are obtained, which can be used to match the reflecting wave of nonuniform mesh or improve the transmitted characteristics for a mesh wave to travel along the nonuniform mesh. Formulas for analyzing the MN are given. The characteristics are realized in both one- and three-dimensional cases. The applications and advantages of the MN are shown by computing three different structures, i.e., microstrip-gap capacitor, parallel-coupling filter, and microstrip slot-line transformer.





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Novel planar, square-shaped, dielectric-waveguide, single-, and dual-mode filters

Chi-Yang Chang and Wei-Chen Hsu. "Novel planar, square-shaped, dielectric-waveguide, single-, and dual-mode filters." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2527-2536.

This paper presents a novel concept of a square-shaped dielectric-waveguide resonator, which can easily realize a dielectric-waveguide cross-coupled filter or a dielectric-waveguide dual-mode filter, using the conventional printed circuit board (PCB) process. This planar dielectric-waveguide resonator has a higher Q value than a microstrip resonator. The physical mechanisms of both single- and dual-mode filters are elucidated. Some new coupling structures are developed for undergoing the PCB process. Filter design procedures are detailed. Design curves for the coupling coefficients of internal- and external-coupling structures are determined by full-wave finite-element-method electromagnetic calculations. Measurement results are highly consistent with theory for all trial filters. This study offers an effective means of producing low-cost high-performance planar circuit filters.

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The generation of optimal microwave topologies using time-domain field synthesis

M.H. Bakr, P.P.M. So and W.J.R. Hoefer. "The generation of optimal microwave topologies using time-domain field synthesis." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2537-2544.

We present a novel approach to the design of microwave structures using time-domain field synthesis. A standard transmission-line matrix (TLM) electromagnetic analysis of the starting geometry yields the structure response and the field distribution on the optimizable boundary parts. A number of characteristic frequencies equal to the number of designable parameters of the structure are determined first. For narrow-band structures, these frequencies may be natural resonance frequencies. For wide-band structures, we create appropriate resonance conditions. The target response of the structure allows us to identify the desirable values of these frequencies. For each parameter, a synthesis phase is then performed. In this phase, the optimizable boundary parts are replaced by matched TLM sources that inject sampled sinusoidal streams at the desired characteristic frequency. The TLM field model generates an electromagnetic field pattern. The synthesized geometry is obtained by examining the envelope of that field pattern. Our approach is illustrated by means of several examples.

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Analysis of dielectric-loaded cavities using an orthonormal-basis method

J.A. Monsoriu, M.V. Andres, E. Silvestre, A. Ferrando and B. Gimeno. "Analysis of dielectric-loaded cavities using an orthonormal-basis method." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2545-2552.

An orthonormal-basis method to analyze dielectric-loaded cavities is proposed. Resonant frequencies and fields are obtained by solving an eigenvalue problem in which the modes of an auxiliary problem define the orthonormal-basis that is used to expand the fields of the original problem. The merit of our approach is to take advantage of some mathematical properties to develop a computationally efficient and versatile method. The accuracy of the method is demonstrated by comparing our results with other results available in the literature.

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An analytical small-signal bias-dependent nonuniform model for p-i-n traveling-wave photodetectors

G. Torrese, I. Huynen, M. Serres, D. Gallagher, M. Banham and A.V. Vorst. "An analytical small-signal bias-dependent nonuniform model for p-i-n traveling-wave photodetectors." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2553-2557.

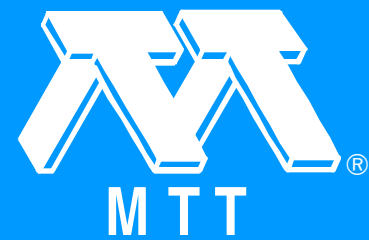
A fully analytical small-signal model is developed for the frequency response of traveling-wave photodetectors. It takes into account the dependence of the equivalent transmission-line admittance on the position, induced by the nonuniform distribution of the optical beam along the traveling direction. Moreover, the influence of the bias voltage on the transit time has been accurately investigated. The model is applied to the design of an InAlAs-InGaAs p-i-n photodetector. Its performances are investigated in term of electrical bandwidth.



Time-domain reflectometry using arbitrary incident waveforms

Te-Wen Pan, Ching-Wen Hsue and Jhin-Fang Huang. "Time-domain reflectometry using arbitrary incident waveforms." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2558-2563.

A novel time-domain reflectometry technique is developed for detecting the physical structures of transmission lines by using arbitrary waveforms. By discretizing both incident and reflected waves, we formulate the reflection coefficient of a nonuniform transmission line as a polynomial ratio in the Z-transform, wherein the numerator and denominator represent the reflected and incident waves, respectively. A reconstruction scheme is derived to obtain the characteristic impedance profile of a transmission line. Some examples are presented to illustrate the validity of this new technique.



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A 1-17-GHz InGaP-GaAs HBT MMIC analog multiplier and mixer with broad-band input-matching networks

Bosen Tzeng, Chun-Hsien Lien, Huei Wang, Yu-Chi Wang, Pane-Chane Chao and Chung-Hsu Chen. "A 1-17-GHz InGaP-GaAs HBT MMIC analog multiplier and mixer with broad-band input-matching networks." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2564-2568.

An InGaP-GaAs heterojunction bipolar transistor (HBT) analog multiplier/mixer monolithic microwave integrated circuit (MMIC) is developed that adopts a Gilbert-cell multiplier with broad-band input-matching networks to widen the bandwidth up to 17 GHz. This MMIC was fabricated using a commercially available 6-in InGaP-GaAs HBT MMIC process. It achieved a measured sensitivity of above 1100 V/W for an analog multiplier and a conversion gain of better than 9 dB for a mixer. It also demonstrated a lower corner frequency and noise than that of an InP HBT analog multiplier. The measured low-frequency noise was 10 nV/sqrt(Hz), which is about half of that of an InP HBT analog multiplier with a similar architecture. The corner frequency of the low-frequency noise was roughly estimated to be 15 kHz. The measured performance of this MMIC chip with gain-bandwidth-product (GBP) of 47 GHz rivals that of the reported GaAs-based analog multipliers and mixers. The high GBP result achieved by this chip is attributed to the HBT device performance and the broad-band input-matching network.





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Near-ideal RF upconverters

N. Vasudev and O.M. Collins. "Near-ideal RF upconverters." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2569-2575.

This paper presents experimental results on the application of a new quadrature modulator compensator, which allows existing quadrature modulators to achieve near-ideal RF upconversion over a wide bandwidth. A test setup using an arbitrary waveform generator and a spectrum analyzer shows that over 70 dB of spurious-free dynamic range may be obtained over a bandwidth of 1.2 MHz using an off-the-shelf Mini Circuits in-phase/quadrature modulator operating at 895 MHz. A conventional compensator provides only 45 dB of sideband suppression in the same experimental setup.

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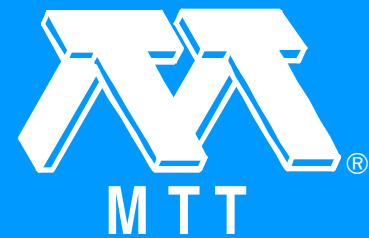
Dyadic Green's function of multilayer cylindrical closed and sector-structures for waveguide, microstrip-antenna, and network analysis

M. Thiel and A. Dreher. "Dyadic Green's function of multilayer cylindrical closed and sector-structures for waveguide, microstrip-antenna, and network analysis." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2576-2579.

A clear and systematic method to derive the spectral- and space-domain dyadic Green's function of arbitrary cylindrical multilayer and multiconductor structures is proposed. The derivation is either done for a circumferentially closed or a cylindrical sector structure, which is bounded by electric or magnetic walls in an azimuthal direction. The solution for the dyadic Green's function in the spectral domain is obtained via an equivalent circuit. Relations between the spectral and space domains for the dyadic Green's functions are derived using eigensolution expansions. Finally, the dyadic Green's function is applied to the problem of finding the propagation constants of the two-layer dielectric rod.

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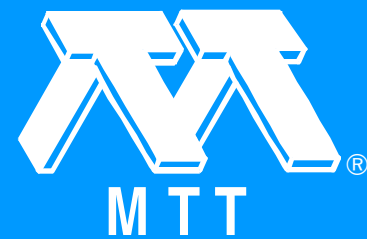
A 60-GHz uniplanar MMIC 4/spl times/ subharmonic mixer

M.W. Chapman and S. Raman. "A 60-GHz uniplanar MMIC 4/spl times/ subharmonic mixer." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2580-2588.

A uniplanar GaAs monolithic microwave integrated circuit /spl times/4 subharmonic mixer (SHM) has been fabricated for 60-GHz-band applications using an antiparallel diode pair in finite ground coplanar (FGC) waveguide technology. This mixer is designed to operate at an RF of 58.5-60.5 GHz, an IF of 1.5-2.5 GHz, and an LO frequency of 14-14.5 GHz. FGC transmission-line structures used in the mixer implementation were fully characterized using full-wave electromagnetic simulations and on-wafer measurements. Of several mixer configurations tested, the best results show a maximum conversion loss of 13.2 dB over the specified frequency range with a minimum local-oscillator power of 3 dBm. The minimum upper sideband conversion loss is 11.3 dB at an RF of 58.5 GHz and an IF of 2.5 GHz. This represents excellent performance for a 4/spl times/ SHM operating at 60 GHz.

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Numerical analysis of traveling-wave photodetectors' bandwidth using the finite-difference time-domain method

Soon-Cheol Kong, Seung-Jin Lee, Jung-Hoon Lee and Young-Wan Choi. "Numerical analysis of traveling-wave photodetectors' bandwidth using the finite-difference time-domain method." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2589-2597.

We present full-wave analysis of traveling-wave photodetectors (TWPDs) using the finite-difference time-domain (FDTD) method. Impulse response in the frequency domain is obtained after time-domain data are calculated by the FDTD method. The impulse response includes the optical field profile, carrier transit time, microwave loss, microwave dispersion, and velocity mismatch all together. Three-decibel bandwidth is analyzed with the thickness of an i-layer and waveguide width as the design parameters. It is shown how transit time and microwave characteristics affect the bandwidth according to the TWPD's length. Three-decibel bandwidth is dominated by carrier transit time in case the device length is shorter than 300-500 μm under the conditions given in this paper. However, if the device length gets longer, microwave characteristics affect the bandwidth.

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A spline large-signal FET model based on bias-dependent pulsed I-V measurement

Kyoungmin Koh, Hyun-Min Park and Songcheol Hong. "A spline large-signal FET model based on bias-dependent pulsed I-V measurement." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2598-2603.

A spline large-signal FET model is presented. This includes a quiescent bias dependency to predict nonlinear dynamic behavior of FETs in which self-heating and trap effects are present. The intrinsic device of the model represented by a parallel connection of current and charge sources and the model parameters are extracted from bias-dependent pulsed I-Vs and S-parameters, respectively. The validity of the model is demonstrated by comparing the simulated small-signal S-parameters over a wide bias range with measured data. Nonlinear behaviors of FETs such as P_{in}/P_{out} , third-order intermodulation distortion, and efficiency are also compared.

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Microwave variable delay line using dual-frequency switching-mode liquid crystal

T. Kuki, H. Fujikake and T. Nomoto. "Microwave variable delay line using dual-frequency switching-mode liquid crystal." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2604-2609.

A method was investigated to reduce the insertion loss and response time in the phase shift in a microwave variable delay line using liquid crystal (LC). In variable delay lines using conventional nematic LC, reducing the insertion loss conflicts with reducing the phase-shift response-time dependence on the thickness of the LC layer; thus, it is very difficult to simultaneously satisfy both requirements. Here, the use of dual-frequency switching-mode liquid crystal (DFSM LC) for the variable delay line is demonstrated as one approach to solving this problem. By using the characteristics of DFSM LC, in that the alignment of the LC can be controlled with a control voltage and its frequency, it becomes possible to control the LC alignment to be in an always electrically driven condition by applying a combination of control voltages of dc and several kilohertz. Experimental results of a microwave variable delay line using DFSM LC show that it is possible to reduce both the phase-shift response time and insertion loss.

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Submillimeter-wave sideband generation using varactor Schottky diodes

D.S. Kurtz, J.L. Hesler, T.W. Crowe and R.M. Weikle, II. "Submillimeter-wave sideband generation using varactor Schottky diodes." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2610-2617.

A submillimeter-wave sideband generator based on phase modulation is described. The sideband generator consists of a whisker-contacted Schottky varactor mounted in a reduced-height waveguide. A microwave pump signal modulates the reflection coefficient the varactor presents to an incident submillimeter-wave carrier. The circuit discussed in this paper has exhibited a carrier-to-single sideband conversion loss of 14 dB and an output power of 55 μ W at 1.6 THz.



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A 200-285-GHz waveguide SIS mixer with an inhomogeneous distributed junction array

M. Takeda and T. Noguchi. "A 200-285-GHz waveguide SIS mixer with an inhomogeneous distributed junction array." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2618-2623.

In this paper, we present the experimental results of a waveguide superconductor-insulator-superconductor (SIS) mixer with an inhomogeneous distributed junction array. The mixer consists of five Nb-AlO/sub x/-Nb SIS junctions with different dimensions distributed on a superconducting microstrip. The critical current density of the fabricated junctions was 3100 A/cm/sup 2/. Detailed measurements of the receiver noise temperature have been made in the frequency range from 190 to 284 GHz at 4.2 K. A double-sideband (DSB) receiver noise temperature of 5 hw/k was obtained in the frequency range from 202 to 284 GHz and the lowest DSB receiver noise temperature of 46 K was obtained at 210 GHz.

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Propagation characteristics of finite-width conductor-backed coplanar waveguides with periodic electromagnetic bandgap cells

Shau-Gang Mao and Ming-Yi Chen. "Propagation characteristics of finite-width conductor-backed coplanar waveguides with periodic electromagnetic bandgap cells." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2624-2628.

Wave propagation along the finite-width conductor-backed coplanar waveguide (FW-CBCPW) with periodically loaded one-dimensional electromagnetic bandgap (EBG) cells proposed earlier by the authors is investigated theoretically and experimentally in this paper. The full-wave simulation in conjunction with Floquet's theorem is employed to find the dispersion diagram for characterizing the guided and leaky waves over a wide frequency range. For examining the guided-wave mode, the equivalent-circuit model is established to obtain the analytical formula of the Bloch impedance. The remarkable slow-wave factor 1.9-2.9 times higher than that of a conventional FW-CBCPW is presented. When operating frequency is sufficiently high, the leaky-wave mode is emitted so that the structure radiates in the backward direction. Good agreement among the results of the full-wave simulation, equivalent-circuit model, published data, and measurement supports the usefulness of the proposed full-wave simulation and also validates the analytical formula. By properly adjusting the circuit configuration, the periodic EBG structure with controllable propagation characteristics, which include the bandgap zone, the slow-wave factor, and the Bloch impedance for the guided wave, as well as the radiation main beam for the leaky wave, may be achieved.

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SAW front-end module for GSM-based dual-band cellular phones with direct-conversion demodulation

M. Hikita, N. Matsuura, K. Yokoyama, N. Shibagaki and K. Sakiyama. "SAW front-end module for GSM-based dual-band cellular phones with direct-conversion demodulation." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2629-2638.

Assuming direct-conversion (DC) demodulation, the required characteristics for surface-acoustic-wave (SAW) front-end modules (FEMs) have been investigated. A new FEM configuration is described that consists of not only transmitter (Tx) switching p-i-n diodes and a diplexer with low-pass/high-pass filters, but also SAW filters and baluns. A direct parallel connection between a SAW filter and a p-i-n diode makes it possible to drastically reduce the number of circuit elements. A module developed for an extended global system for mobile communications (EGSM)/digital cellular system (DCS) dual-band cellular-phone transceiver achieved insertion losses in the receiver (Rx) portions as small as 3.0 and 3.3 dB for EGSM and DCS, respectively. The Rx portions had attenuation characteristics as high as 30-40 dB at harmonic frequencies up to several gigahertz and complete differential output signals with amplitude and phase imbalances less than ± 0.5 dB and $\pm 4^\circ$, respectively. These characteristics are particularly required for DC demodulation. Small insertion losses in the Tx portions, 1.0 and 1.2 dB for EGSM and DCS, respectively, were also obtained.

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Analysis and control of harmonic radiation from active integrated oscillator antennas

M.J. Cryan, G.R. Buesnel and P.S. Hall. "Analysis and control of harmonic radiation from active integrated oscillator antennas." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2639-2646.

Harmonic radiation from microstrip patch oscillators is examined experimentally and theoretically using both a single and dual parallel-tuned circuit Van der Pol oscillator model. Closed-form expressions are obtained for the fundamental and first harmonic voltage amplitudes, and results show reasonably good agreement with a commercial circuit simulator. Such expressions will be useful for designers of active integrated antennas, giving them greater physical insight into their operation. Experimental results are presented for three configurations of a patch oscillator, i.e., rectangular patch, circular-sector patch, and quarter-wave shorted patch. The latter two configurations present very low resistance at the first harmonic frequency and this leads to improved harmonic suppression performance. This is in qualitative agreement with theoretical predictions.

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Whispering-gallery modes in shielded hemispherical dielectric resonators

Z.E. Eremenko, Y.F. Filipov, S.N. Kharkovsky, V.V. Kutuzov and A.E. Kogut. "Whispering-gallery modes in shielded hemispherical dielectric resonators." 2002 Transactions on Microwave Theory and Techniques 50.11 (Nov. 2002 [T-MTT] (Mini-Special Issue on the 2002 IEEE Radio Frequency Integrated Circuit (RFIC) Symposium)): 2647-2649.

The results of the numerical and experimental investigations of whispering-gallery (WG) modes in shielded hemispherical dielectric resonators are presented in this paper. It is shown that the Q factor of WG modes in the shielded resonator can be ten times much higher than the Q factor of the similar open hemispherical dielectric-resonator modes. Shielding the resonator can decrease the dimensions of both the dielectric hemisphere and resonator as a whole, saving the high-Q factor of WG modes. The usage of a cylindrical shield and local flat reflectors in the experiment provides the investigation of the high-Q factor of WG modes in the resonator.

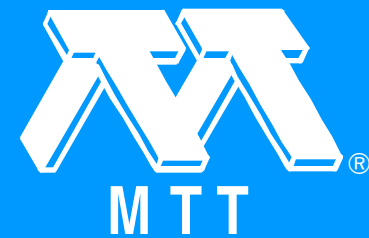
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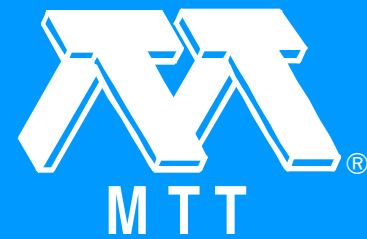
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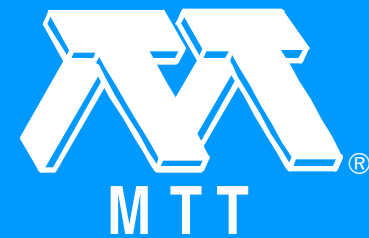
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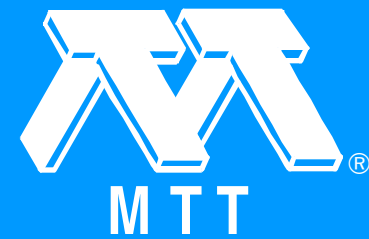
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Editors' overview (Dec. 2002 [T-MTT])

A. Weisshaar, G.L. Heiter and W.J.R. Hoefer. "Editors' overview (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2660-2663.



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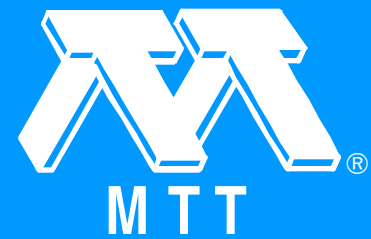
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IMS 2002 Celebrates the 50th Anniversary of the MTT-S (Dec. 2002 [T-MTT])

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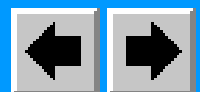
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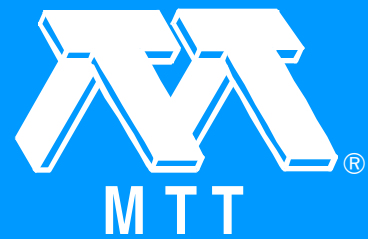
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The IMS2002 Technical Program (Dec. 2002 [T-MTT])

E.W. Strid and E. Godshalk. "The IMS2002 Technical Program (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2668-2670.



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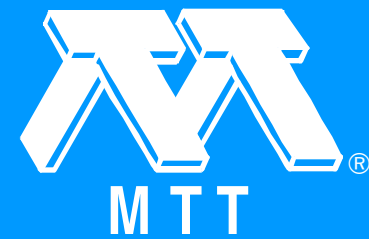
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Abstracts

2002 MTT-S awards (Dec. 2002 [T-MTT])

P.W. Staecker. "2002 MTT-S awards (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2671-2678.



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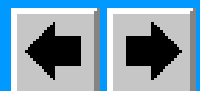
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The danger of high-frequency spurious effects on wide microstrip line (Dec. 2002 [T-MTT])

F. Mesa and D.R. Jackson. "The danger of high-frequency spurious effects on wide microstrip line (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2679-2689.

It has been found that remarkably severe spurious effects can occur in the current excited on microstrip line at moderate to high frequency, when the strip is wide (approximately $w/h > 3$). This newly observed effect occurs because one or more leaky modes (LMs) approaches the branch point at $k_{\text{sub } 0}$ in the complex longitudinal wavenumber plane. When this happens, the attenuation (leakage) constant of these LMs becomes very small. Hence, the LMs can propagate to very large distances along the line with only minimal attenuation. This effect only occurs when the strip is fairly wide, and at certain frequencies. When it occurs, the effect can be disastrous since the continuous-spectrum (radiation) part of the current on the strip then decays very slowly with distance from the source so that the total strip current excited by the source exhibits spurious oscillations out to very large distances from the source. An approximate design rule for predicting this effect is given, which is accurate for wide strips (approximately $w/h > 6$). The LMs that are responsible for this effect are identified, and the behavior of these modes are studied for different strip widths.

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Approximate analytical evaluation of the continuous spectrum in a substrate-superstrate dielectric waveguide (Dec. 2002 [T-MTT])

P. Baccarelli, P. Burghignoli, F. Frezza, A. Galli, G. Lovat and D.R. Jackson. "Approximate analytical evaluation of the continuous spectrum in a substrate-superstrate dielectric waveguide (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2690-2701.

In this paper, an original closed-form approximate evaluation is performed for the continuous-spectrum field excited by an infinite line source in a dielectric substrate-superstrate configuration, optimized for leaky-wave radiation. By means of a suitable approximate asymptotic representation obtained via Watson's lemma, the continuous-spectrum field has been expressed as the sum of the contributions of two leaky-pole singularities, each weighted by a transition function that depends on both the frequency and observation distance. The validity of these results is shown in the near and far fields at different frequencies, including the frequency range in which the leaky wave is physical and the entire transition region through the spectral gap. This new closed-form result explicitly shows the nature of the continuous-spectrum field in the transition region, and provides insight into the nature of the fields on more complicated structures in microwave integrated circuits.

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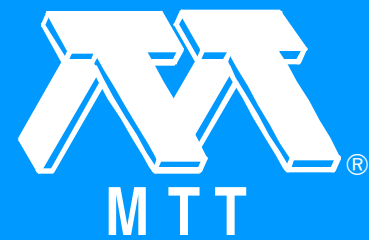
Planar negative refractive index media using periodically L-C loaded transmission lines

G.V. Eleftheriades, A.K. Iyer and P.C. Kremer. "Planar negative refractive index media using periodically L-C loaded transmission lines." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2702-2712.

Recent demonstrations of negative refraction utilize three-dimensional collections of discrete periodic scatterers to synthesize artificial dielectrics with simultaneously negative permittivity and permeability. In this paper, we propose an alternate perspective on the design and function of such materials that exploits the well-known L-C distributed network representation of homogeneous dielectrics. In the conventional low-pass topology, the quantities L and C represent a positive equivalent permeability and permittivity, respectively. However, in the dual configuration, in which the positions of L and C are simply interchanged, these equivalent material parameters assume simultaneously negative values. Two-dimensional periodic versions of these dual networks are used to demonstrate negative refraction and focusing; phenomena that are manifestations of the fact that such media support a propagating fundamental backward harmonic. We hereby present the characteristics of these artificial transmission-line media and propose a suitable means of implementing them in planar form. We then present circuit and full-wave field simulations illustrating negative refraction and focusing, and the first experimental verification of focusing using such an implementation.

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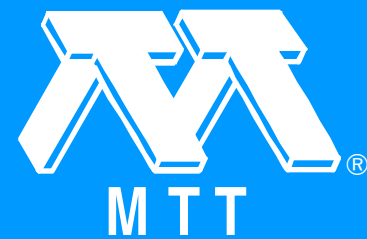
Dual-frequency electric-magnetic-electric microstrip leaky-mode antenna of a single fan beam

Yu-Chiao Chen, Ching-Kuo Wu and C.-K.C. Tzuang. "Dual-frequency electric-magnetic-electric microstrip leaky-mode antenna of a single fan beam." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2713-2720.

This paper presents a dual-frequency electric-magnetic-electric (EME) microstrip exhibiting two leaky-wave regions of similar radiation characteristics like the microstrip EH/sub 1/ mode. The EME microstrip incorporates a photonic bandgap (PBG) structure, which is a two-dimensional array consisting of unit cell made of coupled coils connected by a via. The PBG structure employed in the EME prototype conducts at dc and shows the first stopband between 8.8-12.4 GHz, thus rendering the so-called magnetic surface. The EME microstrip is essentially made by substituting the PBG cells for the metal strip of a conventional microstrip. The finite-element method (FEM) analyses of the PBG structure show that the first and second modes are TM-like and TEM-like, respectively. The latter is leaky between 12.4-12.9 GHz and is found to be responsible for the second leaky region of the EME microstrip. The dispersion characteristics of the EME microstrip are obtained by two theoretical methods, namely, the matrix-pencil method and the FEM. Both show excellent agreement in the two leaky regions. Furthermore, the measured far-field radiation patterns of the two leaky regions also validate the dispersion curves. The first leaky region is of EH/sub 1/ type and between 5.05-5.45 GHz. The second leaky region radiates a frequency-scanning fan beam between 11.95-13.0 GHz, similar to those of the EH/sub 1/ mode. Detailed modal current analyses show even and odd symmetry along longitudinal and transverse plane of EME microstrip, respectively, further confirming the two leaky regions behave like the well-known EH/sub 1/ leaky mode. The proposed EME microstrip enriches the modal characteristics of the conventional, uniform microstrip and is thus a manifestation of application of PBG structure for new guiding device.

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Efficient analysis of microwave passive structures using 3-D envelope-finite element (EVFE)

Hsiao-Ping Tsai, Yuanxun Wang and T. Itoh. "Efficient analysis of microwave passive structures using 3-D envelope-finite element (EVFE)." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2721-2727.

A three-dimensional envelope-finite element (EVFE) technique is proposed to solve the transient responses of general microwave passive structures. EVFE simulates the signal envelope rather than the original signal waveform by de-embedding the carrier from the time-domain wave equation. The sampling rate of the time-domain waveform is only governed by the Nyquist rate of the envelope, rather than that of the carrier in traditional time-domain simulators. Compared to traditional finite-element time-domain (FETD) methods, the computational cost can be dramatically reduced when the signal envelope-to-carrier ratio is very small. It also provides much higher computational efficiency than frequency-domain finite-element methods for simulating frequency responses over certain bandwidth. This technique is applied to solve a waveguide structure with a dielectric post discontinuity and a microstrip patch antenna. The accuracy and efficiency is demonstrated and compared with traditional unconditionally stable FETD methods.

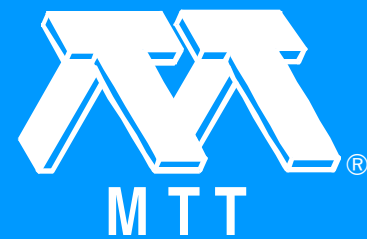


Abstracts

A TLM-SPICE interconnection framework for coupled field and circuit analysis in the time domain

P.P.M. So and W.J.R. Hoefer. "A TLM-SPICE interconnection framework for coupled field and circuit analysis in the time domain." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2728-2733.

A general SPICE-transmission-line matrix (TLM) interconnection framework has been developed. The connection algorithm is based on the representation of the TLM network by equivalent Thevenin and/or Norton sources. Fundamental issues such as source equivalence and SPICE-TLM interconnection options have been examined. The framework opens new and far-reaching possibilities for hybrid global microwave and high-speed digital circuit modeling in the time domain because it combines the extensive circuit and device models of SPICE with general three-dimensional field solutions.



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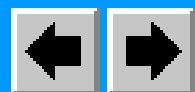
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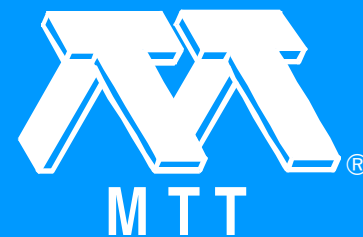


Abstracts

A new 2-D image reconstruction algorithm based on FDTD and design sensitivity analysis (Dec. 2002 [T-MTT])

No-Weon Kang, Young-Seek Chung, Changyul Cheon and Hyun-Kyo Jung. "A new 2-D image reconstruction algorithm based on FDTD and design sensitivity analysis (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2734-2740.

This paper proposes a numerical algorithm that reconstructs the complex permittivity profile of unknown scatterers by the design sensitivity analysis (DSA) and topology optimization technique. By introducing the DSA and adjoint-variable method, the derivatives of the error function with respect to the complex permittivity variables can be calculated, and the material property in each cell can be changed simultaneously using sensitivity information. The steepest descent method is used as an optimization technique. The proposed method is validated by applying it to reconstructions of unknown two-dimensional scatterers that are illuminated by TM/sup z/ with a Gaussian-pulsed plane wave.



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EM-based optimization exploiting partial space mapping and exact sensitivities (Dec. 2002 [T-MTT])

J.W. Bandler, A.S. Mohamed, M.H. Bakr, K. Madsen and J. Sondergaard. "EM-based optimization exploiting partial space mapping and exact sensitivities (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2741-2750.

We present a family of robust techniques for exploiting sensitivities in electromagnetic (EM)-based circuit optimization through space mapping (SM) technology. We utilize derivative information for parameter extractions and mapping updates. We exploit a partial SM (PSM) concept, where a reduced set of parameters is sufficient for parameter extraction optimization. It reflects the idea of tuning and execution time is reduced. Upfront gradients of both EM (fine) model and coarse surrogates can initialize possible mapping approximations. We introduce several effective approaches for updating the mapping during the optimization iterations. Examples include the classical Rosenbrock function, modified to illustrate the approach, a two-section transmission-line 10:1 impedance transformer and a microstrip bandstop filter with open stubs.





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Feasible adjoint sensitivity technique for EM design optimization (Dec. 2002 [T-MTT])

N.K. Georgieva, S. Glavic, M.H. Bakr and J.W. Bandler. "Feasible adjoint sensitivity technique for EM design optimization (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2751-2758.

An adjoint-variable approach to frequency-domain design sensitivity analysis is proposed for the optimization of high-frequency structures with full-wave electromagnetic solvers. We investigate sensitivity estimations based on a feasible perturbation technique which is versatile and requires only minor modifications of existing analysis algorithms. It extends the feasible adjoint-sensitivity technique previously applied in nonlinear microwave circuits to full-wave electromagnetic analysis. The solution to the adjoint problem is obtained with very little overhead once the original problem is solved. The gradient of the objective function is consequently computed through a single analysis regardless of the number of the design parameters. The concept is illustrated through the sensitivity analysis and the design of a Yagi-Uda array and a rectangular patch antenna using suitable method of moments simulators.





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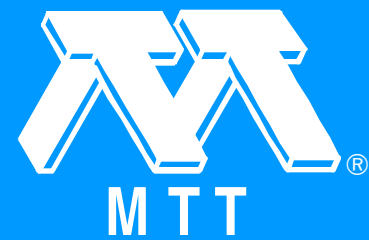
Addressing transient errors in passive macromodels of distributed transmission-line networks

A. Dounavis, R. Achar and M.S. Nakhla. "Addressing transient errors in passive macromodels of distributed transmission-line networks." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2759-2768.

Recently, several time-domain passive macromodeling algorithms were proposed for distributed transmission-line networks. Most of them employ some kind of approximation in the frequency domain to match the response up to a maximum frequency of interest and the behavior after the highest frequency is generally not considered. This can cause significant errors in transient responses (especially in the early-time period). In order to address this difficulty, we will present a new algorithm to reduce high-frequency errors in time-domain macromodels, while preserving passivity. The proposed algorithm is very useful in eliminating spurious ripples in the flat delay portion of transient responses of distributed transmission-line networks without needing to increase the order of approximation.

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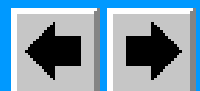
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Subjects

Neural-based dynamic modeling of nonlinear microwave circuits (Dec. 2002 [T-MTT])

Jianjun Xu, M.C.E. Yagoub, Runtao Ding and Qi-Jun Zhang. "Neural-based dynamic modeling of nonlinear microwave circuits (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2769-2780.

A neural network formulation for modeling nonlinear microwave circuits is achieved in the most desirable format, i.e., continuous time-domain dynamic system format. The proposed dynamic neural network (DNN) model can be developed directly from input-output data without having to rely on internal details of the circuit. An algorithm is developed to train the model with time or frequency domain information. Efficient representations of the model are proposed for convenient incorporation of the DNN into high-level circuit simulation. Compared to existing neural-based methods, the DNN retains or enhances the neural modeling speed and accuracy capabilities, and provides additional flexibility in handling diverse needs of nonlinear microwave simulation, e.g., time- and frequency-domain applications, single-tone and multitone simulations. Examples of dynamic modeling of amplifiers, mixer, and their use in system simulation are presented.





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Computer-aided tuning of microwave filters using fuzzy logic (Dec. 2002 [T-MTT])

V. Miraftab and R.R. Mansour. "Computer-aided tuning of microwave filters using fuzzy logic (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2781-2788.

This paper introduces an algorithm based on fuzzy logic for tuning microwave filters. The approach is demonstrated by considering two filters: a four-pole Chebyshev filter and an eight-pole elliptic filter. Each filter is then detuned to perform two examples: one is slightly detuned and the other is highly detuned. In both cases, the approach has proven to be very efficient in identifying the filter elements that cause the detuning. The fuzzy rules are extracted from sampled data. The expert rules could also be added. The algorithm can be applied to any microwave circuit tuning problem.

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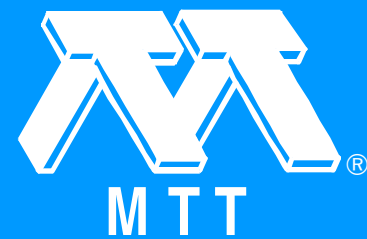


Abstracts

On the synthesis of equivalent-circuit models for multiports characterized by frequency-dependent parameters (Dec. 2002 [T-MTT])

R. Neumayer, A. Stelzer, F. Haslinger and R. Weigel. "On the synthesis of equivalent-circuit models for multiports characterized by frequency-dependent parameters (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2789-2796.

The synthesis of lumped-element equivalent circuits for time-domain analysis of problems with frequency-dependent parameters is of great interest in microwave theory. This paper presents a systematic approach to generate minimal-order realizations for passive microwave circuits characterized by either admittance, impedance, or scattering-parameter data. In addition, a very efficient method to ensure inherent system properties such as stability and passivity is described. The proposed method is suitable for simulating frequency-response-based linear subnetworks in a general circuit environment consisting of lumped/distributed elements and nonlinear devices. Modeling examples for a two-, four-, and ten-port system with nonlinear and linear terminations, respectively, are given.



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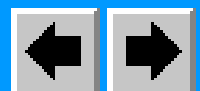
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Optimal parameter extraction and uncertainty estimation in intrinsic FET small-signal models

C. Fager, L.J.P. Linner and J.C. Pedro. "Optimal parameter extraction and uncertainty estimation in intrinsic FET small-signal models." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2797-2803.

Analytical expressions for the relative sensitivities in the parameters of a standard intrinsic FET small-signal model with respect to deviations in the measured S-parameters are derived. This enables, in combination with a measurement uncertainty model, the model parameter uncertainties to be studied versus frequency. As a result, optimal, minimum uncertainty, parameter extraction can be performed independent of the bias voltage and without prior knowledge about the device frequency behavior, thus making it suitable for implementation in automatic multibias extraction programs. The derived sensitivities are furthermore used to analytically calculate the uncertainty in the S-parameter response of the extracted model in terms of the uncertainties in either the parameters or the measurement it was extracted from.





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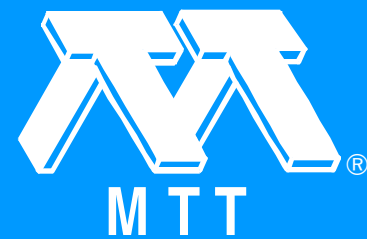
A peeling algorithm for extraction of the HBT small-signal equivalent circuit

B. Sheinman, E. Wasige, M. Rudolph, R. Doerner, V. Sidorov, S. Cohen and D. Ritter. "A peeling algorithm for extraction of the HBT small-signal equivalent circuit." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2804-2810.

Direct extraction is the most accurate method for the determination of equivalent-circuits of heterojunction bipolar transistors (HBTs). The method is based on first determining the parasitic elements and then the intrinsic elements analytically. The accuracy and robustness of the whole algorithm therefore is determined by the quality of the extraction of the extrinsic elements. This paper focuses on a new extraction method for the extrinsic capacitances which have proven to be the main source of uncertainty compared to the other extrinsic parameters. Concerning the intrinsic parameters, all the elements are extracted using exact closed-form equations, including exact expressions for the base-collector capacitances, which model the distributed nature of the base. The expressions for the base-collector capacitances are valid for both the hybrid- π and the physics-based T-topology equivalent circuits. Extraction results for InP HBT devices on measured S-parameters up to 100 GHz demonstrate good modeling accuracy.

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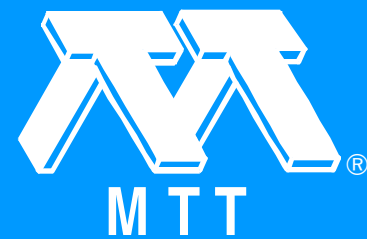
Subjects

Characterization and modeling of bias dependent breakdown and self-heating in GaInP/GaAs power HBT to improve high power amplifier design

S. Heckmann, R. Sommet, J.-M. Nebus, J.-C. Jacquet, D. Floriot, P. Auxemery and R. Quere. "Characterization and modeling of bias dependent breakdown and self-heating in GaInP/GaAs power HBT to improve high power amplifier design." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2811-2819.

It is usual to say that power GaInP/GaAs heterojunction bipolar transistors (HBTs) have many advantages for power amplification at microwave frequencies, because of their high gain and high power density. Furthermore, the possibility of controlling the base biasing conditions (voltage, current, self-bias control) compared to a field-effect transistor offers additive degrees of freedom to make a tradeoff between linearity and power-added efficiency. Nevertheless existing devices are limited because of the relatively low breakdown voltage whereas high collector voltage swings are required to achieve high power. This drawback makes them not appropriate for use in the next generation of mobile communication base station or radar systems. Silicon technologies such as LDMOS and III-V devices (MESFET and HFET) present competitive performances in term of high power level but for medium power added efficiency. Important improvements have been made in recent years which make possible large breakdown voltages for GaInP/GaAs HBTs. Breakdown value close to 67 V has been achieved. The aim of this work is to significantly improve the modeling of the breakdown voltage on this type of transistor. Furthermore, the in depth characterization and modeling of self-heating effects have been greatly improved in order to improve thermal management solutions which enable us to enhanced design solutions of HBT high power amplifiers.





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Global coupled EM-electrical-thermal simulation and experimental validation for a spatial power combining MMIC array (Dec. 2002 [T-MTT])

W. Batty, C.E. Christoffersen, A.B. Yakovlev, J.F. Whitaker, A. Mortazawi, A. Al-Zayed, M. Ozkar, S.C. Ortiz, R.M. Reano, K. Yang, L.P.B. Katehi, C.M. Snowden and M.B. Steer. "Global coupled EM-electrical-thermal simulation and experimental validation for a spatial power combining MMIC array (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2820-2833.

A unique electromagnetic (EM)-electrothermal global simulation tool based on a universal error concept is presented. The advantages of this electrothermal model are illustrated by comparison with a commercial electrothermal circuit simulator. The first description of a fully physical, electrothermal, microwave circuit simulation, based on coupling of the Leeds Physical Model of MESFETs and high electron-mobility transistors, to a microwave circuit simulator, fREEDA (NCSU), is presented. The modeling effort is supported by parallel developments in electrooptic and thermal measurement. The first fully coupled EM-electrothermal global simulation of a large microwave subsystem, here a whole spatial power combining monolithic-microwave integrated-circuit (MMIC) array, is described. The simulation is partially validated by measurements of MMIC array temperature rise and temperature dependent S-parameters. Electrothermal issues for spatial power combiner operation and modeling are discussed. The computer-aided-design tools and experimental characterization described, provide a unique capability for the design of quasi-optical systems and for the exploration of the fundamental physics of spatial power combining devices.

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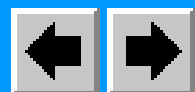
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Prediction of IMD in LDMOS transistor amplifiers using a new large-signal model

C. Fager, J.C. Pedro, N.B. de Carvalho and H. Zirath. "Prediction of IMD in LDMOS transistor amplifiers using a new large-signal model." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2834-2842.

In this paper, the intermodulation distortion (IMD) behavior of LDMOS transistors is treated. First, an analysis is performed to explain measured IMD characteristics in different classes of operation. It is shown that the turn-on region plays an important role in explaining measured IMD behavior, which may also give a clue to the excellent linearity of LDMOS transistors. Thereafter, with this knowledge, a new empirical large-signal model with improved capability of predicting IMD in LDMOS amplifiers is presented. The model is verified against various measurements at low as well as high frequency in a class-AB power amplifier circuit.

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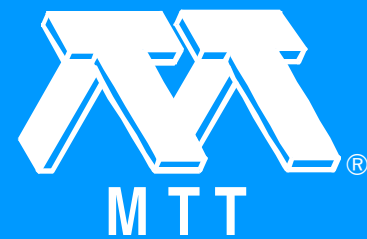
Quantifying memory effects in RF power amplifiers

H. Ku, M.D. McKinley and J.S. Kenney. "Quantifying memory effects in RF power amplifiers." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2843-2849.

This paper proposes a system-level behavioral model for RF power amplifiers (PAs), which exhibit memory effects, that is based on the parallel Wiener system. The model extraction is performed using two-tone intermodulation distortion (IMD) measurements with different tone frequency spacings and power levels. It is found that by using such a model, more accurate adjacent-channel power-ratio levels may be predicted for high PAs close to the carrier frequency. This is validated using IS-95B CDMA signals on a low-power (0.5 W) class-AB PA, and on a high-power (45 W) class-B PA. The model also provides a means to quantify memory effects in terms of a figure-of-merit that calculates the relative contribution to the IMD of the memoryless and memory portion of the PA nonlinearity. This figure-of-merit is useful in providing an estimate of the amount of correction that a memoryless predistortion system may have on PAs that exhibit memory effects.

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High-performance air-gap transmission lines and inductors for millimeter-wave applications

Inho Jeong, Seong-Ho Shin, Ju-Hyun Go, Joong-Soo Lee, Choong-Mo Nam, Dong-Wook Kim and Young-Se Kwon. "High-performance air-gap transmission lines and inductors for millimeter-wave applications." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2850-2855.

The air-gap transmission lines and inductors are developed by new multilayer process. The developed transmission lines are air-gap coaxial line, air-gap strip line, air-gap coplanar waveguides (CPW), and air-gap buried microstrip line (BMSL). The air-gap transmission lines show very low signal loss and very high isolation performances. The transmission line loss of the coaxial line is less than 0.08 dB/mm up to 40 GHz. Those of the CPW, strip line and BMSL are about 0.07, 0.15, and 0.13 dB/mm, respectively. The isolation characteristics of the coaxial line and BMSL are measured. In case of the coaxial line with 2-mm coupling length and 60-/spl mu/m distance between signal lines, the coupling is less than -52 dB up to 40 GHz. In case of the BMSL with the same conditions, the coupling is less than -43 dB. Therefore, the air-gap transmission line is very suitable structure for high performance and high-density RF application. Additionally, the air-gap inductors are monolithically fabricated using the same process of the transmission line. The fabricated inductors have very high quality factors, the maximum Q factor of 1.46-nH air-gap inductor is about 130. Using the developed multilayer process, we can realize various types of air-gap transmission lines (coaxial line, CPW, strip line and BMSL) and air-gap inductors simultaneously.

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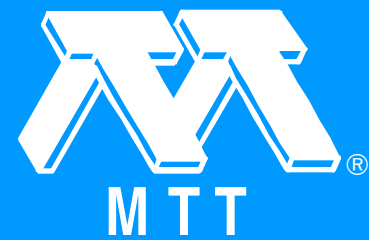
Subjects

Fabrication of MOD-derived YBCO films on [001]LaAlO/sub 3/ and their application to $\lambda/4$ CPW SIR BPFs

A. Sanada, M. Kimura, T. Yamamoto and I. Awai. "Fabrication of MOD-derived YBCO films on [001]LaAlO/sub 3/ and their application to $\lambda/4$ CPW SIR BPFs." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2856-2861.

Chemically derived epitaxial thin films of YBa/sub 2/Cu/sub 3/O/sub 7- δ (YBCO) are fabricated on [001]LaAlO/sub 3/ substrates by the metalorganic-deposition (MOD) process, which has advantages of high quality, nonvacuum, low-cost, and large-scale production of high-T/sub c/ superconducting films. The MOD-derived YBCO films have a sharp transition at the critical temperature (90.4 K) and a high-quality film with a surface resistance of 0.13 m Ω (30 K, 9.98 GHz) is obtained. As a microwave application, simple and compact bandpass filters (BPFs) using $\lambda/4$ coplanar-waveguide. stepped-impedance resonators are demonstrated on the YBCO films. A two-stage Chebyshev BPF of center frequency of 5.731 GHz, bandwidth of 135 MHz, and insertion loss of 0.29 dB with little input power dependency in a power range less than 10 dBm is realized on the film.





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Synthesis of advanced microwave filters without diagonal cross-couplings (Dec. 2002 [T-MTT])

R.J. Cameron, A.R. Harish and C.J. Radcliffe. "Synthesis of advanced microwave filters without diagonal cross-couplings (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2862-2872.

Asymmetric filtering characteristics are frequently used for the design of microwave filters for the cellular telephony industry, particularly for the transmit/receive diplexers for base stations. Typically, such filters have to be manufactured in large quantities at the lowest possible cost. However, due to the asymmetric filtering characteristics, the designs often include diagonal cross-couplings between nonadjacent resonators in addition to the usual "straight" couplings. Diagonal couplings tend to be mechanically difficult to manufacture and assemble and can be electrically awkward to tune and be sensitive to temperature, vibration, etc., all of which drives up unit costs. This paper introduces the methods for the synthesis of two novel filter network configurations that do not require diagonal couplings, but nonetheless are able to realize asymmetric filtering functions.

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Integrated power transistor in 0.18- μm CMOS technology for RF system-on-chip applications

Heng-Ming Hsu, Jiong-Guang Su, Chih-Wei Chen, D.D. Tang, Chun Hsiung Chen and J.Y.-C. Sun. "Integrated power transistor in 0.18- μm CMOS technology for RF system-on-chip applications." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2873-2881.

A novel design and performance of a power MOS transistor for RF system-on-chip applications are reported. The power MOS transistor with high breakdown voltage is integrated into 0.18- μm CMOS technology with only one additional mask. By an optimized design considering all aspects of DC and RF performances, a power MOS transistor with 16-GHz cutoff frequency and 24-GHz maximum oscillation frequency has been demonstrated. In addition, the power gain is 12 dB at 2.4 GHz with power-added efficiency of 50%. In this study, the device architectures that include drain engineering, substrate engineering, and gate scaling are investigated comprehensively.

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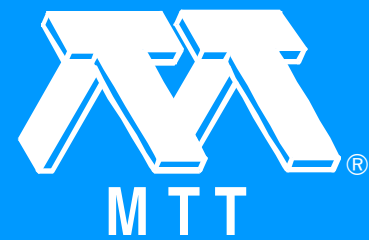
Dual-mode filters with grooved/splitted dielectric resonators for cellular-radio base stations

L. Accatino, G. Bertin, M. Mongiardo and G. Resnati. "Dual-mode filters with grooved/splitted dielectric resonators for cellular-radio base stations." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2882-2889.

Dual-mode filters for cellular-radio base stations require resonators with a high unloaded Q-factor, a wide spurious-free operating window and the possibility of high coupling values either to input or between resonators. These features are obtained by employing a cavity resonator loaded by grooved/split ceramic disks, which allows insertion of probes and/or tuning/coupling screws where the field is highly concentrated. In this paper, cavity resonator behavior, intercavity couplings, and filter computer-aided tuning are discussed in detail. Experimental results of an eight-pole transmit filter confirm the suitability of the proposed resonator for realizing cellular-radio base stations filters for UNITS and IMT-2000 applications.

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Suspended resonators for filters - reduced β excitation of evanescent cavities using high dielectric constant feedlines (Dec. 2002 [T-MTT])

R.V. Snyder, E. Niver, Keehong Um and Sanghoon Shin. "Suspended resonators for filters - reduced β excitation of evanescent cavities using high dielectric constant feedlines (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2890-2895.

A structure consisting of dielectric-loaded feed lines (such as surface-wave lines similar to Goubau lines) and below-cutoff air-filled cavities can be used to form essentially L-C sections. The capacitance is due to electric-field coupling from the feed-line dielectric medium into the below-cutoff section. The inductance results from combining the inductors in the inductive tee equivalent circuit for such below-cutoff sections. Dielectric loading is used to shorten the guide wavelength at the input to the evanescent section, increasing the effective input inductance. The dielectrically loaded feed lines can comprise microstrip, coplanar waveguide (CPW), coplanar stripline (CPS), Goubau lines (surface-wave structures), waveguide, etc. The resulting resonant elements are usable at frequencies below 1 GHz, with small dimensions. If connected to the common ground plane, these L-C sections act as a transmission zero. If "floated," i.e., connected in the "hot" line rather than to the ground plane, the sections form bandpass circuits (transmission poles). The air-filled below-cutoff sections (evanescent mode) are placed in a supporting low dielectric-constant medium (air, Teflon, or similar) with the open end in proximity to the dielectric portion of the feed line and are, thus, termed "suspended." The individual L-C sections can be coupled together using microstrip, surface-wave line, CPW, CPS, finline, waveguide, or lumped elements. Such combinations can be chosen to implement Chebychev, Butterworth, quasi-elliptic, etc. responses.

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Novel coupling schemes for microwave resonator filters (Dec. 2002 [T-MTT])

U. Rosenberg and S. Amari. "Novel coupling schemes for microwave resonator filters (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2896-2902.

This paper introduces novel coupling schemes for microwave resonator filters. It is shown that higher order filter characteristics can be obtained from lower order sections, which are connected in parallel between the source and load, by proper superposition of the individual lower order responses. This property can be used in modular filter design by focusing on separate sections of the filter one at a time. In addition, some of these coupling schemes exhibit zero-shifting properties, whereby transmission zeros can be shifted from one side of the passband to the other by simply changing the resonant frequencies of the resonators while keeping all the coupling coefficients unchanged. Several novel filter designs of different kinds (microstrip, planar waveguide cavity, and dual-mode types) are introduced to prove the new method and to give an idea of the extended design possibilities. Good agreement between measured, computed, and synthesized results is demonstrated.

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A wide-band reflection-type phase shifter at S-band using BST coated substrate

Dongsu Kim, Yoonsu Choi, M.G. Allen, J.S. Kenney and D. Kiesling. "A wide-band reflection-type phase shifter at S-band using BST coated substrate." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2903-2909.

The design and experimental results of a wide-band monolithic reflection-type phase shifter are presented in this paper. The phase shifter fabricated on Ba/sub 0.6/Sr/sub 0.4/TiO/sub 3/ (BST)/sapphire consists of a coplanar waveguide (CPW) Lange coupler, a series resonated LC termination, and a bias network. The CPW Lange coupler results in a power split of 3.5 dB/spl plusmn/0.5 dB in the range of 1.6-3.2 GHz. The BST interdigital capacitor has a tunability ($C_{\text{sub max}}/C_{\text{sub min}}$) of 3.1 with 140 V. Measured and simulated performance of a series resonated LC termination was described. The phase shifter has achieved a phase-shift range of over 90/spl deg/ with an insertion loss of better than 2.0 dB and a return loss of higher than 14 dB in the frequency range of 1.9-2.5 GHz over a bias voltage range from 0 to 160 V. A figure-of-merit of maximum 72/spl deg/dB at 2 GHz was obtained. The smaller phase shifter using the folded-type CPW Lange coupler, which maintains a smaller aspect ratio for easier packaging, has an insertion loss of better than 2.3 dB with a phase-shift range of over 130/spl deg/ at 2.5 GHz. Two-tone measurements of the phase shifter indicate an input IP/sub 3/ of 32 dBm with 0 V and 41.9 dBm with 60 V. Total size of the monolithic BST phase shifter is 11.2 mm /spl times/ 4.9 mm /spl times/ 0.43 mm for the straight coupler design and 5.4 mm /spl times/ 6.5 mm /spl times/ 0.43 mm for the folded-type design.

Microstrip and stripline ferrite-coupled-line (FCL) circulator's

Cham Kiong Queck and L.E. Davis. "Microstrip and stripline ferrite-coupled-line (FCL) circulator's." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2910-2917.

Measurements on an 11-GHz four-port microstrip ferrite-coupled-line (FCL) circulator, employing a broad-band hybrid coupler and an improved air bridge, confirm that only a weak biasing field of 3-4 kA/m (35-50 Oe) is required. By cascading the S-matrices of the FCL section and hybrid coupler using signal flow graphs, the measured and predicted bandwidth and losses are compared for the first time. Simulated results for stripline FCL sections exhibit broader bandwidths than those obtained with microstrip FCL sections. Using such a structure, the simulated performance of a three-port circulator indicates that, in principle, bandwidths of at least 3:1 or 4:1 may be possible.



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V-band 2-b and 4-b low-loss and low-voltage distributed MEMS digital phase shifter using metal-air-metal capacitors

Hong-Teuk Kim, Jae-Hyoung Park, Sanghyo Lee, Seongho Kim, Jung-Mu Kim, Yong-Kweon Kim and Youngwoo Kwon. "V-band 2-b and 4-b low-loss and low-voltage distributed MEMS digital phase shifter using metal-air-metal capacitors." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2918-2923.

Low-loss digital distributed phase shifters have been developed using micromachined capacitive shunt switches for V-band applications. Instead of conventional metal-insulator-metal capacitors, high-Q metal-air-metal capacitors were used in series with the microelectromechanical system (MEMS) shunt capacitive switches to minimize the dielectric loss. The operation voltage for the phase shifters was also reduced by applying the bias directly to the MEMS shunt switches through choke spiral inductors. Fabricated 2-b (270/spl deg/) and 4-b (337.5/spl deg/) distributed phase shifters showed low average insertion losses of 2.2 dB at 60 GHz and 2.8 dB at 65 GHz, respectively. The average phase errors for 2-b and 4-b phase shifters were 6.5% and 1.3%, respectively. The return losses are better than 10 dB over a wide frequency range from 40 to 70 GHz. Most of the circuits operated at 15-35-V bias voltages. These phase shifters present promising solution to low-loss integrated phase shifting devices at the V-band and above.

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Ultra-selective 22-pole 10-transmission zero superconducting bandpass filter surpasses 50-pole Chebyshev filter

S.M.I. Tsuzuki, Shen Ye and S. Berkowitz. "Ultra-selective 22-pole 10-transmission zero superconducting bandpass filter surpasses 50-pole Chebyshev filter." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2924-2929.

An ultra-selective filter for third-generation (3G) and fourth-generation wireless application is presented. The demonstrated filter consists of 22 resonators and five cross couplings that produce ten transmission zeros. The filter was designed at 1950-MHz center frequency with a 20-MHz bandwidth to meet existing 3G wireless applications. The measured filter data shows excellent selectivity, better than 30-dB/100-kHz skirt slopes, and 90 dB of rejection at 350 kHz from the band edge. This filter performance surpasses the performance of a 50-pole Chebyshev filter. In order to fit a large number of resonators into a limited wafer area, a new compact resonator was developed. The filter was fabricated using a YBCO thin film on a 2-in MgO wafer.

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A fully integrated broad-band amplifier MMIC employing a novel chip-size package

Young Yun, Masaaki Nishijima, Motonari Katsuno, Hidetoshi Ishida, Katsuya Minagawa, Toshihide Nobusada and Tsuyoshi Tanaka. "A fully integrated broad-band amplifier MMIC employing a novel chip-size package." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2930-2937.

In this work, we used a novel RF chip-size package (CSP) to develop a broad-band amplifier monolithic microwave integrated circuit (MMIC), including all the matching and biasing components, for Ku- and K-band applications. By utilizing an anisotropic conductive film for the RF-CSP, the fabrication process for the packaged amplifier MMIC could be simplified and made cost effective. STO (SrTiO/sub 3/) capacitors were employed to integrate the dc biasing components on the MMIC. A novel pre-matching technique was used for the gate input and drain output of the FETs to achieve a broad-band design for the amplifier MMIC without any loss of gain. To improve the circuit stability of the amplifier MMIC in the out-of-band, a parallel RC circuit was employed at the input of the amplifier MMIC. The packaged amplifier MMIC exhibited good RF performance and stability over a wide frequency range. This work is the first report of a fully integrated CSP amplifier MMIC successfully operating in the Ku-/K-band.



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Ultralow DC power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless applications

A. Cidronali, G. Collodi, M. Camprini, V. Nair, G. Manes, J. Lewis and H. Goronkin. "Ultralow DC power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless applications." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2938-2946.

The monolithic integration of tunneling diodes (TDs) with other semiconductor devices such as high electron-mobility transistors (HEMTs) or HBTs, creates novel quantum functional nonlinear devices and circuits with unique properties: the negative differential resistance and the extremely low dc power consumption. In this paper, we present a family of InP-HEMT-TD-based voltage-controlled oscillators operating in the 4-6-GHz band suitable for wireless applications, along with an effective analytical treatment of the stability issues. Prototypes having different circuit topologies of HEMT-TD devices have been designed and fabricated. The circuits generated an output power in the range of -11 to -18 dBm when operated at a bias current of 1.75 mA at 500 mV. Phase noise characteristics and tuning capability of the circuit configuration have been experimentally determined. The maximum tuning range of 150 MHz and the maximum single sideband-to-carrier ratio of -97 dBc/Hz at 200 kHz have been achieved.

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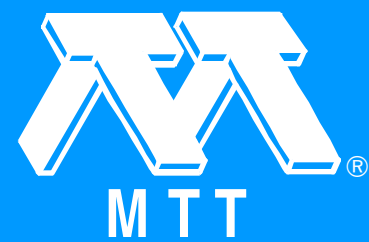
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A filter synthesis technique applied to the design of multistage broad-band microwave amplifiers (Dec. 2002 [T-MTT])

J.-P. Rooney, R. Parry, I. Hunter and R.D. Pollard. "A filter synthesis technique applied to the design of multistage broad-band microwave amplifiers (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2947-2953.

A method for designing multistage broad-band amplifiers based upon well-known filter synthesis techniques is presented. Common all-pole low-pass approximations are used to synthesize prototype amplifier circuits that may be scaled in frequency and impedance. All-pass filters introduced at the first stage are shown to improve input match while maintaining circuit performance less 6 dB gain. A theoretical comparison is made with the distributed amplifier and the cascaded single-stage distributed amplifier. Theoretically, a larger gain-bandwidth product is achieved using the synthesis technique. A proof-of-concept Butterworth low-pass two-stage amplifier was designed, simulated, and measured and achieved a flat gain performance of 1-4 GHz with a power gain of 14.5/spl plusmn/1 dB close to the predicted 1-4.2 GHz, 15/spl plusmn/1 dB.





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Optimum bias conditions for linear broad-band InGaP/GaAs HBT power amplifiers (Dec. 2002 [T-MTT])

M. Iwamoto, C.P. Hutchinson, J.B. Scott, T.S. Low, M. Vaidyanathan, P.M. Asbeck and D.C. D'Avanzo. "Optimum bias conditions for linear broad-band InGaP/GaAs HBT power amplifiers (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2954-2962.

A design strategy for a linear broad-band InGaP/GaAs heterojunction bipolar transistor (HBT) power amplifier is presented. This design is based on the bias dependence of the nonlinear base-collector charge, as expressed in the C_{BC} versus V_{CE} and f_t versus I_C characteristics of the device. Using this technique, it is shown that the second- and third-order distortions have separate optimum bias conditions and, furthermore, there is an inherent tradeoff in optimizing the second- and third-order distortions. The strong bias dependence of the nonlinear base-collector charge and the tradeoff between the different orders of distortion are verified on two 24-dBm 0.5-11-GHz distributed power amplifiers optimized for second and third-order distortions, respectively. The experimental results show that the harmonic and intermodulation levels are sensitive to the different order derivatives of the f_t versus I_C curve. Specifically, second-order distortion is related to the slope of the f_t versus I_C curve and third-order distortion is related to both the slope and curvature of the f_t versus I_C curve. This design technique suggests the importance of HBT device design to minimize distortion in high-frequency broad-band amplifier designs. Furthermore, to minimize high-frequency distortion in HBT amplifiers across a wide range of bias, it is desirable to linearize the base-collector charge, where flat C_{BC} versus V_{CE} and f_t versus I_C characteristics are ideally desired.

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A 1.8-GHz high-efficiency 34-dBm silicon bipolar power amplifier

F. Carrara, A. Scuderi, T. Biondi and G. Palmisano. "A 1.8-GHz high-efficiency 34-dBm silicon bipolar power amplifier." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2963-2970.

The low-voltage power capabilities of a low-cost high-performance silicon bipolar process were investigated. By optimizing the emitter finger layout, epilayer thickness, and collector doping level, efficiency values up to 83% were achieved by on-wafer load-pull measurements on a single-cell test device operating at 1.8 GHz and 2.7-V power supply. The detrimental effect of the emitter distributed resistance on the current capability of long-emitter bipolar transistors was also considered.. An analytical model for a proper device design was derived and experimentally validated. Using the optimized unit power device, a 1.8-GHz 2.7-V three-stage monolithic power amplifier was implemented, which provides a 57% power-added efficiency and a 33-dB gain while delivering a 34-dBm output power to the load.



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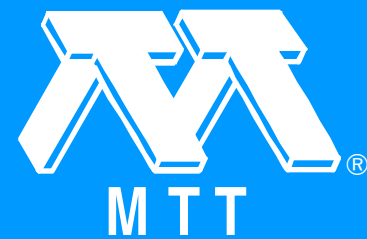
Parameter extraction for symmetric coupled-resonator filters (Dec. 2002 [T-MTT])

Heng-Tung Hsu, Zhenyu Zhang, K.A. Zaki and A.E. Ati. "Parameter extraction for symmetric coupled-resonator filters (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2971-2978.

A new parameter-extraction procedure for symmetric coupled-resonator filters is presented. Closed-form recursive formulas are derived for the synthesis of all the filter parameters (resonant frequencies of the individual resonators and couplings between resonators) from known measured or simulated zeros and poles of input impedance functions of the singly terminated even and odd-mode networks. Capable of accurately predicting the unavoidable spurious couplings between nearby resonators, this simple and straightforward procedure can eliminate complicated optimization routines and have extensive applications in design and tuning of filters.

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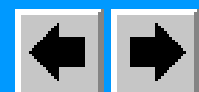
Subjects

Power-amplifier module with digital adaptive predistortion for cellular phones (Dec. 2002 [T-MTT])

S. Kusunoki, K. Yamamoto, T. Hatsugai, H. Nagaoka, K. Tagami, N. Tominaga, K. Osawa, K. Tanabe, S. Sakurai and T. Iida. "Power-amplifier module with digital adaptive predistortion for cellular phones (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2979-2986.

This paper describes a new type of power amplifier (PA) module with a predistortion function and can be applied to a N-CDMA (narrow-band CDMA system defined in IS-95B Standard) handset terminals. Distortion compensation technology to improve the efficiency of the PA is discussed, quantitatively. Various parameters to be considered in designing are investigated in detail. The predistortion technology proposed is based on the lookup-table method using the input and output signal envelopes and can operate independently from the baseband block. By omitting adaptative predistortion for amplitude/phase modulation and integrating the main controlling functions on a single CMOS integrated-circuit chip, the predistortion capability has been realized in a PA module. The PA module has a power-added efficiency (PAE) of 48% at an output power of 27.5 dBm. This PAE is very high in comparison with that of the conventional PA module for N-CDMA.

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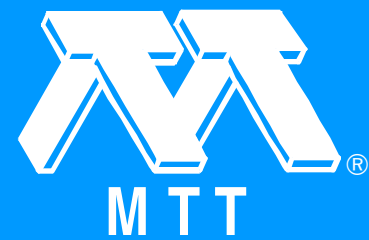
Carrier power to intermodulation-distortion power-ratio-increasing technique in active phased-array antenna systems

T. Kaho, T. Nakagawa, K. Araki and K. Horikawa. "Carrier power to intermodulation-distortion power-ratio-increasing technique in active phased-array antenna systems." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2987-2994.

This paper describes a novel technique to compensate for the intermodulation (IM) distortion components of high-power amplifiers in an active phased-array antenna system. This technique uses IM phase control to break the strong association between carriers and IM components, and can make the radiation patterns of carriers and IM components different on active phased-array antenna systems. As a result, carrier power to IM power ratio (CAM) is increased in the carrier-beam direction. A newly developed IM controller can increase the C/IM of near-saturated solid-state power amplifiers and, therefore, achieve high power efficiency. This paper shows experimental results confirming this technique using a six-element linear array.

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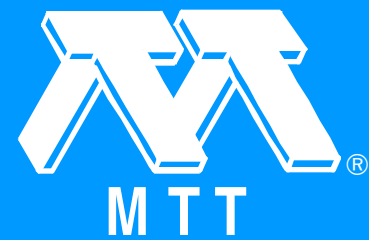
Compact single-chip W-band FMCW radar modules for commercial high-resolution sensor applications

A. Tessmann, S. Kudzus, T. Feltgen, M. Riessle, C. Sklarczyk and W.H. Haydl. "Compact single-chip W-band FMCW radar modules for commercial high-resolution sensor applications." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 2995-3001.

Two compact single-chip 94-GHz frequency-modulated continuous-wave (FMCW) radar modules have been developed for high-resolution sensing under adverse conditions and environments. The first module contains a monolithic microwave integrated circuit (MMIC) consisting of a mechanically and electrically tunable voltage-controlled oscillator (VCO) with a buffer amplifier, 10-dB coupler, medium-power and a low-noise amplifier, balanced rat-race high electron-mobility transistor (HEMT) diode mixer, and a driver amplifier to increase the local-oscillator signal level. The overall chip-size of the FMCW radar MMIC is 2/spl times/3.5 mm/sup 2/. For use with a single transmit-receive antenna, a 94-GHz microstrip hexaferrite circulator was implemented in the module. The radar sensor achieved a tuning range of 1 GHz, an output signal power of 1.5 mW, and a conversion loss of 2 dB. The second FMCW radar sensor uses an MMIC consisting of a varactor-tuned VCO with injection port, very compact transmit and receive amplifiers, and a single-ended resistive mixer. To enable single-antenna operation, the external circulator was replaced by a combination of a Wilkinson divider and a Lange coupler integrated on the MMIC. The circuit features coplanar technology and cascode HEMTs for compact size and low cost. These techniques result in a particularly small overall chip-size of only 2/spl times/3 mm/sup 2/. The packaged 94-GHz FMCW radar module achieved a tuning range of 6 GHz, an output signal power of 1.5 mW, and a conversion loss of 5 dB. The RF performance of the radar module was successfully verified by real-time monitoring the time flow of a gas-assisted injection molding process.

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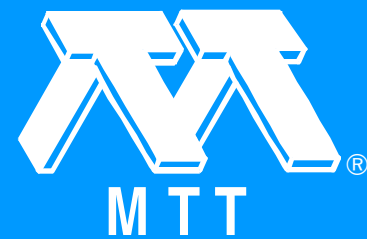
Direct optical injection locking of InP/InGaAs HPT oscillator ICs for microwave photonics and 40-Gbit/s-class, optoelectronic clock recovery

H. Kamitsuna, T. Shibata, K. Kurishima and M. Ida. "Direct optical injection locking of InP/InGaAs HPT oscillator ICs for microwave photonics and 40-Gbit/s-class, optoelectronic clock recovery." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3002-3008.

Presents fully monolithically integrated 10- and 39-GHz-band InP/InGaAs heterojunction phototransistor (HPT) oscillators that can be optically injection locked by directly illuminating the HPT. When optical signals are modulated by fundamental frequencies around free-running oscillations, the 10-GHz-band HPT oscillator integrated circuit (IC) achieves an ultra-wide locking range of 1401 MHz (relative bandwidth of 13.6%), and the 39-GHz-band HPT oscillator IC achieves a wide locking range of 768 MHz, which are records among the indirect and/or direct optical injection-locked oscillators reported to date. The 10-GHz-band HPT oscillator IC also achieves very wide locking ranges of 618 and 160 MHz for third and fifth subharmonic modulated optical signal injection, respectively, which is very useful for microwave photonics applications. Optoelectronic clock recovery for optical transmission systems was tested by using the 39-GHz-band HPT oscillator IC and a planar lightwave circuit Mach-Zehnder interferometer. A 38.8-GHz electrical clock signal was successfully extracted from 38.8-Gbit/s nonreturn-to-zero optical data streams.

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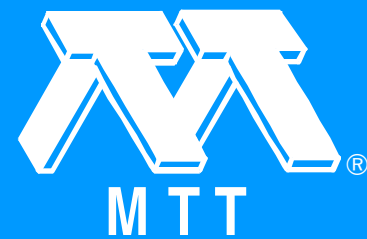
Subjects

Millimeter-wave power-fading compensation for WDM fiber-radio transmission using a wavelength-self-tunable single-sideband filter

E. Vourc'h, B. Della, D. Le Berre and D. Herve. "Millimeter-wave power-fading compensation for WDM fiber-radio transmission using a wavelength-self-tunable single-sideband filter." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3009-3015.

Optical single-sideband (OSSB) sources compensate for deleterious chromatic dispersion effects in fiber-radio systems. We utilize the photorefractive properties of iron-doped indium phosphide (InP:Fe) to allow microwave-photonic interactions and design wavelength-independent OSSB filtering. Therefore, a wavelength-self-tunable single-sideband filter is built and characterized up to the millimeter-wave (31.5 GHz) domain. Compensation for fiber-dispersion penalties is achieved, showing photodetected power fluctuation along the fiber as low as 1 dB. In addition, we demonstrate the wavelength-division-multiplexing fiber-radio transmission of two OSSB channels transporting 140-Mbit/s binary phase-shift keying data at a 16 GHz RF over a 14-km fiber length followed by a 3-m radio link.





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Realistic power-amplifiers characterization with application to baseband digital predistortion for 3G base stations

S. Boumaiza and F.M. Ghannouchi. "Realistic power-amplifiers characterization with application to baseband digital predistortion for 3G base stations." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3016-3021.

In this paper, a realistic, accurate, versatile, and thermal-free complex behavior test bed suitable for third-generation power-amplifiers characterization is proposed. Using this approach, a 90-W peak power amplifier based on Motorola-LDMOS class-AB transistors was measured under several signal excitations such as W-CDMA, cdma2000, and eight-tone signals. The results obtained show noticeable discrepancies compared to those measured using a vector network analyzer (HP-8510C) for both AM/AM and AM/PM curves. This test bed was also used for the investigation of the memory effect in RF power amplifiers. In the second part of this paper, the characterization results obtained by the test bed were used to design a digital predistorter for an LDMOS amplifier. A baseband predistortion accurate synthesis algorithm is presented. Indeed, a memoryless baseband digital predistorter lookup table was directly synthesized using the measured AM/AM and AM/PM curves without any need to perform additional analytical derivations and/or numerical optimizations. The predistorter synthesis procedure requires only one iteration, contrary to previous works, which need several iterations to obtain similar performances.





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Enhanced on-wafer time-domain waveform measurement through removal of interconnect dispersion and measurement instrument jitter

J.B. Scott, J. Verspecht, B. Behnia, M. Vanden Bossche, A. Cognata, F. Verbeyst, M.L. Thorn and D.R. Scherrer. "Enhanced on-wafer time-domain waveform measurement through removal of interconnect dispersion and measurement instrument jitter." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3022-3028.

We have measured the output waveshape and rise time of two high-speed digital circuits on a wafer using a 50-GHz prototype of a new instrument. The instrument uses vector error correction to de-embed the component under test like a network analyzer, but reads out in the time domain after the fashion of an equivalent-time oscilloscope. With the calibration plane of the instrument set at the tips of the wafer probes, errors arising from dispersion in the connection hardware are removed. We show that the random jitter in the measurement system is removed without the convolution penalty usually incurred by averaging so that anomalies such as pattern-dependent jitter are exposed. The system rise time is 7 ps, compared to a system rise time of 12-13 ps for a conventional equivalent-time oscilloscope of the same bandwidth in the presence of wafer probes, bias networks, and cables.

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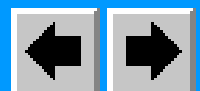
[Subjects](#)

Theoretical evaluation of GSM/UMTS electromagnetic fields on neuronal network response

F. Apollonio, M. Liberti and G. D'Inzeo. "Theoretical evaluation of GSM/UMTS electromagnetic fields on neuronal network response." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3029-3035.

Understanding the modalities of interaction of electromagnetic (EM) fields with biological material is a key point in the identification of possible induced effects. An integrated approach to model EM field interaction with biological systems is proposed in this paper. Here, a neuronal network is identified as the biological target. In this paper, for the first time, the possible effects of EM signals related to universal mobile telecommunication system and global system for mobile communication standard on the setup model are investigated.

[Click on title for a complete paper.](#)



Modeling of planar applicators for microwave thermotherapy

J. Carlier, V. Thomy, J.-C. Camart, L. Dubois and J. Pribetich. "Modeling of planar applicators for microwave thermotherapy." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3036-3042.

In order to improve the external applicators used for microwave thermotherapy controlled by microwave radiometry in medical applications, we propose specific planar applicators developed for heating: either annular ones to be used at the frequency equal to 915 MHz or in the shape of a horseshoe (short-circuited ring) for 434 MHz. The final goal of this paper is the realization of a honeycomb network for the treatment of larger areas and greater volumes.



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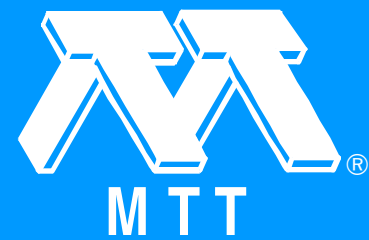
Subjects

Performance characterization of FPGA techniques for calibration and beamforming in smart antenna applications

T.W. Nuteson, J.E. Stocker, J.S. Clark, D.S. Haque and G.S. Mitchell. "Performance characterization of FPGA techniques for calibration and beamforming in smart antenna applications." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3043-3051.

A field-programmable gate array (FPGA) implementation is presented for a smart antenna application employing digital beamforming. The digital beamforming is performed at the RF signal carrier frequency by means of bandpass (IF) sampling, using high-speed 8-b analog-to-digital converters. The digital phased array receiver presented in this paper consists of an eight-channel system with back-end FPGAs for calibration and digital beamforming processing. The system operates in the L-band (1.8-2 GHz) with various bandwidths depending on the application and FPGA processing requirements. This paper focuses on two main topics, calibration methodologies and FPGA implementation for calibration and digital beamforming, and includes several performance trades. Results presented include real measured data that were collected with the system and processed via FPGAs.





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A smart antenna receiver array using a single RF channel and digital beamforming (Dec. 2002 [T-MTT])

J.D. Fredrick, Yuanxun Wang and T. Itoh. "A smart antenna receiver array using a single RF channel and digital beamforming (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3052-3058.

A new type of smart antenna array receiver with adaptive beamforming is proposed. The novel system offers a drastic reduction in hardware requirements for the smart antenna system through the use of a new Spatial Multiplexing of Local Elements (SMILE) scheme. In this scheme, a single element of the array is sequentially connected to signal processing circuitry in order to sample the incoming modulated carrier. The sampling rate is higher than the signal bandwidth so that the information of the original signal can be fully restored in the post stages using low-pass filters. This system offers an N times reduction in RF hardware for an N-element array. A four-element prototype is built. System principles, SNR, advantages, and hardware, including a new type of array feed network, are discussed. The system performance is validated through a link test with digitally modulated data.





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A microwave communication link with self-heterodyne direct down conversion and system predistortion (Dec. 2002 [T-MTT])

Jin Park, Yuanxun Wang and T. Itoh. "A microwave communication link with self-heterodyne direct down conversion and system predistortion (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3059-3063.

A novel design of a microwave communications link operating at 5.8 GHz is presented based on self-heterodyne direct downconversion (SHDDC) and system predistortion. Utilizing the SHDDC scheme eliminates the need of any local oscillators at the receive ends and minimizes spectrum usage; however, the transmitter power efficiency is low, and there exist high mixer intermodulation levels in the receiver. To overcome these drawbacks, a system predistortion approach is proposed. A two-tone measurement is performed to validate the idea. It shows 12.67 dBc of overall improvement in the signal-to-intermodulation ratio by applying a fourth-order predistortion technique. Further, successful transmission of a digitally modulated signal is also demonstrated.





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Design of high-speed master-slave D-type flip-flop in InP DHBT technology (Dec. 2002 [T-MTT])

A.-E. Kasbari, P. Andre, A. Konczykowska, M. Riet, S. Blayac, H. Ouslimani and J. Godin.
"Design of high-speed master-slave D-type flip-flop in InP DHBT technology (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3064-3069.

In this paper, we present some design problems of high-speed master-slave D-type flip-flop (MS D-FF). Essential to the long-haul optical-fiber communication systems, this circuit is critical since it operates at the highest clock frequency for a given bit rate. We discuss specific aspects of electrical design of such a circuit and underline some important points for the layout of gigabit circuits. In particular, we tackle the problem of ringing, which can appear in emitter-follower structures using the fast transistors necessary for high-speed operation. We have pointed out also some difficulties of circuit layout, particularly certain connections that can cause serious ill functioning. The MS D-FF was fabricated in our self-aligned InP double heterojunction-bipolar-transistor technology. On-wafer characterizations at 40 Gb/s show 75% horizontal and 68% vertical eye opening.

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Integrated microwave sensors for cavity-length measurement in machine engineering

A. Megej, K. Beilenhoff, M. Schussler, A. Ziroff, B. Mottet, O. Yilmazoglu, K. Mutamba, C.D. Hamann, R. Baican and H.L. Hartnagel. "Integrated microwave sensors for cavity-length measurement in machine engineering." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3070-3076.

A novel measurement procedure using microwaves is presented. The implemented sensor prototype determines the length of a cylindrical cavity (e.g., a hydraulic system) with submillimeter accuracy in real time. The principle of operation is based on the detection of the resonance-frequency distribution in a cavity resonator.

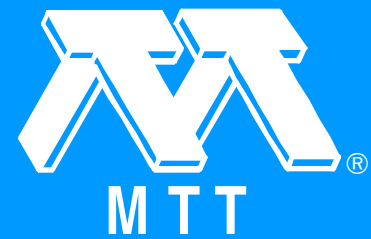
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Information for Authors (Dec. 2002 [T-MTT])

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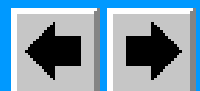
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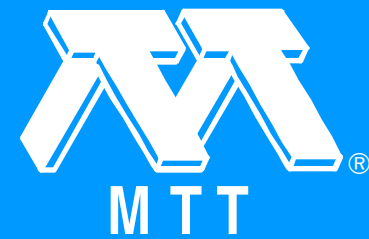
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"Index of Authors (Dec. 2002 [T-MTT])." 2002 Transactions on Microwave Theory and Techniques 50.12 (Dec. 2002 [T-MTT] (Special Issue on 2002 International Microwave Symposium)): 3081-3122.



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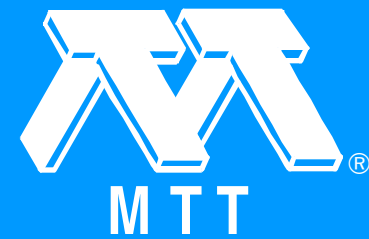
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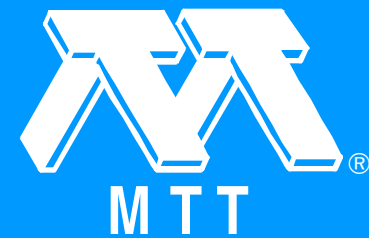
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*"Table of Contents (Jan. 2002 [MWCL])." 2002 Microwave and Wireless Components Letters
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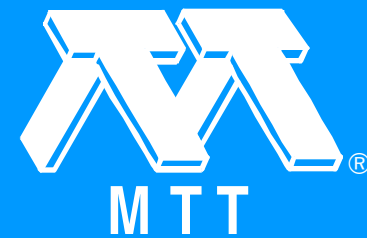
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Inside Cover (Jan. 2002 [MWCL])

"Inside Cover (Jan. 2002 [MWCL])." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 0_2-0_2.



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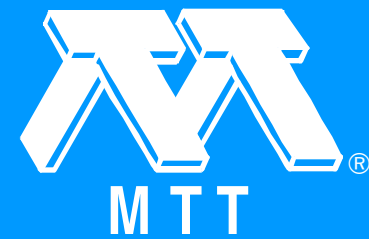
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Information for Authors Submitting Manuscripts in Electronic Form (Jan. 2002 [MWCL])

*"Information for Authors Submitting Manuscripts in Electronic Form (Jan. 2002 [MWCL])." 2002
Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 0_3-0_3.*



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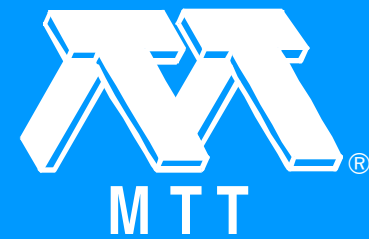
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Determination of receiver selectivity and transmit frequency using a common resonator

S.D. Silk and S.L. Kuffner. "Determination of receiver selectivity and transmit frequency using a common resonator." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 1-2.

In this work, the determination of receiver selectivity and transmit frequency using a common resonator is presented for a 5.3 GHz transceiver employing a time division duplex, on-off keyed modulation format. The microstrip circuit is fabricated on Rogers RO4003/sup (R)/, a high frequency laminate. In receive mode, a 3 dB passband of 35 MHz and a small-signal gain of 26 dB has been achieved. In transmit mode, an output power of +7 dBm for the fundamental, -15.0 dBm for the second harmonic, -18.0 dBm for the third harmonic, and -35.0 dBm for the fourth harmonic has been achieved.

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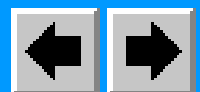
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Tunable barium strontium titanate thin film capacitors for RF and microwave applications

A. Tombak, J.-P. Maria, F. Ayguavives, Zhang Jin, G.T. Stauf, A.I. Kingon and A. Mortazawi.
"Tunable barium strontium titanate thin film capacitors for RF and microwave applications." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 3-5.

The measurement results for thin film barium strontium titanate (BST) based voltage tunable capacitors intended for RF applications are reported. At 9 V DC, BST capacitors fabricated using MOCVD (metalorganic chemical vapor deposition) method achieved 71% (3.4:1) tunability. The measured device quality factor (Q) for BST varactors is comparable with the device Q for commercially available varactor diodes of similar capacitance. The typical dielectric loss tangent was in the range 0.003-0.009 at VHF. Large signal measurement and modeling results for BST thin film capacitors are also presented.

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Miniaturized Wilkinson power dividers utilizing capacitive loading

M.C. Scardelletti, G.E. Ponchak and T.M. Weller. "Miniaturized Wilkinson power dividers utilizing capacitive loading." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 6-8.

The authors report the miniaturization of a planar Wilkinson power divider by capacitive loading of the quarter wave transmission lines employed in conventional Wilkinson power dividers. Reduction of the transmission line segments from $\lambda/4$ to between $\lambda/5$ and $\lambda/12$ are reported here. The input and output lines at the three ports and the lines comprising the divider itself are coplanar waveguide (CPW) and asymmetric coplanar stripline (ACPS), respectively. The 10 GHz power dividers are fabricated on high resistivity silicon (HRS) and alumina wafers. These miniaturized dividers are 74% smaller than conventional Wilkinson power dividers, and have a return loss better than +30 dB and an insertion loss less than 0.55 dB. Design equations and a discussion about the effect of parasitic reactance on the isolation are presented for the first time.

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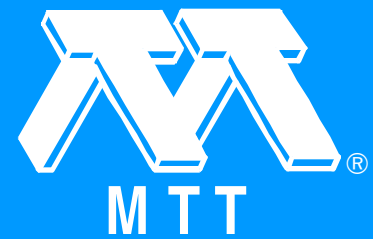
Spatial power splitting and combining based on the Talbot effect

T.J. Tayag, M.B. Steer, J.F. Harvey, A.B. Yakovlev and J. Davis. "Spatial power splitting and combining based on the Talbot effect." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 9-11.

The Talbot effect, a multimode interference phenomenon, is investigated as a technique for combining power from solid-state devices in order to generate higher levels of microwave and millimeter-wave power in a process referred to as quasioptical or spatial power combining. We explore the feasibility of using the Talbot effect to implement a 1 /spl times/ 8 power splitter and an 8 /spl times/ 1 power combiner at 94 GHz. We report the first demonstration of the multimode interface phenomenon in a planar waveguide at 8 GHz.

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Quasi-static finite-element analysis of a skewed microstrip crossover

K. Nyka and M. Mrozowski. "Quasi-static finite-element analysis of a skewed microstrip crossover." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 12-14.

In this work, we present a quasistatic analysis of a microstrip crossover on a dielectric substrate. The microstrips are located at different planes and may cross at an arbitrary angle. Capacitances and inductances are calculated from scalar potentials. For magnetostatic formulation, the boundary conditions for scalar potential are introduced by means of partitioning surfaces. The use of the adaptive finite element method provides the required flexibility with respect to the analyzed geometry, optimal discretization and good efficiency.

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A compact single layer injection-locked linear scanning array

K.H.Y. Ip and G.V. Eleftheriades. "A compact single layer injection-locked linear scanning array." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 15-17.

A compact, single layer, CPW-fed, patch scanning array architecture using injection locking at 9.83 GHz is presented. The patch antennas are printed on the front side of the substrate while the electronics are situated at the back side leading to a simple and compact design. The unit element for the array is a self oscillating active patch antenna with a GaAs FET centered behind the patch for tight packing. The feedback for the oscillator is provided through electromagnetic coupling using a twin-slot arrangement behind the patch. A low power control signal is injected through parasitic coupling at the CPW side of the circuit. Phase shifting of the elements is achieved by electronically adjusting the gate voltage of the GaAs FETs. A scan range of $-12^\circ/\text{spl deg}/$ $+9.5^\circ/\text{spl deg}/$ is obtained for a four element prototype array.

A compact circularly polarized subdivided microstrip patch antenna

Ji-Yong Park, C. Caloz, Yongxi Qian and T. Itoh. "A compact circularly polarized subdivided microstrip patch antenna." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 18-19.

A compact circularly polarized subdivided microstrip patch antenna is proposed. The antenna is composed of the interconnection of four corner patches alternating with four strips and a fifth central patch. It presents the very small size of $0.28/\sqrt{\epsilon_r} \lambda$ by $0.28/\sqrt{\epsilon_r} \lambda$ at resonance (5.85 GHz), which represents a surface reduction of 60% compared with a conventional microstrip square patch antenna. The proposed antenna exhibits a gain of 4.3 dBi to 5 dBi and an axial ratio lower than 1.8 dB in the range of its bandwidth, which is of 30 MHz.



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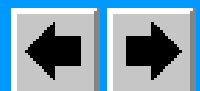
Subjects

Ultra-wide band corrugated gaussian profiled horn antenna design

J. Teniente, R. Gonzalo and C. del-Rio. "Ultra-wide band corrugated gaussian profiled horn antenna design." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 20-21.

Nowadays, an increasing number of applications need stable radiation patterns with low sidelobes and low crosspolar levels in a very wide bandwidth. Gaussian profiled horn antennas (GPRAs) have demonstrated their feasibility as one of the best solutions. A corrugated Gaussian horn antenna design with more than 40% bandwidth is proposed. The measured radiated far field patterns are in good agreement with the simulated ones. The measured results show a Gaussian antenna with extremely wide bandwidth, low sidelobes, and low crosspolar levels.

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A transformer of one-third wavelength in two sections - for a frequency and its first harmonic

Y.L. Chow and K.L. Wan. "A transformer of one-third wavelength in two sections - for a frequency and its first harmonic." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 22-23.

The quarter-wave transformer transforms in one frequency f_0 , but not its first harmonic $2f_0$. The transform in $2f_0$ is needed in a dual-band operation of GSM and PCS. This requirement can be fulfilled in a two line-sections of $1/6$ wavelengths each, adding to $1/3$ wavelengths for the total transformer length in the lower band centering at f_0 (fundamental), or $2/3$ wavelengths in the upper band centering at $2f_0$ (1st harmonic). The $1/3$ -wave transformer is analytically inexact but effectively exact for engineering applications. For example, for impedance transforms of $K = 4$, the inexactness gives a reflection of $|\Gamma| = 0.013$.

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Parallel implementation of the steepest descent fast multipole method (SDFMM) on a Beowulf cluster for subsurface sensing applications

D. Jiang, W. Meleis, M. El-Shenawee, E. Mizan, M. Ashouei and C. Rappaport. "Parallel implementation of the steepest descent fast multipole method (SDFMM) on a Beowulf cluster for subsurface sensing applications." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 24-26.

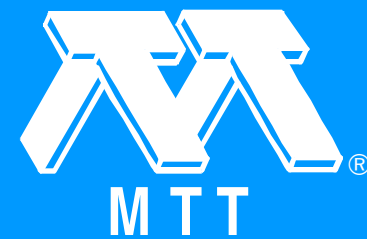
We present the parallel, MPI-based implementation of the SDFMM computer code using a thirty-two node Intel Pentium-based Beowulf cluster. The SDFMM is a fast algorithm that is a hybridization of the method of moments (MoMs), the fast multipole method (FMM), and the steepest descent integration path (SDP), which is used to solve large-scale linear systems of equations produced in electromagnetic scattering problems. An overall speedup of 7.2 has been achieved on the 32-processor Beowulf cluster and a significant reduced runtime is achieved on the 4-processor 667 MHz Alpha workstation.



Abstracts

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"Patent abstracts (Jan. 2002 [MWCL])." 2002 Microwave and Wireless Components Letters 12.1 (Jan. 2002 [MWCL]): 27-33.



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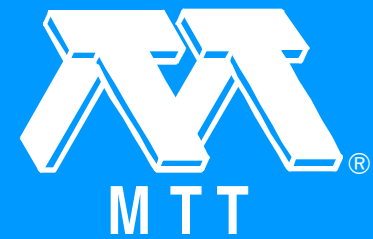
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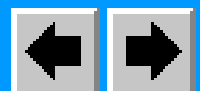
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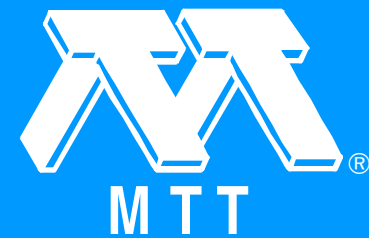
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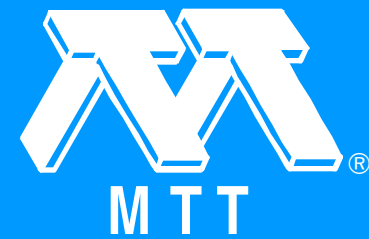
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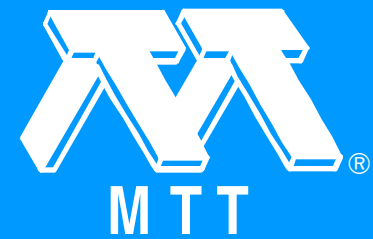
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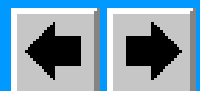
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A 5.7 GHz interpolative VCO using InGaP/GaAs HBT technology

Shih-An Yu, Chin-Chun Meng and Shey-Shi Lu. "A 5.7 GHz interpolative VCO using InGaP/GaAs HBT technology." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 37-38.

A 5.7 GHz monolithic interpolative voltage-controlled oscillator using InGaP/GaAs HBT technology is demonstrated for the first time. Frequency tuning is achieved by changing the open loop gain instead of the tank capacitor. The experimental result showed that a 500 MHz tuning range at 5.7 GHz was realized, which can meet the requirement of 5.7 GHz ISM band.

Click on title for a complete paper.



A novel phase noise reduction technique in oscillators using defected ground structure

Young-Taek Lee, Jong-Sik Lim, Jun-Seok Park, D. Ahn and Sangwook Nam. "A novel phase noise reduction technique in oscillators using defected ground structure." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 39-41.

A new technique to reduce the phase noise in microwave oscillators is developed using the resonant characteristic of the defected ground structure (DGS). Two kinds of oscillators have been designed and measured for the examination of the reduction of phase noise by the DGS. The first adopts the DGS section under the microstrip line at the gate circuit, while the second has only the conventional microstrip line. Measurement shows reduced phase noise by 10-15 dB in the oscillator with the DGS compared to the conventional one.



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Synthesis of prototype filters with triplet sections starting from source and load

G. Macchiarella. "Synthesis of prototype filters with triplet sections starting from source and load." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 42-44.

Describes a method for synthesizing an inline prototype filter with a triplet section starting from source and/or from load. This topology allows placing one or two transmission zeros without using cross-couplings inside the filter (it is only required to couple the source (or the load) to the first (or the last) two resonators). The proposed method employs the coupling matrix of a generic prototype, obtained through well-established procedures; then, the coupling matrix of the desired inline topology is determined with a procedure based on multiple matrix rotations (similarity transforms) and numerical optimization.

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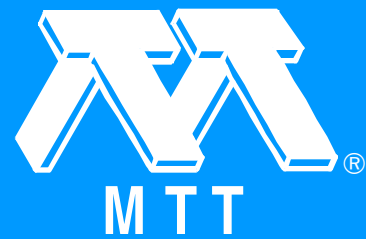


Abstracts

An adaptive multiresolution approach to the simulation of planar structures

P. Pirinoli and G. Vecchi. "An adaptive multiresolution approach to the simulation of planar structures." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 45-47.

An efficient approach for the full-wave analysis of printed structures is presented. It is based on the use of vector multiresolution (MR) functions in conjunction with the impedance matrix compression (IMC) technique, which leads to a reduced set of iteratively selected basis functions. The multilevel structure of the functions makes the matrix compression possible and also allows its further sparsification, with the subsequent reduction of the computational time and the matrix memory occupancy. Numerical results confirm the efficiency of the technique.



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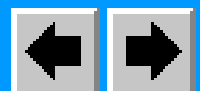
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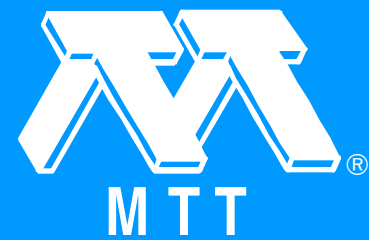
A highly directive dipole antenna embedded in a Fabry-Perot type cavity

T. Akalin, J. Danglot, O. Vanbesien and D. Lippens. "A highly directive dipole antenna embedded in a Fabry-Perot type cavity." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 48-50.

We investigate the origin of the directivity of a dipole antenna embedded in a dielectric slab Fabry-Perot cavity. It is shown that the focusing effect is due to the angular selection rules in the Bragg-type mirror and is directly correlated to the frequency selectivity of the cavity. For a 6 GHz resonant device, having a quality factor of 100, the aperture of the beam pattern (E-H plane) is close to 12/spl deg/ in agreement with the arguments based on frequency and angular selectivities. Hence, this kind of cavity could be used in free-space based communication links.

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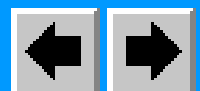
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Comparative investigation on numerical de-embedding techniques for equivalent circuit modeling of lumped and distributed microstrip circuits

Lei Zhu and Ke Wu. "Comparative investigation on numerical de-embedding techniques for equivalent circuit modeling of lumped and distributed microstrip circuits." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 51-53.

A so-called "short-open calibration" (SOC) technique is applied together with two existing numerical de-embedding techniques for equivalent circuit modeling of microstrip circuits based on a full-wave method-of-moments (MoM) algorithm. A stub-loaded microstrip line discontinuity with both electrically short (lumped) and long (distributed) stub lengths is extensively studied in terms of its Z-matrix circuit model. Our obtained results show that the SOC scheme allows an accurate calibration of all the potential error terms out of the core circuit network, thereby avoiding numerical noise-related behaviors regardless of either lumped or distributed circuits, which are nevertheless observed for the two existing techniques.

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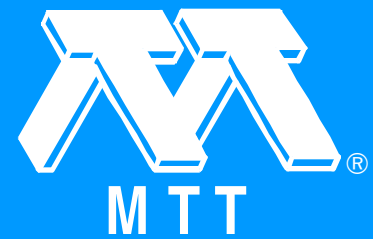
Enhancing the natural frequency doublet splitting in almost periodic azimuthally corrugated cavities

A. Serebryannikov and K. Schuenemann. "Enhancing the natural frequency doublet splitting in almost periodic azimuthally corrugated cavities." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 54-56.

A symmetry of a corrugated periodic structure can be broken due to loading or/and fabrication defects so that frequency doublets may appear, whose frequencies are just slightly splitted. In this letter, we study the potentials to enhance this splitting by enhancing the asymmetry of the cavity. This is provided by a single (loaded) resonator which differs in its geometry from other resonators. The initial causes of the asymmetry are not taken into account. The used characteristic matrix equation is obtained by a mode-matching technique. It is shown that the doublet splitting can reach several percent due to a convenient choice of the geometry of the loaded resonator.

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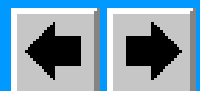
Subjects

An improvement on analytic accuracy of circular groove guide

Hong-Sheng Yang and Yong Liu. "An improvement on analytic accuracy of circular groove guide." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 57-59.

In this paper, an Nth order approximate eigenequation of circular groove guide is presented. Using the sixth order approximate results, some propagation properties of the TE/sub 11/ mode of circular groove guide are recalculated. The results are more accurate than before and in good agreement with the measurements.

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Resonance frequency and bandwidth of rectangular microstrip antenna on thick substrate

A.K. Verma and Nasimuddin. "Resonance frequency and bandwidth of rectangular microstrip antenna on thick substrate." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 60-62.

We report an improved cavity model called modified Wolff model (MWM) to compute the resonance frequency of a rectangular patch antenna on the thick PTFE substrate ($0.037/\lambda_{\text{sub } g} - 0.229/\lambda_{\text{sub } g}$). The MWM accounts for the effect of anisotropy and total losses on the resonance frequency, therefore it has a maximum deviation 2% against the experimental results. The previous cavity model, the multiport cavity model, and MOM based commercial software, Ensemble, compute resonance frequency with deviation between 4%-36%. Results on the bandwidth computed by these models have also been compared against the experimental results.

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An efficient mixed algorithm of L-MEI and DDM for the wave scattering by a concave cylinder

Xiaoxing Yin and Wei Hong. "An efficient mixed algorithm of L-MEI and DDM for the wave scattering by a concave cylinder." 2002 Microwave and Wireless Components Letters 12.2 (Feb. 2002 [MWCL]): 63-65.

In this paper, a localized MEI method (L-MEI) is developed and combined with the domain decomposition method (DDM) for the simulation of scattering by a concave cylinder. In the L-MEI, the whole domain is decomposed into many subdomains. Different from the conventional MEI method, the MEI coefficients of the L-MEI method in each subdomain are only dependent on the localized metrons that are defined in the subdomain. The localization of metrons has the following advantages: (1) speeding up the calculation of MEI coefficients and saving memory, (2) making the MEI method available for concave structures, and (3) obtaining a band sparse matrix directly without any modification.

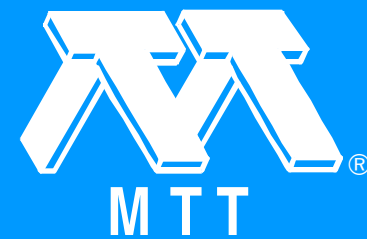
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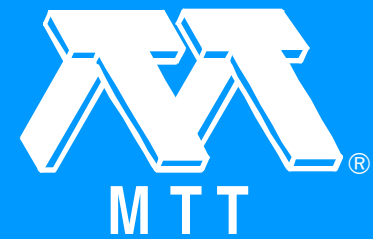
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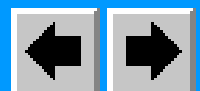
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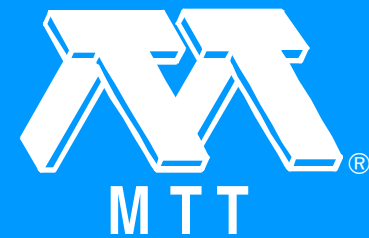
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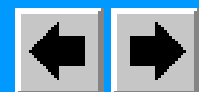
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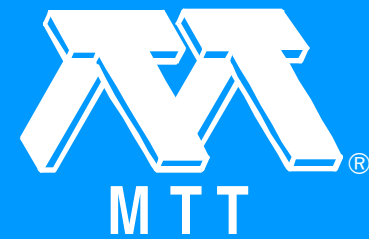
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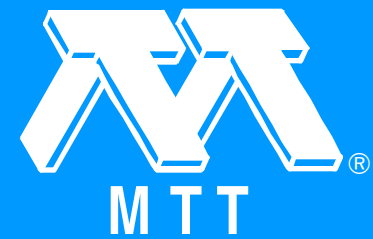
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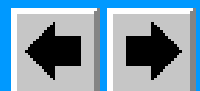
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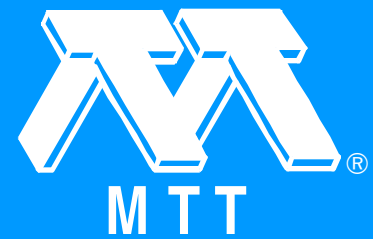
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Four-element planar Butler matrix using half-wavelength open stubs

H. Hayashi, D.A. Hitko and C.G. Sodini. "Four-element planar Butler matrix using half-wavelength open stubs." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 73-75.

A simple design of a four-element planar Butler matrix is presented, comprising half-wavelength open stubs to improve relative-phase characteristics between output ports. Over the frequency range from 0.85 to 0.90 GHz, the experimental matrix exhibits phase errors (in the desired phase differences between output ports) and couplings of within 2/spl deg/ and -6.45/spl plusmn/0.25 dB, respectively.

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A novel surface-mountable millimeter-wave bandpass filter

N. Kinayman, C. Eswarappa, N. Jain and A. Buckle. "A novel surface-mountable millimeter-wave bandpass filter." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 76-78.

A novel millimeter-wave waveguide bandpass filter structure suitable for surface mounting is introduced. The filter is constructed using a rectangular waveguide formed in MMIC substrate employing recently introduced microstrip-to-waveguide transducer. Input and output of the filter are implemented as microstrip lines. The transitions between the microstrip lines and the rectangular waveguide are implemented by using the microstrip-to-waveguide transition. The waveguide filter structure is surface-mountable as flip-chip and can be manufactured using a MMIC process that makes it extremely accurate. It has potential applications in millimeter-wave systems like local multipoint distribution system (LMDS) and autonomous cruise control (ACC) radar for automobiles.

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47 GHz VCO with low phase noise fabricated in a SiGe bipolar production technology

H. Li, H.-M. Rein, R. Kreienkamp and W. Klein. "47 GHz VCO with low phase noise fabricated in a SiGe bipolar production technology." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 79-81.

A low-phase-noise and low-cost millimeter-wave voltage-controlled oscillator (VCO) has been fully integrated in commercial SiGe bipolar technologies. By varying the bias voltage of the on-chip varactor, the frequency can be continuously tuned from 43.6 to 47.3 GHz. In this frequency range, single-sideband phase noise between -103 and -108.5 dBc/Hz at 1 MHz offset frequency was measured. The output voltage swing of the differential circuit is about 0.85 V/sub p-p/ for the single-ended and 1.7 V/sub p-p/ for the differential output.

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Decoupled solutions for design of filters having TEM resonators with attenuation poles in upper stopband

Yoonmi Shin, Kyungdong Lee and Bomson Lee. "Decoupled solutions for design of filters having TEM resonators with attenuation poles in upper stopband." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 82-84.

The equivalent circuits together with decoupled equations are provided as a solution to the problem of designing the filters having TEM resonators with an attenuation pole in the upper stopband. The proposed method simplifies the design of inserting attenuation poles and gives us much flexibility. The presented design example verifies the exactness of the solutions and shows the usefulness of the approach.

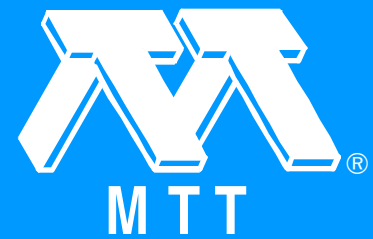
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A new circuit topology for continuous group delay synthesis

J.D. Fredrick, Yuanxun Wang and T. Itoh. "A new circuit topology for continuous group delay synthesis." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 85-87.

A new circuit topology is realized in order to synthesize group delay continuously. The circuit is based upon a new variable coupling coefficient coupled line section and a microstrip feedback loop. The new variable coupler is designed by periodically loading an edge coupled microstrip coupler. With this new design, coupling variation of more than 10 dB may be achieved. To the best of the authors knowledge, this is the first report of this type of microstrip coupler. The complete circuit consumes no dc power and exhibits more than 500 ps of continuous variable true time delay. Insertion loss is better than 3 dB and return loss is better than 15 dB.



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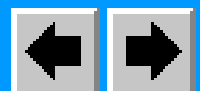
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Ill conditioning in self-heating FET models

S.A. Maas. "Ill conditioning in self-heating FET models." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 88-89.

This paper shows that the introduction of self heating effects into a FET model can cause severe ill conditioning in nonlinear circuit simulators. Depending on the parameter values of the model, the solutions can be indistinct, multiple, or even nonexistent. The result is poor convergence in nonlinear simulations using such models.

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A CPW T-resonator technique for electrical characterization of microwave substrates

R.L. Peterson and R.F. Drayton. "A CPW T-resonator technique for electrical characterization of microwave substrates." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 90-92.

An impedance independent method is proposed using a finite ground coplanar waveguide (CPW) T-resonator to electrically characterize microwave materials. Silicon-based CPW T-resonators are designed and measured, with calibrated data agreeing well with other methods up to 30 GHz. Uncalibrated measurements produce dielectric constant and attenuation results within 3.7% and 25%, respectively, of those obtained with calibration. Hence, the CPW T-resonator can be used to provide rapid and accurate characterization of microwave substrates with unknown dielectric properties.

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Calibration procedure of a microwave total-power radiometer

K. Al-Ansari, P. Garcia, J.M. Riera, A. Benarroch, D. Fernandez and L. Fernandez. "Calibration procedure of a microwave total-power radiometer." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 93-95.

A total-power radiometer built in combination with a beacon receiver is being used for low-level attenuation measurements. This experimental receiver was built to measure atmospheric propagation impairments, using the ITALSAT satellite 50 GHz signal. The radiometer is mainly used to provide the reference level for the beacon measurements. Its precision should be better than ± 3 K, for low attenuation levels, in order to have 0.1 dB accuracy in the attenuation measurements. A suitable calibration procedure is described.

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A reconfigurable patch antenna using switchable slots for circular polarization diversity

Fan Yang and Y. Rahmat-Samii. "A reconfigurable patch antenna using switchable slots for circular polarization diversity." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 96-98.

A novel design of a microstrip patch antenna with switchable slots (PASS) is proposed to achieve circular polarization diversity. Two orthogonal slots are incorporated into the patch and two pin diodes are utilized to switch the slots on and off. By turning the diodes on or off, this antenna can radiate with either right hand circular polarization (RHCP) or left hand circular polarization (LHCP) using the same feeding probe. Experimental results validate this concept. This design demonstrates useful features for wireless communication applications and future planetary missions.

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Concurrent complementary operators for mesh truncation in frequency-domain simulations

O.M. Ramahi. "Concurrent complementary operators for mesh truncation in frequency-domain simulations." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 99-101.

The concurrent complementary operators method (C-COM), when used in the finite-difference time-domain method (FDTD), achieved levels of accuracy unprecedented in any previous mesh-truncation technique. In this paper, we introduce the extension of the C-COM theory to frequency-domain (time-harmonic) simulations. A validation of the new method is demonstrated by using the finite-difference frequency domain (FDFD) method.

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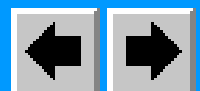
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Reinterpretation of the auxiliary differential equation method for FDTD

Y. Takayama and W. Klaus. "Reinterpretation of the auxiliary differential equation method for FDTD." 2002 Microwave and Wireless Components Letters 12.3 (Mar. 2002 [MWCL]): 102-104.

The auxiliary differential equation method used for treating Lorentz media with the FDTD algorithm is reinterpreted to reduce computer memory requirements while maintaining full time synchronism. This new formulation enables us to save up to 20% of computer memory when compared to the previous approach. The validity of our formulation is proved analytically by comparing the resulting equations with those from the previous method. We also employ this approach for Debye media and show that no disadvantage arises in terms of memory requirement.

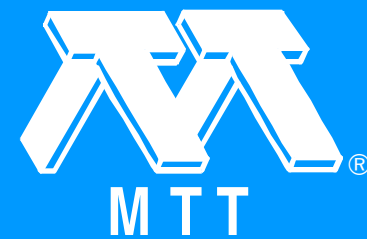
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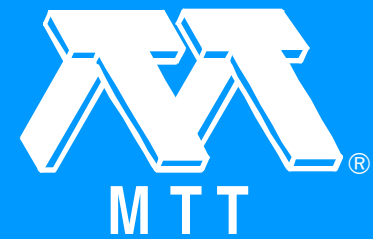
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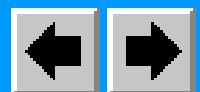
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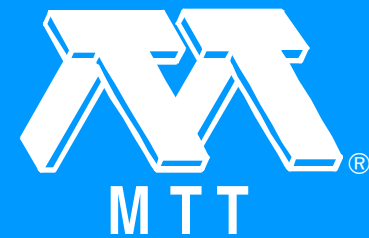
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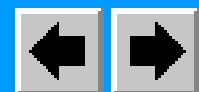
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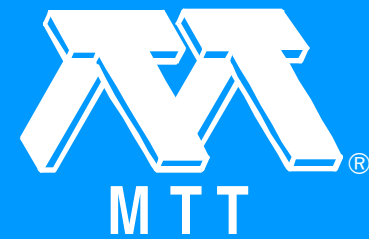
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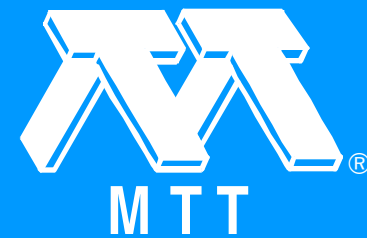
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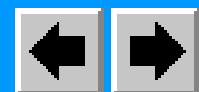
Subjects

A broadband 800 GHz Schottky balanced doubler

G. Chattopadhyay, E. Schlecht, J. Gill, S. Martin, A. Maestrini, D. Pukala, F. Maiwald and I. Mehdi. "A broadband 800 GHz Schottky balanced doubler." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 117-118.

A broadband planar Schottky balanced doubler at 800 GHz has been designed and built. The design utilizes two Schottky diodes in a balanced configuration on a 12 μm thick gallium arsenide (GaAs) substrate as a supporting frame. This broadband doubler (designed for 735 GHz to 850 GHz) uses a split waveguide block and has a relatively simple, fast, and robust assembly procedure. The doubler achieved $\approx 10\%$ efficiency at 765 GHz, giving 1.1 mW of peak output power when pumped with about 9 mW of input power at room temperature.

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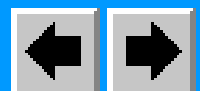
Resistive SiC-MESFET mixer

K. Andersson, J. Eriksson, N. Rorsman and H. Zirath. "Resistive SiC-MESFET mixer." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 119-121.

A single-ended silicon carbide resistive MESFET mixer was designed and characterized. The mixer has a minimum conversion loss of 10.2 dB and an input third order intercept point of 35.7 dBm at 3.3 GHz.



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Feedback for multiband stabilization of CS and CG MESFET transistors

H.F. Hammad, A.P. Freundorfer and Y.M.M. Antar. "Feedback for multiband stabilization of CS and CG MESFET transistors." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 122-124.

A new feedback scheme is used to achieve multiband unconditional stability in common source (CS) and common gate (CG) GaAs MESFET configurations. This technique extends the range of operation of both CG and CS beyond what is currently available. Results based on analytical formulations together with a description of the feedback design procedures are provided. Several CS and CG stabilized transistors were monolithically fabricated and tested.



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Subjects

Microwave photonic vector modulator for high-speed wireless digital communications

W.D. Jemison, A.J. Kreuzberger and E. Funk. "Microwave photonic vector modulator for high-speed wireless digital communications." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 125-127.

The authors present the design, realization, and experimental results of a microwave/photonic circuit suitable for high-speed direct digital modulation of microwave signals. The modulator employs a combination of microwave, photonic, and digital techniques to produce a discrete phase and amplitude (i.e., vector) modulated carrier signal. The proof-of-concept demonstration presented in this paper was performed using a carrier frequency of 1 GHz and supports BPSK, QPSK, and 16-QAM. The authors also discuss ways to modify the modulator to simultaneously achieve data rates on the order of several hundreds of Mbs and wideband frequency hopping.

Click on title for a complete paper.



Novel transition between different configurations of planar transmission lines

A.M.E. Safwat, K.A. Zaki, W. Johnson and C.H. Lee. "Novel transition between different configurations of planar transmission lines." *2002 Microwave and Wireless Components Letters* 12.4 (Apr. 2002 [MWCL]): 128-130.

New designs of coplanar waveguide (CPW)-microstrip, CPW-stripline, conductor backed CPW (CBCPW)-microstrip, and CBCPW-stripline transitions are presented. Simulation using the high frequency structures simulator (HFSS) shows that the return loss of the CPW-microstrip transition is less than -25 dB up to 11 GHz. Similarly is the CPW-stripline transition. In the case of two back to back CBCPW-stripline transitions, the return loss is less than -22 dB up to 9 GHz. Experimentally, the S_{11} of two back to back CBCPW-microstrip transitions on an alumina substrate is less than -15 dB up to 25 GHz.



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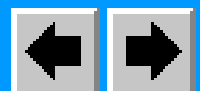
Subjects

Efficient simulation of interconnect networks with frequency-dependent lossy transmission lines

L.Y. Li, G.E. Bridges and I.R. Ciric. "Efficient simulation of interconnect networks with frequency-dependent lossy transmission lines." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 131-133.

Accurate and efficient moment generation methods are important when using moment matching based circuit reduction techniques for the simulation of transients on transmission line networks. A modified matrix exponential method is presented for fast computation of the moments associated with frequency-dependent lossy transmission lines. Numerical examples are given which demonstrate the improved performance of the proposed method with respect to existing techniques.

Click on title for a complete paper.



Transmission characteristics of metallodielectric photonic crystals and resonators

A. Serpenguzel. "Transmission characteristics of metallodielectric photonic crystals and resonators." 2002 *Microwave and Wireless Components Letters* 12.4 (Apr. 2002 [MWCL]): 134-136.

K/sub u/ band Fabry-Perot type resonances have been observed in the stop band of a metallodielectric photonic crystal by transmission measurements at microwave frequencies. The metallodielectric photonic crystal has a face centered cubic Bravais lattice structure with a lattice constant of 15 mm. Metallic spheres with 6.35 mm diameter are placed at the lattice sites. The metallodielectric photonic crystal displayed a directional bandgap with a lower band edge of 13.0 GHz, an upper band edge of 21.5 GHz and a center frequency of 17.25 GHz, corresponding to a stop bandwidth center frequency ratio of 50%. The maximum rejection at the band center is 35 dB, corresponding to a 7 dB per unit cell rejection ratio. The Fabry-Perot type resonance in the K/sub u/ band has a quality factor of 200, with a maximum transmission peak of -5 dB.



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Photonic bandgap dielectric waveguide filter

Chi-Yang Chang and Wei-Chen Hsu. "Photonic bandgap dielectric waveguide filter." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 137-139.

The application of photonic bandgap (PBG) structures as the sidewall of the printed circuit board (PCB) dielectric waveguide filter is investigated. The effect of different PBG parameters on the Q-value of PBG dielectric waveguide resonator is evaluated. A PBG dielectric waveguide three-pole Chebyshev bandpass filter is realized. The measured performance matched well with the calculated results. The newly proposed I/O coupling structure makes the filter much easier for mass production.

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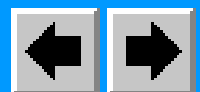
Subjects

A quick and efficient method for determining the scattering matrix of lossless microwave circuits

G. Roussy and B. Willmann. "A quick and efficient method for determining the scattering matrix of lossless microwave circuits." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 140-141.

The measurements of scattering coefficients of an n-port lossless circuit with a VNA may be tedious because the experimental results may be incompatible with each other and do not verify the conditions which relate the coefficients of the unitary matrix. In this letter, we show that it is efficient to fuse the data by calculating, in one step, the unitary part of the primary experimental scattering matrix.

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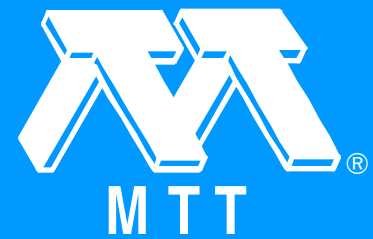
Spherical wave sources in FDTD

M.E. Potter, M. Okoniewski and M.A. Stuchly. "Spherical wave sources in FDTD." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 142-144.

A method is described which simulates the propagation of electromagnetic waves as spherical wave modes, approximated by an FDTD method. Modal equations in radius and time are discretized for explicit time-stepping. Angular functions are implemented analytically as required. Computed results for two examples are compared with analytic solutions - a resonator and a dipole near a conducting sphere - to demonstrate the validity of the method with very good agreement. This method is intended as a source condition in total/scattered FDTD methods, to allow for modeling of near-field object interactions without explicitly modeling the source.

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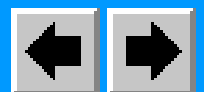
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Miniaturized Wilkinson power dividers utilizing capacitive loading (Comments and reply)

J. Staudinger and M.C Scardellitti. "Miniaturized Wilkinson power dividers utilizing capacitive loading (Comments and reply)." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 145-145.



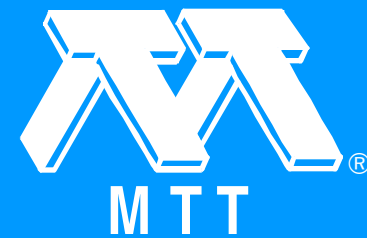
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H.C. Bell. "Patent abstracts (Apr. 2002 [MWCL])." 2002 Microwave and Wireless Components Letters 12.4 (Apr. 2002 [MWCL]): 146-154.



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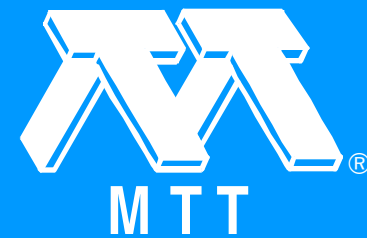
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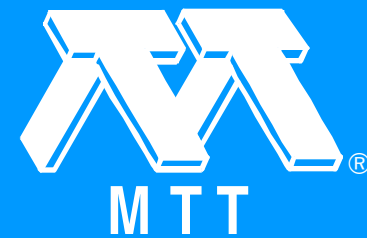
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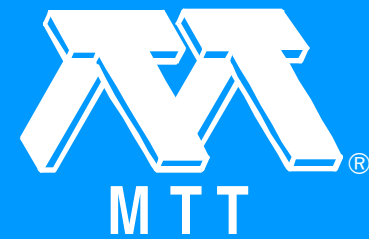
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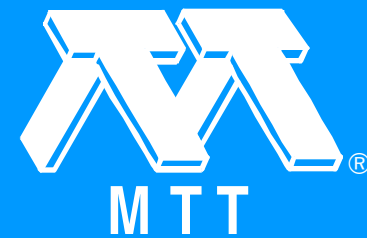
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Ultra low phase noise sapphire-SiGe HBT oscillator

O. Llopis, G. Cibieli, Y. Kersale, M. Regis, M. Chaubet and V. Giordano. "Ultra low phase noise sapphire-SiGe HBT oscillator." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 157-159.

A state of the art C-band oscillator is presented. It is based on a high Q WGM sapphire resonator combined with a low residual phase noise SiGe HBT amplifier. A two oscillator experiment performed on this system has revealed a phase noise level of -133 dBc/Hz at 1 kHz offset from the 4.85 GHz carrier, which is the best published phase noise result for a single loop, free running microwave oscillator.

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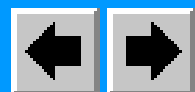
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A 3-D broadband dual-layer multiaperture microstrip directional coupler

Chunlei Wang and Kai Chang. "A 3-D broadband dual-layer multiaperture microstrip directional coupler." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 160-162.

A three-dimensional (3-D) broadband dual-layer multiaperture microstrip directional coupler is presented in this paper. The dual-layer, multiaperture directional coupler consists of two-layer back-to-back substrates with 15 small coupling apertures on the center ground plane. A novel rectangular multiaperture coupling structure with very small width is used to greatly extend the bandwidth and operating frequency of the coupler. The ± 2.4 dB coupling variation bandwidth of the couplers is more than 1.5 octaves from 9.79 to 29.55 GHz. The insertion losses, return losses at all ports and directivities, are better than 1.7 dB, 10.26 dB, and 10.3 dB over the bandwidth, respectively. The measurements agree well with the simulations.

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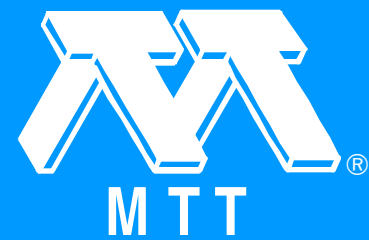
Focusing properties of liquid crystal lens cells with stack-layered structure in the millimeter-wave region

M. Tanaka and S. Sato. "Focusing properties of liquid crystal lens cells with stack-layered structure in the millimeter-wave region." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 163-165.

Liquid crystal (LC) lens cells are fabricated using a nematic LC material with a positive dielectric anisotropy and semicircle-shaped metal substrates as quasioptical millimeter-wave devices. The millimeter-wave focusing properties of the LC lens are measured at 94 GHz and its convergent effects caused by the lens-shaped configuration are then observed. Changes in the focusing properties by applying an external electric field are confirmed.

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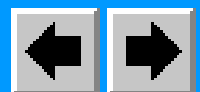
Subjects

A novel electromagnetic bandgap metal plate for parallel plate mode suppression in shielded structures

D. Dawn, Y. Ohashi and T. Shimura. "A novel electromagnetic bandgap metal plate for parallel plate mode suppression in shielded structures." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 166-168.

A novel type of metal plate structure incorporated with electromagnetic bandgap holes for use as metal shields with the capability of suppressing the propagation of unwanted parallel plate mode has been proposed. The holes can be of any shape and the periods of those holes should be selected to half the guided wavelength of the parallel plate mode at a desired center frequency of suppression. To show the validity of the proposal, inert electromagnetic wave simulation, results of a shielded microstrip structure designed for application in the 76 GHz frequency band are demonstrated. Experiments are performed with a prototype designed in the 10 GHz frequency band and parallel plate mode suppression is verified successfully with the excellent agreement between experimental and simulation results.

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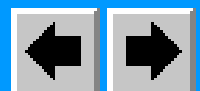
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Coupling suppression in microstrip lines using a bi-periodically perforated ground plane

K.M.K.H. Leong, A.C. Guyette, B. Elamaram, W.A. Shiroma and T. Itoh. "Coupling suppression in microstrip lines using a bi-periodically perforated ground plane." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 169-171.

A perforated ground plane is used to suppress the coupling between adjacent and intersecting transmission lines. Experimental results indicate 40-dB suppression of broadside coupling between two adjacent 50-/spl Omega/ lines. A new option in the design of circuit routing schemes is proposed by demonstrating 28-dB coupling reduction between two intersecting 50-/spl Omega/ lines.

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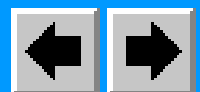
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A wideband orthogonal-mode junction using a junction of a quad-ridged coaxial waveguide and four ridged sectoral waveguides

H.Z. Zhang. "A wideband orthogonal-mode junction using a junction of a quad-ridged coaxial waveguide and four ridged sectoral waveguides." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 172-174.

A wideband orthogonal-mode junction (OMJ) using a quad-ridged circular coaxial waveguide and four single-ridged sectoral waveguides is described. The new structure is used for extracting a wide lower band signal from a coaxial dual-band feed. Theoretical results show that the broadband incoming signal in the quad-ridged coaxial waveguide can be coupled to four single-ridged sectoral waveguides with low reflection. The new structure transforms a complex system to a simple single-ridged sectoral waveguide where multi-band separation can be accomplished by a number of means. The transformation eliminates the interference among the excitation sources and enables the accurate mathematical modeling of the complete system possible.

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Realistic equivalent circuit model of coplanar waveguide open circuit: lossy shunt resonator network

Lei Zhu. "Realistic equivalent circuit model of coplanar waveguide open circuit: lossy shunt resonator network." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 175-177.

Realistic equivalent circuit model of coplanar waveguide (CPW) open circuit is proposed and formulated as a lossy shunt resonator network based on the fact that the electromagnetic (EM) wave propagates at the transverse direction around the open-end. A "short-open calibration" (SOC) technique is applied in the full-wave method of moments (MoM) to effectively extract all the model parameters over a wide frequency range. After the extracted capacitance at low frequency is confirmed by the previous static results, extensive investigation is implemented to reveal the high-frequency dynamic features of CPW open circuit, e.g., shunt resonance and radiation loss. A CPW open-end circuit is then fabricated and measured to provide an experimental verification of the proposed model.

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Reducing the mutual coupling effect in adaptive nulling using a re-defined mutual impedance

Hon Tat Hui. "Reducing the mutual coupling effect in adaptive nulling using a re-defined mutual impedance." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 178-180.

The effect of mutual coupling in an adaptive antenna array for the nulling of interferences is investigated. The concept of mutual impedance is re-defined to take into account of the scattering effect due to the other antenna elements in the array. The re-defined mutual impedances are used to reduce the mutual coupling effect by calculating the open-circuit voltages from the measured voltages on the antenna terminals. Results show that by using the re-defined mutual impedances, substantial improvements in term of the depths and the accuracy of the nulls can be obtained over a previous method.

A perfectly matched layer for the 3-D wave equation in the time domain

Y. Rickard, N. Georgieva and Wei-Ping Huang. "A perfectly matched layer for the 3-D wave equation in the time domain." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 181-183.

In this paper, a three-dimensional (3-D) PML for the 3-D scalar wave equation is proposed for applications in practical finite difference time-domain schemes such as the time-domain wave-potential (TDWP) technique and the time-domain scalar wave equation approaches to the analysis of optical waveguides. The theoretical formulation is based on the stretched coordinates approach. It is shown that this PML is suitable for the termination of open problems as well as for port terminations in high-frequency circuit problems. New PML conductivity profile is proposed, which offers lower reflections in a wider frequency band in comparison with the commonly used profiles.



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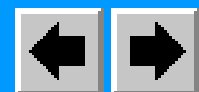
Subjects

A flat four-beam compact phased array antenna

M. Krairiksh, P. Ngamjanyaporn and C. Kessuwan. "A flat four-beam compact phased array antenna." 2002 Microwave and Wireless Components Letters 12.5 (May 2002 [MWCL]): 184-186.

This paper presents a flat four-beam compact phased array antenna. The low-cost and compact phased array antenna is designed using a circular array of four circular microstrip antennas made of low-cost material and four 1-bit phase shifters. The main beam of the antenna can be switched in four directions with the gain of about 4 dBi in each main-beam direction. More than 90/spl deg/ half-power beamwidth and over 10 dB F/B ratio are obtained. In addition, the diversity performance is considered and the diversity performance of this antenna can be provided with the envelope correlation about 0.6.

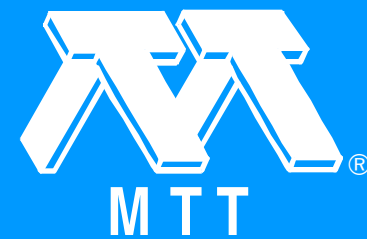
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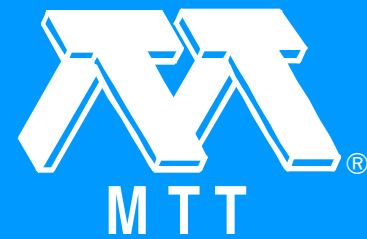
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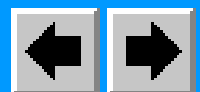
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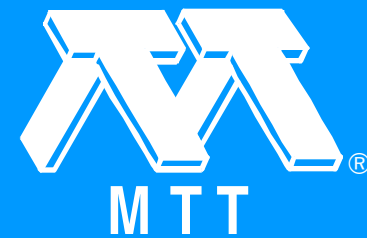
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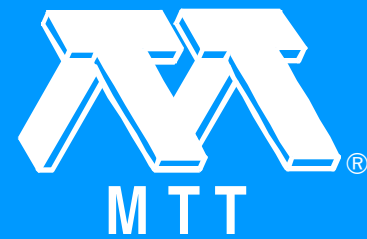
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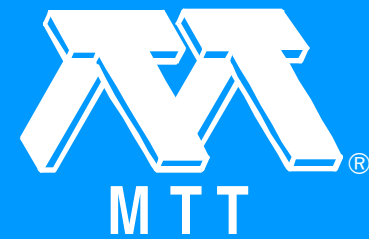
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Photovaractor for remote optical control of microwave circuits

S.A. Malyshev, B.A. Galwas, J. Piotrowski, A.L. Chizh and Z.R. Szczepaniak. "Photovaractor for remote optical control of microwave circuits." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 201-203.

A photovaractor for the remote optical control of microwave circuits was studied. The photovaractor was fabricated as a p-i-n photodiode placed in a pigtailed fiber optical module. The study of the impedance in the frequency range up to 3 GHz in darkness and under illumination has shown that the photovaractor capacitance strongly depends on the incident optical power. The capacitance variation of the photovaractor diode under illumination is discussed.

Linearized mixer using predistortion technique

Youngwook Kim, Youngsik Kim and Soonghak Lee. "Linearized mixer using predistortion technique." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 204-205.

A predistortion technique has been proposed to reduce intermodulation distortion (IMD) generated from the conversion process of a mixer. In this technique, the IMD generated from a mixer in the IF band was cancelled by the controlled RF error signal, which is generated by a predistorter. The magnitude and phase of the RF error signal were properly adjusted through a vector modulator. This linearization technique has been verified by experiment of a down conversion mixer in the cellular band. A two tone test has been performed at the frequency of 836 MHz with 442 kHz separation. The results show that this method improves about 16 dB of IMD3 at -18 dBm IF output power in 10 MHz frequency band and increases about 3.5 dB of P1 dB of the mixer. Simple topology and good performance in linearization of IF signals renders this technique suitable for highly linear frequency conversion in communication systems.



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A new ultra-wideband, ultra-short monocycle pulse generator with reduced ringing

Jeongwoo Han and Cam Nguyen. "A new ultra-wideband, ultra-short monocycle pulse generator with reduced ringing." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 206-208.

We introduce a new ultra-wideband (UWB), ultra-short, step recovery diode monocycle pulse generator. This pulse generator uses a simple RC high-pass filter as a differentiator to generate the monocycle pulse directly. The pulse-shaping network employs a resistive circuit to achieve UWB matching and substantial removal of the pulse ringing, and rectifying and switching diodes to further suppress the ringing. An ultra-short monocycle pulse of 300-ps pulse duration, -17-dB ringing level, and good symmetry has been demonstrated. Good agreement between the measured and calculated results was achieved.

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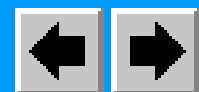
Subjects

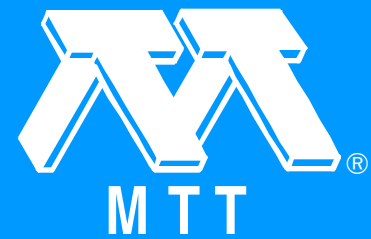
A 78-114 GHz monolithic subharmonically pumped GaAs-based HEMT diode mixer

Yuh-Jing Hwang, Chun-Hsien Lien, Huei Wang, M.W. Sinclair, R.G. Gough, H. Kanoniuk and Tah-Hsiung Chu. "A 78-114 GHz monolithic subharmonically pumped GaAs-based HEMT diode mixer." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 209-211.

A W-band subharmonically pumped (SHP) diode mixer is designed for fixed LO frequency operation. It is fabricated on a 4-mil substrate using 0.15 μm GaAs PHEMT MMIC process. The on-wafer measurement results show that the conversion loss is about 10 to 14 dB across the W band, as a 10 dBm 48 GHz LO signal is pumped. To our knowledge, this is the state-of-the-art result on low-conversion-loss wideband MMIC SHP diode mixer. The packaged module measurement shows a similar result. Both the simulation and measurement results are shown to be in good agreement.

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A DC-contact MEMS shunt switch

Guan-Leng Tan and G.M. Rebeiz. "A DC-contact MEMS shunt switch." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 212-214.

This paper presents the design, fabrication, and performance of a metal-to-metal contact micro-electro-mechanical (MEMS) shunt switch. The switch is composed of a fixed-fixed metal beam with two pull-down electrodes and a central DC-contact area. The switch is placed in an in-line configuration in a coplanar waveguide transmission line. This topology results in a compact DC-contact shunt switch and high isolation at 0.1-18 GHz. The isolation at MM-wave frequencies is limited by the inductance to ground and is -20 dB at 18 GHz. The application areas are in wireless communications and high-isolation switching networks for satellite systems.

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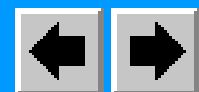
Subjects

Design of triple mode TE/sub 01/spl delta// resonator transmission filters

V. Walker and I.C. Hunter. "Design of triple mode TE/sub 01/spl delta// resonator transmission filters." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 215-217.

The use of triple mode TE/sub 01/spl delta// cubic resonators for the design of transmission mode filters is presented. Frequency tuning and coupling between modes are studied experimentally. The tunability of all inter-cavity couplings, necessary for the realization of a wide range of transfer functions, is demonstrated with a 6th degree, 5 MHz wide filter at 2 GHz. With an insertion loss of 0.7 dB in a volume of 260 cm/sup 3/, the filter presents a 2:1 volume reduction over conventional TE/sub 01/spl delta// filters.

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Application of the CFS PML to the absorption of evanescent waves in waveguides

J.-P. Berenger. "Application of the CFS PML to the absorption of evanescent waves in waveguides." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 218-220.

The author shows that the complex frequency shifted PML (CFS PML) can be optimized in view of absorbing both the evanescent and traveling waves at the end of waveguiding structures. Numerical results are provided to illustrate the effectiveness of the optimized CFS PML in FDTD computations.

Click on title for a complete paper.



A new millimeter-wave step-frequency radar sensor for distance measurement

Joongsuk Park and Cam Nguyen. "A new millimeter-wave step-frequency radar sensor for distance measurement." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 221-222.

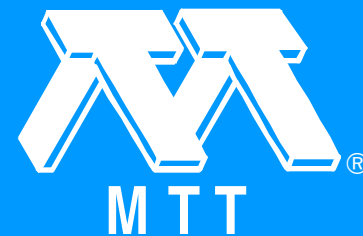
A new compact millimeter-wave distance-measurement sensor prototype has been developed. The sensor is a step-frequency radar implemented using coherent heterodyne technique. It operates in Ka-band (26.5-40 GHz) and is realized using MICs and MMICs. The sensor transmits sinusoidal signals of incremental frequencies and demodulates the received signals into base-band I/Q signals for processing. Experimental results show that the sensor is capable of measuring distance with less than 0.2 inch of absolute error and a low transmitted power of only -20/spl plusmn/3 dBm.

Abstracts

Optimization of subgridding schemes for FDTD

Shumin Wang, F.L. Teixeira, R. Lee and Jin-Fa Lee. "Optimization of subgridding schemes for FDTD." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 223-225.

A procedure to optimize the coupling coefficients between fine and coarse mesh regions for two-dimensional (2-D) finite-difference time-domain (FDTD) subgridding algorithms is introduced. The coefficients are optimized with respect to different angles and expanded in a form suitable for FDTD computation.



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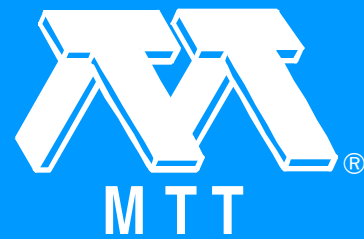
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Abstracts

A wideband orthogonal mode junction using a junction of a quad-ridged coaxial waveguide and four ridged sectoral waveguides (Correction)

H.Z. Zhang. "A wideband orthogonal mode junction using a junction of a quad-ridged coaxial waveguide and four ridged sectoral waveguides (Correction)." 2002 Microwave and Wireless Components Letters 12.6 (Jun. 2002 [MWCL]): 226-226.



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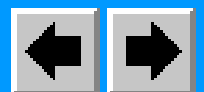
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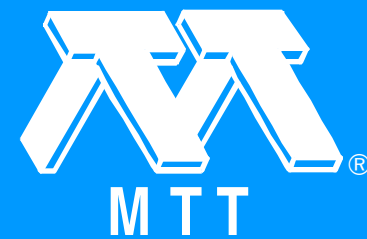
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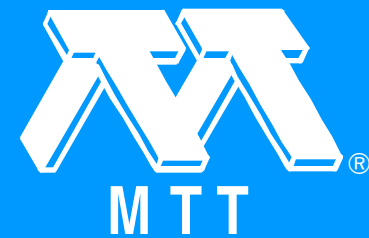
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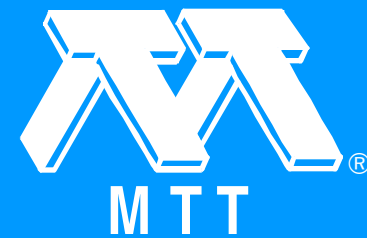
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"Inside Cover (Jul. 2002 [MWCL])." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 0_2-0_2.



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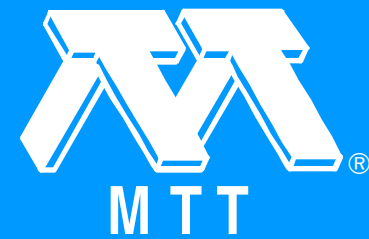
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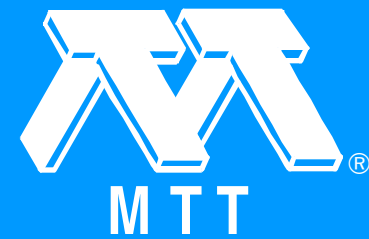
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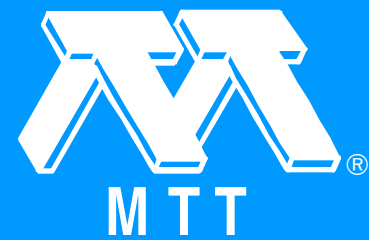
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A new high performance phase shifter using $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ thin films

B. Acikel, T.R. Taylor, P.J. Hansen, J.S. Speck and R.A. York. "A new high performance phase shifter using $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ thin films." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 237-239.

In this paper, a new device topology has been proposed to implement parallel plate capacitors using $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ (BST) thin films. The device layout utilizes a single parallel capacitor and minimizes conductor losses in the base electrode. The new design simplifies the monolithic process and overcomes the problems associated with electrode patterning. An X-band 180/spl deg/ phase shifter has been implemented using the new device design. The circuit provided 240/spl deg/ phase shift with an insertion loss of only 3 dB at 10 GHz at room temperature. We have shown a figure of merit 93/spl deg//dB at 6.3 GHz and 87/spl deg//dB at 8.5 GHz. To our knowledge, these are the best figure of merit results reported in the literature for distributed phase shifters implemented using BST films at room temperature.

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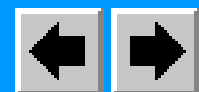
Subjects

Multilayer LTCC bandpass filter design with enhanced stopband characteristics

Wing-Yan Leung, K.-K.M. Cheng and Ke-Li Wu. "Multilayer LTCC bandpass filter design with enhanced stopband characteristics." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 240-242.

Lumped-element bandpass filter structures with enhanced stopband rejection targeted for low temperature co-fired ceramic (LTCC) implementation are proposed. Design equation formulations that take into account the effect of the transmission zeros are presented. For demonstration, RF filters operating at 2.4 GHz are fabricated and characterized. Both simulation and measurement results are shown for comparison.

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S-band reflection type variable attenuator

C.R. Trent and T.M. Weller. "S-band reflection type variable attenuator." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 243-245.

A reflection type variable attenuator is described in this letter. The main component of the circuit is a microstrip 3 dB quadrature coupler. The coupler is used in conjunction with two varactor diodes to vary the attenuation from 2.2 dB to 17 dB over a 40% bandwidth (2.8-4.2 GHz). If married with a programmable voltage controller, the proposed design will provide a low-cost solution for applications with narrow instantaneous bandwidth.

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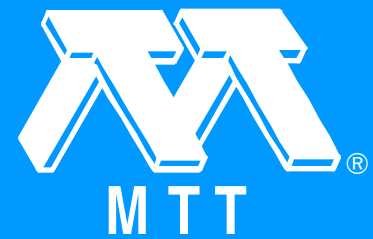
A study of MIMIM on-chip capacitor using Cu/SiO/sub 2/ interconnect technology

Chen Zhen, Guo Lihui, Yu Mingbin and Zhang Yi. "A study of MIMIM on-chip capacitor using Cu/SiO/sub 2/ interconnect technology." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 246-248.

In this work, a new metal-insulator-metal-insulator-metal (MIMIM) on-chip capacitor is fabricated using Cu/SiO/sub 2/ backend technology. A capacitance density of 1.7 fF//spl mu/m/sup 2/ has been achieved with satisfactory dc and RF characteristics. Compared with conventional metal-insulator-metal (MIM) capacitors, the MIMIM doubles the capacitance density without weakening quality in either dc or RF characteristics. Also, its yield is predictable. Therefore, it has been shown to be a convenient and reliable method to improve capacitance density for on-chip standard Cu/SiO/sub 2/ backend technology.

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A general small-signal series impedance extraction technique

L. Vestling and J. Ankarcrona. "A general small-signal series impedance extraction technique." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 249-251.

A new technique for extracting the series inductances and resistances in a small-signal equivalent circuit is presented. The technique does not rely on approximation and should therefore be as accurate as the measured data. The technique can also be used to extract the intrinsic parameters if they are not easily achieved using other methods. The method is exemplified with a microwave LDMOS transistor.

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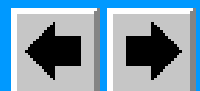
Subjects

A modified microstrip circular patch resonator filter

Boon Tiong Tan, Siou Teck Chew, Mook Seng Leong and Ban Leong Ooi. "A modified microstrip circular patch resonator filter." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 252-254.

Circular holes are etched off a microstrip disk resonator. This results in a size reduction of 30%. By offsetting the positions of some of these holes, a degenerate orthogonal mode is excited, resulting in a split-mode bandpass filter. This filter can be considered as a lattice-type structure. A filter with a bandwidth of 8% centered at 2.0 GHz was designed. The measured insertion loss is 0.6 dB.

Click on title for a complete paper.



A planar X-band electromagnetic band-gap (EBG) 3-pole filter

Hsuan-ju Hsu, M.J. Hill, J. Papapolymerou and R.W. Ziolkowski. "A planar X-band electromagnetic band-gap (EBG) 3-pole filter." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 255-257.

A Duroid-based X-band electromagnetic band gap (EBG) Chebyshev 3-pole bandpass filter that is compatible with standard printed circuit board (PCB) fabrication techniques has been designed, fabricated, and tested. The filter consists of three EBG cavities in a multi-layer design. It provides a 5.95% bandwidth response at the resonant frequency $f_{\text{sub res}} = 9.72$ GHz with a corresponding insertion loss of 0.9 dB. Isolation is higher than 30 dB below 9 GHz and above 11 GHz.



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Efficient body of revolution finite-difference time-domain modeling of integrated lens antennas

M.J.M. van der Vorst and P.J.I. de Maagt. "Efficient body of revolution finite-difference time-domain modeling of integrated lens antennas." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 258-260.

An efficient body of revolution finite-difference time-domain (BOR-FDTD) method for the analysis of the radiation properties of integrated lens antennas is presented in this paper. By neglecting most of the reactive power of the planar feed and by expanding the filtered source currents into azimuthal modes, lenses with both rotationally and nonrotationally symmetric planar feeds can be handled. It appears that three to four azimuthal modes are sufficient to adequately model the magnetic currents of a double-slot feed. Therefore, compared to a full three-dimensional (3-D) numerical method, the implementation of the proposed method is very time and memory efficient. If only the radiation properties are required, the model described here can also be applied efficiently to other axially symmetric geometries with an asymmetric feeding structure.

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Application of defected ground structure in reducing the size of amplifiers

Jong-Sik Lim, Jun-Seok Park, Young-Taek Lee, Dal Ahn and Sangwook Nam. "Application of defected ground structure in reducing the size of amplifiers." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 261-263.

This letter presents a new technique to reduce the size of microwave amplifiers using a defected ground structure (DGS). The DGS on the ground plane of a microstrip line provides an additional effective inductive component, which enables a microstrip line with very high impedance to be realized and shows slow-wave characteristics. The resultant electrical length of the microstrip line with DGS is longer than that of a conventional line for the same physical length. Therefore, the microstrip line with DGS can be shortened in order to maintain the same electrical length, matching, and performances of the basic (original) amplifier. To confirm the validity of this idea, two amplifiers, one of which is designed using a conventional microstrip line and the other is reduced using DGS, are fabricated, measured, and compared. The performance of the reduced amplifier with DGS is quite similar to that of the basic amplifier, even though the series microstrip lines with DGS are much smaller than those of the basic amplifier by 53.8% and 55.6% at input and output matching networks, respectively.



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A simple recursive formula for calculating the S-parameters of finite periodic structures

Cen Yen Ong and M. Okoniewski. "A simple recursive formula for calculating the S-parameters of finite periodic structures." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 264-266.

A simple and efficient recursive formula to calculate the S-parameters of large, finite periodic structures is introduced. The technique utilizes measured or computed S matrices of structures with a small number of periods. The formula is verified on a simple rectangular waveguide with periodic gratings. Results from the formula are plotted against similar results obtained from finite-difference time-domain (FDTD) simulations, and they show excellent agreement. This formula can be used to compute the S-parameters of large microwave or optical periodic structures, which, by virtue of their finiteness may not be open to the application of periodic boundary conditions.

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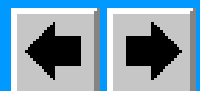
Subjects

Full-wave analysis of cross-aperture waveguide couplers

Zhihua Jiang and Zhongxiang Shen. "Full-wave analysis of cross-aperture waveguide couplers." *2002 Microwave and Wireless Components Letters* 12.7 (Jul. 2002 [MWCL]): 267-269.

This paper presents a full-wave analysis of coupling between rectangular waveguides through a cross-aperture. The rigorous mode-matching method is used to derive the generalized scattering matrix of a waveguide T-junction having a crossed waveguide as the side arm. Two three-port T-junctions are then cascaded together to form a number of cross-aperture couplers. The analysis method can handle both broad-wall and narrow-wall, both parallel and crossed coupling structures. Our numerical results for a variety of couplers are in good agreement with those obtained by Ansoft's HFSS.

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Optimized compact active downconverters having low power consumption and high conversion gain

B.P. Kumar, G.R. Branner, D. Xu and A. Ching. "Optimized compact active downconverters having low power consumption and high conversion gain." 2002 Microwave and Wireless Components Letters 12.7 (Jul. 2002 [MWCL]): 270-272.

An in-depth technique for modeling, optimized design, and fabrication of compact, active low power downconverters, operating at /spl sim/1 GHz, is presented in this paper. The designs employ precision computer models of active devices, developed to assist in providing optimal self oscillating mixer based designs. The designs yield measured conversion gains of up to 9 dB (for maximum bias power of 17.3 mW) and 6.5 dB (for maximum bias power as low as 1.7 mW).

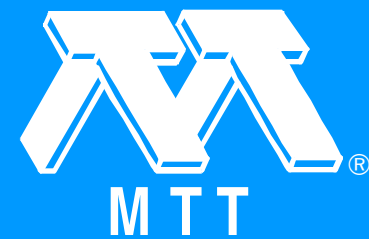
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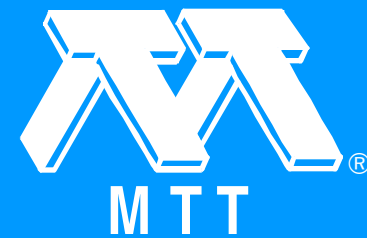
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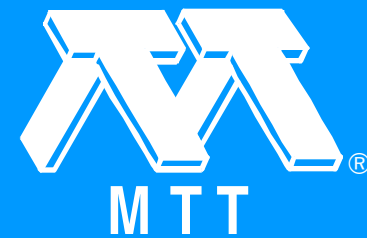
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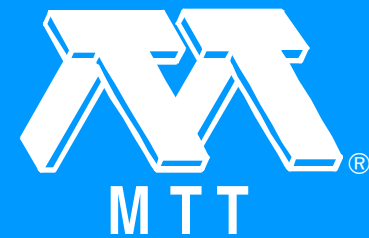
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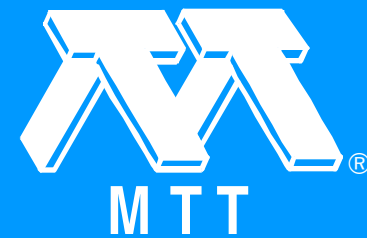
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Monolithic integrated circuits incorporating InP-based heterostructure barrier varactors

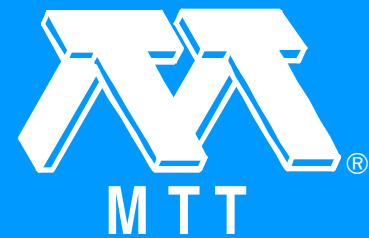
T. David, S. Arscott, J.-M. Munier, T. Akalin, P. Mounaix, G. Beaudin and D. Lippens.

"Monolithic integrated circuits incorporating InP-based heterostructure barrier varactors." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 281-283.

Fully integrated monolithic circuits incorporating InP-based heterostructure barrier varactor (HBV) frequency multipliers have been fabricated via epitaxial liftoff and transfer-substrate techniques onto a quartz substrate. We have obtained a maximum output power of 6 mW at 288 GHz: corresponding to an overall efficiency of 6%. In addition, we have observed a 45-GHz, 3-dB bandwidth centered around 300 GHz for a constant input power of 70 mW.

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Simple and accurate technique for extracting the parasitic resistances of the dual-gate GaAs MESFET

M. Ibrahim, B. Syrett and J. Bennett. "Simple and accurate technique for extracting the parasitic resistances of the dual-gate GaAs MESFET." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 284-286.

A procedure to extract the extrinsic resistances of the dual-gate GaAs MESFET (DGFET) is described. Six dc measurement setups are used to generate nine independent relations from which all the unknown extrinsic resistances of the DGFET are extracted. The described technique distinguishes between the forward bias and the nonforward bias values of the channel resistance. The extrinsic resistances of 29 devices with different topologies are determined using the developed technique. The extracted resistances follow normal scaling rules versus gate width. The developed procedure is a practical and accurate approach to extract the extrinsic resistances of the DGFET.

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Harmonic-balance analysis of digital frequency dividers

A. Anakabe, J.P. Pascual, J. Portilla, J. Jugo and J.M. Collantes. "Harmonic-balance analysis of digital frequency dividers." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 287-289.

In this letter, a novel technique that enables the simulation of digital frequency dividers at low computation cost using conventional harmonic-balance software is presented. It relies on a continuation method, implemented with standard library elements, which is externally coupled to the core of the harmonic-balance algorithm. The technique provides a straightforward method for tracing solution curves and input sensitivity curves of frequency dividers. A digital divide-by-two monolithic microwave integrated circuit (MMIC) has been analyzed using the proposed technique.

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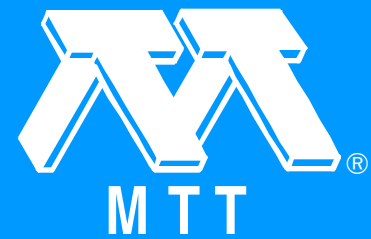
Hybrid multilevel/multigrid potential preconditioner for fast finite element modeling

Yu Zhu and A.C. Cangellaris. "Hybrid multilevel/multigrid potential preconditioner for fast finite element modeling." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 290-292.

A robust hybrid multilevel/multigrid potential preconditioner is introduced for the fast and robust finite-element modeling of electromagnetic structures. The proposed preconditioning process combines the advantages of the hierarchical multilevel preconditioner and the nested multigrid potential preconditioner into a novel preconditioner with superior computational versatility. Numerical experiments from the application of the new preconditioner to the finite-element analysis of microwave devices demonstrate its superior numerical convergence and efficient memory usage.

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Modeling of frequency-dependent magnetized plasma in hybrid symmetrical condensed TLM method

M.I. Yaich, M. Khalladi, I. Zekik and J.A. Morente. "Modeling of frequency-dependent magnetized plasma in hybrid symmetrical condensed TLM method." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 293-295.

In this paper, magnetized plasma media are modeled using the time-domain TLM method with hybrid symmetrical condensed node (HSCN). The proposed technique consists in adding voltage sources characterizing dispersive media in the HSCN. Numerical results are presented for reflection and transmission coefficients for a magnetized plasma wall, proving the efficiency of the proposed model.

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Novel design possibilities for dual-mode filters without intracavity couplings

U. Rosenberg and S. Amari. "Novel design possibilities for dual-mode filters without intracavity couplings." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 296-298.

This letter presents coupling schemes and design guidelines for dual-mode filters without intracavity couplings. Examples of filters of orders two and four are presented to document the flexibility of these solutions. These coupling schemes allow the change of transmission zeros from either side of the passband to the other by only detuning the resonators and without changing the coupling coefficients.

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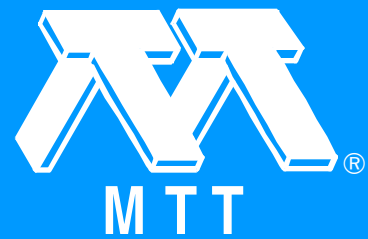


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A new coax to troughguide transition

G.D. Hopkins, B.K. Edenfield, J.G. Hampton and R.L. Roberts. "A new coax to troughguide transition." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 299-301.

This letter presents a new transition from coax to troughguide. The transition was developed using a combination of finite element method modeling and experimental validation. A frequency bandwidth of approximately 12% was achieved at a reflection coefficient of -20 dB. Detailed design parameters and a comparison between modeled and measured results are presented.



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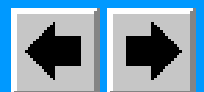
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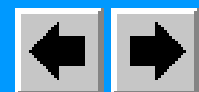
Subjects

Theoretical analysis of surface mountable triple-mode ceramic cavity

Y. Tikhov and Jeong Phill Kim. "Theoretical analysis of surface mountable triple-mode ceramic cavity." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 302-304.

A novel surface-mountable ceramic cavity has been considered. The high-permittivity ceramic filling of the basic triple-mode waveguide cavity makes the proposed structure physically small. Integrated microstrip to ceramic filled waveguide transitions provide effective coupling between ceramic cavity and planar circuit. A key point of the suggested theory consists of utilization of weighted Gegenbauer polynomials as the basis functions for the Galerkin's procedure. Such a choice of basis functions guarantees high accuracy and efficiency for the entire simulation algorithm. As an application example, a three-pole L-band filter with advanced high-quality factor is demonstrated.

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Broadband loop antenna for DCS-1800/IMT-2000 mobile phone handsets

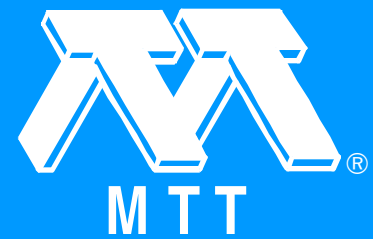
R.L. Li, E.M. Tentzeris, J. Laskar, V.F. Fusco and R. Cahill. "Broadband loop antenna for DCS-1800/IMT-2000 mobile phone handsets." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 305-307.

A rectangular loop antenna is proposed for DCS-1800 and IMT-2000 mobile phone handsets. By introducing a small gap in the wire loop, an impedance bandwidth of 24% can be achieved. The antenna mounted on a metal box is simulated using the FDTD method. It is found that the introduction of a small gap also results in a radiation pattern with desirable polarization independence and a reduced gain in the direction of the user's head. The simulated and measured results are presented.

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Improvements in the performance of microstrip antennas on finite ground planes through ground plane edge serrations

G.H. Huff and J.T. Bernhard. "Improvements in the performance of microstrip antennas on finite ground planes through ground plane edge serrations." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 308-310.

This paper explores how edge serrations on a truncated ground plane affect the performance of a microstrip antenna. The investigation includes both simulations and measurements of a range of serration dimensions. Improvements in performance through ground plane edge serration include lower cross-polarization level, increased beam width, and slight impedance tuning compared to a microstrip antenna on a simple finite ground plane.

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Two-dimensional scanning leaky-wave antenna by utilizing the phased array

Chien-Jen Wang, Hua-Lin Guan and C.F. Jou. "Two-dimensional scanning leaky-wave antenna by utilizing the phased array." 2002 Microwave and Wireless Components Letters 12.8 (Aug. 2002 [MWCL]): 311-313.

An aperture-fed patch antenna array is connected to the open end of a short leaky-wave antenna (LWA) to demonstrate the two-dimensional beam-scanning capability in this paper. This design not only offers another radiation path of the reflected wave, but also creates another scanning radiation pattern on the back plane of the substrate. The reflected wave of the LWA is equally separated by a power divider, modulated by each varactor-tuned phase shifter, and injected into two radiating aperture-coupled antennas. The operated frequencies are tuned to control the LWA main position in the elevation plane; meanwhile, by tuning the phase difference between two phase shifters, the main beam of the aperture-coupled antenna array can be scanned in the backside E plane. Experimental result shows that the suppression of the reflected wave can be 7 dB at 10.0 GHz with a short LWA length of 6 cm (two wavelengths). The H-plane and backside E-plane scanning radiation patterns have great potential in many applications and provide more flexibility to traditional designs.

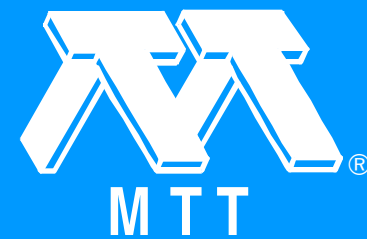
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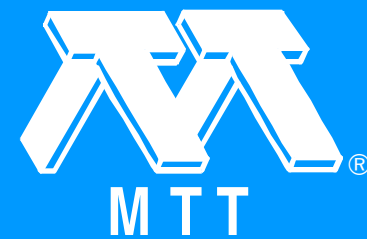
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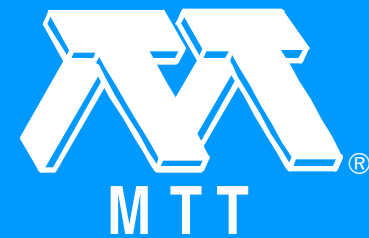
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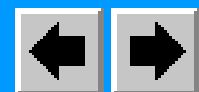
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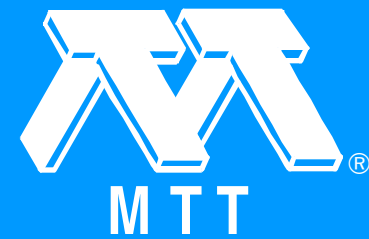
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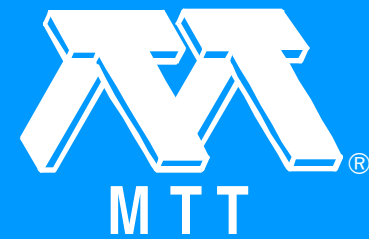
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A 2-bit RF MEMS phase shifter in a thick-film BGA ceramic package

K. Varian and D. Walton. "A 2-bit RF MEMS phase shifter in a thick-film BGA ceramic package." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 321-323.

The development of a thick-film hermetic BGA package for a radio-frequency (RF) microelectromechanical systems (MEMS) 2-bit phase shifter is presented. The measured packaged MEMS phase shifter average in-band insertion loss was 1.14 dB with an average return loss of 15.9 dB. The package transition insertion loss was less than 0.1 dB per transition with excellent agreement between simulated and measured results. It was also demonstrated that the RF MEMS phase shift performance could be improved to obtain a phase error of less than 3.3 degrees. The first reported measurements of the average rise and fall times associated with a MEMS circuit (in this case a 2-bit phase shifter) were 26 and 70 /spl mu/s, respectively. The advent of packaged RF MEMS phase shifters will reduce the cost (both design and building) of future phase arrays.

A compact V-band 2-bit reflection-type MEMS phase shifter

Hong-Teuk Kim, Jae-Hyoung Park, Jounghwa Yim, Yong-Kweon Kim and Youngwoo Kwon. "A compact V-band 2-bit reflection-type MEMS phase shifter." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 324-326.

Air-gap overlay CPW couplers and low-loss series metal-to-metal contact microelectromechanical system (MEMS) switches have been employed to reduce the loss of reflection-type MEMS phase shifters at V-band. Phase shift is obtained by changing the lengths of the open-ended stubs using series MEMS switches. A 2-bit [135] reflection-type MEMS phase shifter showed an average insertion loss of 4 dB with return loss better than 11.7 dB from 50 to 70 GHz. The chip is very compact with a chip size as small as 1.5 mm /spl times/ 2.1 mm.

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Performance of 1-10-GHz traveling wave amplifiers in 0.18-/spl mu/m CMOS

B.M. Frank, A.P. Freundorfer and Y.M.M. Antar. "Performance of 1-10-GHz traveling wave amplifiers in 0.18-/spl mu/m CMOS." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 327-329.

The authors present two four-stage traveling-wave amplifiers (TWA) fabricated in a 0.18-/spl mu/m CMOS process. A TWA with an internal drain bias network achieved a gain of 5 dB out to 10 GHz, and another TWA without an on-chip bias network achieved a gain of 8 dB out to 10 GHz. These are the highest frequency CMOS TWAs known to the authors.

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A spiral-shaped defected ground structure for coplanar waveguide

Jong-Sik Lim, Chul-Soo Kim, Young-Taek Lee, Dal Ahn and Sangwook Nam. "A spiral-shaped defected ground structure for coplanar waveguide." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 330-332.

The authors present a spiral-shaped defected ground structure for coplanar waveguides (DGSCPW), which can be used as a kind of periodic structure for a planar transmission line. The proposed spiral-DGSCPW adopts spiral-shaped defects on both ground planes of CPW. Due to the spiral-shaped defects, the equivalent shunt inductance and slow-wave effects increase more rapidly than the standard CPW or CPW lines combined with the conventional PBG. The modeling and analysis to extract the equivalent circuit, increased slow-wave factor, and simulated and measured performances are presented.



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Dispersion characteristics of substrate integrated rectangular waveguide

Y. Cassivi, L. Perregini, P. Arcioni, M. Bressan, K. Wu and G. Conciauro. "Dispersion characteristics of substrate integrated rectangular waveguide." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 333-335.

Dispersion properties of the substrate integrated rectangular waveguide (SIRW) are rigorously obtained using the BI-RME method combined with the Floquet's theorem. Our analysis shows that the SIRW basically has the same guided-wave characteristics as the conventional rectangular waveguide. Empirical equations are derived from the calculated dispersion curves in order to estimate the cutoff frequency of the first two dominant modes of the SIRW. To validate the analysis results, an SIRW guide was designed and measured. Very good agreements between the experimental and theoretical results were obtained.

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A new approach to amplifier linearization by the generalized baseband signal injection method

Chi-Shuen Leung, Kwok-Keung and M. Cheng. "A new approach to amplifier linearization by the generalized baseband signal injection method." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 336-338.

The authors present a new technique for the reduction of third-order intermodulation distortion (IMD) in microwave amplifiers. A baseband predistortion signal is injected into a diode circuitry and the main amplifier to mix with the fundamental to generate a canceling signal for the suppression of the inherent IMD component. The proposed method can achieve higher linearity performance, in comparison to the conventional difference-frequency approach, and unlike many other techniques, no RF circuitry, such as variable gain amplifiers and phase-shifters, is needed other than baseband amplifiers. Both two-tone and vector signal measurement results are included.

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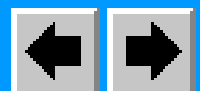
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Equivalent-voltage approach for modeling low-frequency dispersive effects in microwave FETs

A. Santarelli, G. Zucchelli, R. Paganelli, G. Vannini and F. Filicori. "Equivalent-voltage approach for modeling low-frequency dispersive effects in microwave FETs." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 339-341.

In this paper, a simple and efficient approach for the modeling of low-frequency dispersive phenomena in FETs is proposed. The method is based on the definition of a virtual, nondispersive associated device controlled by equivalent port voltages and it is justified on the basis of a physically-consistent, charge-controlled description of the device. Dispersive effects in FETs are accounted for by means of an intuitive circuit solution in the framework of any existing nonlinear dynamic model. The new equivalent-voltage model is identified on the basis of conventional measurements carried out under static and small signal dynamic operating conditions. Nonlinear experimental tests confirm the validity of the proposed approach.

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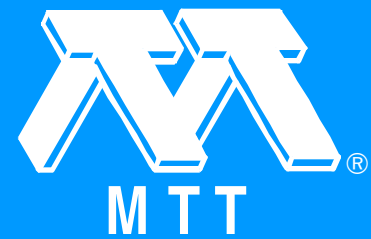
A physics-based GaAs PHEMT noise model for low drain bias operation using characteristic potential method

Jooyoung Jeon, Youngwoo Kwon and Hong-Shick Min. "A physics-based GaAs PHEMT noise model for low drain bias operation using characteristic potential method." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 342-344.

A new physics-based noise model of a GaAs PHEMT is developed using the characteristic potential method (CPM). The model calculates the intrinsic noise current sources using CPM. Combined with the extrinsic noise parameters extracted from the measured S-parameters, the model reproduces four noise parameters of the device accurately under low drain bias voltages without using any fitting parameters. The model is verified with a 0.2-/spl mu/m GaAs PHEMT and shows excellent agreement with the measurements for all the noise parameters up to a drain voltage of 1 V. Also, the proposed method allows the simulation of the microscopic noise distribution and thus allows one to obtain a physical understanding of noise mechanisms inside the device.

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Design of multiband microstrip antennas using a genetic algorithm

H. Choo and H. Ling. "Design of multiband microstrip antennas using a genetic algorithm." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 345-347.

A genetic algorithm (GA) is used to design patch shapes of microstrip antennas for multiband operations. For dual-band operation, the optimized patches show that arbitrary frequency spacing ranging from 1:1.1 to 1:2 can be achieved. Tri-band and quad-band microstrip shapes are also generated and the resulting designs show good operations at the designated frequencies. All results were verified by laboratory measurements on an FR-4 substrate.

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Adaptive antenna receiver module for WLAN at C-band with low-power consumption

F. Ellinger and W. Bachtold. "Adaptive antenna receiver module for WLAN at C-band with low-power consumption." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 348-350.

A low-power consuming adaptive antenna receiver module at C-band for 802.11a and HIPERLAN is presented. The highly integrated GaAs microwave monolithic integrated circuit consists of low noise amplifiers, calibration switches and a vector modulator with 360/spl deg/ phase control and over 15 dB gain control. At 5.2 GHz, the module has a maximum gain of 12.5 dB, a noise figure of 2.7 dB, and a 1 dB output compression point of -7 dBm. The module draws only 2.3 mA up to 3.5 mA from a 2.7 V supply. Chip size is 1.9 mm /spl times/ 1.6 mm.

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Ill conditioning in self-heating FET models (Comments)

A.E. Parker. "Ill conditioning in self-heating FET models (Comments)." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 351-352.

A recent letter by S. A. Maas (see *ibid.*, vol.12, no.3, p.88-9, March 2002) reported ill conditioning in nonlinear circuit simulators caused by the introduction of self-heating effects into FET models. This is true for circumstances outlined in that work but is a consequence of using an incomplete thermal model. This letter points out that an account for both thermal potential and mobility variation with temperature will eliminate the problem.

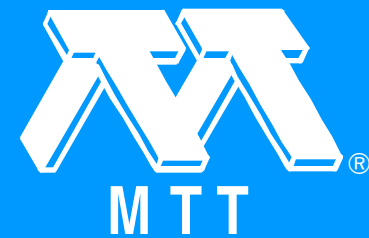
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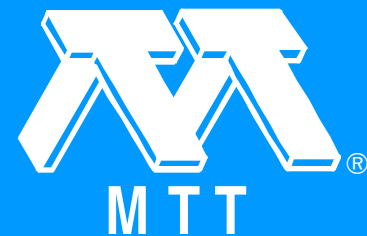
S. Maas. "III conditioning in self-heating FET models (Author's reply)." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 352-352.



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Improvement of broadband feedforward amplifier using photonic bandgap (Comments)

T.J. Ellis. "Improvement of broadband feedforward amplifier using photonic bandgap (Comments)." 2002 Microwave and Wireless Components Letters 12.9 (Sep. 2002 [MWCL]): 352-353.

A number of technical facts were either claimed or implied in the letter by J. Yoon and C. Seo (see *ibid.*, vol.11, no.11, p.450-2, Nov. 2001). Without clarification or supporting data, the claims presented could mislead the reader into drawing inaccurate conclusions regarding the performance increase of feed forward amplifiers due to the so-called photonic bandgap structure.

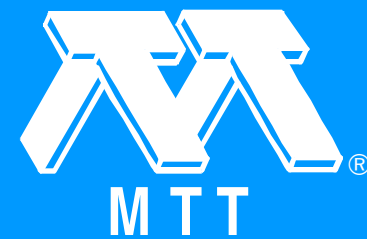
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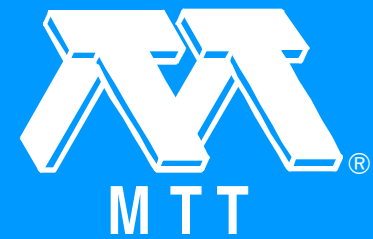
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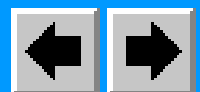
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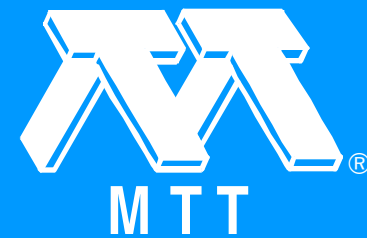
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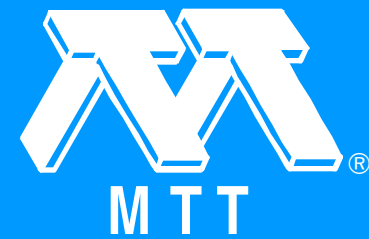
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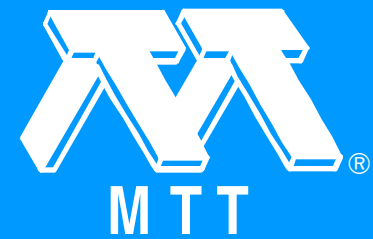
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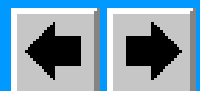
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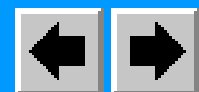
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Characterization of ultrafast devices using near-field optical heterodyning

M.E. Ali, K. Geary, H.R. Fetterman, S.K. Han and K.Y. Kang. "Characterization of ultrafast devices using near-field optical heterodyning." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 369-371.

We demonstrate a novel technique for highly localized injection of millimeter waves in ultrafast devices that combines optical heterodyning and near-field optics. The technique relies on evanescent coupling of two interfering lasers to a submicron area of a device by means of a near-field fiber optic probe. Scanning measurements show the dc and ac photoresponses of two ultrafast device structures, namely low-temperature GaAs photoconductive switches and InP-based high electron mobility transistors. The response characteristics were rich in structures that revealed important details of device dynamics.

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Novel flip-chip bonding technology for W-band interconnections using alternate lead-free solder bumps

K. Onodera, T. Ishii, S. Aoyama, S. Sugitani and M. Tokumitsu. "Novel flip-chip bonding technology for W-band interconnections using alternate lead-free solder bumps." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 372-374.

A novel lead-free flip-chip technology for mounting high-speed compound semiconductor ICs, which have a relatively severe limitation regarding high-heat treatment, is presented. Solder bump interconnections of 0.95Sn-0.05Au were successfully fabricated by reflowing multilayer metal film at as low a temperature as 220/spl deg/C. The bumps were designed to have a diameter of 36 /spl mu/m with a gap between the chip and the motherboard of 24 /spl mu/m. The electrical characteristics of flip-chip-mounted coplanar waveguide chips were measured. The deterioration in reflection loss in the flip chip mounting was less than 3 dB for frequencies up to W-band.

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A compact-size microstrip spiral resonator and its application to microwave oscillator

Young-Taek Lee, Jong-Sik Lim, Chul-Soo Kim, Dal Ahn and Sangwook Nam. "A compact-size microstrip spiral resonator and its application to microwave oscillator." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 375-377.

This letter presents a compact size microstrip spiral resonator and its application to a low phase noise oscillator. This resonator has stopband characteristics to be used in the series feedback oscillator topology. The whole circuit area of the proposed resonator is within 1/10 wavelength, which results in the reduction of the circuit area and cost. A 10-GHz oscillator incorporated with this resonator was designed, fabricated and measured. It shows low phase noise performance of -95.4-dBc/Hz at 100 kHz offset.

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Analysis of high speed p-i-n photodiode S-parameters by a novel small-signal equivalent circuit model

G. Wang, T. Tokumitsu, I. Hanawa, K. Sato and M. Kobayashi. "Analysis of high speed p-i-n photodiode S-parameters by a novel small-signal equivalent circuit model." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 378-380.

A novel small-signal radio frequency (RF) equivalent-circuit of the side-illuminated input tapered waveguide-integrated p-i-n photodiodes (WG PIN PD) is proposed. The proposed RF equivalent-circuit involves both the carrier-transit effect and the external resistance-capacitance (RC) time constant limitation on the frequency response of the p-i-n PD. The carrier-transit effect is realized by adding an RC circuit to an ideal voltage-controlled current source as the input opto-RF equivalent circuit. The carrier transit-time effect is equivalently represented by the time-constant of this input RC circuit. This new equivalent circuit model fits well with both the measured reflection and optoelectronic conversion parameters of the WG PIN PD in a broad frequency range from 45 MHz to 50 GHz.

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Analytical derivation of a two-section impedance transformer for a frequency and its first harmonic

C. Monzon. "Analytical derivation of a two-section impedance transformer for a frequency and its first harmonic." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 381-382.

The feasibility of an electrically small two-section transformer (total length one-third-wavelength at the fundamental) capable of achieving ideal impedance matching at a fundamental frequency and its first harmonic is demonstrated, analytically. To achieve this, the exact solution to the resulting transcendental transmission line equations for two sections is obtained with no restrictions. The parameters of the transformer are presented in explicit closed form and are exact. The results of this study are useful for a number of practical design problems, including dual-band antennas and RF circuits in general.

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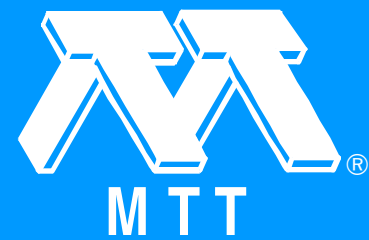
Parallel coupled microstrip filters with suppression of harmonic response

Jen-Tsai Kuo, Wei-Hsiu Hsu and Wei-Ting Huang. "Parallel coupled microstrip filters with suppression of harmonic response." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 383-385.

Corrugated coupled microstrip lines are proposed to design planar microwave filters with suppression of spurious response at twice the center frequency ($2f_{\text{sub o/}}$). The corrugated structure is designed to equalize the phase velocities of the two eigenmodes in the propagation direction. The designed bandpass filters have a wide upper stopband with satisfactory attenuation levels. In addition, the symmetry of the passband response is improved. Measured results of two fabricated circuits show that the idea works very well.

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A novel dual-mode bandpass filter with wide stopband using the properties of microstrip open-loop resonator

A. Gorur. "A novel dual-mode bandpass filter with wide stopband using the properties of microstrip open-loop resonator." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 386-388.

A novel dual-mode microstrip square loop resonator is proposed using the slow-wave and dispersion features of the microstrip slow-wave open-loop resonator. It is shown that the designed and fabricated dual-mode microstrip filter has a wide stopband including the first spurious resonance frequency. Also, it has a size reduction of about 50% at the same center frequency, as compared with the dual-mode bandpass filters such as microstrip patch, cross-slotted patch, square loop, and ring resonator filter.

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Gradient-based optimization of filters using FDTD software

P. Kozakowski and M. Mrozowski. "Gradient-based optimization of filters using FDTD software." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 389-391.

This letter discusses gradient optimization of band-pass filters using electromagnetic simulation software based on the finite difference-time domain algorithm. It is shown that even high-Q-factor circuits can be optimized in acceptable time if robust digital signal processing techniques that take into account signal dynamics are used to predict the frequency behavior of a structure from relatively short sample sequences.

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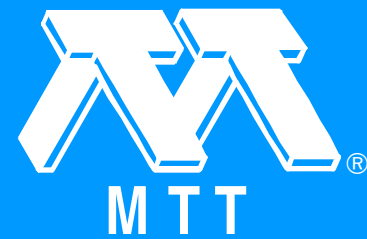


Abstracts

A new MRTD scheme based on Coifman scaling functions for the solution of scattering problems

Xingchang Wei, Erping Li and Changhong Liang. "A new MRTD scheme based on Coifman scaling functions for the solution of scattering problems." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 392-394.

This letter describes a new multiresolution time-domain scheme which is developed based on Coifman compactly supported scaling functions with a number of vanishing moments. The highly linear dispersion properties of this scheme are investigated and two-dimensional and three-dimensional scattering problems are analyzed in order to demonstrate the advantages of this scheme over conventional finite difference time-domain schemes with respect to memory requirements and computing time.



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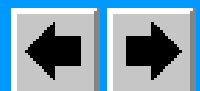
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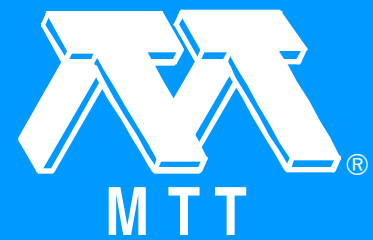
Reliable method for computing the phase shift of multiline LRL calibration technique

J.A. Reynoso-Hernandez. "Reliable method for computing the phase shift of multiline LRL calibration technique." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 395-397.

In this paper, a new method for computing the phase shift of lines used in the multiline line-reflect-line (m) calibration technique is presented. The new method is based on a matrix approach to determine the traveling wave $/\text{spl } \lambda/$ and uses a reliable criterion to compute the constants a/c and b . The new method overcomes the problem of sign ambiguity of the eigenvalues $/\text{spl } \lambda//\text{sub } 1/$ and $/\text{spl } \lambda//\text{sub } 2/$, inherent to the classical method. Another advantage of the new method of computing the phase shift is that the physical length of lines is not needed. The new method computes the line phase shift from the knowledge of the traveling wave $/\text{spl } \lambda/$, that is, without previous knowledge of the wave propagation constant.

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Leaky-wave dispersion behavior on a grounded ferrite slab waveguide

A.B. Yakovlev and G.W. Hanson. "Leaky-wave dispersion behavior on a grounded ferrite slab waveguide." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 398-400.

In this letter, leaky-wave dispersion behavior is studied for a grounded biased-ferrite slab waveguide. The full-wave analysis encompasses space-wave leaky modes, surface waves, and magnetostatic modes supported by a ferrite slab as the magnetic bias field varies in strength. In particular, as the bias field increases from a null value the TE leaky-wave cutoff frequencies of the isotropic slab split into two cutoff frequencies, resulting in complicated dispersion behavior of the corresponding forward and backward leaky waves. TM modes are unaffected by variation in the strength of the bias field for this orientation.

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Effects of mechanical flaws in open-ended coaxial probes for dielectric spectroscopy

D. Popovic and M. Okoniewski. "Effects of mechanical flaws in open-ended coaxial probes for dielectric spectroscopy." 2002 Microwave and Wireless Components Letters 12.10 (Oct. 2002 [MWCL]): 401-403.

A detailed study of dielectric properties of breast tissue in the 0.1 to 20 GHz frequency range currently under way uses open-ended teflon coaxial probes as sensors. This letter quantifies the effects of small mechanical imperfections at the probe aperture on the measured reflection coefficient. The mechanical flaws in the probe can lead to significant errors, thus probes for dielectric spectroscopy of breast tissue have to be carefully manufactured.

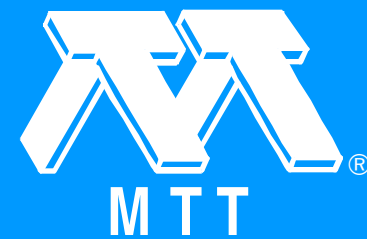
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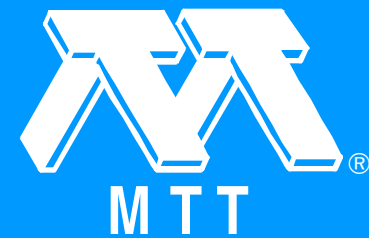
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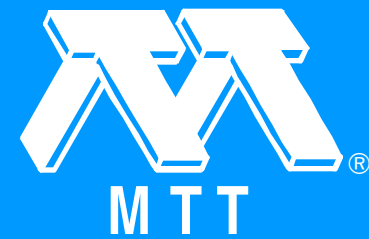
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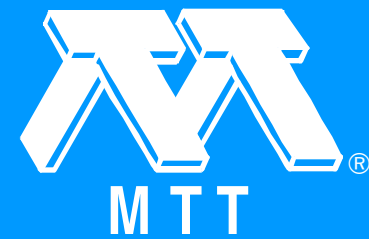
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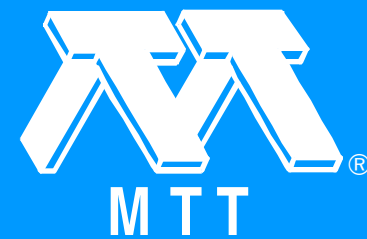
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Effects of output harmonic termination on PAE and output power of AlGaIn/GaN HEMT power amplifier

Y. Chung, C.Y. Hang, S. Cai, Y. Chen, W. Lee, C.P. Wen, K.L. Wang and T. Itoh. "Effects of output harmonic termination on PAE and output power of AlGaIn/GaN HEMT power amplifier." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 421-423.

The authors experimentally investigate and discuss the effects of output harmonic termination on power added efficiency (PAE) and output power of an AlGaIn/GaN high electron mobility transistor (HEMT) power amplifier (PA). The AlGaIn/GaN HEMT PA with gate periphery of 1 mm was built and tested at L-band. Large-signal measurements and comparisons of the PAE and output power were carried out at different DC bias conditions from 50% of saturated drain current (I_{dss}) to 1% of I_{dss} , for the PA with and without output harmonic termination. For class-AB operation at 25% of I_{dss} , an increase of about 10% in peak PAE and 1 dBm in output power were observed in saturated output power range. Improvements of up to 9% in PAE and 1.2 dBm in output power were achieved over the measured DC bias conditions provided the output harmonics are properly terminated.

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A SiGe MMIC variable gain cascode amplifier

Q. Chaudhry, R. Alidio, G. Sakamoto and T. Cisco. "A SiGe MMIC variable gain cascode amplifier." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 424-425.

A silicon-germanium variable gain cascode amplifier has been developed to combine the functionality of an amplifier and an attenuator into one monolithic microwave integrated circuit (MMIC). The cascode amplifier, which was designed for a 7-11 GHz frequency range, achieved a gain of 12.5 dB, an input return loss of 7.5 dB, and an output return loss of 12.5 dB. The cascode amplifier exhibited 16 dB of gain control.

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A phase noise reduction technique in microwave oscillator using high-Q active filter

Jaechun Lee, Young-Taek Lee and Sangwook Nam. "A phase noise reduction technique in microwave oscillator using high-Q active filter." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 426-428.

The authors present a 10 GHz oscillator that uses a high-Q active filter to reduce the phase noise. The loaded Q of active filter is obtained at about 500. This oscillator is compared with another oscillator which uses a passive filter. The difference of two oscillators' Q is estimated at 12.5 times the open-loop gain simulation. The measured result of phase noise at 100 kHz offset shows maximum 10 dB reduction with high-Q active filter.



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40-GHz coplanar waveguide bandpass filters on silicon substrate

K.T. Chan, C.Y. Chen, A. Chin, J.C. Hsieh, J. Liu, T.S. Duh and W.J. Lin. "40-GHz coplanar waveguide bandpass filters on silicon substrate." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 429-431.

We report a very simple process to fabricate high performance filter on Si at 40 GHz using proton implantation. The filter has only -3.4-dB loss at peak transmission of 40 GHz with a broad 9-GHz bandwidth. In sharp contrast, the filter on 1.5- μm SiO₂/isolated Si has much worse transmission and reflection loss. This is the first demonstration of high performance filter at the millimeter-wave regime on Si with process compatible with current VLSI technology.

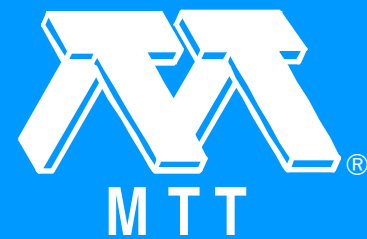
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Low-loss and compact V-band MEMS-based analog tunable bandpass filters

Hong-Teuk Kim, Jae-Hyoung Park, Yong-Kweon Kim and Youngwoo Kwon. "Low-loss and compact V-band MEMS-based analog tunable bandpass filters." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 432-434.

This paper presents compact V-band MEMS-based analog tunable bandpass filters with improved tuning ranges and low losses. For compact size and wide tuning range, the two-pole filters are designed using the lumped-elements topology with metal-air-metal (MAM) bridge-type capacitors as tuning elements. Capacitive inter-resonator coupling has been employed to minimize the radiation loss, which is the main loss contributor at high frequencies. Two filters have been demonstrated at 50 and 65 GHz. The 65-GHz analog tunable filter showed a frequency tuning bandwidth of 10% (6.5 GHz) with low and flat insertion losses of 3.3 /spl plusmn/ 0.2 dB over the entire tuning range.



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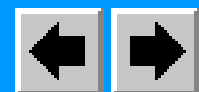
Subjects

New periodic-loaded electromagnetic bandgap coplanar waveguide with complete spurious passband suppression

F. Martin, F. Falcone, J. Bonache, T. Lopetegui, M.A.G. Laso and M. Sorolla. "New periodic-loaded electromagnetic bandgap coplanar waveguide with complete spurious passband suppression." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 435-437.

In this work, coplanar waveguides (CPW) periodically loaded with shunt capacitances and periodically perturbed by varying the distance between the central strip (of constant width) and ground planes are studied. It is demonstrated that the multiple spurious passbands above the Bragg frequency, inherent to the presence of the reactive elements, can be completely and efficiently rejected by means of very simple geometry perturbation. This result is in contrast to previous works, where the rejection of multiple frequencies requires complex layout patterns and reveals that the elimination of spurious frequency bands in periodic loaded CPWs cannot be merely estimated from the Fourier transform of the perturbation geometry.

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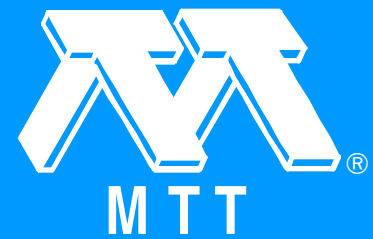
Low-order models from FD-TD time samples

P. Kozakowski and M. Mrozowski. "Low-order models from FD-TD time samples." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 438-440.

The authors introduce several techniques which allow one to create high-quality models of time domain signals produced by the finite-difference time-domain (FD-TD) method. Guidelines for automated selection of key model parameters, such as the length of training sequence for model building and the model order, are given. The application of the criteria for extraction of time signature features based on the initial time sequences proposed in the paper is illustrated on two microwave filters.

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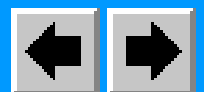
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Analysis and design of periodic structures for microstrip lines by using the coupled mode theory

T. Lopetegi, M.A.G. Laso, M.J. Erro, M. Sorolla and M. Thumm. "Analysis and design of periodic structures for microstrip lines by using the coupled mode theory." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 441-443.

In this work, the coupled mode theory is formulated to analyze distributed periodic structures for microstrip lines. After it, several reasonable approximations are introduced giving rise to analytical solutions for the problem. The obtained results, both numerical and analytical, are checked against measurements showing very good agreement. The proposed method is very attractive for the study of these devices since it avoids the time-consuming full-wave electromagnetic simulations customarily employed and provides analytical solutions that are very useful for analysis and synthesis purposes.

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A nonlinear and dispersive APML ABC for the FD-TD methods

M. Fujii and P. Russer. "A nonlinear and dispersive APML ABC for the FD-TD methods." 2002 Microwave and Wireless Components Letters 12.11 (Nov. 2002 [MWCL]): 444-446.

We have developed a modified anisotropic perfectly matched layer (APML) absorbing boundary condition (ABC) for the finite-difference time-domain (FD-TD) analysis of nonlinear and dispersive media. The formulation is a simple modification to the original nonsplit APML, and retains the robustness and the simple implementation in the FD-TD and the higher-order schemes. The proposed ABC has a broad area of application, and is especially suitable for the analysis of nonlinear optical waveguide problems.

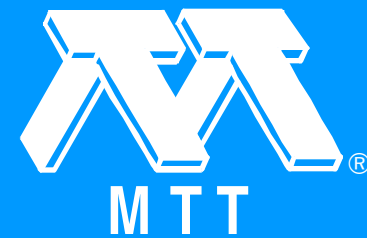
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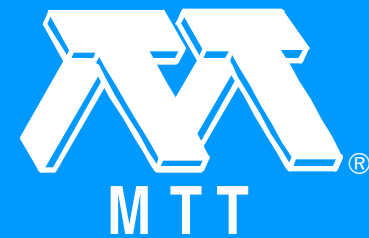
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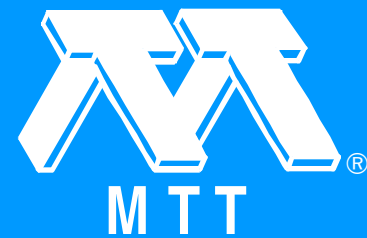
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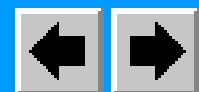
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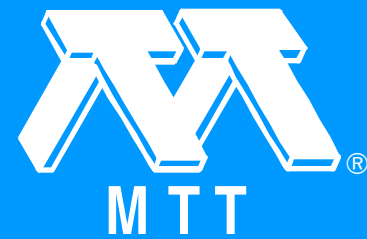
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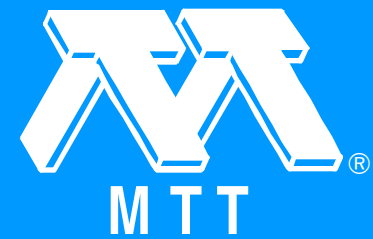
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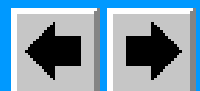
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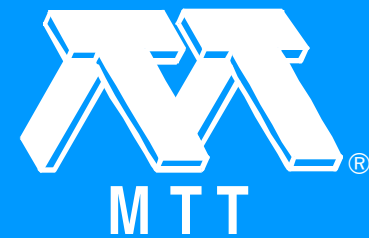
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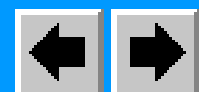
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RF noise in 0.18-/spl mu/m and 0.13-/spl mu/m MOSFETs

C.H. Huang, C.H. Lai, J.C. Hsieh, J. Liu and A. Chin. "RF noise in 0.18-/spl mu/m and 0.13-/spl mu/m MOSFETs." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 464-466.

Studied the gate finger number and gate length dependence on minimum noise figure (NF/sub min/) in deep submicrometer MOSFETs. A lowest NF/sub min/ of 0.93 dB is measured in 0.18-/spl mu/m MOSFET at 5.8 GHz as increasing finger number to 50 fingers, but increases abnormally when above 50. The scaling gate length to 0.13 /spl mu/m shows larger NF_{min} than the 0.18-/spl mu/m case at the same finger number. From the analysis of a well-calibrated device model, the abnormal finger number dependence is due to the combined effect of reducing gate resistance and increasing substrate loss as increasing finger number. The scaling to 0.13-/spl mu/m MOSFET gives higher NF/sub min/ due to the higher gate resistance and a modified T-gate structure proposed to optimize the NF/sub min/ for further scaling down of the MOSFET.



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Improved quality-factor of 0.18-/spl mu/m CMOS active inductor by a feedback resistance design

Chao-Chih Hsiao, Chin-Wei Kuo, Chien-Chih Ho and Yi-Jen Chan. "Improved quality-factor of 0.18-/spl mu/m CMOS active inductor by a feedback resistance design." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 467-469.

A novel CMOS active inductor approach, which can improve the quality-factor, was presented in this report. A cascode-grounded active inductor circuit topology with a feedback resistance was proposed, which can substantially improve its equivalent inductance and quality-factor. This feedback resistance active inductor was implemented by using a 0.18-/spl mu/m 1P6M CMOS technology, which demonstrates a maximum quality-factor of 70 with a 5.7-nH inductance at 1.55 GHz, where the self-resonant frequency is 2.5 GHz. The dc power consumption of this active inductor is less than 8 mW.

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Automated CAD of coupled resonator filters

P. Kozakowski and M. Mrozowski. "Automated CAD of coupled resonator filters." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 470-472.

A gradient-based optimization technique along with a new definition of cost function is applied to the CAD of coupled resonator filters. The topology of the structure is enforced at each step of optimization and its physical dimensions are used as optimization variables. The cost function is defined using location of zeros and poles of the filter's transfer and reflection functions. Numerical tests show that with the new definition of the cost function, the optimization process converges from an arbitrarily selected starting point. This allows one to design filters even without a rough microwave synthesis which usually provides initial dimensions.

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GHz bandstop microstrip filter using patterned Ni/sub 78/Fe/sub 22/ ferromagnetic film

Y. Zhuang, B. Rejaei, E. Boellaard, A. Vroubel and J.N. Burghartz. "GHz bandstop microstrip filter using patterned Ni/sub 78/Fe/sub 22/ ferromagnetic film." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 473-475.

A series of microstrips with patterned Ni/sub 78/Fe/sub 22/ ferromagnetic cores have been investigated for RF applications. The devices have been integrated onto a silicon substrate by using a fully IC-compatible process. The Ni/sub 78/Fe/sub 22/ films were deposited by electroplating onto Si at room temperature and were structured into rectangular prisms with large aspect ratios, i.e., 10:1 and 40:1. Measurements have been performed using a network analyzer. Voltage attenuation of 19 dB/cm has been obtained at 3.9 GHz on a 2-mm-long strip line. The propagating wavelength is reduced by 60% compared to a control device without ferromagnetic core.

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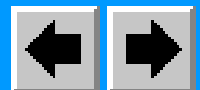
Subjects

Novel reduced-size coplanar-waveguide bandpass filter using the new folded open stub structure

Shry-Sann Liao, Hsien-Ku Chen, Yin-Cheng Chang and Kun-Tai Li. "Novel reduced-size coplanar-waveguide bandpass filter using the new folded open stub structure." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 476-478.

Proposes a novel folded skill and a simpler method than that of older methods. The advantages of this new structure reveals a better skirt factor than that of the conventional folded $\lambda/4$ series open stub, and it reduces the folded area of the conventional structure by at least 50%. Besides, by using the new folded $\lambda/4$ open stub to realize a bandpass filter, the size of the circuit will be reduced greatly and achieve better stopband rejection.

Click on title for a complete paper.



A vertically periodic defected ground structure and its application in reducing the size of microwave circuits

Jong-Sik Lim, Young-Taek Lee, Chul-Soo Kim, Dal Ahn and Sangwook Nam. "A vertically periodic defected ground structure and its application in reducing the size of microwave circuits." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 479-481.

The microstrip and coplanar waveguide transmission lines combined by a vertically periodic defected ground structure (VPDGS) are proposed. The slow-wave effect, equivalent circuit, and the performances are shown. As an application example, VPDGS is adopted in the matching networks of an amplifier for size-reduction. Two series microstrip lines in input and output matching networks of the amplifier are reduced to 38.5% and 44.4% of the original lengths, respectively, due to the increased slow-wave effects, while the amplifier performances are preserved.



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Characterization of rectangular waveguide with a pseudochiral /spl Omega/ slab

K. Dorko and J. Mazur. "Characterization of rectangular waveguide with a pseudochiral /spl Omega/ slab." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 482-484.

A mode matching approach has been employed for evaluating the matrix S of the section of rectangular waveguide with pseudochiral /spl Omega/ slab. Scattering characteristics for different localizations of the /spl Omega/ slab in the guide are predicted numerically and verified by measurements. Based on the numerical analysis, the scattering properties of the guides are discussed. Scattering parameters are next applied in an optimization procedure to extract constitutive parameters of the /spl Omega/ slab used in experiment.

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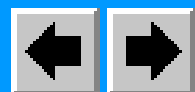
Subjects

Numerical TRL calibration technique for parameter extraction of planar integrated discontinuities in a deterministic MoM algorithm

Lin Li, Ke Wu and Lei Zhu. "Numerical TRL calibration technique for parameter extraction of planar integrated discontinuities in a deterministic MoM algorithm." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 485-487.

In this letter, a thru-reflect-line (TRL) calibration procedure is applied and integrated with a full-wave method-of-moments (MoM) simulator for the parameter extraction of planar discontinuities and circuits. Three TRL calibration standards are numerically formulated and consistently characterized by the MoM simulator. An equivalent circuit model of a circuit discontinuity of interest can then be extracted by calibrating out the erroneous effect of port discontinuity in the deterministic MoM algorithm. As an example, a microstrip open-end circuit is comparatively studied in terms of its equivalent fringing capacitance, and effectiveness of the proposed technique is verified.

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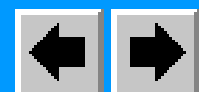
Subjects

Finite-difference time-domain method in custom hardware?

R.N. Schneider, M.M. Okoniewski and L.E. Turner. "Finite-difference time-domain method in custom hardware?." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 488-490.

While the finite-difference time-domain (FDTD) method is very successful in electromagnetics, it is computationally intensive. Reducing the runtime of these simulations, by an order of magnitude or more, would greatly increase the productivity of FDTD users and open new avenues of research. A dedicated hardware implementation that accelerates FDTD computations could provide a means to attain that goal. As the first step, we have implemented a one- and two-dimensional FDTD method in hardware. The experiment proved that computational speed can be increased by as much as two orders of magnitude, and is independent of the number of cells in the simulation.

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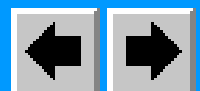
[Subjects](#)

Dispersion and asymmetry effects of ADI-FDTD

M. Darms, R. Schuhmann, H. Spachmann and T. Weiland. "Dispersion and asymmetry effects of ADI-FDTD." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 491-493.

In this paper, a generalized derivation of the alternating direction implicit finite-difference time-domain algorithm based on operator splitting is proposed. The formulation follows the notation of the finite integration technique. A straightforward proof of stability is given and the numerical dispersion formula is presented and verified by numerical experiments. As an additional parasitic effect, the asymmetric behavior of the algorithm even for exactly symmetric setups is revealed. Both the dispersion error and the asymmetry error are discussed in terms of the applicability of ADI for low-frequency problems.

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Feasibility study on beam-forming technique with 1-D mechanical beam steering antenna using niching genetic algorithm

No-Weon Kang, Changyul Cheon and Hyun-Kyo Jung. "Feasibility study on beam-forming technique with 1-D mechanical beam steering antenna using niching genetic algorithm." 2002 *Microwave and Wireless Components Letters* 12.12 (Dec. 2002 [MWCL]): 494-496.

Recently, mechanical beam steering microstrip patch array antenna was fabricated using MEMS technology, and its pattern measured by experiment. As one of its applications, the authors propose a new beam-forming method without phase shifters. Based on the radiation pattern of the element antenna, niching genetic algorithm adopting restricted competition selection (RCS) is used for the optimal synthesis of the desired radiation pattern. The proposed method successfully generates the desired beam pattern by controlling the current and angle of the element antenna.

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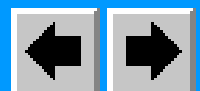
Subjects

Uniaxial perfectly matched layer media for an unconditionally stable 3-D ADI-FD-TD method

An Ping Zhao. "Uniaxial perfectly matched layer media for an unconditionally stable 3-D ADI-FD-TD method." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 497-499.

An unsplit-field perfectly matched layer (PML) medium based on Gedney's uniaxial PML (UPML) scheme is proposed for an unconditionally stable three-dimensional alternating direction implicit finite-difference time-domain (ADI-FD-TD) method. The effectiveness of the proposed ADI-UPML absorber is demonstrated through a numerical example. In addition, to have a better understanding on the ADI-FD-TD method, the actual performance (i.e., while both the reflection and dispersion errors are considered) of the ADI-UPML as a function of the time step is also illustrated.

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A SiGe MMIC 6-bit PIN diode phase shifter

M. Teshiba, R. Van Leeuwen, G. Sakamoto and T. Cisco. "A SiGe MMIC 6-bit PIN diode phase shifter." 2002 Microwave and Wireless Components Letters 12.12 (Dec. 2002 [MWCL]): 500-501.

A 6-bit PIN diode phase shifter has been successfully demonstrated at microwave frequencies in a SiGe bipolar technology. A post-silicon polymer dielectric interconnect technology is implemented to achieve low loss microstrip structures on the silicon substrate. The monolithic microwave integrated circuit exhibits flat phase shift, low VSWR, and low insertion loss variation, over the 7- to 11-GHz band. This phase shifter demonstrates the feasibility of integrating SiGe technology into microwave systems.

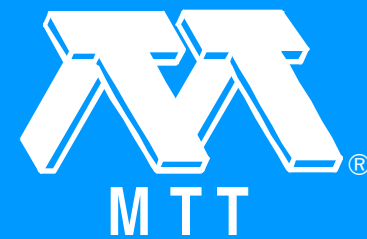
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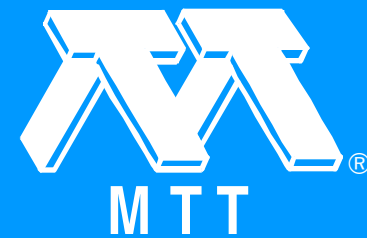
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Asia Pacific abstracts (Dec. 2002 [MWCL])

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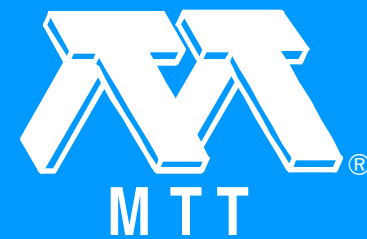
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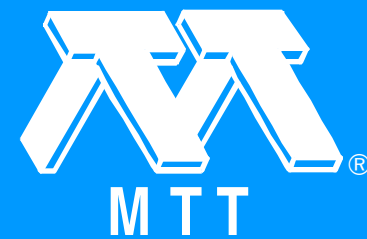
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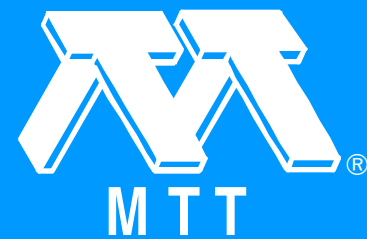
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Front Cover (2002 Vol. I [MWSYM])

"Front Cover (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): i-ii.

The following topics are dealt with: radio frequency integrated circuits for 3G; MMIC technology; phased arrays and beam steering techniques; integrated circuits for 40 Gb/s fiber systems; couplers, dividers, and baluns; nonlinear CAD techniques; silicon substrate and inductor modeling; SiGe RFIC process technologies; RF MEMS switch design; frequency conversion circuits; active device modeling and characterization; RFIC power amplifier technologies; smart antennas; digital beam forming techniques; frequency and phase control circuits; high power amplifiers; microwave and millimeter-wave sensor applications; transmission line structures; microwave oscillators; linear modeling; time-domain techniques for EM field modeling; distortion correction techniques for high power amplifiers; communication systems; radar systems; LTCC; microwave and millimeter wave signal generation; nonlinear device modeling; finite-difference time-domain method; direct conversion techniques for wireless systems; printed-circuit transmission lines; circuit simulation; RF power amplifiers for wireless applications; periodic structures; CAD techniques using computational intelligence; time domain methods; flip-chip techniques organic materials in packaging; low noise devices; multi-mode techniques; ferroelectric, ferrite, and acoustic components; high-speed/noncontacting electrical probing; spatial power combining; quasi-optical techniques; THz technology; filter structures; high efficiency amplifier techniques; microwave measurements; microwave photonics; V-Band transceiver technology; biological effects; medical applications; waveguide and planar filter structures; wide bandgap devices; W-band transceiver components; frequency domain techniques; active, periodic and planar filters optical processing of antenna signals; superconducting components and technology.

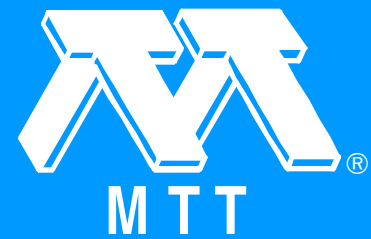
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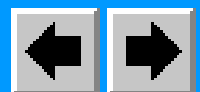
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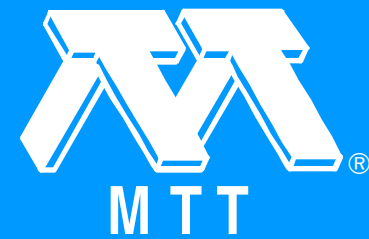
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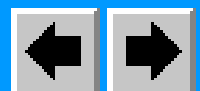
Technical Program Schedule (2002 Vol. I [MWSYM])

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Integrated even harmonic type direct conversion receiver for W-CDMA mobile terminals (2002 Vol. I [MWSYM])

K. Itoh, T. Yamaguchi, T. Katsura, K. Sadahiro, T. Ikushima, R. Hayashi, F. Ishizu, E. Taniguchi, T. Nishino, M. Shimosawa, N. Suematsu, T. Takagi and O. Ishida. "Integrated even harmonic type direct conversion receiver for W-CDMA mobile terminals (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 9-12 vol.1.

This paper is the first demonstration of the overall performance of the integrated even harmonic type direct conversion receiver (EH-DCR) with the RAKE receiver. The configuration of the integrated EH-DCR and its evaluation results based on the 3GPP definition are indicated. The RX LTCC module with the SiGe RX-IC, and BiCMOS ABB-IC are developed to achieve high integration of the receiver with filters. The integrated EH-DCR with low second order distortion can achieve high sensitivity and selectivity of the W-CDMA receiver, even with interference due to the transmitting signal. Described evaluation results satisfy the specifications defined by 3GPP. This paper clarifies effectiveness of the integrated EH-DCR for the third generation mobile terminals.

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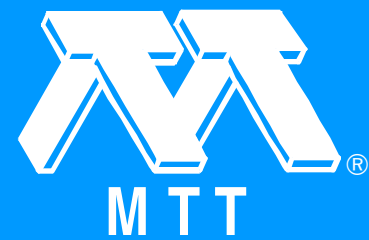
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An analog baseband chain for a UMTS zero-IF receiver in a 75 GHz SiGe BiCMOS technology (2002 Vol. I [MWSYM])

W. Schelmbauer, H. Pretl, L. Maurer, B. Adler, R. Weigel, R. Hagelauer and J. Fenk. "An analog baseband chain for a UMTS zero-IF receiver in a 75 GHz SiGe BiCMOS technology (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 13-16 vol.1.

A zero-IF receiver for UMTS realized by using an advanced 0.35 μm SiGe BiCMOS process with 75 GHz transit frequency is presented. The focal point is the analog baseband chain consisting of a low-noise buffer (LNB), a fully integrated channel selection filter, programmable gain amplifiers (PGA) and circuits to reduce the effects of DC-offsets. The whole chain is able to provide a voltage gain from -14 dB up to 50 dB in 1 dB steps and 43 dB adjacent channel selectivity. The total receiver current consumption for a supply voltage of 2.7 V is less than 45 mA, whereby the baseband chain consumes 15 mA.





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A 2-GHz RF front-end transceiver chipset in CMOS technology for PCS and IMT-2000 applications (2002 Vol. I [MWSYM])

Yong-Sik Youn, Nam-Soo Kim, Jae-Hong Chang, Young-Jae Lee and Hyun-Kyu Yu. "A 2-GHz RF front-end transceiver chipset in CMOS technology for PCS and IMT-2000 applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 17-20 vol. 1.

This paper describes RF front-end transceiver chipset for the dual-mode operation of PCS and IMT-2000. The transceiver chipset has been implemented in a 0.25 μm single-poly five-metal CMOS technology. The receiver IC consists of a LNA and a down-mixer, and the transmitter IC integrates an up-mixer. Measurements show that the transceiver chipset covers the wide RF range from 1.8 GHz for PCS to 2.1 GHz for IMT-2000. The LNA has 2.5/spl sim/2.8 dB NF, 13/spl sim/12 dB gain and 6-4 dBm IIP3. The down mixer has 15.5/spl sim/16.0 dB DSB NF, 15-13 dB power conversion gain and 2-0 dBm IIP3. The up-mixer has 0/spl sim/2 dB power conversion gain and 6/spl sim/3 dBm OIP3. With a single 3.0 V power supply, the LNA, down-mixer, and up-mixer consume 5 mA, 30 mA, and 25 mA, respectively.





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System analysis of a W-CDMA base-station PA employing adaptive digital predistortion (2002 Vol. I [MWSYM])

C. Potter. "System analysis of a W-CDMA base-station PA employing adaptive digital predistortion (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 21-25 vol.1.

An analysis is presented of the implementation requirements for a linear power amplifier (PA) incorporating a predistortion lineariser. It is shown that the statistical distribution of the W-CDMA envelope affects the linearity requirement of the PA when viewed as a function of instantaneous power. Where there is a low probability of a given level, the acceptable non-linearities are higher than at the most probable level. Consequently, a minimum linearity profile is derived that is consistent with meeting the ACLR, PCDE and EVM system requirements. This can be exploited to produce a simpler and more efficient PA while still meeting its specifications.





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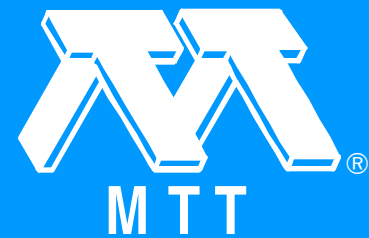
Ku-band MMIC's in low-cost, SMT compatible packages (2002 Vol. I [MWSYM])

H.C. Huang, A. Ezzeddine, A. Darwish, B. Hsu, J. Williams and S. Peak. "Ku-band MMIC's in low-cost, SMT compatible packages (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 27-30 vol. 1.

MM-wave components are very expensive due to the high package and assembly cost. This paper describes a 0.25 /spl mu/m PHEMT Ku-band 2-watt PA, and a 2.2 dB NF LNA MMIC in a low-cost SMT package (\$2.00). The package has excellent thermal resistance, 0.5 C/W, return loss (20 dB), and input/output isolation (40 dB), from DC-40 GHz. We believe this is the first time such a package design has been published.

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ESD protection of RF circuits in standard CMOS process (2002 Vol. I [MWSYM])

K. Higashi, A.O. Adan, M. Fukumi, N. Tanba, T. Yoshimasu and M. Hayashi. "ESD protection of RF circuits in standard CMOS process (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 31-34 vol.1.

The tradeoffs in the ESD protection device for RFCMOS circuits are described, and the characteristics of an SCR-based ESD structure are presented. The parasitic capacitance of the ESD structure is reduced to ~ 150 fF. RV HBM and 750 V CDM are achieved in a LNA working at 2.5 GHz with NF < 4 dB, applicable for Bluetooth wireless transceiver.





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Novel BiCMOS compatible, short channel LDMOS technology for medium voltage RF and power applications (2002 Vol. I [MWSYM])

A. Litwin, Z. Bengtsson and J. Olsson. "Novel BiCMOS compatible, short channel LDMOS technology for medium voltage RF and power applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 35-38 vol.1.

We describe a very short channel, 0.15 μm , LDMOS transistor, with a breakdown voltage of up to 45 V, manufactured in a standard 0.35 μm BiCMOS process. At 1900 MHz and a 12 V supply voltage the 0.4 mm gate width device gives 100 mW output power $P_{1\text{dB}}$ at a drain efficiency of 43%. It has a transducer power gain of more than 20 dB and a current gain cutoff frequency, $f_{T/}$, of 13 GHz. The maximum available gain cutoff frequency, $f_{\text{MAX/}}$, is 27 GHz. The LDMOS process module does not affect the performance or models of other devices. We present for the first time a simple way to create high voltage, high performance LDMOS transistors for RF power amplifier use even in a very downscaled silicon technology.

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Electromagnetic coupling effects in RFCMOS circuits (2002 Vol. I [MWSYM])

A.O. Adan, M. Fukumi, K. Higashi, T. Suyama, M. Miyamoto and M. Hayashi. "Electromagnetic coupling effects in RFCMOS circuits (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 39-42 vol. 1.

The electromagnetic isolation and coupling characteristics of basic structures, namely metal pads, spiral inductors, and spiral-transistors, implemented in a core-logic CMOS process are evaluated and modeled. The models provide design guidelines on the isolation characteristics of guard-rings and shield layers for RF cross-talk suppression between circuit blocks. The importance of electromagnetic coupling to layout interconnects is demonstrated.

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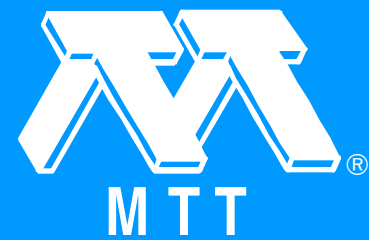
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Ultra low-power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless application (2002 Vol. I [MWSYM])

A. Cidronali, G. Collodi, M. Camprini, V. Nair, G. Manes, J. Lewis and H. Goronkin. "Ultra low-power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless application (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 43-47 vol.1.

The monolithic integration of tunneling diodes (TDs) with other semiconductor devices such as HEMTs or HBTs, creates novel quantum functional nonlinear devices and circuits with unique properties: the Negative Differential Resistance (NDR) and the extremely low DC power consumption. In this paper we present an InP-HEMT/TD based voltage controlled oscillator operating in the 6 GHz band suitable for wireless applications. The circuit draws a current of 1.75 mA at 500 mV and generates an output power of -16 dBm. The maximum tuning range is 150 MHz and the single sideband-to-carrier ratio (SSCR) is of -105 dBc/Hz at 5 MHz.





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Correlation of nonlinear distortion in digital phased arrays: measurement and mitigation

L.C. Howard and D.J. Rabideau. "Correlation of nonlinear distortion in digital phased arrays: measurement and mitigation." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 49-52 vol.1.

In a digital array, each receiver performs analog-to-digital-conversion (ADC), with the resulting digital data later combined via digital beamforming techniques. Since ADC is performed prior to beamforming, it is thus theoretically possible to enhance the dynamic-range (DR) of the individual receivers through post-ADC array integration gain. In practice, however, DR enhancement is limited by correlation of the nonlinearities (from receiver to receiver). Worse still, little published data exists on this subject (i.e. suitable for quantitatively assessing the correlation coefficients). This makes it difficult to predict how much DR enhancement will be achieved on real digital arrays. This paper describes the results of recent experiments involving a, four-channel digital receiver system. The system was used to measure the correlation (between receivers) of different types of nonlinear distortion. The measurements quantitatively demonstrate that some nonlinearities are highly correlated. Next, the system was used to evaluate a recently proposed method for decorrelating nonlinear distortion in digital arrays. The measurements show that the mitigation technique is successful in decorrelating some nonlinear signal components.

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Planar implementation of the partially overlapped subarrays for millimeterwave beam steerable antenna applications

A. Abbaspour-Tamijani and K. Sarabandi. "Planar implementation of the partially overlapped subarrays for millimeterwave beam steerable antenna applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 53-56 vol. 1.

Grouping the elements of a phased array into the partially overlapped subarrays with in-phase excited elements amid using a single phase shifter per subarray has been studied in the past as an approach for reducing the number of phase shifters. Overlapped subarrays require complicated: feeding scenarios, however, that cannot be easily implemented in planar technologies. This paper focuses on a planar implementation which is especially useful for compact millimeterwave arrays and facilitates integration of the antenna and electronics. This design uses a unique combination of series and parallel feeding schemes to form a standing wave array of microstrip elements. The proposed feeding scheme is theoretically insensitive to the mutual coupling between the elements.

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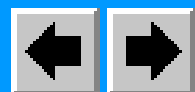
Subjects

A novel multibeam grating antenna with applications to low-cost millimeter-wave beam-steering

C.T. Rodenbeck, M. Li and Kai Chang. "A novel multibeam grating antenna with applications to low-cost millimeter-wave beam-steering." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 57-60 vol. 1.

This paper introduces a low-cost millimeterwave dual-beam scanning antenna that uses a dielectric image line fed grating film designed for bidirectional excitation. An excellent radiation pattern is maintained for both beams across wide scan angles over the 35 to 40 GHz frequency range, with over $\pm 50^\circ$ scanning reported at each frequency. Theoretical calculations closely predict the observed scan angle across the entire range of measurement.

Click on title for a complete paper.



Highly integrated RF-modules for Ka-Band multiple-beam active phased array antennas

J. Butz, M. Spinnler, J. Christ and U. Mahr. "Highly integrated RF-modules for Ka-Band multiple-beam active phased array antennas." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 61-64 vol. 1.

This paper describes design and measurement results of RF modules intended for a proposed spaceborne multimedia Ka-Band multiple-beam transmit phased array antenna. The developed modules include a four-beam RF Control Module (CM) for amplitude and phase shaping, a Solid State Power Amplifier Module (SSPAM) for power amplification as well as a Radiating Module (RM). The CM is realised on a multilayer LTCC substrate with custom-designed 6-bit phaseshifter MMICs and 5-bit attenuator MMICs. The SSPAM is realised on thin-film substrates with GaAs MMIC amplifiers. The modules were designed to meet the electrical, mechanical and thermal requirements of the proposed antenna. Using the developed modules, a subarray demonstrator consisting of four radiating patches was realised. The measurement results show that specified key performance parameters are met and prove the feasibility of the antenna concept.



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High performance voltage controlled bi-directional amplifiers in support of component reuse for large aperture phase array

J.M. Yang, Y.H. Chung, M. Nishimoto, R. Lai, R. Tsai, R. Kagiwada and C.C. Yang. "High performance voltage controlled bi-directional amplifiers in support of component reuse for large aperture phase array." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 65-68 vol.1.

The objective of this paper is to provide a novel and innovative solution to reduce the projected high parts count for large aperture phase array (>100,000 elements). Bi-directional amplifiers are ideal for this application since RF amplification, in either transmit or receive directions, are controlled through bias thus eliminating the need for lossy switches that degrades the system noise figure performance. In addition, the size, weight, and cost of the transceiver module can be greatly reduced since only one amplifier is required. Two bidirectional amplifiers are presented here in both common gate and common-source configurations.

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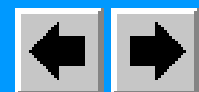
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Experimental investigation of a varactor loaded reflectarray antenna

L. Boccia, F. Venneri, G. Amendola and G. Di Massa. "Experimental investigation of a varactor loaded reflectarray antenna." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 69-73 vol.1.

A new approach for beam steering in reflectarray applications is introduced in this paper. The progressive phase distribution is achieved by loading each microstrip patch element with a varactor diode on the radiating edge. In the following, the scattering characteristics of a single varactor loaded patch antenna will be presented. As a proof of concept, the beam steering capability of a five elements linear reflectarray has been experimentally investigated.

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A 50-Gbit/s 1:4 demultiplexer IC in InP-based HEMT technology

H. Kano, T. Suzuki, S. Yamaura, Y. Nakasha, K. Sawada, T. Takahashi, K. Makiyama, T. Hirose and Y. Watanabe. "A 50-Gbit/s 1:4 demultiplexer IC in InP-based HEMT technology." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 75-78 vol.1.

We have developed a 50-Gb/s 1:4 demultiplexer (DEMUX) integrated circuit with a wide phase margin of 108 degrees in 0.13- μ m InP-based HEMT technology. To increase the phase margin, we designed the data and clock distribution with the aim of achieving high symmetry and eliminating multiple reflections. The measured performance of the fabricated 1:4 DEMUX was suitable for practical use in 50-Gbit/s-class applications.

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A 0.15-/spl mu/m GaAs MHEMT transimpedance amplifier IC for 40-Gb/s applications

C.F. Campbell, M.S. Heins, M.Y. Kao, M.E. Muir and J.M. Carroll. "A 0.15-/spl mu/m GaAs MHEMT transimpedance amplifier IC for 40-Gb/s applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 79-82 vol. 1.

The design and performance of a 0.15-/spl mu/m MHEMT transimpedance amplifier IC suitable for 40-Gb/s receiver applications is presented. Experimental results for the circuit demonstrate 263/spl Omega/ of transimpedance and 42.6 GHz 3dB-bandwidth with 0.075 pF of photodiode capacitance connected at the input. The IC dissipates 180 mW of power from a single +6V supply and has a die area of 0.72 mm/sup 2/.

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A fully integrated 40-Gbit/s clock and data recovery circuit using InP/InGaAs HBTs

H. Nosaka, E. Sano, K. Ishii, M. Ida, K. Kurishima, T. Enoki and T. Shibata. "A fully integrated 40-Gbit/s clock and data recovery circuit using InP/InGaAs HBTs." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 83-86 vol. 1.

An integrated clock and data recovery (CDR) circuit is a key element for optical communication systems at 40 Gbit/s. We present a fully integrated 40-Gbit CDR circuit fabricated using InP/InGaAs HBTs. The circuit contains a linear-type phase detector and a full-data-rate voltage-controlled oscillator. Error-free operation and wide eye opening were obtained for 40-Gbit/s pseudorandom bit sequence (PRBS) with a length of $2^{23}-1$. The fabricated IC dissipates 1.71 W at a supply voltage of -4.5 V.

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40-Gb/s optical receiver IC chipset - including a transimpedance amplifier, a differential amplifier, and a decision circuit - using GaAs-based HBT technology

Y. Amamiya, Y. Suzuki, M. Kawanaka, K. Hosoya, Z. Yamazaki, M. Mamada, H. Takahashi, S. Wada, T. Kato, Y. Ikenaga, S. Tanaka, T. Takeuchi and H. Hida. "40-Gb/s optical receiver IC chipset - including a transimpedance amplifier, a differential amplifier, and a decision circuit - using GaAs-based HBT technology." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 87-90 vol. 1.

GaAs-based HBTs with an InGaP emitter were used to develop key components of a 40-Gb/s optical receiver: a transimpedance amplifier, a differential main amplifier, and a decision circuit. The frequency response of the transimpedance amplifier was flattened by inserting an RC series circuit at the input stage. As a result, the transimpedance amplifier module produced a well-opened 43-Gb/s eye diagram with 400 mVp-p dynamic range. The differential main amplifier and the decision circuit produced 43-Gb/s eye diagrams with a large dynamic range of 700 mVp-p, which is the first 40-Gb/s demonstration using GaAs-based HBTs. These three ICs are thus applicable to a 40-Gb/s optical receiver.





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40-GHz MMICs for optical modulator driver applications

R.S. Virk, E. Camargo, R. Hajji, S. Parker, R. Benelbar, S. Notomi and H. Ohnishi. "40-GHz MMICs for optical modulator driver applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 91-95 vol. 1.

This paper presents the simulated and measured performance of 50 kHz to 40 GHz distributed amplifier MMICs. The chips were fabricated in a double-doped AlGaAs/InGaAs/AlGaAs p-HEMT technology and designed using a microstrip configuration.. The driver MMIC achieves 40-GHz bandwidth and provides 6.6 V/sub p-p/ which is ideal for lithium niobate optical modulator driver applications.

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Design of a miniaturized stripline-to-microstrip-line coupler

K. Rambabu and J. Bornemann. "Design of a miniaturized stripline-to-microstrip-line coupler." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 97-100 vol.1.

A new design methodology for a stripline-to-microstrip-line coupler using apertures in their common ground plane is presented. The design is based on a cosine distribution of aperture sizes and allows the component to be realized within one fifth of a wavelength while maintaining a broadband performance. Various key points of the design such as aperture dimensions and the number of apertures are discussed. The theory is validated by measurements.

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A high-directivity microstrip directional coupler with feedback compensation

Jia-Liang Chen, Sheng-Fuh Chang and Chain-Tin Wu. "A high-directivity microstrip directional coupler with feedback compensation." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 101-104 vol.1.

A new directivity-enhancement method for a microstrip directional coupler is presented. The method utilizes feedback elements between the collinear ports of the parallel-line coupler to generate an isolation zero at the desired frequency. The closed-form equations for designing such compensating elements are developed. Experiments are conducted to verify the proposed method. More than 30 dB directivity improvement is achieved, compared to the conventional microstrip parallel coupler.

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An all 50 ohm divider/combiner structure

E. Turan and S. Demir. "An all 50 ohm divider/combiner structure." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 105-108 vol. 1.

A novel microwave power divider/combiner structure is presented in this paper. The analysis of the structure is based on the exact matching conditions at input/output ports and a perfect isolation condition between the dividing/combining arms (ports). To analyze the structure, the necessary set of nonlinear equations is derived first, and then solved. For a special case, an all-50 Ω structure is obtained (the characteristic impedances of the transmission line sections and the value of the isolation resistance are all 50 Ω). The presented divider/combiner structure is simulated, and simulation results are seen in perfect agreement with the calculation. As a final step, a planar 3-dB power divider is fabricated on GML 1000 substrate ($\epsilon_r=3.05$, $h=0.508$ mm) and a good agreement between the theoretical and experimental results is obtained.



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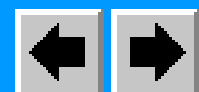
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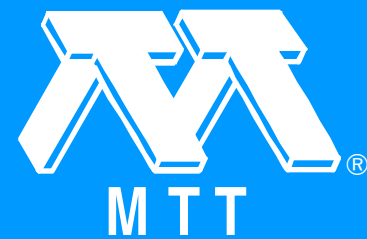
Vertical balun and Wilkinson divider

A. Darwish, A. Ezzeddine, H.C. Huang, K. Bumman, L. Joonyoul, Y. Sungwhan, M. Mah and J. Cook. "Vertical balun and Wilkinson divider." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 109-112 vol.1.

We report the development of a novel broadband 3D vertical balun exhibiting superior performance due to ground plane removal and unique 3D features. The balun offers ± 5 degrees phase and ± 0.5 dB amplitude imbalance, from 2.0-2.7 GHz. In addition, we present the performance of a 3D X-band 4-way Wilkinson divider.

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Analysis and design of a high-performance planar Marchand balun

C.Y. Ng, M. Chongcheawchamnan and I.D. Robertson. "Analysis and design of a high-performance planar Marchand balun." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 113-116 vol.1.

This paper presents an enhanced Marchand balun that offers excellent amplitude and phase balance performance. The enhanced Marchand balun is designed using compensated coupled lines. It employs capacitive compensation, a renowned technique for compensating the unequal even- and odd-mode phase velocities encountered in parallel-coupled microstrips. Analysis carried out in this study has proven that the finite directivity of coupled lines significantly affects the balun performance. The proposed capacitively-compensated Marchand balun is demonstrated at 2.1 GHz and has offered excellent results.

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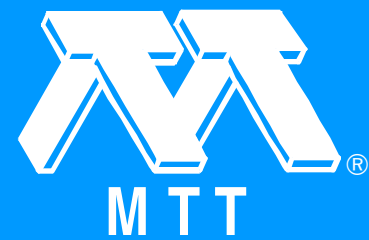
Analysis and design of low-loss planar microwave baluns having three symmetric coupled lines

Jong-Wook Lee and K.J. Webb. "Analysis and design of low-loss planar microwave baluns having three symmetric coupled lines." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 117-121 vol.1.

The bandwidth of the Marchand balun is analyzed as a function of design parameters using a simple model, which provides the analytical design basis for the planar three-coupled-line balun. Analytical and numerical results are presented to facilitate balun design. Using this approach, a low loss planar microstrip balun was designed, fabricated and tested. The measured balun insertion loss for one example was less than 0.5 dB over a 8-13 GHz band, with 3-dB bandwidth 6.5-16 GHz.

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Coupled electromagnetic/nonlinear optimization of self-oscillating microstrip antennas with far-field performance specifications

V. Rizzoli, A. Costanzo and E. Montanari. "Coupled electromagnetic/nonlinear optimization of self-oscillating microstrip antennas with far-field performance specifications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 123-126 vol.1.

The broadband design of self-oscillating microstrip antennas by direct numerical optimization based on electromagnetic (EM) simulation coupled with harmonic-balance (HB) analysis is demonstrated for the first time. The design goals are formulated in terms of far-field performance such as radiation intensity and cross-polarization suppression. The optimization problem is transformed into a system-solving problem, and the solution is found by a Newton iteration globalized by a trust-region method. This results in an order-of-magnitude reduction in the number of expensive EM analyses that are required to achieve convergence.

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Analog frequency divider by variable order 6 to 9

F. Ramirez, E. de Cos and A. Suarez. "Analog frequency divider by variable order 6 to 9." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 127-130 vol. 1.

In this work, concepts from nonlinear dynamics are applied for the design of analog frequency dividers of variable order. The design takes advantage of the multiple Arnold tongues of highly nonlinear oscillators. The variation in the division order is obtained through the modification of a circuit parameter, like, for instance, the capacitance of a varactor diode. Here the design of a bipolar-based analog frequency divider, whose division order can be 6, 7, 8 or 9, is presented. A new simulation tool is proposed for the harmonic-balance analysis of high-order divisions. The circuit has been manufactured and experimentally characterized, with excellent results.

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Intermodulation distortion behavior in LDMOS transistor amplifiers

C. Fager, N.B. de Carvalho, J.C. Pedro and H. Zirath. "Intermodulation distortion behavior in LDMOS transistor amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 131-134 vol.1.

An analysis of the intermodulation distortion (IMD) behavior of LDMOS transistor amplifiers is presented. It is shown that the turn-on region abruptness compared to most other devices is important for explaining the measured IMD behavior such as sweet-spots. The analysis is validated using two-tone measurements at low frequency for different classes of operation. A 1.9 GHz LDMOS power amplifier is designed and characterized to investigate the IMD behavior also at higher frequency.





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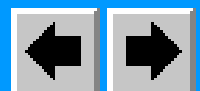
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Augmented behavioral characterization for modeling the nonlinear response of power amplifiers

P.M. Asbeck, H. Kobayashi, M. Iwamoto, G. Hanington, S. Nam and L.E. Larson. "Augmented behavioral characterization for modeling the nonlinear response of power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 135-138 vol.1.

It is shown that a simple extension of the conventional behavioral characterization of amplifier nonlinearity can be used to quantify power amplifier performance including many memory effects. External variables that influence the amplifier behavior (such as power supply voltage, input bias or temperature) are identified. Measurements of gain and phase (AM-AM and AM-PM conversion) are subsequently made over a range of these external variables. The variation of the external variables is explicitly taken into account with linear equivalent circuits at baseband. The method is shown to be useful for the estimation of bias circuit effects and self-heating effects.





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Extraction of accurate behavioral models for power amplifiers with memory effects using two-tone measurements

Hyunchul Ku, M.D. McKinley and J.S. Kenney. "Extraction of accurate behavioral models for power amplifiers with memory effects using two-tone measurements." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 139-142 vol.1.

This paper proposes a system-level behavioral model for RF power amplifiers (PAs) that exhibit memory effects. PAs with memory effects are shown to have two-tone intermodulation distortion (IMD) levels that vary depending on tone-spacing. Thus, typical single tone extracted AM/AM and AM/PM characteristics cannot accurately model PA memory effects. By varying the frequency spacing of two-tone signals, envelope frequency dependent transfer functions can be derived. Using these transfer functions, a behavioral model is developed which is based on the parallel-cascade linear and nonlinear (LN) system. This model gives more accurate results in predicting the behavior of PAs with memory effects close to the carrier frequency. The model is validated by comparing the predicted and measured adjacent channel power ratio (ACPR) of a CDMA signal amplified by a high power class-AB PA. It is found that the parallel cascade model improves ACPR prediction accuracy by as much as 4 dB compared to the single tone derived memoryless model.





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Statistical modeling of the interaction of multiple signals in nonlinear RF systems

K.M. Gharaibeh, K. Gard and M.B. Steer. "Statistical modeling of the interaction of multiple signals in nonlinear RF systems." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 143-147 vol.1.

A nonlinear statistical analysis for modeling distortion, cross modulation, and jammer susceptibility of CDMA signals in a nonlinear RF system is presented. The development of the statistical technique is presented here and applied to various interference scenarios. It is shown that relatively higher nonlinearities must be included in the RF system model so that nonlinear distortion is adequately captured.

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Modeling of passive elements with ASITIC (2002 Vol. I [MWSYM])

A.M. Niknejad. "Modeling of passive elements with ASITIC (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 149-152 vol.1.

Passive elements are key building blocks in realizing fully integrated low cost RF transceivers. The analysis and modeling of passive elements is critical in the design and optimization of building blocks, especially when the quality of passive elements determines the overall achievable performance. Analysis of passive elements near the silicon substrate, though, necessitates solving Maxwell's equations. Furthermore, simulation of passive elements in tools such as SPICE requires lumped-element equivalent circuit models derived through optimization. ASITIC is a software tool that aids the RF designer in the process of design and simulation of such structures.

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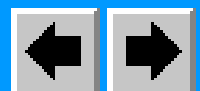
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Modeling of frequency dependent losses in two-port and three-port inductors on silicon (2002 Vol. I [MWSYM])

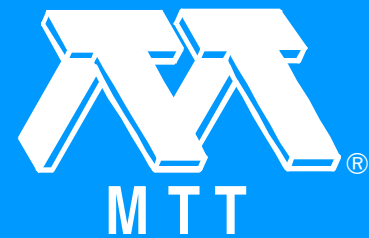
T. Myers and M. Miller. "Modeling of frequency dependent losses in two-port and three-port inductors on silicon (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 153-156 vol.1.

New compact model forms for two-port and three-port symmetric inductors fabricated on silicon are discussed in this paper. These new models incorporate a frequency independent RL network that mimics the skin effect behavior of transmission lines on conductive substrates and can accurately predict the inductive behavior as well as the one-port single-ended and the one-port differential Q of these devices at microwave and millimeter wave frequencies. The new models are validated on inductors fabricated in a thick plated copper process.

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Characterization and modeling of on-chip inductor substrate coupling effect (2002 Vol. I [MWSYM])

C.-J. Chao, Shyh-Chyi Wong, Chia-Jen Hsu, Ming-Jer Chen and Len-Yi Leu. "Characterization and modeling of on-chip inductor substrate coupling effect (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 157-160 vol.1.

The substrate coupling effects of two adjacent coplanar spiral inductors are characterized and modeled. The noise magnitude between two 45 μm -away inductors can be reduced by 6.83 dB by using guard-rings surrounding each inductor, and improved by 10.28 dB further by adding a patterned ground polysilicon shield beneath at 3 GHz. Inductors with patterned polysilicon shields show improved quality factor and noise isolation. Moreover, a macro model is presented for modeling quality factor and inductance of on-chip spiral inductors and associated neighboring inductors' coupling noise effect.

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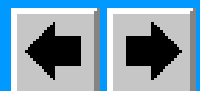
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Characterization and modeling of small-signal substrate resistance effect in RF CMOS (2002 Vol. I [MWSYM])

Yo-Sheng Lin, Shey-Shi Lu, Tai-Hsing Lee and Hsiao-Bin Liang. "Characterization and modeling of small-signal substrate resistance effect in RF CMOS (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 161-164 vol.1.

A novel theory based on dual-feedback circuit methodology is proposed to explain the kink phenomenon of the scattering parameter S_{22} in deep submicrometer MOSFETs. Our results show that the output impedance of MOSFETs intrinsically shows a series RC circuit (for low substrate resistance) or a "shifted" series RC circuit (for very high substrate resistance) at low frequencies, and a parallel RC circuit at high frequencies. It is this inherent triple characteristic of the output impedance that causes the appearance of the double kinks phenomenon of S_{22} in a Smith chart. Our model can not only predict the behavior of S_{22} , but also calculate all S-parameters accurately. Experimental data of 0.25 μm -gate MOSFETs are used to verify our theory. Excellent agreement between theoretical values and experimental data was found.

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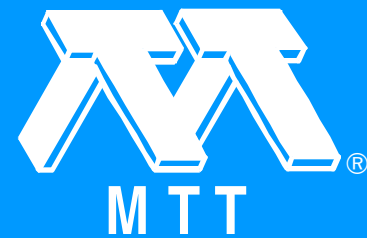


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A new methodology for the computation of the substrate parasitics of octagonal inductors (2002 Vol. I [MWSYM])

W. Tatinian, P. Pannier and R. Gillon. "A new methodology for the computation of the substrate parasitics of octagonal inductors (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 165-169 vol.1.

The paper provides a method for the computation of the substrate parasitics of symmetrical octagonal inductor., using a set of equivalent structures. This method has been tested on a wide range of inductors and the error due to computation is lower than the one due to the topology of the model itself.



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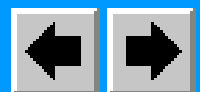
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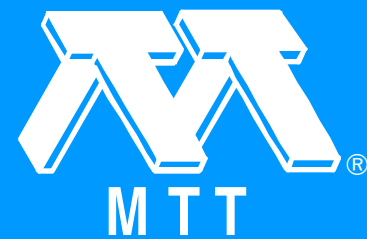
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Review of SiGe process technology and its impact on RFIC design (2002 Vol. I [MWSYM])

A. Das, M. Huang, J. Mondal, D. Kaczman, C. Shurboff and S. Cosentino. "Review of SiGe process technology and its impact on RFIC design (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 171-174 vol.1.

In this paper, we review recently published SiGe BiCMOS technologies for RFIC design. Performance and integration trends in SiGe HBT's are discussed. The performance of passive devices, such as inductors, plays a key role in RF design. We review approaches to realizing high-Q inductor on a Si substrate. Finally, the interaction of HBT performance with design is illustrated through LNA design.

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High performance circuits in 0.18 μm SiGe BiCMOS process for wireless applications (2002 Vol. I [MWSYM])

Peihua Ye, B. Agarwal, M. Reddy, L. Li, J. Cheng, P.C. Mudge, E. McCarthy and S.L. Lloyd.
"High performance circuits in 0.18 μm SiGe BiCMOS process for wireless applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 175-178 vol.1.

Silicon germanium bipolar CMOS (SiGe BiCMOS) process technology is gaining increasing popularity for RF circuits in wireless applications due to high performance, low cost, high yield and higher levels of integration with mixed signal and digital CMOS circuits. Four test circuits were designed and fabricated in Conexant's 0.18 μm SiGe BiCMOS process to evaluate the performance benefits provided by this state of the art process technology. The RF performance achieved in this process clearly makes this a process of choice for future RFIC products.

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Low-frequency noise figures-of-merit in RF SiGe HBT technology (2002 Vol. I [MWSYM])

Jin Tang, Guofu Niu, Zhenrong Jin, J.D. Cressler, Shiming Zhang, A.J. Joseph and D.L. Hame. "Low-frequency noise figures-of-merit in RF SiGe HBT technology (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 179-182 vol.1.

We present the first systematic experimental and modeling results of corner frequency ($f_{sub C}$) and the corner frequency to cut-off frequency ratio ($f_{sub C}/f_{sub T}$) for SiGe HBTs in a commercial SiGe RF technology. The $f_{sub C}/f_{sub T}$ ratio is examined as a function of biasing current for SiGe HBTs featuring multiple collector doping profiles (breakdown voltages) and multiple SiGe profiles.

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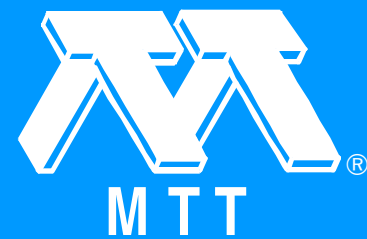


Abstracts

COM2 enhanced graded base SiGe technology for high speed applications (2002 Vol. I [MWSYM])

T. Ivanov, M. Carroll, S. Moinian, M. Mastrapasqua, A. Frej, A. Chen, C. King, A. Hamad, E. Martin, S. Shive, T. Esry, C. Lee, R. Johnson, T. Sorsch, K. Banoo, P. Smith and W. Cochran. "COM2 enhanced graded base SiGe technology for high speed applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 183-186 vol.1.

The COM2 enhanced graded base SiGe modular BiCMOS technology has been developed. It is based on the COM2 digital CMOS process. The technology achieves peak $f_{\text{sub } t}/=100$ GHz, peak $f_{\text{sub } \text{max}}/=101$ GHz, peak $/\text{spl } \beta/ =186$ and $\text{BV}_{\text{sub } \text{cex}}/=2.05$ V. An $f_{\text{sub } t}\text{-BV}_{\text{sub } \text{cex}}/$ product of 205 and good across wafer uniformity are demonstrated.



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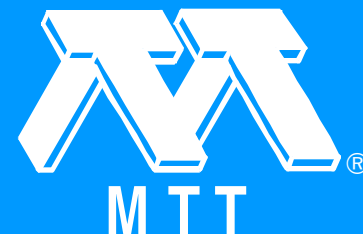


Abstracts

Advanced passive devices for enhanced integrated RF circuit performance (2002 Vol. I [MWSYM])

D. Coolbaugh, E. Eshun, R. Groves, D. Hararnel, J. Johnson, A. Harnmad, Z. He, V. Ramachandran, K. Stein, S. St Ongel, S. Subbanna, D. Wang, R. Volant, X. Wang and K. Watson. "Advanced passive devices for enhanced integrated RF circuit performance (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 187-191 vol.1.

State of the art passive devices have been developed for optimum RF circuit performance. These devices include a hyperabrupt junction varactor with tunability (C_{max}/C_{min}) of 3.3, an accumulation mode MOS varactor, high capacitance nitride metal-insulator-metal capacitors, a BEOL TaN resistor and very high Q inductors with a peak Q of 28 at 3.5 GHz. VCO simulations using several of these elements show a significant reduction in VCO gain variation, phase noise, and power consumption.



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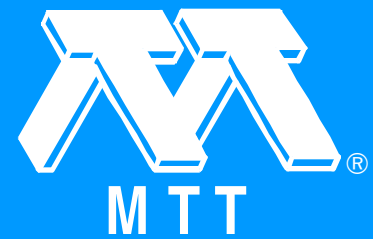
High quality factor and high self-resonant frequency monolithic inductor for millimeter-wave Si-based IC's

D. Dubuc, T. Tournier, I. Telliez, T. Parra, C. Boulanger and J. Graffeuil. "High quality factor and high self-resonant frequency monolithic inductor for millimeter-wave Si-based IC's." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 193-196 vol.1.

Substrate losses of inductors realized with a SiGe BICMOS technology ($\rho_{\text{substrate}}=15 \text{ } \Omega/\square$) are investigated. The benefit of introducing a thin conductive ($\rho=0.5 \text{ } \Omega/\square$) epitaxial layer below the oxide beneath metal strip in order to obtain a high quality factor and a high self-resonant frequency (SRF) is demonstrated. Finally, measurements of the newly developed inductor show a high quality factor of 22 at 30 GHz with the conductive epitaxial layer connected to ground. Moreover, an impressive measured SRF of 64 GHz is achieved for an inductor value of 0.75 nH.

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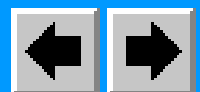
Subjects

Two-port type ferromagnetic RF integrated inductor

M. Yarnaguchi, T. Kuribara and K.-I. Arai. "Two-port type ferromagnetic RF integrated inductor." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 197-200 vol.1.

Two-port type rf integrated inductor with on-top magnetic layer was fabricated. Equivalent circuit analysis of the ferromagnetic RF integrated inductor was performed for the first time. Structure of the possible equivalent circuit is proposed. Parasitic capacitance of the ferromagnetic film is negligibly small if the film is applied slits. Ferromagnetic Co/sub 85/Nb/sub 12/Zr/sub 3/ film with slits effectively enhanced the inductance up to 5 GHz.

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RF MIM capacitors using high-K Al_2O_3 and AlTiO_x dielectrics

S.B. Chen, C.H. Lai, A. Chin, J.C. Hsieh and J. Liu. "RF MIM capacitors using high-K Al_2O_3 and AlTiO_x dielectrics." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 201-204 vol.1.

Record high capacitance density of 0.5 and 1.0 $\mu\text{F}/\text{cm}^2$ are obtained for Al_2O_3 and AlTiO_x MIM capacitors respectively, with loss tangent <0.01 and process compatible to existing VLSI back-end integration. However, the AlTiO_x MIM capacitor has large capacitance reduction as increasing frequencies. In contrast, the Al_2O_3 MIM capacitor has good device integrity of low leakage current of $4.3 \times 10^{-8} \text{ A}/\text{cm}^2$, small frequency-dependent capacitance reduction, and good reliability.

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Performance analysis of monolithic RF transformers by experimental characterization

T. Kamgaing, T. Myers, Feng Ling, M. Petras, M. Miller and O. Ramahi. "Performance analysis of monolithic RF transformers by experimental characterization." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 205-208 vol.1.

Electrical performances of 4-port n:n dual-spiral transformers fabricated in a thick plated copper on silicon process are analyzed. Multiport data analysis techniques and compact modeling are used to study the relationships between the physical and the electrical attributes of the devices. Analytical models, based on measurements from 50 MHz to 20 GHz, are used to explore achievable device performance under different design constraints.

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Lumped and distributed lattice-type LC-baluns

W. Bakalski, W. Simburger, H. Knapp, H.-D. Wohlmuth and A.L. Scholtz. "Lumped and distributed lattice-type LC-baluns." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 209-212 vol.1.

This paper presents two balun circuits derived from the lumped Lattice-type LC-balun. First the lumped LC-balun bridge elements are substituted by microstrip lines. This results in an improved performance at the 2nd and 3rd harmonic frequency for RF power amplifier output baluns. Secondly, the lumped Lattice-type LC-balun is extended to a dual band balun. Independent impedance transformation and balun conversion can be done at two different frequencies. The design equations are derived.

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Design of a novel lumped element backward directional coupler based on parallel coupled-line theory

Taek-Young Song, Jae-Ho Kim, Sang-Hyuk Kim, Jae-Bong Lim and Jun-Seok Park. "Design of a novel lumped element backward directional coupler based on parallel coupled-line theory." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 213-217 vol. 1.

In this paper, a novel lumped equivalent circuit for a conventional parallel directional coupler is proposed. The equivalent circuit and design formula for the presented lumped element coupler is derived based on the even and odd-mode properties of a parallel-coupled line. By using the derived design formula, we have designed the 3 dB and 10 dB lumped element directional couplers at the center frequency of 100 MHz. Furthermore, a chip type directional coupler has been designed to fabricate with multilayer configurations by employing the Low Temperature Cofired Ceramic (LTCC) process. The designed chip-type directional coupler has a 10 dB coupling value at the center frequency of 2 GHz. Excellent agreements between simulations and measurements on the designed directional couplers show the validity of this paper.

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Toggle-switch - a new type of RF MEMS switch for power applications

B. Schauwecker, K.A. Strohm, W. Simon, J. Mehner and J.-F. Luy. "Toggle-switch - a new type of RF MEMS switch for power applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 219-222 vol.1.

A new type of RF MEMS switch for power applications using a push-pull concept is described. The switching element consist of a cantilever which is fixed by a suspension spring to the ground of the coplanar lines. The switching voltages are 30 V to close and 35 V to open. The switches exhibit low loss (<0.2 dB at 27 GHz) with good isolation (20 dB at 27 GHz).

Low contact resistance series MEMS switches

D. Peroulis, K. Sarabandi and L.P.B. Katehi. "Low contact resistance series MEMS switches." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 223-226 vol.1.

This paper reports on the design and development of a novel DC-contact MEMS switch for microwave applications. The switching operation utilizes two different forces: electrostatic and stress-induced forces. The former is employed as the actuation force, while the latter is responsible for achieving the actual DC contact. In particular, when no bias voltage is applied, the deformation of a metallic cantilever beam caused by residual gradient stress leads to a metal-to-metal contact. On the other hand, when a DC-voltage is applied between the cantilever beam and an actuation electrode, the cantilever deflects due to electrostatic force and the metallic contact ceases to exist. Contact resistance of less than 1 Ω is demonstrated with this technique in the closed position, which corresponds to an RF insertion loss of 0.1-0.2 dB up to 40 GHz. In this switch the contact force does not depend on the actuation voltage and there is no DC potential across the closed contact, which constitute the main advantages of this design.

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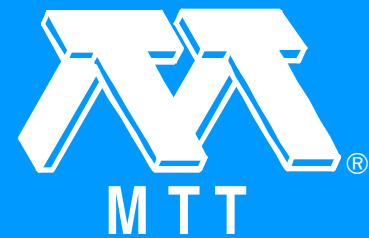
High-isolation BST-MEMS switches

Yu Liu, T.R. Taylor, J.S. Speck and R.A. York. "High-isolation BST-MEMS switches." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 227-230 vol.1.

In this paper, emerging (Ba,Sr)TiO/sub 3/ thin film technology was investigated for enhancing RF-MEMS capacitive switches. Materials properties of high-permittivity BST thin films and fabrication issues are discussed. Prototype BST-MEMS switches for K-/Ka-band applications were fabricated and measured. This measured data is compared with measurements from conventional SiN-based MEMS switches, showing improved isolation at lower frequencies due to the higher down-state capacitance density.

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RF MEMS capacitive switches fabricated with HDICP CVD SiN/sub x/

C.H. Chang, J.Y. Qian, B.A. Cetiner, Q. Xu, M. Bachman, H.K. Kim, Y. Ra, F. De Flaviis and G.P. Li. "RF MEMS capacitive switches fabricated with HDICP CVD SiN/sub x/." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 231-234 vol.1.

The role of very low temperature (90-170/spl deg/C) high density inductively coupled plasma chemical vapor deposition (HDICP CVD) process in RF MEMS switch fabrication is addressed. The results on SiN/sub x/ layers produced by both HDICP CVD and plasma enhanced CVD (PECVD) are compared in terms of surface roughness, breakdown voltage and RF MEMS switch performance. It is found that HDICP CVD can provide very thin (250 /spl Aring/) nitride layer having root mean square (rms) roughness value of 1.6 nm at very low temperature (90/spl deg/C). The breakdown strength is measured to be 9MV/cm A SiN/sub x/ layer with these characteristics improves the device reliability and dramatically increases its down position capacitance providing additional degree of freedom in RF MEMS switch design.

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A study of thermal effects in RF-MEM-switches using a time domain approach

W. Thiel, K. Tornquist, R. Reano and L.P.B. Katehi. "A study of thermal effects in RF-MEM-switches using a time domain approach." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 235-238 vol.1.

A thermal analysis of RF-MEM-switches based on the heat conduction is presented. The heat equation is solved by employing a Forward Time Centered Space (FTCS) difference scheme. For the electromagnetic (EM) characterization, the standard FDTD method is used which provides the dissipated RF power in the MEMS metal structure for a subsequent separate heat analysis. The computed temperature distribution in the switch was utilized as an input to a mechanical simulator for a mechanical analysis. This analysis has shown that when the MEMS switch operates under high power, a temperature gradient develops on the structure that strongly affects stress distribution on the switch. This stress redistribution impacts operation and affects switch lifetime. The accuracy of the presented method is demonstrated by comparing the theoretically computed and experimentally verified thermal profile of a patch antenna.

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Steady state thermal analysis and high-power reliability considerations of RF MEMS capacitive switches

J.B. Rizk, E. Chaiban and G.M. Rebeiz. "Steady state thermal analysis and high-power reliability considerations of RF MEMS capacitive switches." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 239-243 vol.1.

This paper presents a detailed steady-state thermal analysis of RF MEMS capacitive switches. In the up-state position, the maximum temperature on the bridge occurs at the center and is only 50/spl deg/ and 70/spl deg/C for 1 /spl mu/m-thick gold and aluminum membranes, respectively, for a power dissipation in the bridge of 20 mW. This corresponds to an incident RF power of 10 W for $C_{\text{u}} = 100$ fF at 12 GHz (or $C_{\text{u}} = 35$ fF at 35 GHz) and $R_{\text{s}} = 0.5$ /spl Omega/. In the down-state position, it is shown that the bridge temperature does not increase considerably for an incident power of 1 W, and therefore, does not contribute to the reliability problems at high RF powers. On the other hand, it is our opinion that the RF current density on the leading edge of the bridge membrane is the main factor of the failure of MEMS capacitive switches at high RF powers. Two-dimensional temperature measurements are currently being done at Rockwell Scientific, and will be presented at the conference.





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A balanced resistive mixer avoiding an IF balun

T.A. Bos and E. Camargo. "A balanced resistive mixer avoiding an IF balun." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 245-248 vol. 1.

A balanced resistive mixer topology is proposed, that avoids the requirement of an external 180/spl deg/ IF hybrid. Instead of a balun, the IF signal is extracted once at the drain and once at the source of the balanced FETs. Thus, the IF signals can simply be combined. Operating as up- and downconverter, the fabricated MMIC mixer has a measured conversion loss of better than 10 dB over a frequency range from 29 to 39 GHz.

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A compact L-band LTCC mixer with high image rejection

G. Passiopoulos and K. Lamacraft. "A compact L-band LTCC mixer with high image rejection." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 249-252 vol.1.

Low Temperature Cofired Ceramic (LTCC) Technology has been perceived as a potentially enabling integration technology for addressing the commercial viability of the size and performance requirements of high functionality Telecommunication equipment for Multi-Radio applications. In this paper a 1.7-1.8 GHz Multi-Layer Ceramic Technology Image Reject Mixer Module is presented. The Ball Grid Array (BGA) assembled LTCC Mixer Module achieves double balanced operation and an Image Rejection of greater than 67 dB. By virtue of its multilayer construction and high level passives integration the mixer occupies an active area of 15/spl times/13 mm/sup 2/. To our knowledge this is the smallest non-IC based DBM Image Reject Mixer Module in the 1-2 GHz range.

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An even harmonic mixer using self-biased anti-parallel diode pair

M. Shimosawa, T. Katsura, K. Maeda, E. Taniguchi, T. Ikushima, N. Suematsu, K. Itoh, Y. Isota and T. Takagi. "An even harmonic mixer using self-biased anti-parallel diode pair." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 253-256 vol.1.

This paper presents a novel even harmonic mixer using self-biased anti-parallel diode pair (APDP). Resistors for self-bias are employed in APDP, and voltage differences in D.C. arise at each diode when LO power is applied. As increasing of LO power, voltage differences become larger, so maximum voltages of LO wave added to each diode are almost constant and conversion loss of the mixer is kept constantly. In the developed L-band even harmonic mixer using self-biased APDP for a direct conversion receiver, fluctuation of voltage conversion gain is below 1 dB with LO power of from 0 dBm to 14 dBm.



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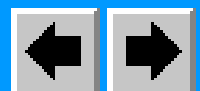
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A monolithic, 2 to 18 GHz upconverter

L.M. Devlin, A.W. Dearn, G.A. Pearson, P.D.L. Beasley and G.D. Morgan. "A monolithic, 2 to 18 GHz upconverter." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 257-261 vol.1.

This paper describes the design and evaluation of an upconverter IC for Electronic Surveillance Measures (ESM) applications. The purpose of the IC is to enable a signal anywhere in the 2-18GHz frequency band to be converted to 21-23GHz for subsequent downconversion to an IF suitable for digitisation. The required LO range is 23-41GHz. The RF, LO and IF ports of the IC are all single ended but the internal mixer is balanced at all ports and single-ended to differential conversion is realised on-chip, using novel broadband active and passive balun structures. The IC has been fabricated on the Triquint Semiconductor Texas' 0.25/spl mu/m PHEMT process and has a measured conversion loss of 7dB to 14GHz, rising to 10dB by 18GHz. Input return loss is better than 12dB from 2 to 18GHz and LO rejection is over 30dB.

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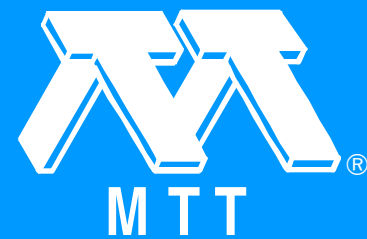


Abstracts

A robust high voltage Si LDMOS model extraction process to achieve first pass linear RFIC amplifier design success (2002 Vol. I [MWSYM])

J.A. Pla and D. Bridges. "A robust high voltage Si LDMOS model extraction process to achieve first pass linear RFIC amplifier design success (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 263-266 vol.1.

A robust model extraction procedure was developed for a high voltage Si LDMOS RFIC process to achieve first pass linear RFIC amplifier design success. The model extraction process utilizes pulsed isothermal small-signal S-parameter measurements and extracted large-signal root models at three different temperatures to extract model parameters for Motorola's Electro-Thermal (MET) FET analytical model. Large-signal model validation was performed against loadpull measurements under 1-tone and 2-tone stimuli. Also, the models were developed into a design kit within Agilent/sup R/ EEsof/sup R/s ADS/sup R/ (Advanced Design System) to design a wide-band 30 Watt power amplifier IC which achieved first pass design success.



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Large-signal modeling of GaN FET and nonlinearity analysis using Volterra series (2002 Vol. I [MWSYM])

S.S. Islam and A.F.M. Anwar. "Large-signal modeling of GaN FET and nonlinearity analysis using Volterra series (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 267-270 vol.1.

A large-signal model is reported to investigate the nonlinearities of a GaN MESFET. The model developed accounts for the observed current collapse and frequency dispersion of output resistance and transconductance and uses Volterra series technique to determine the nonlinearities. Calculated $f_{sub T}$ and $f_{sub max}$ of a $0.8 \mu\text{m}/\text{spl}$ times $150 \mu\text{m}/\text{m}$ GaN MESFET are 6.5 GHz and 13 GHz, respectively, and are in close agreement with their measured values of 6 GHz and 14 GHz, respectively. For a $1.0 \mu\text{m}/\text{spl}$ times $150 \mu\text{m}/\text{m}$ FET operating at 1 GHz, 1-dB compression point and output referred third-order intercept point (OIP3) are 18 dBm and 25.3 dBm, respectively. The corresponding quantities are 19.6 dBm and 30.5 dBm for a $0.6 \mu\text{m}/\text{spl}$ times $150 \mu\text{m}/\text{m}$ FET at same frequency. Similar improvements in third-order intermodulation (IM3) for shorter gate length devices are reported.





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Direct parameter extraction on RF-CMOS (2002 Vol. I [MWSYM])

F.X. Pengg. "Direct parameter extraction on RF-CMOS (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 271-274 vol.1.

The good knowledge of all parameters of the models used with the circuit simulations is one of the major prerequisites for a successful design. This is particularly true for the design of analog radio-frequency (RF) circuits. An efficient and accurate method to directly extract the parameters needed for accurate modeling of transistors in a standard CMOS sub-micron technology for RF-applications is presented. The paper concentrates on the extraction procedure, with emphasis on its simplicity, hence excluding fitting or optimization, and on the accuracy of its results. The extracted parameters are applied to a first order nonquasistatic (NQS) model and the simulation results compared with measurements. Excellent agreement between simulations and measurements up to 50GHz is achieved.

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Low frequency noise characterization and modeling of microwave bipolar devices: application to the design of low phase noise oscillator (2002 Vol. I [MWSYM])

L. Bary, G. Cibiel, I. Telliez, J. Rayssac, A. Rennane, C. Boulanger, O. Llopis, M. Borgarino, R. Plana and J. Graffeuil. "Low frequency noise characterization and modeling of microwave bipolar devices: application to the design of low phase noise oscillator (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 275-278 vol.1.

This paper addresses advanced low frequency noise measurements and modeling of SiGe HBTs. Results have been implemented into a nonlinear Gummel Poon model which has been validated through the design of a DRO made of an integrated SiGe negative resistance in the 10 GHz range. We have obtained phase noise of -105 dBc/Hz at 10 kHz offset, which is close to the state of the art, and we have demonstrated a design technique that provides an accurate phase noise prediction.

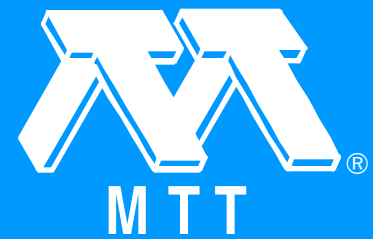


Linearity analysis of CMOS for RF application (2002 Vol. I [MWSYM])

Sanghoon Kang, Byounggi Choi and Bumman Kim. "Linearity analysis of CMOS for RF application (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 279-283 vol.1.

The linearity of CMOS is analyzed. Transconductance and output conductance are two dominant nonlinear sources of CMOS. Capacitances and substrate leakage network do not generate any significant distortions. But they reduce the output impedance for the best linearity and the power gain at a high frequency and the output conductance nonlinearity is significantly at a high frequency. Up to a few GHz, the output conductance is the dominant nonlinear source, and at a higher frequency, the transconductance is the dominant nonlinearity source. OIP3 is reduced by the effects of those components. OIP3s are calculated for various gate length processes. CMOS linearity is dependent only on current density and drain bias voltage but is not dependent on gate length.

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RF power devices for wireless communications (2002 Vol. I [MWSYM])

C.E. Weitzel. "RF power devices for wireless communications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 285-288 vol.1.

A wide variety of semiconductor devices are used in wireless power amplifiers. This paper will review the advantages and disadvantages of these devices for handheld and infrastructure applications.

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SiGe/Si power HBTs for X- to K-band applications (2002 Vol. I [MWSYM])

S. Mohammadi, Zhenqiang Ma, Jaehoon Park, P. Bhattacharya, L.P.B. Katehi, G.E. Ponchak, S.A. Alterovitz, K.M. Strohm and J.-F. Luy. "SiGe/Si power HBTs for X- to K-band applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 289-292 vol. 1.

High performance power SiGe/Si HBTs at X-band (8.4 GHz), Ku-band (12.6 GHz) and K-band (18 GHz) have been demonstrated. Under continuous wave operation, a single 20-finger Si/Si/sub 0.75/Ge/sub 0.25//Si (emitter area of 1200 /spl mu/m/sup 2/) HBT, biased in class AB, delivers 28.5 dBm (700 mW) of RF output power at X-band, 25.5 dBm (350 mW) at Ku-band and 22.5 dBm (180 mW) at K-band. These represent the state-of-the-art power performance of SiGe-based HBTs at frequencies above X-band. An in-depth analysis of the power performance of HBTs with different geometry and configuration is also presented, which will eventually serve as a design guide for SiGe/Si power HBTs at different operating frequencies.

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RF power characteristics of SiGe heterojunction bipolar transistor with high breakdown voltage structures (2002 Vol. I [MWSYM])

T. Matsuno, K. Nishii, S. Sonetaka, Y. Toyoda and N. Iwamoto. "RF power characteristics of SiGe heterojunction bipolar transistor with high breakdown voltage structures (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 293-295 vol.1.

The collector profile dependences of RF power characteristics of SiGe heterojunction bipolar transistors (HBT) have been studied. A selective ion implanted collector (SIC) structure with a thick and lightly doped collector layer showed good RF power characteristics including the adjacent-channel-power-ratio (ACPR) characteristics for middle class power at around an output power of 16 dBm while maintaining BV/sub CEO/ over 5 V. The maximum BV/sub CEO/ of 9 V was obtained using the same process only by removing the SIC structure. Both structures are available for fabrication of multi-stage RF power amplifiers on one chip by a single process.



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Design techniques for improved microwave performance of small outline packages (2002 Vol. I [MWSYM])

D. Jessie and L. Larson. "Design techniques for improved microwave performance of small outline packages (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 297-300 vol.1.

General techniques to improve the microwave performance of plastic leaded packages have been developed. These techniques result in an improvement of the bandwidth and reduction of losses in the structure. The techniques were applied to an SSOP8 configuration, and the useful frequency range was extended from 6 GHz to well above 10 GHz.

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Spiral inductor performance in deep-submicron bulk-CMOS with copper interconnects (2002 Vol. I [MWSYM])

W.B. Kuhn, A.W. Orsborn, M.C. Peterson, S.R. Kythakyapuzha, A.I. Hussein, Jun Zhang, Jianming Li, E.A. Shumaker and N.C. Nair. "Spiral inductor performance in deep-submicron bulk-CMOS with copper interconnects (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 301-305 vol. 1.

This paper reviews design considerations for spiral inductors in bulk CMOS and reports investigations carried out in a commercial 0.18 μm process using 6-layer copper metalization. Quality factors of approximately 8 are measured for 10 nH spirals operating between 1 and 2 GHz. Comparisons of Q and self-resonant frequency are provided for a variety of construction variables including with/without a patterned ground shield, metal-6 only versus stacking layers 3 thru 6, dense versus sparse vias, wide versus narrow traces, and with/without metal-fill.

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Digital beamforming and calibration for smart antennas using real-time FPGA processing

T.W. Nuteson, J.S. Clark, IV, D.S. Haque and G.S. Mitchell. "Digital beamforming and calibration for smart antennas using real-time FPGA processing." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 307-310 vol.1.

A real-time field programmable gate array (FPGA) implementation is presented for a smart antenna application employing digital beamforming (DBF). The DBF is performed at the RF signal carrier frequency by means of bandpass (IF) sampling, using high-speed 8-bit analog-to-digital (A/D) converters. The digital phased array receiver presented in this paper consists of an 8-channel system with back-end FPGAs for real-time calibration and DBF processing. The system operates in the L-band (1.8 GHz to 2 GHz) with various bandwidths depending on the application and FPGA processing requirements. Two main topics are discussed in this paper: (1) calibration methodologies and (2) FPGA implementation for calibration and DBF. Results presented include real measured data that was collected with the system and processed via FPGAs.

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A smart antenna receiver array using a single RF channel and digital beamforming (2002 Vol. I [MWSYM])

J.D. Fredrick, Yuanxun Wang, Seong-Sik Jeon and T. Itoh. "A smart antenna receiver array using a single RF channel and digital beamforming (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 311-314 vol.1.

A new type of smart antenna array receiver with adaptive digital beamforming is proposed. The proposed system offers a drastic reduction in hardware requirements for the smart antenna system through the use of a new Spatial Multiplexing of Local Elements (SMILE) scheme. In this scheme a single element of the array is sequentially connected to signal processing circuitry in order to sample the modulated carrier signal. The sampling rate is higher than the signal bandwidth so the information of the original signal can be fully restored in the post stages using low pass filters. The reconstructed baseband data is then used for adaptive digital beamforming. This system offers an N times reduction in RF hardware for an N element array. A four element prototype is built and discussed, including a new type of array feed network.





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A 62/66 GHz frequency offset retrodirective array

N.B. Buchanan, T. Brabetz and V.F. Fusco. "A 62/66 GHz frequency offset retrodirective array." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 315-318 vol.1.

Measured and predicted results are presented for a 62/66 GHz frequency offset retrodirective array. Measurements show the array to produce a self steered monostatic 3 dB beamwidth of 22.5/spl deg/. Predictions carried out using an active element approach showed close agreement with a theoretical value of 21/spl deg/, confirming for the first time, frequency offset retrodirective action in the millimetre wave region. In addition, amplitude/pulse modulation was shown to be readily applied to the re-transmit self-steered signal. This work enables a variety of short range mm-wave broadband wireless links and sensor applications such as asset tagging.

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A compact beamforming matrix module for use in multibeam communication satellites

W. Kornrumpf, A. Jacomb-Hood and R. Melcher. "A compact beamforming matrix module for use in multibeam communication satellites." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 319-322 vol.1.

A 16/spl times/4 beamformer has been designed, fabricated and tested. It provides 6 bits of phase shift and 8 bits of attenuation in 64 paths in a single multichip module (MCM) for use in multibeam antenna systems. It can be operated with 16 beams and 4 radiating elements or 4 beams and 16 radiating elements. The MCM is fabricated using the Lockheed Martin/GE high-density interconnect (HDI) technology to interconnect 16 multifunction MMICs and digital control circuits. The HDI technology is used to fabricate 42 Wilkinson dividers with greater than 40% bandwidth on the same layers as the stripline interconnects. The resulting beam former matrix module (BFMM) is approximately 63/spl times/41/spl times/1.3 mm (3.5 cm/sup 3/) and weighs 7 grams.

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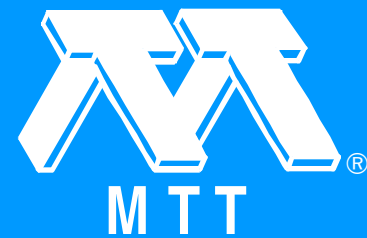


Abstracts

Smart antenna system implementation based on digital beam-forming and software radio technologies

J. Wu, W.-X. Sheng, K.-P. Chan, W.-K. Chung, K.-K.M. Cheng and K.-L. Wu. "Smart antenna system implementation based on digital beam-forming and software radio technologies." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 323-326 vol.1.

This paper presents the design and implementation of a complete receiving smart antenna system. By using software radio techniques, the system can be re-programmed to meet different modulation standards. The platform consists of antenna array, RF module, digital IF module and digital signal processing module. Digital beam-forming and demodulation algorithms are all Implemented on DSP. Experimental results are shown for both anechoic chamber and outdoor measurements.



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RF power handling of capacitive RF MEMS devices

B. Pillans, J. Kleber, C. Goldsmith and M. Eberly. "RF power handling of capacitive RF MEMS devices." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 329-332 vol.1.

RF MEMS switches provide a low-cost, high-performance solution to many RF/microwave applications. In this paper, progress in characterizing capacitive MEMS devices under high RF power is presented. The switches tested demonstrated power handling capabilities of 510 mW for continuous RF power and 4 W for pulsed RF power. In addition, the reliability of these switches was tested at various power levels indicating that under continuous RF power, the lifetime is not affected until the 510 mW power level is reached. Once a power failure is observed, it is completely recoverable by lowering the RF power level below the threshold point. A description of the power failures and their associated operating conditions is presented.

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A very-low-loss 2-bit X-band RF MEMS phase shifter

G.L. Tan, R.E. Mihailovich, J.B. Hacker, J.F. DeNatale and G.M. Rebeiz. "A very-low-loss 2-bit X-band RF MEMS phase shifter." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 333-335 vol. 1.

A novel low-loss phase shifter, based on RF MEMS series switches and a single-pole four-throw (SP4T) switch design, is presented. The phase shifter is fabricated on a 200 μm -thick GaAs substrate, and occupies less than 12 mm² of space. The measured average insertion loss is -0.55 dB, with a reflection loss of less than -17 dB over the 8-12 GHz frequency range. The 2-bit phase shifter performs well up to 18 GHz with an average loss of only -0.85 dB and a near-perfect linear phase shift from DC-18 GHz. This is the lowest loss MMIC-type phase shifter to-date at 8-18 GHz.

A low-loss Ka-band distributed MEMS 2-bit phase shifter using metal-air-metal capacitors

J.S. Hayden and G.M. Rebeiz. "A low-loss Ka-band distributed MEMS 2-bit phase shifter using metal-air-metal capacitors." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 337-340 vol.1.

A two-bit wideband distributed CPW phase shifter has been developed on a 500 μm /m quartz substrate for Ka-band operation. The design utilizes MEMS switches in a DMTL (Distributed MEMS Transmission Line) periodically loaded by MEMS switches and high Q (>250 at 30 GHz) metal-air-metal capacitors. The MEMS switches are actuated by a low 20 volt P-P AC bias voltage via a high-resistance bias line. Estimated spring constant and switching time of the MEMS switch is 30 N/m and $\sim 9 \mu\text{s}$, respectively. The two-bit design results in a reflection coefficient better than -11.5 dB, an average insertion loss of -1.5 dB, and phase shifts of 89/spl deg/, 180/spl deg/, and 270/spl deg/ at 37.7 GHz. This is currently the lowest loss distributed phase shifter at Ka-band frequencies.



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V-band low-loss and low-voltage distributed MEMS digital phase shifter using metal-air-metal capacitors

Hong-Teuk Kim, Jae-Hyoung Park, Yong-Kweon Kim and Youngwoo Kwon. "V-band low-loss and low-voltage distributed MEMS digital phase shifter using metal-air-metal capacitors." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 341-344 vol.1.

A low-loss digital distributed phase shifter has been developed using micromachined capacitive shunt switches for V-band communication system. Instead of conventional MIM (metal-insulator-metal) capacitors, high-Q MAM (metal-air-metal) capacitors were used in series with the MEMS shunt capacitive switches to minimize the dielectric loss. The operation voltage for the phase shifter was also reduced by applying the bias directly to the MEMS shunt switches through choke spiral inductors. The fabricated 2-bit (270/spl deg/) distributed phase shifter showed low average insertion loss of 2.2 dB at 60 GHz. The return loss is better than 10 dB over a wide frequency range from 40 to 70 GHz. The circuit operates at 15-20 V bias voltages. This phase shifter is very promising for the integrated circuits at V-band requiring low loss and good return loss over a broad band.

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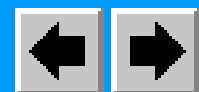
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Differential multi-finger MEMS tunable capacitors for RF integrated circuits

G.V. Ionis, A. Dec and K. Suyama. "Differential multi-finger MEMS tunable capacitors for RF integrated circuits." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 345-348 vol. 1.

Several micro-electro-mechanical tunable capacitors fabricated in polysilicon surface micro-machining process are presented. These devices are based on parallel-plate and zipper actuation principles. Differential and multi-finger techniques are used to achieve higher quality factors. These devices are evaluated by direct measurements and by measuring phase noise of voltage-controlled oscillators that use these devices. A voltage-controlled oscillator with a two-finger parallel-plate variable capacitor shows the phase noise of -129 dBc/Hz at 600 kHz offset from the carrier while outputting 1.3 dBm and tuning between 1.81 GHz and 1.85 GHz. An experimental fractal capacitor with quality factor better than 17 at 1.5 GHz and capacitance varying from 1.9 pF to 6.7 pF is also presented.

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Miniaturized and broadband V-band balanced frequency doubler for highly integrated 3-D MMIC

K. Nishikawa, B. Piernas, T. Nakagawa and K. Araki. "Miniaturized and broadband V-band balanced frequency doubler for highly integrated 3-D MMIC." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 351-354 vol.1.

This paper presents a compact V-band balanced frequency doubler 3-D MMIC with broadband performance. The MMIC was fabricated by combining a commercial 0.15 μm GaAs pHEMT technology with the 3-D MMIC technology. A fabricated frequency doubler MMIC, which occupies 0.92 mm², achieves 2.5-dBm output power and more than 15-dB fundamental signal suppression over 50-GHz to 68-GHz (30% bandwidth) for an 8-dBm input signal. A transmit MMIC, intended for 50-GHz application, realizes a 10-dBm output power and 40-dB isolation in an area of 1.48 mm², it is supported by input and output buffer amplifiers. These fabricated MMICs are very effective in realizing compact and highly integrated single-chip transceiver MMICs. Furthermore, they can be re-used for various V-band applications, resulting in significant cost reduction.

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Integrated quadrupler circuit in coplanar technology for 60 GHz wireless applications

M. Schefer. "Integrated quadrupler circuit in coplanar technology for 60 GHz wireless applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 355-358 vol. 1.

This paper describes the design, the simulation and the measured results of a frequency quadrupler ($\times 4$ multiplier) circuit for mm-wave applications. The coplanar circuit was designed in a balanced configuration which makes it extremely small in area while maintaining excellent performance. A large number of circuits from several wafers were measured. The conversion loss is 4 dB and the harmonic suppression >20 dB with 6 dBm input power.

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Some rules for the choice of the C(V) characteristic for the design of frequency triplers with symmetrical varactors

J.M. Duchamp, P. Ferrari, J.W. Tao and D. Lippens. "Some rules for the choice of the C(V) characteristic for the design of frequency triplers with symmetrical varactors." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 359-362 vol.1.

In this paper we consider multipliers designed with varactors that have a symmetric C(V) capacitance-voltage characteristic, i.e. triplers, quintuplers, ... We show that for a tripler the optimal C(V) characteristic is not the most abrupt one, as stated in much works, but rather a cosine-like one. Our work is validated with the design of a frequency tripler based on the use of HBVs non-linear transmission lines. We obtained a significant improvement for the maximum conversion efficiency when a cosine C(V) is used instead of an abrupt one, for a 15 HBVs NLTL frequency tripler.

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Microwave variable delay line using a membrane impregnated with liquid crystal

T. Kuki, H. Fujikake, H. Kamoda and T. Nomoto. "Microwave variable delay line using a membrane impregnated with liquid crystal." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 363-366 vol.1.

A microwave variable delay line using a membrane impregnated with liquid crystal was newly fabricated. By employing this device configuration, the phase-shift response becomes fast independently of the liquid crystal thickness. Experimental results show that the phase-shift response time of 33 ms is obtained, which is two orders of magnitude faster than that of a conventional delay line. The new delay line also exhibits a 270-degree phase-shift and non-dispersive delay characteristics over a wide microwave-frequency range. Moreover, it is clarified that the phase-shift characteristics to a control voltage depend on the pore size of the membrane.

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Tunable inverted-microstrip phase shifter device using nematic liquid crystals

C. Weil, G. Luessem and R. Jakoby. "Tunable inverted-microstrip phase shifter device using nematic liquid crystals." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 367-371 vol.1.

This paper introduces an alternative low-cost planar integrated, tunable liquid crystal phase shifter device for microwave applications, using the dielectric anisotropy of a nematic liquid crystal in conjunction with inverted-microstrip technology and a DC control voltage. With a standard nematic liquid crystal, a differential phase shift of 53/spl deg/ was achieved at 18 GHz for a physical line length of 49 mm, indicating a figure-of-merit of up to 12/spl deg//dB with a control voltage of only 40 V and a very low power consumption of 0.1 mW. On this basis, the phase shifter performance can be considerably improved by miniaturizing the device and by optimizing liquid crystals in the microwave region.



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Harmonic rejection filters for the dominant and the higher waveguide modes based on the slotted strips

A. Kirilenko and L. Mospan. "Harmonic rejection filters for the dominant and the higher waveguide modes based on the slotted strips." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 373-376 vol.1.

The simplest notch-type filters to reject the dominant and higher modes in the multimode frequency band are proposed using resonant properties of the iris formed by slotted capacitive strips. Various configurations of the slotted strip iris are considered. The simplest one is a centered capacitive strip in a rectangular waveguide with centered single slot that is able to reject the dominant mode up to the TE₃₀-cutoff. The second one is the double-slot capacitive iris that has the ability to reject at the same frequency both the dominant mode and the TE₂₀-mode. The third configuration is based on two double-slot capacitive strips placed close to the upper and lower walls of the waveguide and provides rejection of the TE₁₀, TE₂₀ and TM₁₁-modes simultaneously. Configurations based on slotted inductive strips to reject TE₀₁ and TM₁₁ modes are also considered. These notch filters are perfectly matched in the operating single-mode range, can be easily fabricated and implemented.





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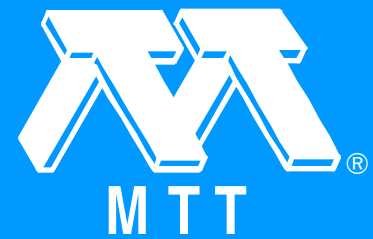
A novel compact millimeter wave diplexer

E. Ofli and R. Vahldieck. "A novel compact millimeter wave diplexer." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 377-380 vol. 1.

A novel compact millimeter wave diplexer is presented. The structure is composed of an H-plane transformer section and two cross-coupled folded E-plane metal-insert filters. The design is based on generalized scattering matrices of the key building blocks of the diplexer which are computed using a standard mode matching technique. The new diplexer requires half the number of resonators of a conventional E-plane diplexer with T-section power dividers, is thus much shorter and shows less insertion loss. At the same time the ease of manufacturing known from typical E-plane filters is maintained.

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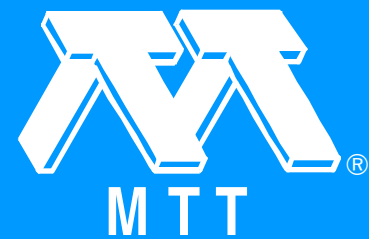
Broadband TEM-mode planar-rectangular dielectric waveguide bandpass filter and its miniaturization

A.C. Kundu. "Broadband TEM-mode planar-rectangular dielectric waveguide bandpass filter and its miniaturization." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 381-384 vol. 1.

This paper presents a novel design method of a two-pole, low-profile, high performance broadband planar-rectangular dielectric waveguide bandpass filter (BPF) using a $\lambda/2$ TEM-mode resonator, where there is no hole, no dent or any other discontinuity in the BPF structure. Keeping the electrical performance almost unchanged, miniaturization technology of the BPF is proposed. All of the BPF models are verified by electromagnetic simulation.

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$\lambda/4$ stepped-impedance resonator bandpass filters fabricated on coplanar waveguide

A. Sanada, H. Takehara, T. Yamamoto and I. Awai. " $\lambda/4$ stepped-impedance resonator bandpass filters fabricated on coplanar waveguide." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 385-388 vol. 1.

Simple and compact multi-stage microwave bandpass filters (BPFs) using $\lambda/4$ stepped-impedance resonators (SIRs) fabricated on coplanar waveguide (CPW) are presented, which are applicable for MMICs or high-T/sub c/ superconducting filters. An accurate, tuning-free, design method of the $\lambda/4$ SIR-BPF is demonstrated with assistance of full-wave electromagnetic field simulator, which is based on a conventional filter design method using impedance inverters. Full-wave simulation and experimental results for a two-stage Chebyshev BPF designed at 5 GHz agreed well with theoretical results.

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A stepped cavity resonator with optimized spurious performance and its applications to BPFs

K. Konno and M. Kubota. "A stepped cavity resonator with optimized spurious performance and its applications to BPFs." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 389-392 vol. 1.

To improve spurious characteristics of the dual-mode cavity resonator, the stepped cavity resonator is proposed, and the difference between the fundamental resonant and the spurious resonant frequencies is a 200 MHz improvement seen in the case of stepped cylindrical fundamental band of 1.8 GHz against the conventional cylindrical cavity. These are used in a two-stage BPF, showing an improvement in spurious characteristics.

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Efficient analysis of waveguide filters by the integral equation technique and the BI-RME method

V.E. Boria, M. Bozzi, F. Bruni, S. Cogollos, G. Conciauro, B. Gimeno and L. Perregrini.
"Efficient analysis of waveguide filters by the integral equation technique and the BI-RME method." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 393-396 vol. 1.

This paper presents the study of rectangular waveguide filters with rounded corners in the cross-section of the waveguides. These components are suitable for low-cost mass production and can be rigorously analyzed by efficient CAD tools. The analysis approach described in this paper is based on the integral equation technique in conjunction with the boundary integral-resonant mode expansion method. Two representative examples are also reported.

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Generation of RF pulsewidth modulated microwave signals using delta-sigma modulation

J. Keyzer, R. Uang, Y. Sugiyama, M. Iwamoto, I. Galton and P.M. Asbeck. "Generation of RF pulsewidth modulated microwave signals using delta-sigma modulation." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 397-400 vol.1.

With RF pulsewidth modulation, microwave signals are encoded in a binary signal having one pulse per period of the microwave signal, in which the pulse timing varies with the phase of the RF signal, and the pulse width varies in accordance with the signal amplitude. RF pulsewidth modulated signals are advantageous for use with high efficiency amplifiers (class D switching mode amplifiers or class C amplifiers) for the quasi-linear amplification of signals with time-varying envelope. This paper demonstrates a digital technique to generate RF pulse modulated signals for narrowband microwave signals such as those used in wireless communications. The technique makes use of delta-sigma modulation of the phase and amplitude of the signal. The generation of OQPSK signals is shown as an example. The approach is a candidate for the design of single-chip, DSP-based transmitters.





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Using silicon-germanium mainstream BiCMOS technology for X-band and LMDS (25-30 GHz) microwave applications

S. Subbanna, R. Groves, B. Jagannathan, D. Greenberg, G. Freeman, R. Volant, D. Ahlgren, B. Martin, K. Stein, D. Herman and B. Meyerson. "Using silicon-germanium mainstream BiCMOS technology for X-band and LMDS (25-30 GHz) microwave applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 401-404 vol.1.

The 0.18 μm SiGe HBT BiCMOS technology we have developed has found a variety of uses in high-speed digital applications, up to 50 Gb/s (Freeman et al, 2001). This paper focuses on the use and applicability of this mainstream HBT BiCMOS technology for microwave applications, particularly X-band, satellite, and LMDS (20-30 GHz). We discuss the pros and cons relative to the well-known III-V MMIC technology, as well as Si microwave circuits on high-resistivity substrates (SIMMWICs) (Russer, 1998). It is shown that the SiGe BiCMOS technology is widely applicable to microwave technology, with examples such as filters, switches, and VCOs. We also review new technology developments that can be applied to the SiGe BiCMOS technology.

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Low frequency noise in boron doped poly-SiGe resistors

Kun-Ming Chen, Guo-Wei Huang, Jui-Feng Kuan, Hsiang-Jen Huang, Chun-Yen Chang and Tsung-His Yang. "Low frequency noise in boron doped poly-SiGe resistors." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 405-408 vol.1.

Low frequency noise in moderately and heavily boron doped poly-SiGe resistors was studied. The poly-SiGe films were grown using an ultra-high vacuum chemical molecular epitaxy system. The Ge content is in the range of 0 /spl sim/ 36%. The low frequency noise was measured at room temperature. We found that the low frequency noise in poly-SiGe was almost independent of Ge content for heavily doped samples. However, for moderately doped samples, the noise decreases with increasing Ge incorporation. This is due to the lower grain boundary barrier height for high Ge content samples. The carrier mobility fluctuation model can explain this phenomenon.



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A fully-integrated broadband amplifier MMIC employing a novel chip size package

Young Yun, M. Nishijima, M. Katsuno, H. Ishida, K. Minagawa, T. Nobusada and T. Tanaka. "A fully-integrated broadband amplifier MMIC employing a novel chip size package." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 409-412 vol.1.

In this work, using a novel RF-CSP, a broadband amplifier MMIC including all the matching and biasing components was developed for Ku and K band applications. To integrate DC biasing components on the MMIC, an STO (SrTiO/sub 3/) capacitor was employed. By employing an anisotropic conductive film for the RF-CSP, the MMIC fabrication process became very simple and cost effective. The packaged amplifier MMIC exhibited good RF performance in a wide frequency range. This work is the first report for fully-integrated Ku or K band MMICs which have all the biasing and matching components.

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RF performance tradeoffs of SiGe HBT fabricated by reduced pressure chemical vapor deposition

Bongki Mheen, Dongwoo Suh, Hong Seung Kim, Seung-Yun Lee, Chan Woo Park, Sang Hoon Kim, Kyu-Hwan Shim and Jin-Yeong Kang. "RF performance tradeoffs of SiGe HBT fabricated by reduced pressure chemical vapor deposition." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 413-416 vol.1.

In this paper, we developed high cutoff frequency and low noise SiGe HBT devices using a low-cost high-throughput reduced pressure chemical vapor deposition (RPCVD) process. In addition, RPCVD can alleviate large thermal variations even on a single wafer, such as occurs in ultra-high vacuum chemical vapor deposition. We also adopted the cheap localized oxidation of silicon (LOCOS) instead of the shallow trench for isolation of terminals to reduce the parasitic from linkage at the RF arena. The cutoff frequency and maximum oscillation frequency of SiGe HBTs with emitter size of $1/\text{spl times}/2.5/\text{spl mu}/\text{m}/\text{sup } 2/$ were 48 and 62 GHz, respectively. With the tradeoff of base profile and by adopting a finger-type base structure, the measured minimum noise figure of 1.5 dB and associated gain of 16 dB at 1.5 GHz with collector current of 3.1 mA were also observed in the low noise device. Limitation of noise performance related with this process was also discussed.

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A novel equivalent circuit and modeling method for defected ground structure and its application to optimization of a DGS lowpass filter

Jun-Seok Park, Jae-Ho Kim, Jong-Hun Lee, Sang-Hyuk Kim and Sung-Ho Myung. "A novel equivalent circuit and modeling method for defected ground structure and its application to optimization of a DGS lowpass filter." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 417-420 vol. 1.

In this paper, a novel equivalent circuit and modeling method for a defected ground structure is proposed to design an optimized DGS lowpass filter circuit. The equivalent circuit presented in this paper has parallel capacitance to explain the fringing fields due to the defects on the metallic ground plane. Several comparisons between the EM-simulations on the DGS circuits and circuit simulations on its equivalent circuits are demonstrated to show the validity of the proposed model. Optimization for the DGS circuit is carried out by using the proposed equivalent circuit. Simulation and measurements on the fabricated DGS lowpass filter show optimized passband and stopband performance.

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Microwave planar active filters in GaAs and SiGe technologies

H. Bazzi, F. Biron, S. Bosse, L. Delage, B. Barelaud, L. Billonnet and B. Jarry. "Microwave planar active filters in GaAs and SiGe technologies." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 421-424 vol.1.

This paper deals with the design of integrated planar active filters on Si and GaAs substrates. Implementation techniques are detailed in both technologies for active LC filters. A comparison between the two technologies is made with the design of integrated negative resistance circuits.

Click on title for a complete paper.



GSM 900/DCS 1800 fractional-N modulator with two-point-modulation

B. Neurauter, G. Marzinger, A. Schwarz, R. Vuketich, M. Scholz, R. Weigel and J. Fenk. "GSM 900/DCS 1800 fractional-N modulator with two-point-modulation." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 425-428 vol.1.

This paper presents a fractional-N modulator architecture that uses the technique of two-point-modulation. This technique allows direct modulation of the VCO within the closed loop of a high resolution PLL based fractional-N frequency synthesizer, without restriction due to loop bandwidth and PLL dynamics. A prototype transmitter was implemented using the GSM standard to verify the superior performance predicted by simulation. The core element of this new modulator architecture is a PLL-based fractional-N frequency synthesizer. This prototype synthesizer consists essentially of a full custom IC for the analog section, and the digital functionality was implemented in a filed programmable gate array (FPGA). The analog circuitry was fabricated in a 25 GHz BiCMOS process with 0.8 μm as minimum feature size. Measurements of the spectrum for the GSM modulated signal and of the demodulated signal show that the strict demands of the GSM specification can be met.



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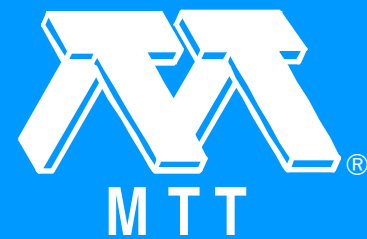
On the stability of millimeter-wave power amplifiers

*L. Samoska, Kun-You Lin, Huei Wang, Yun-Ho Chung, M. Aust, S. Weinreb and D. Dawson.
"On the stability of millimeter-wave power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 429-432 vol.1.*

In this paper, we discuss issues affecting high-frequency power amplifier stability. Two methods for simulating K-factor stability in a monolithic millimeter-wave, integrated circuit (MMIC) power amplifier will be discussed. Both methods will be used to predict the occurrence of millimeter-wave oscillations (Ka-band and above) in a W-band power amplifier. We present experimental results confirming the simulation data, and discuss how the methods may be applied to eliminate instabilities in MMIC power amplifiers.

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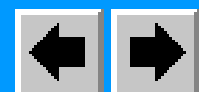
Subjects

Output harmonic termination techniques for AlGaIn/GaN HEMT power amplifiers using active integrated antenna approach

Younkyu Chung, C.Y. Hang, Shujun Cai, Yongxi Qian, C.P. Wen, K.L. Wang and T. Toh.
"Output harmonic termination techniques for AlGaIn/GaN HEMT power amplifiers using active integrated antenna approach." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 433-436 vol. 1.

In this paper, effects of output harmonic terminations on PAE and output power of AlGaIn/GaN HEMT power amplifier are investigated. Using a traditional method of harmonic termination, we observe a substantial increase in PAE and output power. Further, we demonstrate the high efficiency AlGaIn/GaN HEMT power amplifier with harmonic termination characteristics by using the active integrated antenna approach. For the microstrip-based AlGaIn/GaN HEMT power amplifier, large signal measurements and comparisons of PAE and output power were done in class-AB operation with and without output harmonic terminations. For the antenna integrated power amplifier using an AlGaIn/GaN HEMT with 1 mm gate periphery, output power of 30 dBm and peak PAE of 55 % with a power gain of 14 dB were achieved at a drain voltage of 18 V and a gate voltage of -2.8 V.

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An advanced 2 watt high power amplifier for CDMA 900 MHz system

T.H. Kim, C.S. Kim, K.Y. Lee, J.H. Moon, J.C. Lee, J.H. Kim, B. Lee and N.Y. Kim. "An advanced 2 watt high power amplifier for CDMA 900 MHz system." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 437-440 vol.1.

In this paper, an advanced 2 watt high power amplifier (HPA) for CDMA 900 MHz system is described. The results of this HPA - the linear gain of 30 dB, the gain flatness of 0.27 dB at the desired frequency range (895 MHz - 910 MHz), the input return loss of 18 dB, and the output return loss of 33 dB are obtained. The output power of 39.74 dBm is measured at 0.42 dB gain compression. The back-off technique (BOT) and the pre-distortion technique (PDT) applied to improve the linearity of HPA. The improvement as 7.25 dB of Adjacent Channel Power Ratio (ACPR) is obtained by PDT.

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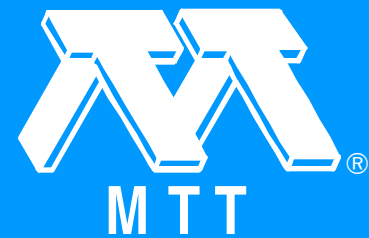


2W Ku-band coplanar MMIC HPA using HBT for flip-chip assembly

J.P. Fraysse, O. Vendier, M. Soulard and P. Auxemery. "2W Ku-band coplanar MMIC HPA using HBT for flip-chip assembly." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 441-444 vol.1.

A coplanar HBT MMIC amplifier in Ku-band for space applications is presented. This HPA is based on the commercial HB20P process of UMS adapted to flip-chip assembly. An output power closed to 2W has been measured over 10.5-12.2GHz frequency range with an associated PAE higher than 25% and an associated gain of 20dB. The coplanar technology (CPW) and flip-chip mounting impact on the HPA design is also described.

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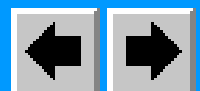
Subjects

1 and 2 watt MMIC power amplifiers for commercial K/Ka-band applications

J.M. Schellenberg. "1 and 2 watt MMIC power amplifiers for commercial K/Ka-band applications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 445-448 vol. 1.

Two ICs, specifically designed for commercial applications at K/Ka-band frequencies, are presented. These ICs provide 1 and 2 watts of linear power respectively, gain levels of typically 17 dB and a power added efficiency of 25% at the 1 dB gain compression point. While the RF performance parameters are not state-of-the-art, these compact chips establish new levels for power density, i.e. the ratio of output power to chip area. This figure of merit is particularly important for the cost sensitive commercial market.

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Characteristics of microwave power GaN HEMTs on 4-inch Si wafers

S. Manohar, A. Narayanan, A. Keerti, A. Pham, J. Brown, R. Borges and K. Linthicum.
"Characteristics of microwave power GaN HEMTs on 4-inch Si wafers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 449-452 vol.1.

We present the design and development of AlGaIn/GaN high electron mobility transistors (HEMTs) fabricated on a 4-inch Si wafer. The GaN HEMT devices demonstrate a maximum drain current of 900 mA/mm, a peak $g_{\text{sub m}}$ of 300 mS/mm, and a microwave output power density of 1.5 W/mm. To the best of the authors' knowledge, these are the best results reported on GaN HEMTs on 4-inch Si wafers.

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Intercept point behavior of Ka-band GaAs high power amplifiers

T. Merkle, A. Tessmann and S. Ramberger. "Intercept point behavior of Ka-band GaAs high power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 453-456 vol. 1.

Intermodulation distortion (IMD) and output intercept point (OIP) behavior due to output power saturation, thermal effects and bias conditions were investigated for AlGaAs/InGaAs/GaAs pHEMT power amplifiers at Ka-Band frequencies. A power amplifier with a chip size of 3.3 mm/sup 2/ and a saturated output power of more than 27 dBm from 37-41 GHz, and a 3 mm/sup 2/ high gain compact dual-gate power amplifier with an output power saturation of 27 dBm at 35 GHz were designed. Intermodulation distortion for these two power amplifiers was compared. In order to separate fundamental effects from measurement induced phenomena, the principle accuracy of multi-tone measurement systems that are based on scalar spectrum analyzers was reviewed.



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Traveling-wave tube amplifier performance evaluation and design optimization for applications in multi-level digital communications

J. Qiu, D. Abe, T.M. Antonsen, Jr., B.G. Danly and B. Levush. "Traveling-wave tube amplifier performance evaluation and design optimization for applications in multi-level digital communications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 457-460 vol.1.

In this paper, we use power margin as a figure of merit for evaluating the performance of TWT amplifiers used in multi-level digital communications applications. Power margin is better at predicting the system level performance of TWT amplifiers than device-level measures like EVM. We compare the calculated power margin performances for helix TWT circuits optimized with different optimization goal functions in CHRISTINE. A digital goal function that provides enhanced power margin is constructed to demonstrate the approach of TWT circuit design optimization from a system perspective.

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An adaptive Volterra predistorter for the linearization of RF high power amplifiers

Anding Zhu and T.J. Brazil. "An adaptive Volterra predistorter for the linearization of RF high power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 461-464 vol. 1.

An efficient digital baseband predistortion linearizer is presented to compensate for nonlinear distortions induced by RF high power amplifiers in wireless communication systems. The proposed approach utilizes an indirect learning architecture with a fast recursive least squares (RLS) filtering algorithm, implemented using V-vector algebra, to update the coefficients of a Volterra-based predistorter. There is no requirement for an initial identification of the nonlinear characteristics of HPA as in linearizers based on conventional pth-order inverse methods. Simulation results show that that good performance and low computational complexity are achieved in the linearization of both narrow and wide bandwidth systems.

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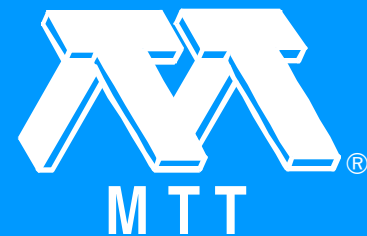


Abstracts

A low cost traveling wave tube for wireless communications

B.K. Vancil and E.G. Wintucky. "A low cost traveling wave tube for wireless communications." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 465-468 vol.1.

Demand for high data rate wireless communications is pushing up amplifier power, bandwidth and frequency requirements. Some systems are using vacuum electron devices again because solid-state power amplifiers are not able to efficiently meet the new requirements. The traveling wave tube is the VED of choice because of its excellent broadband capability as well as high power efficiency and frequency. However, TWTs are very expensive on a per watt basis below about 200 watts of output power. We propose a new traveling wave tube that utilizes cathode ray tube construction technology and electrostatic focusing. We believe the tube can be built in quantity for under \$1,000 each. We discuss several traveling wave tube slow wave circuits that lend themselves to the new construction. We present modeling results and data on prototype devices.



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Effects of anti-aliasing filters in feedback path of adaptive predistortion

Weiyun Shan and L. Sundstrom. "Effects of anti-aliasing filters in feedback path of adaptive predistortion." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 469-472 vol. 1.

Adaptive predistortion is one of the most promising methods to linearize RF power amplifiers (PAs). Its linearity performance is, however, limited by various memory effects existing in the system. In this paper, we study the effects of anti-aliasing filters in the feedback path of adaptive predistortion. Different filter approximations are examined with a class AB power amplifier by means of simulations. Of the filters studied, Butterworth filters perform better than Chebyshev filters when they have the same noise-equivalent bandwidth (NEB). Simulation results also show that the cut-off frequency of the anti-aliasing filter affects both the convergence speed of the adaptation algorithm and the level of mean square error (MSE) between the desired and the feedback signals. To a certain degree, the higher the cut-off frequency of the filter, the less the number of iterations needed by the adaptation process.



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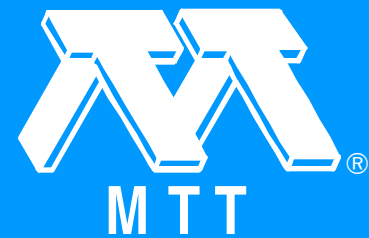
Error signal reuse in a feedforward amplifier

A. Khanifar, M. Gurvich and B. Vassilakis. "Error signal reuse in a feedforward amplifier." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 473-475 vol.1.

In this paper, the concept of frequency selective feedback is examined in the context of feedforward (FFWD) amplifier architecture. In a typical FFWD system, a time-delayed signal that represents the distortion products is injected in anti-phase at the main amplifier output, thus improving the overall intermodulation distortion (IMD) of the system. This signal may also be reused as a feedback signal for improving the uncorrected main amplifier performance. Main amplifier linearity improvement is important in terms of efficiency, size and cost, and can be achieved at a small price in terms of added complexity. This paper presents simulation and measured results that were obtained from a realized system. The practical limitations of this technique are also outlined.

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RF-interconnect for multi-Gb/s digital interface based on 10 GHz RF-modulation in 0.18 μm CMOS

Hyunchol Shin, Zhiwei Xu and M.F. Chang. "RF-interconnect for multi-Gb/s digital interface based on 10 GHz RF-modulation in 0.18 μm CMOS." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 477-480 vol.1.

Presents an RF-interconnect (RFI) for multi-Gb/s digital interface based on capacitive coupling and RF-modulation over an impedance-matched transmission line. The RFI can reduce the switching noise coupling greatly and eliminate the dc current dissipation completely over the channel. The improved signal-to-noise ratio enables data transmission with reduced signal swing (as low as 0.2 V) and potentially enhanced data speed. A prototype RFI implemented in 0.18 μm CMOS demonstrates a maximum data rate of 2.2 Gb/s with 10.5 GHz RF-carrier.

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50 GHz high output voltage distributed amplifiers for 40 Gb/s EO modulator driver application

C. Yuen, K. Laursen, Duc Chu and K. Mar. "50 GHz high output voltage distributed amplifiers for 40 Gb/s EO modulator driver application." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 481-484 vol.1.

Both single-ended and differential distributed amplifiers were developed using 0.15 μm GaAs power PHEMT for 40 Gb/s EO modulator driver circuits. The single-ended approach has achieved 12 dB gain up to 50 GHz, greater than 5 dB gain control range and output voltage >6.5 Vp-p measured at 10 Gb/s. Power transfer data shows Psat of 20 dBm at 40 GHz, which translates to 6.3 Vp-p swing at 40 GHz. The differential approach has achieved 8 dB gain up to 45 GHz and differential output voltage of 9 Vp-p measured at 10 Gb/s. These amplifiers are suitable for use in fiber-optic communication systems.

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Development of 4-Gsps 2-bit ADC with GaAs ICs for radio astronomy

*M. Okiura, S. Iguchi, S.K. Okumura, M. Momose, K. Matsumoto and N. Kawaguchi.
"Development of 4-Gsps 2-bit ADC with GaAs ICs for radio astronomy." 2002 MTT-S
International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 485-488 vol.1.*

We developed two sets of prototype 4-Gsps 2-bit analog to digital converters (ADCs) with GaAs ICs for the realization of 4 GHz sampling in an ADC system for the Atacama Large Millimeter / submillimeter Array (ALMA). This consists of three sets of 12-Gbps decision circuits and 12-Gbps demultiplexers, and has the capability of sampling in a bandwidth of 6 GHz. Toward implementation of GaAs ICs in the ADC system, we measured the sampling jitter of the ADC using the ultra-wide band correlator (UWBC) developed for the Nobeyama Millimeter Array (NMA). The measured Allan standard deviation of phase, corresponding to the stability of sampling timing is $2.3/\text{spl times}/10/\text{sup -15/}$ at 10 seconds, and the Allan standard deviation due to the flicker-frequency noise is $0.8/\text{spl times}/10/\text{sup -15/}$. It is shown that the coherence loss becomes 0.95 at a coherence time of 86400 seconds (24 hours). The Allan standard deviation of sampling timing and its long-time stability are acceptable for application to radio astronomical ADC systems.



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0.25/spl mu/m pHEMT 40Gb/s E/O modulator drivers

J.M. Carroll, A. Coutant, M.S. Heins, C.F. Campbell and E. Reese. "0.25/spl mu/m pHEMT 40Gb/s E/O modulator drivers." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 489-492 vol.1.

The development of two high voltage, 40 Gb/s E/O modulator driver ICs is described. Both were designed with a Distributed Amplifier (DA) topology utilizing a 0.25/spl mu/m GaAs pHEMT production process. The modulator drivers exhibit 6 dB of small signal gain, greater than 42 GHz of 3-dB bandwidth, and better than 6.5-V/sub pp/ output swing.

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Suppression of the parallel-plate noise in high-speed circuits using a metallic electromagnetic band-gap structure

R. Abhari and G.V. Eleftheriades. "Suppression of the parallel-plate noise in high-speed circuits using a metallic electromagnetic band-gap structure." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 493-496 vol.1.

A novel approach for the suppression of the parallel-plate noise in high-speed circuits is proposed by utilizing a metallic electromagnetic band-gap (EBG) structure. The key idea relies on replacing one of the two solid electric conductor plates with a metallic EBG surface of compact texture. To validate the concept, an EBG surface was fabricated and employed in a number of via-containing parallel-plate test boards. Frequency domain measurements showed a band-gap of about 1.7 GHz around 3.77 GHz. More importantly, suppression of the parallel-plate noise by 65% was achieved based on time domain reflectometry experiments.

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Results on a direct digital receiver operated with fast learning networks

O. Mireux, J.-J. Brault and R.G. Bosisio. "Results on a direct digital receiver operated with fast learning networks." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. 1 [MWSYM]): 497-500 vol. 1.

In this paper, learning algorithms are used to decode QPSK modulated signals in a direct conversion microwave/millimetre wave receiver using an application specific six port module. Two different algorithms, K-Means and Online Bayesian Network, are considered for operation of the decoder to recover IQ data from modulated signals. Bit Error Rate (BER) vs. Noise level (Eb/No) results are presented including the case where the Local Oscillator (LO) is not locked to carrier signal.

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A 6.5-mW receiver front-end for Bluetooth in 0.18- μm CMOS (2002 Vol. I [MWSYM])

F. Beffa, R. Vogt, W. Bachtold, E. Zellweger and U. Lott. "A 6.5-mW receiver front-end for Bluetooth in 0.18- μm CMOS (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 501-504 vol.1.

This paper describes the design of a low-IF receiver front-end for Bluetooth fabricated in a 0.18 μm CMOS technology. The chip includes an LNA and an image-reject mixer and provides a down-conversion gain to the 2 MHz IF of 21.4 dB, an image rejection of 28 dB and a NF of 13.9 dB consuming only 6.5 mW at 1.8 V.

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An active SiGe sub-harmonic direct-conversion receiver front-end design for 5-6 GHz band applications (2002 Vol. I [MWSYM])

R. Svitek, D. Johnson and S. Raman. "An active SiGe sub-harmonic direct-conversion receiver front-end design for 5-6 GHz band applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 505-508 vol.1.

This paper describes a packaged SiGe RF front-end design for use in the Unlicensed National Information Infrastructure (U-NII) bands. The front-end is based on a sub-harmonic direct-conversion architecture and is composed of an LNA, I and Q /spl times/2 sub-harmonic mixers (SHMs), and an LO conditioning chain. The receiver is completely differential and is designed for operation from a 3.3 V supply. Simulated performance shows >25 dB conversion gain, 6.8 dB noise figure (cascode LNA), 0/spl deg/ I/Q phase imbalance, and 39.1 mA total current consumption. To the authors' knowledge, this is the first 5-6 GHz SiGe active sub-harmonic direct-conversion receiver design presented in the literature.





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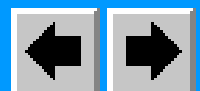
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Soft breakdown and hot carrier reliability of CMOS RF mixer and redesign (2002 Vol. I [MWSYM])

Qiang Li, Wei Li, Jinlong Zhang and J.S. Yuan. "Soft breakdown and hot carrier reliability of CMOS RF mixer and redesign (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 509-512 vol.1.

In this paper, CMOS RF down-conversion mixer circuit hot-carrier (HC) and soft breakdown (SBD) reliability estimation and redesign is presented. First of all, MOS transistor reliability under analog operation was evaluated by experiment. The mixer circuit operation conditions for the occurrence of HC and SBD are analyzed, and a circuit performance model is presented to relate device degradation to circuit performance degradation. Finally, we propose mixer circuit redesign strategies, which reduce the HC and SBD problem. Simulation shows improved noise performance with similar gain, IIP3 and power consumption.

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High-Q copper inductors on standard silicon substrate with a low-k BCB dielectric layer (2002 Vol. I [MWSYM])

Xiao Huo, K.J. Chen and P.C.H. Chan. "High-Q copper inductors on standard silicon substrate with a low-k BCB dielectric layer (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 513-516 vol.1.

High-Q Cu inductors using low-k benzocyclobutene (BCB) dielectric as an interface layer have been fabricated on a standard CMOS-grade silicon substrate. Metal ohmic loss and substrate loss, the two major factors that degrade the Q-factors of on-chip inductors, are suppressed by the employment of electroplated copper and the BCB dielectric, respectively. Quality-factor as high as 25 was obtained for a 1-nH inductor at 2 GHz. The inductor fabrication process is low-cost and low-temperature, making it suitable for post-IC process for high-performance RFIC's and MMIC's.

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Geometry and bias current optimization for SiGe HBT cascode low-noise amplifiers (2002 Vol. I [MWSYM])

Qingqing Liang, Guofu Niu, J.D. Cressler, S. Taylor and D.L. Hareme. "Geometry and bias current optimization for SiGe HBT cascode low-noise amplifiers (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 517-520 vol.1.

This work presents a new design methodology for inductively-degenerated cascode low-noise amplifiers using advanced epitaxial-base SiGe HBTs. Noise figure, gain, and IIP3 are calculated using calibrated linear circuit analysis and a Volterra series methodology as a function of the two major design variables: emitter geometry and biasing current. An optimum SiGe HBT LNA design point which balances input impedance match, high IIP3, noise figure, gain, and power consumption is obtained from calculated noise figure, gain, and IIP3 contours as a function of bias current and geometry. Simplified analytical expressions of IIP3, gain, and noise figure are presented to give additional insight. The optimum LNA design point for the 50 GHz SiGe HBT process technology under study yields a 2 GHz LNA with 15.8 dBm IIP3, 18 dB gain, 1.15 dB noise figure, and a $|s_{11}|$ less than -20 dB for a biasing current of 7.5 mA. The calculated results show good agreement with HP Advanced-Design-System simulations. The design tradeoffs illuminated by this optimization methodology are highlighted and discussed.

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High linearity low-k BCB-bridged AlGaAs/InGaAs power HFETs (2002 Vol. I [MWSYM])

Hsien-Chin Chiu, Ming-Jyh Hwu, Shih-Cheng Yang and Yi-Jen Chan. "High linearity low-k BCB-bridged AlGaAs/InGaAs power HFETs (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 521-524 vol.1.

A novel low-k BCB (benzocyclobutene) bridged and passivated process for AlGaAs/InGaAs doped-channel power FETs with high reliability and linearity was characterized and developed. In this study, we applied the low-k BCB-bridged interlayer to replace the conventional air-bridged process and the SiN/sub x/ passivation technology of the 1 mm-wide power device fabrication. This novel process technique demonstrates a lower power gain degradation under a high input power swing, and exhibits an improved adjacent channel power ratio (ACPR) than the air-bridged ones due to its lower gate leakage current. The power gain degradation ratio of BCB-bridged devices under a high input power operation ($P_{\text{sub in}} = 5 \text{ dBm}$) is 0.51 dB/dBm, and this value is 0.65 dB/dBm of conventional air-bridged devices.

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Performance of a CMOS Bluetooth transceiver IC with copper RF passives (2002 Vol. I [MWSYM])

My The Doan, Qian Yin, Khoo Ee Sze, P.B. Khannur, S.C. Rustagi, Shi Jinglin, Pang Dow Foo and A.B. Ajikuttira. "Performance of a CMOS Bluetooth transceiver IC with copper RF passives (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 525-528 vol. 1.

On-chip copper inductors, MIM capacitors and precision resistors in a novel, low-cost process are described. A CMOS transceiver for Bluetooth was realized with these new RF passive components and compared with the same IC realized in a commercial 0.35 μm CMOS process with Al metalization. In the low-noise amplifier (LNA) a gain improvement of around 5 dB and a noise-figure reduction of 1.2 dB were observed. For the image-reject mixer (IRM), the conversion gain improved by 3.5 dB. The output power of the power amplifier (PA) increased by 1.5 dB. For the phase-locked loop (PLL) frequency synthesizer, the settling time was reduced almost in half.

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Effects of dummy patterns and substrate on spiral inductors for sub-micron RF ICs (2002 Vol. I [MWSYM])

Jae-Hong Chang, Yong-Sik Youn, Hyun-Kyu Yu and Choong-Ki Kim. "Effects of dummy patterns and substrate on spiral inductors for sub-micron RF ICs (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 529-532 vol.1.

In today's sub-micron CMOS technologies, dummy patterns are necessary to obtain the desired metal density for uniform etching. This paper shows the effect of the dummy patterns on the quality factor of the inductor. The effects of the polysilicon ground shield and p-doped substrate on inductor performance have also been investigated. As the distance of between dummy and inductor is increased, the quality factor is less influenced by eddy current loss due to dummy. And we can achieve $Q=13$ @ 3GHz and $L=6.05$ nH using patterned ground shield using slotted polysilicon layers in a commercial standard 0.18 μm CMOS technology.





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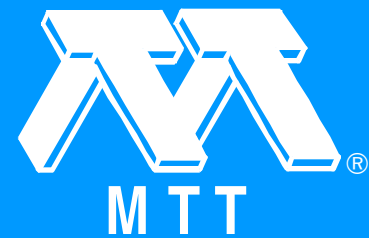
Schottky Junction Transistors for micropower RFICs (2002 Vol. I [MWSYM])

J. Spann, Zhiyuan Wu, P. Jaconelli, Jinman Yang and T.J. Thornton. "Schottky Junction Transistors for micropower RFICs (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 533-536 vol.1.

Results are presented from measurements and numerical simulations of Schottky Junction Transistors, a new type of micropower device capable of operating at GHz frequencies in the sub-threshold regime. Detailed measurements of the d.c. characteristics of a 2 μm gate length device agree well with numerical simulations. Measurements of transconductance and gate capacitance suggest that this relatively long gate length device will have a cut-off frequency of 126 MHz, which is again consistent with the numerical simulations. When projected to gate lengths of 0.1 μm cut-off frequencies in excess of 10 GHz are predicted for drain currents of less than 1 μA .

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ESD protection design for 900-MHz RF receiver with 8-kV HBM ESD robustness (2002 Vol. I [MWSYM])

Ming-Dou Ker, Wen-Yu Lo, Chien-Ming Lee, Chia-Pei Chen and Hong-Sing Kao. "ESD protection design for 900-MHz RF receiver with 8-kV HBM ESD robustness (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 537-540 vol.1.

This paper presents a state-of-art ESD protection design for an RF circuit with a human-body-model (HBM) ESD robustness of 8 kV. By including a turn on efficient power-rails clamp circuit into the RF circuit, the ESD clamp devices of the RF input pin are operated in the forward-biased conduction, rather than the traditional junction breakdown condition. Therefore, the dimension of ESD devices for the RF input pin can be further downsized to reduce the input capacitance loading for the RF signal. This design has been successfully applied in a 900-MHz RF receiver and fabricated in 0.25- μm CMOS process with a thick top metal layer. The experimental results have confirmed that its ESD robustness is as high as >8 kV under the HBM ESD test.

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Improvements to performance of spiral inductors on insulators (2002 Vol. I [MWSYM])

D. Kelly and F. Wright. "Improvements to performance of spiral inductors on insulators (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 541-543 vol. 1.

The performance of spiral inductors on insulating substrates is far superior to ones fabricated in bulk CMOS or BiCMOS processes. In spite of this, SOI inductors are generally not satisfactory for very low noise or low insertion loss circuits. This work studies high frequency effects on current density in inductors and discusses improvements in metallization and layout. Based on this research, a 5.5 nH inductor has been fabricated on sapphire with a 540 μm diameter and 4.5 μm thick aluminum, resulting in a quality factor of 25 at 2 GHz.

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Octave tunable, highly linear, RC-ring oscillator with differential fine-coarse tuning, quadrature outputs and amplitude control for fiber optic transceivers (2002 Vol. I [MWSYM])

M.A.T. Sanduleanu, D. van Goor and H. Veenstra. "Octave tunable, highly linear, RC-ring oscillator with differential fine-coarse tuning, quadrature outputs and amplitude control for fiber optic transceivers (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 545-548 vol.1.

This paper presents a low-voltage, RC-ring oscillator for fiber optic transceivers (SDH/SONET applications). It has one octave coarse tuning range, differential tuning inputs, quadrature outputs and a linear fine-control. A replica biasing circuit regulates the common-mode voltage and the amplitude at the output. The oscillator has been realized in a pre-production 70GHz f/sub T/, SiGe, BiCMOS process (QUBIC4G). The tuning range covered with process and temperature variations is 3.4GHz-6.8GHz. At 6.6GHz oscillation frequency the measured phase noise is -92dBc/Hz @ 3MHz offset from the carrier. The typical power consumption of the VCO core is 80mW from a 2.5V power supply and the area is 0.3mm/sup 2/.





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A 2.45GHz fully-differential CMOS image-reject mixer for Bluetooth application (2002 Vol. I [MWSYM])

P.B. Khannur and Koh Soo Ling. "A 2.45GHz fully-differential CMOS image-reject mixer for Bluetooth application (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 549-552 vol. 1.

The design of a 2.45GHz image-reject mixer (IRM) for Bluetooth application using low-cost 0.35um, double-poly four-metal standard CMOS process with the metal-insulator-metal (MIM) capacitor option is described. The proposed design uses Hartley architecture with temperature compensation to significantly reduce the gain variation with temperature (-40/spl deg/C to +85/spl deg/C). In-house extracted models were used for active and passive components to achieve image rejection ratio (IRR) better than 45dB, input referred third-order intercept point (IIP3) better than -7dBm, voltage conversion gain better than 20dB and noise figure less than 20dB under all process, temperature, and voltage supply conditions. The intermediate frequency (IF) is 2MHz. The circuit operates from a 3V/spl plusmn/10% supply and draws 10.4mA.

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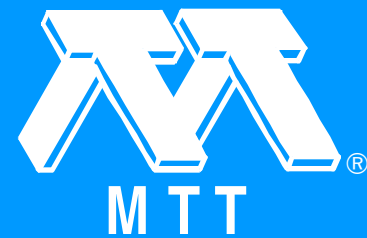


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Super compact RFIC inductors in 0.18/spl mu/m CMOS with copper interconnects (2002 Vol. I [MWSYM])

H. Feng, G. Jelodin, K. Gong, R. Zhan, Q. Wu, C. Chen and A. Wang. "Super compact RFIC inductors in 0.18/spl mu/m CMOS with copper interconnects (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 553-556 vol.1.

Design of super compact on-chip inductors with deep-shrunk dimension of 22/spl mu/m/spl times/23/spl mu/m, as opposed to several hundreds /spl mu/m by several hundreds /spl mu/m, is reported. Implemented in a 6-metal all-copper 0.18/spl mu/m CMOS process, a flat inductor value of 10nH up to 4GHz, satisfactory to many typical RFIC applications, is achieved. The aggressive shrinkage reduces parasitic capacitance substantially and makes it realistic and cost-effective to realize single-chip RFICs in very deep sub-micron technologies. A new inductor model is proposed for accuracy. A 2.4GHz LNA circuit with on-chip matching using the compact inductor is demonstrated.



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High performance single supply power amplifiers for GSM and DCS applications using true enhancement mode FET technology (2002 Vol. I [MWSYM])

E. Glass, M. Shields and A. Reyes. "High performance single supply power amplifiers for GSM and DCS applications using true enhancement mode FET technology (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 557-560 vol.1.

Two high performance single supply power amplifier IC products have been developed for GSM and DCS applications using true enhancement mode FET technology. At $V_D=3.2V$, under CW conditions, the GSM IC supplies +35.5 dBm output power at 58% PAE and the DCS IC supplies +33.5 dBm at 46% PAE. These ICs have low leakage currents similar to HBT and LDMOS and do not require the use of a drain switch. In addition, due to a high threshold voltage ($V_{th}=+0.6V$), they exhibit excellent RF isolation at $V_{ref}=0.1V$ and $P_{in}=+5$ dBm and do not require on-chip attenuators.





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Integrated 2.4 GHz CMOS quadrature VCO with symmetrical spiral inductors and differential varactors (2002 Vol. I [MWSYM])

Baoyong Chi and Bingxue Shi. "Integrated 2.4 GHz CMOS quadrature VCO with symmetrical spiral inductors and differential varactors (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 561-564 vol.1.

A 2.4 GHz CMOS quadrature VCO is presented. By using symmetrical inductors and differential varactors, the circuit has been integrated into a single chip completely. The principles of this VCO are described. A prototype is fabricated in 0.25 μm single-poly five-metal CMOS standard digital process. The measured results show that the proposed VCO could generate quadrature LO signals with a tuning range of more than 300 MHz and phase noise -104.33 dBc/Hz at 600 kHz offset/spl odot/2.41 GHz (when only one port of differential outputs is measured). It consumes 21 mA when VDD=2.5 V (Including 8 mA output buffers). Die area is only 0.83/spl times/0.68 mm/sup 2/. This VCO could be used in many integrated wireless transceivers.

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A fully monolithic SiGe quadrature voltage controlled oscillator design for GSM/DCS-PCS applications (2002 Vol. I [MWSYM])

D. Cordeau, J.-M. Paillot, H. Cam, G. De Astis and L. Dascalescu. "A fully monolithic SiGe quadrature voltage controlled oscillator design for GSM/DCS-PCS applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 565-568 vol.1.

This paper describes the design and optimization in terms of phase noise of a fully monolithic SiGe Voltage Controlled Oscillator (VCO) with quadrature outputs. The proposed circuit is made of two cross-coupled differential VCO's, with integrated resonator, to ensure the quadrature outputs. The quadrature VCO core runs on 13 mA from a 2.7 V power supply. The simulated phase noise is about -140 dBc/Hz at 3 MHz frequency offset almost all over the tuning range. The oscillator is tuned from 1.44 GHz to 1.76 GHz with a tuning voltage varying from 0 to 3 V.

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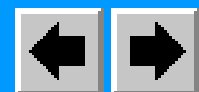
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Hot carrier and soft breakdown effects on VCO performance (2002 Vol. I [MWSYM])

E. Xiao and J.S. Yuan. "Hot carrier and soft breakdown effects on VCO performance (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 569-572 vol.1.

This paper systematically investigates the hot carrier and soft-breakdown induced performance degradation in a CMOS voltage-controlled oscillator used in phase locked loop frequency synthesizers. After deriving the closed-form equations to predict phase noise and VCO gain, we relate VCO RF performance such as phase noise, tuning range and gain of VCO subject to electrical stress. The circuit degradations predicted by analytical model equations are verified by SpectraRF simulation using parameters extracted from the experimental data of 0.16 μm CMOS technology.

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A 1.5-V 4-GHz dynamic-loading regenerative frequency doubler in a 0.35- μ m CMOS process (2002 Vol. I [MWSYM])

J.M.C. Wong and H.C. Luong. "A 1.5-V 4-GHz dynamic-loading regenerative frequency doubler in a 0.35- μ m CMOS process (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 573-576 vol.1.

This paper proposes a new topology of a frequency doubler using a dynamic-loading technique to achieve higher operating frequency, larger output swing, larger bandwidth and lower phase noise compared to traditional designs. Implemented in a standard 0.35- μ m digital CMOS process and at a 1.5-V supply, the proposed frequency doubler measures a maximum operating output frequency of 4 GHz with a bandwidth of 2.4 GHz while consuming a power of 3.7mW. The single-ended output amplitude is ranging from -3.0 to -6.5 dBm, and the phase noise is as low as -111dBc/Hz @ 500kHz offset.

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Very low phase-noise fully-integrated coupled VCOs (2002 Vol. I [MWSYM])

H. Jacobsson, B. Hansson, H. Berg and S. Gevorgian. "Very low phase-noise fully-integrated coupled VCOs (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 577-580 vol.1.

With the aim of achieving very low phase noise, two area and power consumption efficient methods of coupling two or more identical VCOs are presented. To verify the principles, a set of fully integrated, coupled VCOs of the cross-coupled differential pair type, was manufactured in a commercial SiGe HBT technology. The measured phase noise at 100 kHz offset frequency was -106 dBc/Hz at 6 GHz using two coupled VCOs and -103 dBc/Hz at 12 GHz using four coupled VCOs. A phase noise reduction of 1-6 dB was achieved relative to a single VCO of the same topology. In one of the two methods, output signals are additionally obtained in quadrature.

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Wide-tuning-range dual-VCOs for cable modem receivers (2002 Vol. I [MWSYM])

K. Stadius and K. Halonen. "Wide-tuning-range dual-VCOs for cable modem receivers (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 581-584 vol. 1.

A double-conversion receiver for cable modem applications requires a wide-tuning-range VCO with low phase noise characteristics for the first LO generation. Achieving simultaneously low phase noise and large tuning range from a monolithic VCO is an exceptionally challenging task. The design aspects of wideband monolithic LC-VCO are tackled in this paper with the boundaries set by a 0.9- μm SiGe HBT technology. Two dual-VCO implementations are presented and a method for buffering the VCO signal without loading the LC-resonator is proposed. Both simulation and experimental results are given.

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A 5.8 GHz fully integrated low power low phase noise CMOS LC VCO for WLAN applications (2002 Vol. I [MWSYM])

J. Bhattacharjee, D. Mukherjee, E. Gebara, S. Nuttinck and J. Laskar. "A 5.8 GHz fully integrated low power low phase noise CMOS LC VCO for WLAN applications (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 585-588 vol.1.

A fully integrated low power and low phase noise 5.8 GHz VCO is designed and fabricated in standard 0.24 μm single-poly, 5-metal digital CMOS process. The VCO-core draws 2 mA of current from a 2.5 V supply. Measured phase noise at 1 MHz offset from the center frequency is -112 dBc/Hz. It has a tuning range of 810 MHz with low phase noise performance throughout the tuning range. It meets the requirements for IEEE802.11a WLAN standard. Low power and low phase noise have been achieved simultaneously by the use of np complementary cross-coupled topology. The novel orientation of the inductor pair used in the design minimizes the effect of any unwanted common-mode magnetic coupling that may arise from other on-chip inductors in an integrated environment.





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A 5 GHz fast-switching CMOS frequency synthesizer (2002 Vol. I [MWSYM])

Xiaomin Yang, T. Wu and J. McMacken. "A 5 GHz fast-switching CMOS frequency synthesizer (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 589-592 vol.1.

A 5 GHz PLL-based frequency synthesizer for wireless LAN applications is presented in this paper. The proposed PLL is designed using 0.25 μm CMOS technology with 3.3 V power supply. The enlarged VCO tuning range gives extra bandwidth to achieve a reduced locking time. And the buffer amplifier provides additional gain to compensate the smaller VCO output amplitude level. The phase noise at 1 MHz offset is -120 dBc/Hz, and the power consumption is 30 mw.

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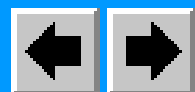
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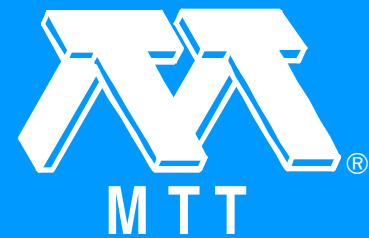
A Wilkinson power divider on a low resistivity Si substrate with a polyimide interface layer for wireless circuits (2002 Vol. I [MWSYM])

J. Papapolymerou, G.E. Ponchak and E.M. Tentzeris. "A Wilkinson power divider on a low resistivity Si substrate with a polyimide interface layer for wireless circuits (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 593-596 vol.1.

A 3-dB Wilkinson power divider on a low resistivity silicon substrate (20 /spl Omega/-cm) with a polyimide interface layer is presented for the first time. The divider utilizes Finite Ground Coplanar (FGC) line technology, and operates at a center frequency of 15 GHz. Low insertion loss and high return loss and isolation is achieved by using a 20 /spl mu/m thick polyimide interface layer on top of the silicon wafer, and a line geometry that minimizes field interaction with the lossy Si substrate. The attenuation of the FGC lines is comparable with that of thin film microstrip lines on similar substrates. Experimental and full-wave analysis results are provided.

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Development and verification of a new non-linear MOSFET model (2002 Vol. I [MWSYM])

H. Romdane, E. Bergeault and B. Huyart. "Development and verification of a new non-linear MOSFET model (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 597-599 vol.1.

A new non-linear model of Si MOSFET transistor based on a device characterization using DC and small-signal scattering parameter measurements is proposed. It is shown that interpolation of measured data and look up tables provide an extensive description of the extrinsic and intrinsic MOSFET non-linearities. Model verification is achieved by comparing simulations and on-wafer measurements of S parameters at a typical bias point.

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Design and analysis of a multi-layer transformer balun for silicon RF integrated circuits (2002 Vol. I [MWSYM])

H.Y.D. Yang, L. Zhang and J.A. Castaneda. "Design and analysis of a multi-layer transformer balun for silicon RF integrated circuits (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 601-604 vol.1.

In this paper, we present the design and analysis of an on-chip transformer balun for silicon RFIC. Both the primary and secondary spread over four metal layers along a common symmetric axis to reduce the overall area maintaining reasonable quality factor. A five port transformer balun circuit model is developed to facilitate the device simulation. A 4:11 transformer balun is fabricated and test. It is ideal for LNA to enhance the gain with optimum noise figure.

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Smoothing gate capacitance models for CMOS radio frequency and microwave integrated circuits CAD (2002 Vol. I [MWSYM])

J. Dobes. "Smoothing gate capacitance models for CMOS radio frequency and microwave integrated circuits CAD (2002 Vol. I [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.1 (2002 Vol. I [MWSYM]): 605-608 vol. 1.

Convergence problems for both voltage- and charge-controlled models of MOSFET gate capacitances are often a limiting factor of CAD tools. An idea for exponential smoothing of model discontinuities is proposed. The method is demonstrated by smoothing the discontinuity of Meyer's model at zero drain-source voltage. The updated model is tested on a flip-flop circuit by an advanced algorithm.

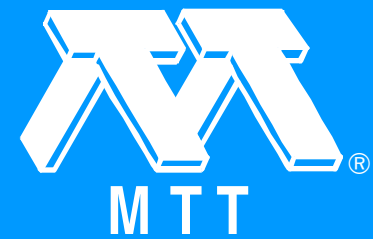
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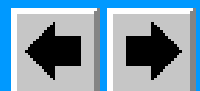
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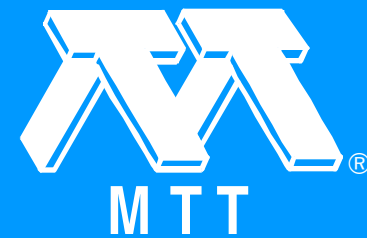
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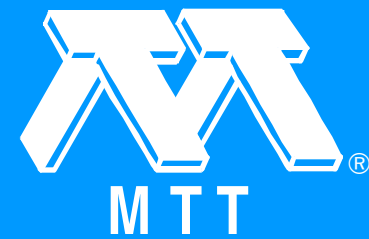
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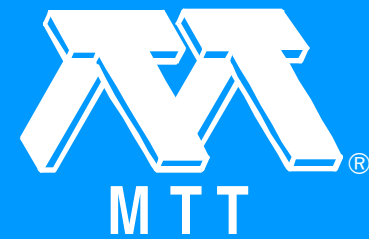
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Technical Program Schedule (2002 Vol. II [MWSYM])

"Technical Program Schedule (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): vi-xx.



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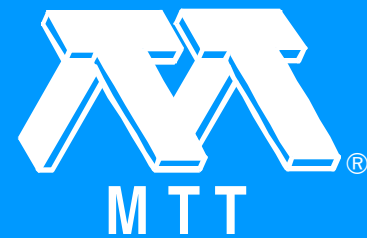


Abstracts

A 20 W 2080-2200 MHz hybrid power amplifier optimized for error amplifier applications

E.J. Crescenzi, Jr.. "A 20 W 2080-2200 MHz hybrid power amplifier optimized for error amplifier applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 613-616 vol.2.

A hybrid power amplifier module has been designed for application as an error amplifier in feedforward PAs for UNITS multi-channel operation. Error amplifiers require excess bandwidth, excellent gain flatness, and high linearity. Si LDMOS power devices were integrated with chip-and-wire matching and hybrid SMT amplifier circuitry chosen to optimize these characteristics.



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A 15 watt PFP GaAs PHEMT MMIC power amplifier for 3G wireless transmitter applications

J. Staudinger, R. Sherman, T. Quach, M. Miller and L. Frye. "A 15 watt PFP GaAs PHEMT MMIC power amplifier for 3G wireless transmitter applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 617-620 vol.2.

This work describes a wide-bandwidth highly integrated MMIC linear power amplifier implemented with high voltage GaAs PHEMT device technology targeting 3G wireless infrastructure applications. The MMIC amplifier exhibits 34 dB small signal gain, less than 0.5 dB gain variation across the UMTS frequency band centered at 2.14 GHz, and a peak-envelope power in excess of 15 W when biased with a 12 volt supply. Under a 64 traffic channel single carrier W-CDMA signal (test model 1, with a 11 dB peak-to-average signal ratio), the amplifier achieves 2W average output power and 17% power added efficiency at an ACPR of -40 dBc. Under a 9-channel single carrier IS-95 forward-link signal, the amplifier achieves 4 W average power at an efficiency of 25% at an ACPR of -38 dBc. The MMIC amplifier is highly integrated consisting of 3-gain stages, input and interstage matching circuits, and output pre-matching - all contained on the GaAs IC. The use of on-chip pre-matching for the output load line greatly simplifies and reduces off chip component matching elements and their tolerances. To the author's best knowledge, this amplifier represents the highest power and efficiency reported to date for a GaAs PHEMT amplifier realized at this level of integration.

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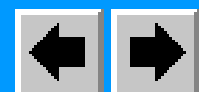
Subjects

70% high efficient C-band 27 W hetero-structure FET for space application

H. Minamide, M. Kohno, N. Yoshida, K. Yajima, K. Mori, T. Ogata and T. Sonoda. "70% high efficient C-band 27 W hetero-structure FET for space application." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 621-623 vol.2.

A highly reliable and 70% highly efficient C-band 27 W internally-matched GaAs FET with a total gate width of 18.9 mm /spl times/ 4 has been developed for space applications. The newly developed Hetero-structure FET (HFET) successfully reduces the gate leakage current even for RF overdrive region, which is indispensable to improve the power-added efficiency and reliability, simultaneously. The bias conditions and the 2/sup nd/ harmonic tuning for both the input and output matching circuits are also optimized to increase high efficiency. No failure in reliability tests was observed under RF operation based on the European Space Agency Specification (ESA) and RF overdrive at 5dB compression. These excellent results promise that the newly developed HFET can replace the conventional traveling-wave tube amplifiers (TWTAs) for space applications.

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Ka-band coupled-cavity TWT amplifiers for military radar and commercial satellite communication

J.R. Legarra, P.E. Kolda, H.P. Freund, T.M. Antonsen, Jr. and B. Levush. "Ka-band coupled-cavity TWT amplifiers for military radar and commercial satellite communication." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 625-628 vol.2.

Ka-band coupled-cavity traveling wave tube amplifiers have been developed for military radar applications requiring high power, moderate bandwidth and light weight. The design features and measured performance characteristics of these devices are presented. The technology advancements achieved in the radar programs are being leveraged to design Ka-band satellite communication amplifiers that surpass power limitations of existing solid state or helix TWT systems. The design features and expected performance of the communication amplifiers are presented. Recent development of a 3-D nonlinear time-domain simulation code, GATOR, is aiding the communication device design effort. The application of the codes to high efficiency amplifier design are illustrated.

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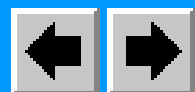
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Subjects

High performance microwave power modules for military and commercial systems

M. Basten, D. Whaley, J. Duthie, V. Heinen, K. Kreischer, J. Tucek, A. Ferek, F. Trimble and B. Gannon. "High performance microwave power modules for military and commercial systems." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 629-632 vol.2.

The desirable attributes of solid state and vacuum electronics have been combined in Microwave Power Module (MPM) technology to create miniaturized amplifiers for high power transmitter applications in the 2-40 GHz range. These modules have demonstrated an order of magnitude increase in RF output power per unit weight when compared to conventional traveling wave tube amplifiers (TWTAs) and solid state power amplifiers (SSPAs). In this paper, the recent performance improvements of MPMs developed by Northrop Grumman are described. These improvements include power booster efficiencies that have reached in excess of 60%, and bandwidths that have reached almost three octaves.





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Production and operation of a high-efficiency DBS-band klystron utilizing a multistage depressed collector

T. Habermann, R. Batra, R. Begum, E.W. McCune and E.L. Wright. "Production and operation of a high-efficiency DBS-band klystron utilizing a multistage depressed collector." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 633-636 vol.2.

The satellite communications market has previously been served by klystrons with grounded collector. Now, CPI has developed a new generation of air-cooled, permanent-magnet (PM) focused, high-efficiency klystrons utilizing a multistage depressed collector (MSDC). We describe the development and production of the VKU-8891M series, pioneering MSDC technology in the direct broadcasting satellite (DBS) market. With a saturated efficiency of 40 percent this klystron far surpasses the performance of a conventional klystron. As a result, this technology saves more than 50 percent of the power required by existing products in this market in average field-operating conditions.

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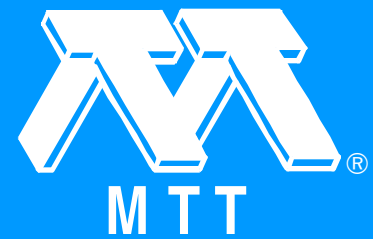
Development of RF carbon nanotube resonant circuit sensors for gas remote sensing applications

S. Chopra, A. Pham, J. Gaillard and A.M. Rao. "Development of RF carbon nanotube resonant circuit sensors for gas remote sensing applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 639-642 vol.2.

We present the design, development and analysis of highly sensitive and ultra-fast responsive electromagnetic microwave resonant sensors for monitoring the presence of gas. These novel sensors consist of circular electromagnetic resonant circuits coated with single and multi walled carbon nanotubes (SWNT & MWNT) that are highly sensitive to adsorbed gas molecules. Upon exposure to ammonia, the electrical resonant frequency of the sensor exhibits a frequency shift of as high as 6.25 MHz. The recovery and response times of these sensors is nominally 10 minutes when operating at room temperatures. This sensor technology is suitable for designing remote sensing systems to monitor gases inside sealed opaque packages and for environmental conditions that do not allow physical wire connections.

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Integrated microwave sensor for cavity-length measurement with sub-millimeter accuracy

A. Megej, K. Beilenhoff, M. Schussler, A. Ziroff, B. Mottet, O. Yilmazoglu, K. Mutamba, C.D. Hamann, R. Baican and H.L. Hartnagel. "Integrated microwave sensor for cavity-length measurement with sub-millimeter accuracy." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 643-646 vol.2.

A novel measurement procedure using microwaves is presented. The implemented sensor determines the length of a cylindrical cavity (e.g. hydraulic system) with sub-millimeter accuracy in real time. The principle of operation is based on the detection of the resonance-frequency distribution in a cavity resonator.

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A planar resonant sensor for the complex permittivity characterization of materials

E. Fratticcioli, M. Dionigi and R. Sorrentino. "A planar resonant sensor for the complex permittivity characterization of materials." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 647-650 vol.2.

A microwave planar resonant sensor for the measurement of the complex permittivity in compact areas and thin layers of the material under test (MUT) is presented. Compared to transmission or reflection sensors, the adoption of a scalar 2-port measurement procedure reduces the cost of the system and improves its robustness. Compared to coaxial line sensors, a substantial cost reduction is achieved. The low cost of the sensor allows its use even in a disposable manner. Through the fullwave characterization of the probe a simple equivalent semilumped model of the interaction with the MUT has been derived along with a software calibration procedure. An excellent measurement accuracy in a wide range of complex dielectric permittivities is shown to be feasible.



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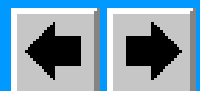
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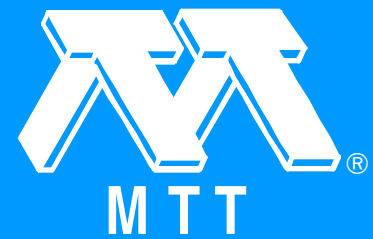
Microwave reflection tomography array for damage detection in concrete structures

Yoo Jin Kim, L. Jofre, F. De Flaviis and M.Q. Feng. "Microwave reflection tomography array for damage detection in concrete structures." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 651-654 vol.2.

Microwave sub-surface imaging system for structural damage detection using reflection array is developed. The analytical expressions of bi-focusing procedures are derived and applied to a series of numerical simulations. Slot antenna array is designed and fabricated for experimental study. From the results of measurements, it is demonstrated that the proposed imaging system can reconstruct sub-surface images efficiently.

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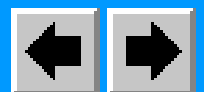
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Wireless IDT ice sensor

K.A. Jose, G. Sunil, V.K. Varadan and V.V. Varadan. "Wireless IDT ice sensor." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 655-658 vol.2.

This paper presents the design and performance evaluation of a Wireless IDT Ice Sensor for sensing the phase change from water to ice and hence to detect and monitor the ice formation at a remote location. The sensor is based on the principle of shear horizontal waves and its undamped nature in the presence of a liquid. The frequency shift due to the phase change of water to ice is measured wirelessly and it is observed that, the sensor has potential applications for ice detection in airplane wings.

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High performance air gap transmission lines for millimeter wave applications

Inho Jeong, Seong-Ho Shin, Ju-Hyun Go, Joong-Soo Lee, Choong-Mo Nam, Dong-Wook Kim and Young-Se Kwon. "High performance air gap transmission lines for millimeter wave applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 661-664 vol.2.

The air gap transmission lines are developed by a new multi-layer process. The developed transmission lines are air gap coaxial line, air gap strip line and air gap BMSL (buried microstrip line). Air gap transmission lines show very low signal loss and very high isolation performances. The transmission line loss of the coaxial line is less than 0.08 dB/mm up to 40 GHz. Those of the strip line and the BMSL are about 0.15 dB/mm and 0.13 dB/mm, respectively. Reduction of the parasitic coupling between signal lines is very important in high-density MICs and MMICs. The isolation characteristics of the coaxial line and the BMSL are measured. In case of coaxial lines with 2 mm coupling length and 60 /spl mu/m distance between signal lines, the coupling is less than -52 dB up to 40 GHz. Under the same conditions, the coupling of the BMSL is less than -43 dB. Therefore the air gap transmission lines are very suitable structures for high performance and high-density RF applications.



Reconfigurable quasi-fractal transmission line structures

J. Sor, Yuanxun Wang and T. Ltoh. "Reconfigurable quasi-fractal transmission line structures." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 665-668 vol.2.

Several transmission line structures bearing fractal-like characteristics are presented. Using pin-diode switches, the transmission line structures can be reconfigured into quasi-fractal self-similar structures. The reconfigured structures closely resemble the pre-reconfigured transmission line structures both physically and electromagnetically, with the frequency response inversely proportional to the number of segments involved. Proposed quasi-fractal transmission line structures for both microstrip and coplanar waveguide are presented and biasing issues are discussed.



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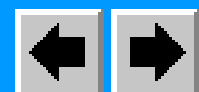
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Miniaturized slow-wave coplanar waveguide circuits on high-resistivity silicon

J. Naylor, T. Weller, J. Culver and M. Smith. "Miniaturized slow-wave coplanar waveguide circuits on high-resistivity silicon." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 669-672 vol.2.

This paper discusses slow-wave (SW) coplanar waveguide structures printed on high-resistivity silicon. Relative to a uniform line, a SW structure can reduce the guide wavelength by 45% with a 17% increase in loss per wavelength, allowing circuit miniaturization with minimal additional loss. The SW structure is demonstrated in new topologies for $\lambda/4$ impedance transformers and an RF short. The transformer length is reduced by as much as 80% relative to a conventional design.

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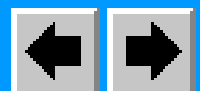
Subjects

Modeling of real-shaped LTCC stripline structure having sharpened edges and embedded pores

Jae Hyuk Jang, N. Ishitobi and Chul Ho Kim. "Modeling of real-shaped LTCC stripline structure having sharpened edges and embedded pores." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 673-676 vol.2.

A real-shaped LTCC stripline model including sharpened edges and embedded pores was proposed and simulated using the high frequency simulator software, HFSS. These structural defects occur when LTCC process is used in real fields. The pores made the characteristic impedance of the stripline increase, and α and β decrease in the range higher than 6% of corresponding initial values. 6% of β could have an important meaning for circuit designers. Sharpened edge made the characteristic impedance and α increase, while did not affect β .

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High-isolation bonding pad with depletion-insulation structure for RF/microwave integrated circuits on bulk silicon CMOS

Sang Lam, Wing Hung Ki and Mansun Chan. "High-isolation bonding pad with depletion-insulation structure for RF/microwave integrated circuits on bulk silicon CMOS." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 677-680 vol.2.

Bonding pads for RF/microwave integrated circuits on bulk silicon CMOS is designed with a simple depletion-insulation (DI) structure. Experimental results show high isolation and low substrate loss. An inter-pad isolation of more than 40 dB at 10 GHz is obtained for a 90-/spl mu/m separation distance. The isolation is about two orders of magnitude higher than that of the conventional structure. The return loss is also less than 1.5 dB at 10 GHz. The high Q factor of the DI pad is achieved a few times greater that of the conventional type. The low pad capacitance of about 0.013 fF//spl mu/m/sup 2/ is attained. This will increase the resonant frequency of the bond-wire-pad connection. The application of the useful DI structure is extendable to interconnect and planar spiral inductor to reduce the substrate loss and increase the Q factor.

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Porosity effects on coplanar waveguide porous silicon interconnects

I.K. Itotia and R.F. Drayton. "Porosity effects on coplanar waveguide porous silicon interconnects." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 681-684 vol.2.

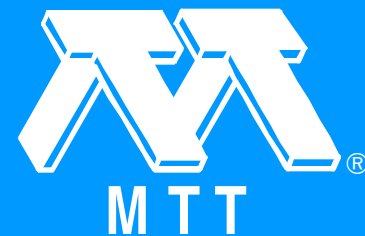
Oxidized porous silicon (OPS) has the potential to produce low loss designs for high-density RF passive and CMOS integrated circuits. Herein are findings on porosity effects on finite ground coplanar waveguide (FGCPW) lines printed on OPS material up to 50 GHz. At 51% porosity, measured effective dielectric constant data ($\epsilon_{r,eff}$) is approximately 2.8 and is consistent with Bruggeman models. For similar low (low- ρ) and high (high- ρ) resistivity silicon designs, OPS attenuation (dB/cm) exhibits 78% less loss than low- ρ designs with 1.5 and 9.5% less than and greater than, the high- ρ design at 10 and 20 GHz, respectively. Furthermore, wideband 50-ohm impedance matching is achieved. These findings, therefore, support consideration of oxidized porous silicon for RFIC design.

Abstracts

Substrate loss mechanisms for microstrip and CPW transmission lines on lossy silicon wafers

D. Lederer and J.-P. Raskin. "Substrate loss mechanisms for microstrip and CPW transmission lines on lossy silicon wafers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 685-688 vol.2.

Loss mechanisms for microstrip and coplanar transmission lines on lossy silicon substrates are analyzed. It is shown that the losses are bias-dependent. This is supported both by experimental results and numerical simulations. We attribute this effect to changes in the carrier static distribution underneath the oxide. A continuous analysis of the losses is performed from accumulation to strong inversion. It demonstrates that neglecting the variations of RF losses versus DC bias conditions can lead to important inaccuracies on the extracted values of circuit and device physical parameters.



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Ultra low phase noise SiGe HBT. Application to a C band sapphire resonator oscillator

G. Cibiél, M. Regis, O. Llopis, Y. Kersale, V. Giordano, H. Lafontaine, R. Plana and M. Chaubet.
"Ultra low phase noise SiGe HBT. Application to a C band sapphire resonator oscillator." 2002
MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 691-694 vol.2.

In this paper, the electrical and noise performance of a 0.8 μm Silicon Germanium (SiGe) transistor optimized for the design of low phase noise circuits are described. The nonlinear model developed for the transistor and its use for the design of low phase noise C band Sapphire resonator oscillator are reported. The best measured phase noise (at ambient temperature) is -133 dBc/Hz at 1 kHz offset from a 4.85 GHz carrier frequency for a loaded Q/sub L/ factor of 60,000.

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A low phase noise silicon 9 GHz VCO and an 18 GHz push-push oscillator

L. Dussopt, D. Guillois and G.M. Rebeiz. "A low phase noise silicon 9 GHz VCO and an 18 GHz push-push oscillator." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 695-698 vol.2.

The design and measurement of a Voltage Controlled Oscillator (VCO) at 9 GHz and a push-push oscillator at 18 GHz are described in this paper. Both oscillators use a packaged silicon transistor (Siemens BFP 540 F). The microstrip resonator is tuned with a GaAs varactor diode (M/A-COM ML46580). A 270 MHz tuning range is obtained with an output power varying from 3.2 to 8.7 dBm. The phase noise is below -109 dBc/Hz at 100 kHz offset and below -129 dBc/Hz at 1 MHz over the whole tuning bandwidth. The push-push oscillator shows a phase noise of -108 dBc/Hz at 100 kHz and below -124 dBc/Hz at 1 MHz from the carrier. These are, to our knowledge, one of the best phase noise from a silicon fixed or voltage-controlled oscillators using a packaged device at X to K-band frequencies.



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A novel microwave oscillator using double-sided MIC

K.I. Kawahata, N. Miyayoshi and M. Aikawa. "A novel microwave oscillator using double-sided MIC." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 699-702 vol.2.

A novel microwave feedback oscillator utilizing the advantages of the "double-sided MIC" is proposed. The oscillator is formed incorporating microstrip lines on a dielectric substrate and CPW on a reverse side with no via holes. The fabricated and demonstrated oscillator exhibits an output power of 9.17 dBm and the harmonic suppression is -45 dBc at X-band. The phase noise performance is 114.5 dBc/Hz at the offset frequency of 1 MHz. Voltage controlled oscillators and sub-harmonic injection locked oscillators can be easily realized up to the millimeter wave band.

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C-band oscillator using high-Q inductors embedded in multi-layer organic packaging

S.-W. Yoon, M.F. Davis, K. Lim, S. Pinel, M. Maeng, C.-H. Lee, S. Chakraborty, S. Mekela, J. Laskar, G. White and R. Tummala. "C-band oscillator using high-Q inductors embedded in multi-layer organic packaging." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 703-706 vol.2.

We present C-band oscillators with external high-Q inductors: wire-bond inductors and embedded inductors in a Multi-Layer Organic (MLO) board fabricated by a thick-film MCM-L technology. The phase-noise performance of oscillators is compared with the oscillator using on-chip inductors. Inductors are designed to obtain high quality factor in C-band. The phase-noise performance of the oscillator with on-chip inductors measures -108 dBc/Hz at 600 kHz offset frequency, and that of the oscillator with external inductors shows -113 dBc/Hz at the same offset. Using MLO inductors, the phase-noise is better than the oscillator with on-chip inductors and comparable to the oscillator with wire-bond inductors. To our knowledge, this is the first C-band oscillator using inductors embedded in the multi-layer organic packaging technology. This is also the first report comparing the performance of oscillators using three different inductor technologies: on-chip integration, wire-bonding, and multi-layer organic packaging technology.

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A differentially-tuned CMOS LC VCO for low-voltage full-rate 10 Gb/s CDR circuit

D. Mukherjee, J. Bhattacharjee and J. Laskar. "A differentially-tuned CMOS LC VCO for low-voltage full-rate 10 Gb/s CDR circuit." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 707-710 vol.2.

A fully-integrated differentially-tuned CMOS LC voltage controlled oscillator (VCO) is presented. The VCO is designed in a 0.13 μm standard digital CMOS process with a 1.2 V supply. It achieves a phase noise of -99 dBc/Hz at 1 MHz offset from a carrier frequency of 10 GHz and has a tuning range of 3.7 GHz with the core consuming only 3.6 mW of DC power. This satisfies the requirements of clock-and-data-recovery (CDR) circuits for 10 gigabit optical communication systems. This paper also investigates, for the first time, the circuit topologies of other building blocks for a fully-differential implementation of a closed loop full-rate CDR circuit with low supply voltage (1.2 V).

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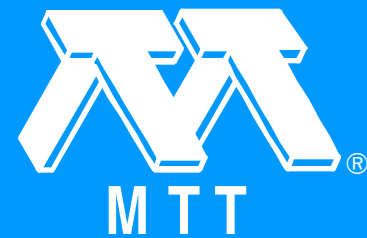


Abstracts

Implicit space mapping EM-based modeling and design exploiting preassigned parameters

J.W. Bandler, Qingsha Cheng, N. Georgieva and M.A. Ismail. "Implicit space mapping EM-based modeling and design exploiting preassigned parameters." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 713-716 vol.2.

We present a simple new approach to EM-based microwave modeling and design. It is a special case of a novel concept we call Implicit Space Mapping. We propose to calibrate a suitable coarse model against a fine model (full wave EM simulation) by relaxing certain coarse model preassigned parameters. Our algorithm updates these preassigned parameters through parameter extraction, reoptimizes the coarse model to suggest a new EM design and terminates when relevant stopping criteria are satisfied. We illustrate our approach through an HTS filter example.



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Wide-band compact modeling of spiral inductors in RFICs

D. Melendy, P. Francis, C. Pichler, Kyuwoon Hwang, G. Srinivasan and A. Weisshaar. "Wide-band compact modeling of spiral inductors in RFICs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 717-720 vol.2.

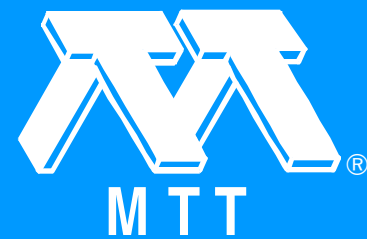
A new wide-band compact modeling methodology for planar spiral inductors on lossy silicon substrate is presented. The new ideal lumped-element equivalent circuit model employs transformer loops in the series branch to include the effects of the frequency-dependent losses, in particular eddy-current loss in the bulk silicon substrate. A robust automated extraction procedure is employed to extract the element values of the new compact model. The new automated modeling methodology has been applied to a typical 1.5 nH spiral fabricated on a low-resistivity CMOS substrate. The frequency-dependent series resistance and inductance as well as the quality factor obtained with the new wideband model are in excellent agreement with the measured results over a 10 GHz bandwidth.

Abstracts

On the synthesis of equivalent circuit models for multiports characterized by frequency-dependent parameters (2002 Vol. II [MWSYM])

R. Neumayer, F. Haslinger, A. Stelzer and R. Weigel. "On the synthesis of equivalent circuit models for multiports characterized by frequency-dependent parameters (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 721-724 vol.2.

The synthesis of lumped-element equivalent circuits for time-domain analysis of problems with frequency-dependent parameters is of great interest in microwave theory. This paper presents a systematic approach to generate minimal order realizations for passive microwave circuits characterized by either admittance, impedance or scattering parameter data. Also a very efficient method to ensure inherent system properties such as stability and passivity is described. Modeling examples for a two- and four-port system are given.



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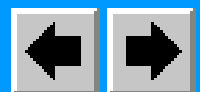
Subjects

New extraction algorithm for GaAs-HBTs with low intrinsic base resistance

F. Lenk and M. Rudolph. "New extraction algorithm for GaAs-HBTs with low intrinsic base resistance." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 725-728 vol.2.

A new algorithm for extraction of the small-signal equivalent circuit elements of HBTs is presented. An analytical non-iterative approach is used in order to ensure physical significance of the extracted parameters. In order to enhance the robustness and reliability of the extraction routine, a simplified formula to determine the intrinsic base resistance R_{b2}/I_s is presented. The new algorithm is verified by extraction of GaInP/GaAs HBT equivalent-circuit elements.

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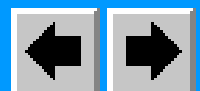
[Subjects](#)

Uncertainty estimation and optimal extraction of intrinsic FET small signal model parameters

C. Fager, P. Linner and J.C. Pedro. "Uncertainty estimation and optimal extraction of intrinsic FET small signal model parameters." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 729-732 vol.2.

In this paper, analytical expressions for the sensitivities in the parameters of a standard intrinsic FET small signal model are derived with respect to variations in the S-parameters. The sensitivities are used to estimate the uncertainty in extracted model parameters. The theories are applied to measurements made on a commercial HEMT device. Using models for the measurement uncertainties allows the model parameter uncertainties to be studied versus frequency and bias. As a result, optimal, minimum uncertainty parameter extraction can be performed independent of the bias voltage and without prior knowledge of the FET device characteristics. Thus making it suitable for implementation in automatic multi-bias extraction programs.

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An analytic expression for the HBT extrinsic base-collector capacitance derived from S-parameter measurements

E. Wasige, B. Sheinman, V. Sidorov, S. Cohen and D. Ritter. "An analytic expression for the HBT extrinsic base-collector capacitance derived from S-parameter measurements." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 733-736 vol.2.

Direct extraction is the most accurate method for the determination of equivalent-circuits of heterojunction bipolar transistors (HBTs). However, previous work lacks an exact expression for the extrinsic base-collector capacitance, which models the distributed nature of the base. This paper gives the derivation of an exact expression for this capacitance. As a result, each intrinsic equivalent-circuit parameter is determined using a simple exact expression at each measured frequency. The expression is valid for both the hybrid- π and the physics-based T-topology equivalent circuits. Extraction results for InP- and GaAs-HBTs are given.

Click on title for a complete paper.



Enhanced PML-like ABCs for layered media transmission line termination

A. Lauer, A. Wien, P. Waldow and I. Wolff. "Enhanced PML-like ABCs for layered media transmission line termination." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 739-742 vol.2.

An equivalent circuit (EC) based analytical way is shown to optimize the discrete conductivity profile of PML-like Absorbing Boundary Conditions for layered media transmission line termination. for validation, a two cell microstrip transmission line (Substrate $\epsilon_r = 12.9$) absorber is presented with $S_{11} < -60$ dB in a 3D FDTD simulation, which is in excellent agreement with the Equivalent Circuit model's prediction. Therefore a significant reduction of the ABC computation time can be achieved.



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Global modeling of active microwave devices incorporating a novel large-signal time-domain full-hydrodynamic physical simulator using wavelet-based adaptive grids

Y.A. Hussein and S.M. El-Ghazaly. "Global modeling of active microwave devices incorporating a novel large-signal time-domain full-hydrodynamic physical simulator using wavelet-based adaptive grids." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 743-746 vol.2.

A novel large-signal time-domain simulation approach for full-hydrodynamic physical modeling of semiconductor devices using Wavelet-based adaptive grids is presented. The non-uniform grids of the main variables are conceived at a given time by applying biorthogonal Wavelet transforms to the current variable solutions followed by thresholding. A general criterion is mathematically defined for grid updating of each variable within the simulation. This criterion allows grid updating only when needed. In addition, few rules have been defined to take care of the fact that boundary conditions as well as discretization have to be handled differently for each new grid. Grids of the main variables are combined into one non-uniform grid whenever a new variable grid is conceived. The proposed technique is validated by simulating a submicrometer MESFET. The results of the proposed technique are compared with the results of a regular grid case showing more than 60% simulation time reduction while maintaining the same degree of accuracy. This is a first step toward applying Wavelets to global modeling of active microwave devices aiming to reduce the simulation time.

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Coupling front tracking and wavelet techniques for fast time domain simulations

C.D. Sarris and L.P.B. Katehi. "Coupling front tracking and wavelet techniques for fast time domain simulations." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 747-750 vol.2.

The main attractive feature of wavelet-based, time-domain techniques is the simple implementation of adaptive meshing, through the application of a thresholding procedure to eliminate wavelet coefficients that attain relatively insignificant values, at a limited compromise of accuracy. However, little attention has been devoted so far to the investigation of computational costs and accuracy trade-offs in order to obtain thresholding-related operation savings. This paper presents an efficient implementation of thresholding applied to a non-linear problem and reports significant execution time savings compared to the conventional FDTD technique, that the application of the proposed method has led to.

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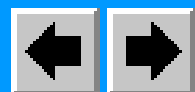
Subjects

Demonstration and suppression of numerical divergence errors in FDTD analysis of practical microwave problems

M. Celuch-Marcysiak. "Demonstration and suppression of numerical divergence errors in FDTD analysis of practical microwave problems." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 751-754 vol.2.

Field divergence emulation in FDTD is revisited, and new theoretical aspects as well as problems of practical importance are revealed and resolved. Various choices of divergence definition are discussed in terms of their predictive power. It is shown that total FDTD solutions inevitably violate Gauss law in dipole radiation or eigenvalue analysis. The theory of S- and P-eigenmodes is applied to understand these problems and to restore their physical solutions. Recipes for extracting correct radiation efficiency, radiation resistance, Q-factors and modal field patterns in the presence of P-modes are proposed.

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Analysis of guided wave structures using 3-D envelope-finite element (EVFE) technique

Hsiao-Ping Tsai, Yuanxun Wang and Tatsuo Itoh. "Analysis of guided wave structures using 3-D envelope-finite element (EVFE) technique." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 755-758 vol.2.

A novel three-dimensional Envelope-Finite Element (EVFE) technique is proposed to solve the transient response of an electromagnetics problem. EVFE simulates the signal envelope rather than the original signal waveform by de-embedding the signal carrier from the time-domain wave equation. The sampling rate of the time-domain waveform is only governed by the Nyquist rate of the envelope signal instead of the carrier signal in the unconditionally stable FETD method. Compared to the traditional FDTD and FETD methods, the computational cost can be dramatically reduced when the signal envelope and carrier ratio is very small. This technique is implemented to solve a microwave guided structure with dielectric post discontinuity. The accuracy and efficiency is demonstrated and compared with the unconditionally stable FETD method.

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A surface impedance approach for modeling multilayer conductors in FDTD

W. Thiel and L.P.B. Katehi. "A surface impedance approach for modeling multilayer conductors in FDTD." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 759-762 vol.2.

Surface impedance boundary conditions (SIBC's) are implemented in the finite-difference time-domain (FDTD) method to analyze the electromagnetic field around multilayer conductors. The conducting region is replaced by an equivalent surface where SIBC's are applied locally. To incorporate the equivalent surface impedance into the FDTD code, at first the surface impedance is determined in the frequency domain by replacing the multilayer conductor by a cascade of transmission lines and calculating the total impedance matrix of the network. Following this, a wide-band polynomial approximation of the SIBC's leads to an efficient and recursive solution of the convolution integrals in the time domain. As a numerical example, the impedance matrix of a symmetric three layer conductor is derived and the scattering parameters are compared to the analytical solutions.

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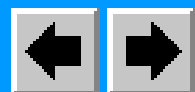
Subjects

Power amplifier module with digital adaptive predistortion for cellular phone (2002 Vol. II [MWSYM])

S. Kusunoki, K. Yamamoto, T. Hatsugai, K. Tagami, H. Nagaoka, N. Tominaga, K. Osawa, K. Tanabe, S. Sakurai and T. Iida. "Power amplifier module with digital adaptive predistortion for cellular phone (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 765-768 vol.2.

This paper describes a new type of PA-module which contains a predistortion function and the application to N-CDMA handset terminals. The predistortion technology is based on look-up-table method using the input and output signal envelopes and can operate independent from the base-band block. By omitting the adaptative predistortion for AM/PM, and integrating main controlling functions on CMOS IC chip, the predistortion technique has been realized in a PA-module. The PA-module has been achieved the power added efficiency (PAE) of 48% at the output power of 27.5 dBm. This PAE is extremely high in comparison with the conventional PA-module for N-CDMA.

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Feedforward amplifier for WCDMA base stations with a new adaptive control method

Young Yun Woo, Youngoo Yang, Jaehyok Yi, Joongjin Nam, Jeong Hyeon Cha and Bumman Kim. "Feedforward amplifier for WCDMA base stations with a new adaptive control method." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 769-772 vol.2.

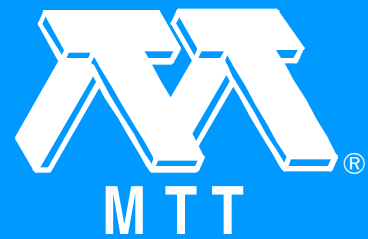
This paper describes a feedforward amplifier with a new adaptive control method. For the modulated signal with a high peak-to-average ratio, the residual output error level of the feedforward amplifier can be further reduced by adjusting the 1st loop control parameters to have an imperfect signal cancellation since an error amplifier generates less distortion in the case. For verification, a baseband signal simulation and experiments have been performed. A 30 W feedforward amplifier for WCDMA base stations at 2.14 GHz shows a 4 dB improvement of linearization when it is controlled by the proposed method.

Abstracts

A novel technology for linearizing traveling wave tube amplifiers

Tong Chen, Y. Goren, C. Jensen, P. Lally and D. Gagne. "A novel technology for linearizing traveling wave tube amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 773-776 vol.2.

The Traveling Wave Tube (TWT) has great potential to provide high power for wireless communication. However, its poor linearity has limited its application. This paper describes a new method to linearize TWTs based on the physics of the device. The technique requires low-cost circuitry. The test results show a dramatic improvement.



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New linearization method for the modulated signals with high peak-to-average ratio: peak-to-average ratio reduction and expansion

Youngoo Yang, Young Yun Woo, Jeonghyeon Cha, Jaehyok Yi and Bumman Kim. "New linearization method for the modulated signals with high peak-to-average ratio: peak-to-average ratio reduction and expansion." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 777-780 vol.2.

A new linearization method for the high power amplifier modulated by a high peak-to-average ratio signal is proposed. The amplifier consists of a high power amplifier with a predistorter, a peak power limiter, and cancellation loops similar to the feedforward amplifier. The linearization performance is enhanced by reducing the peak input power to the amplifier using a rate limiter and the distortion from the limited signal is restored at the cancellation sub-path. Simulation and experimental results for the amplifier module with WCDMA signal show a significant improvement of ACLR.





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Subjects

Reduction of intermodulation distortion in active phased array antenna systems using a distortion controller

T. Kaho, T. Nakagawa and K. Araki. "Reduction of intermodulation distortion in active phased array antenna systems using a distortion controller." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 781-784 vol.2.

This paper describes a novel technique to compensate the intermodulation distortion (IM) of high power amplifiers in an active phased array antenna system. This technique uses IM phase control to break the strong association between carrier and IM. This technique can make the radiation patterns of carriers and IMs different on the active phased array antenna system. As a result, carrier power to intermodulation distortion power ratio (C/IM) is increased at the carrier beam direction. This paper shows the experimental result to confirm this technique using 6-element linear array.

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A compact Ka-band 156 Mbps transceiver for a wireless LAN system using PTFE/FR-4 laminated MCMs

K. Takahashi, S. Fujita, M. Inoue, Gang Wu and H. Yabuki. "A compact Ka-band 156 Mbps transceiver for a wireless LAN system using PTFE/FR-4 laminated MCMs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 787-790 vol.2.

A millimeter-wave radio access system has a number of features that makes it appealing as one approach to broadband communications. However, for a millimeterwave system to come into wide use, it must be miniaturized and the associated costs reduced. We have succeeded in realizing a compact 156 Mbps radio transceiver with a 38 GHz band optimizing RF architecture. We also adopted newly developed three-dimensional laminated MCMs using low cost plastic materials. It was confirmed in the initial experiments that this millimeter-wave wireless LAN equipment can cover a sufficient service area for broadband telecommunications in an indoor environment.

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An obstacle sensing radar system for a railway crossing application: a 60 GHz millimeter wave spread spectrum radar

M. Watanabe, K. Okazaki, J. Fukae, N. Tamiya, N. Ueda and M. Nagashima. "An obstacle sensing radar system for a railway crossing application: a 60 GHz millimeter wave spread spectrum radar." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 791-794 vol.2.

We have developed a 60 GHz millimetre wave spread spectrum radar system. The radar was designed as a sensor for an obstacle sensing radar system for a railway crossing application, in which the sensing range per radar installation covers up to 90 degrees. With a pair of these radar systems (radar 1 and radar 2), the whole area of the railway crossing can be monitored. This paper describes the structure of the radar and it's working principles, and also our experimental test results.

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Highly integrated microwave point-to-point outdoor unit optimized for ultra high volume manufacturing

J.T. Louhi, H. Somerma, K. Nikkanen, M. Koivisto, N. Nordman, T. Tuoriniemi, M. Hirvilampi, M. Pehkonen, K. Vepsalainen, P. Bergholm, P. Ruhanen, M. Platan, J. Rantiala, P. Mikkonen and J. Makinen. "Highly integrated microwave point-to-point outdoor unit optimized for ultra high volume manufacturing." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 795-798 vol.2.

A digital microwave point-to-point radio platform has been developed for the frequency range of 13-38 GHz. The most important design requirement was to obtain a radio, which is suitable for high volume manufacturing. This goal was successfully met first, by employing an electromechanical structure, which is easy and fast to assemble, secondly, by using an architecture, which allows a short and simple testing process after assembly, and thirdly, by employing novel circuit designs with a highly integrated microwave module.

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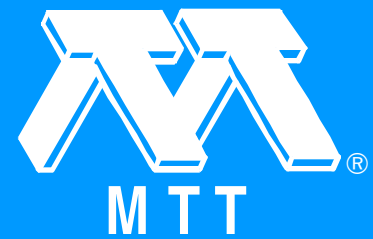
Architecture and algorithm for high precision image rejection and spurious rejection mixers using digital compensation

Youngjin Kim, Sangho Shin and Kwyro Lee. "Architecture and algorithm for high precision image rejection and spurious rejection mixers using digital compensation." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 799-802 vol.2.

A high precision IRM and SRM architecture composed of analog RF and digital IF mixers are proposed. A precise and fast measurement algorithm for gain and phase mismatches is proposed, which are, then, compensated by digital signal processing. A prototype 2.4 GHz IRM with $IRR > 70$ and $BW = 11$ MHz is demonstrated by using this technique.

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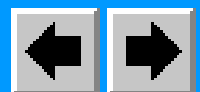
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Power-amplifier transient tracking in OFDM

D. Bateman, S. Simoens, M. de Courville and G. Julien. "Power-amplifier transient tracking in OFDM." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 803-806 vol.2.

The effect of the transmitter gain transient when the power-amplifier is switched on and off (to conserve battery power) is investigated for OFDM systems. A simple receiver-side correction technique is proposed for the HIPERLAN/2 OFDM system, and the improvement in performance is demonstrated.

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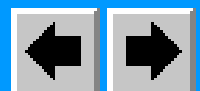
Subjects

Analysis and synthesis of in-line coaxial-to-waveguide adapters

R. Levy and L.W. Hendrick. "Analysis and synthesis of in-line coaxial-to-waveguide adapters." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 809-811 vol.2.

An equivalent circuit for a class of in-line coaxial to waveguide adapters is presented. It takes into account the existence of two propagating modes in part of the transition, a phenomenon which had previously escaped attention. When treated correctly, it is possible to analyze the multi-step structure by cascading sections, enabling the design to be based on a synthesized prototype circuit, using minimal optimization. Broadband return losses of >40 dB have been obtained.

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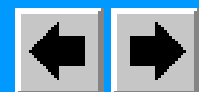
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A transition from microstrip to dielectric-filled rectangular waveguide in surface mounting

K. Sano and T. Yoneyama. "A transition from microstrip to dielectric-filled rectangular waveguide in surface mounting." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 813-816 vol.2.

This paper presents a design method for the transition from microstrip to dielectric-filled rectangular waveguide. It is based on the theory of the coupled transmission line, and is verified by a fabrication. The dielectric-filled rectangular waveguide is made of synthetic quartz and is mounted on a substrate. Experimental results in a back-to-back construction show good performances. The insertion loss becomes 0.3 dB at the design frequency of 26 GHz and the return loss becomes better than 15 dB from 23 GHz to 30 GHz.

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A millimeter-wave perpendicular coax-to-microstrip transition

M. Morgan and S. Weinreb. "A millimeter-wave perpendicular coax-to-microstrip transition." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 817-820 vol.2.

A novel transition from coaxial cable to microstrip is presented in which the coax connector is perpendicular to the substrate of the printed circuit. Such a right-angle transition has practical advantages over more common end-launch geometries in some situations. The design is compact, easy to fabricate, and provides repeatable performance of better than 14 dB return loss and 0.4 dB insertion loss from DC to 40 GHz.

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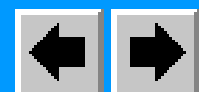
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Mono-grooved circular waveguide polarizers

N. Yoneda, M. Miyazaki, T. Horie and H. Satou. "Mono-grooved circular waveguide polarizers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 821-824 vol.2.

This paper presents a unique type of polarizer that is composed of a circular waveguide with an only groove. The presented polarizer is suitable for realizing compact size and reducing degradation in performance due to manufacturing inaccuracy. An accurate design of the polarizer is performed using mode-matching techniques. A W-band polarizer has, been designed, and the results of error analysis have verified the high efficiency of the presented polarizer.

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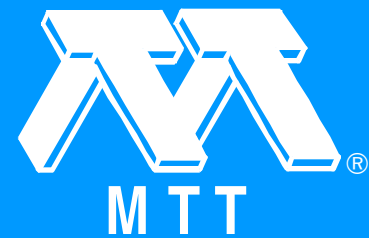
Analysis of coupling characteristics between transmission lines with a buried meshed-ground in LTCC-MCMs

Jun-Goo Kim, Eun-Tae Lee, Dong-Hoon Kim, Jong-Hun Lee, Sun-Young Lee, Hyeong-Seok Kim, Jun-Seok Park and Chang-Yul Cheon. "Analysis of coupling characteristics between transmission lines with a buried meshed-ground in LTCC-MCMs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 825-828 vol.2.

Since the manufacturing process does not allow solid ground planes between ceramic layers to isolate the signal lines, the buried ground should be realized as a meshed ground plane. Both characteristic impedances of the signal lines and couplings between different signal layers are influenced by the properties of these meshed planes. In this paper, we propose a new analysis method for coupling behavior between internal transmission lines, which are isolated by the buried meshed-ground planes. The coupling behavior between layers isolated by meshed-ground plane is investigated by the coupled-transmission lines model for the isolated layers. The coupling factors between isolated lines with the meshed-ground are extracted by 2-D FEM calculations.

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45 GHz highly integrated phase-locked loop frequency synthesizer in SiGe bipolar technology

G. Ritzberger, J. Bock and A.L. Scholtz. "45 GHz highly integrated phase-locked loop frequency synthesizer in SiGe bipolar technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 831-834 vol.2.

This paper presents a highly integrated 45 GHz phase-locked loop frequency synthesizer. The monolithic circuit consists of a voltage-controlled oscillator with frequency doubler and divide-by-16 static frequency divider and is manufactured in a pre-production low-cost 0.4 μm /85 GHz SiGe bipolar technology. The power consumption is 650 mW from the 5 V supply. External synthesizer building blocks are a commercially available PLL-IC, a passive loop filter, and a reference oscillator.

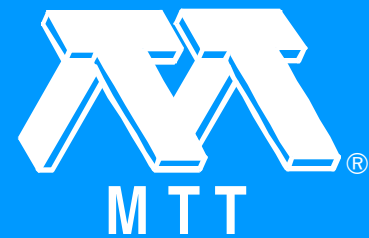
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Single-chip 20-GHz VCO and frequency divider in SiGe technology

K. Ettinger, A. Stelzer, C.G. Diskus, W. Thomann, J. Fenk and R. Weigel. "Single-chip 20-GHz VCO and frequency divider in SiGe technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 835-838 vol.2.

This paper presents the design, implementation and testing of a fully integrated 20 GHz voltage controlled oscillator, a frequency divider with a divide ratio of 16, as well as an output driver. All blocks are integrated on one IC with an area of $890 \text{ } \mu\text{m}^2$ and are fabricated in a production SiGe bipolar technology. The VCO is a varactor-tuned LC-type oscillator with a tuning range of 600 MHz. The differential signal of the output driver is converted to a single-ended signal by an external microstrip balun and delivers a maximum of 2 dBm of output power into a $50 \text{ } \Omega$ load. The chip works with a single supply voltage of 3.6 V, the VCO draws 12 mA of supply current, divider and output driver consume 17 mA and 51 mA, respectively. The measured phase-noise of the VCO is -85 dBc/Hz at 1 MHz offset frequency.



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38 GHz push-push GaAs-HBT MMIC oscillator

A. Schott, H. Kuhnert, F. Lenk, J. Hilsenbeck, J. Wurfl and W. Heinrich. "38 GHz push-push GaAs-HBT MMIC oscillator." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 839-842 vol.2.

Two differential coplanar MMIC HBT oscillators are presented, a fixed frequency and a VCO version. They provide single-ended output at the second harmonic at 38 GHz as well as differential output at 19 GHz. The oscillators show excellent phase noise performance, the fixed-frequency type reaches -95 dBc/Hz at the fundamental frequency and -89 dBc/Hz at the second harmonic, at 100 kHz offset.

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A 40 GHz-band fully monolithic VCO with a one-wave length microstrip resonator for accurate oscillation frequency

H. Ikematsu, K. Kawakami, T. Katoh and K. Itoh. "A 40 GHz-band fully monolithic VCO with a one-wave length microstrip resonator for accurate oscillation frequency." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 843-846 vol.2.

A 40 GHz-band fully monolithic VCO with a one-wavelength microstrip resonator (MSR) associated with a dumping resistor is presented. Employing a one-wavelength MSR, high setting accuracy of oscillation frequency can be obtained, and it is a very effective method to improve yield of millimeter wave MMIC oscillator. Also the one-wavelength MSR with a dumping resistor is proposed for suppression of parasitic oscillation. In analytical approach, variation of oscillation frequency is less than 150 MHz over $C_{\text{sub}}/C_{\text{ds}}/C_{\text{dg}}$ variation of $\pm 10\%$ in worst case. The measured VCO tuning range is 493 MHz and it is much wider than the variation of oscillation frequency caused by process variations.

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A Ku band InGaP/GaAs HBT MMIC VCO with a balanced and a differential topologies

Dong-Hyun Baek, Jeong-Geun Kim and Songcheol Hong. "A Ku band InGaP/GaAs HBT MMIC VCO with a balanced and a differential topologies." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 847-850 vol.2.

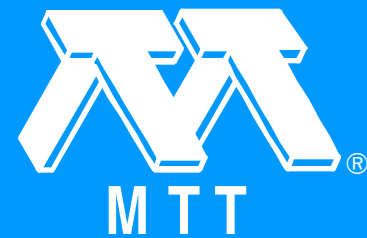
Two fully integrated voltage controlled oscillators (VCO) with low phase noise are presented. The VCOs are realized on a commercially available InGaP/GaAs heterojunction bipolar transistor (HBT) technology with an f_T of 30 GHz. The circuits are based on the balanced common base Colpitts topology and the capacitively coupled differential topology. To improve the quality factor of the LC tank, a 70-ohm microstrip line is incorporated as an inductor with a varactor. The balanced VCO provides single ended output power of 0 dBm and a phase noise of -90.5 dBc/Hz at 100 kHz offset from a carrier frequency 13.5 GHz. The differential VCO has single ended output power of -1.5 dBm and -88 dBc/Hz at 100 kHz offset from a carrier frequency of 12.2 GHz. The balanced and the differential VCOs achieve very low FOMs of -180.7 and -177.6 dBc/Hz, respectively.

Abstracts

A new behavioral model taking into account nonlinear memory effects and transient behaviors in wideband SSPAs

A. Soury, E. Ngoya and J.M. Nebus. "A new behavioral model taking into account nonlinear memory effects and transient behaviors in wideband SSPAs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 853-856 vol.2.

Accurate and non quasi-static behavioral models of SSPAs taking into account nonlinear memory effects become of prime importance for a breakthrough in system level analysis and design of wideband digital communication systems. This paper describes a new method to characterize and integrate memory effects in nonlinear behavioral models of SSPAs allowing to reproduce both transient and steady state behaviors.



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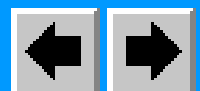
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Accurate prediction of PHEMT intermodulation distortion using the nonlinear discrete convolution model

A. Costantini, R.P. Paganelli, P.A. Traverso, D. Argento, G. Favre, M. Pagani, A. Santarelli, G. Vannini and F. Filicori. "Accurate prediction of PHEMT intermodulation distortion using the nonlinear discrete convolution model." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 857-860 vol.2.

A general-purpose, technology-independent behavioral model is adopted for the intermodulation performance prediction of PHEMT devices. The model can be easily identified since its nonlinear functions are directly related to conventional DC and small-signal differential parameter measurements. Experimental results which confirm the model accuracy at high operating frequencies are provided in the paper.

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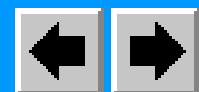
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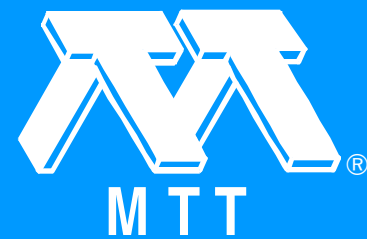
An electrothermal BSIM3 model for large-signal operation of RF power LDMOS devices

O. Tomblad and C. Blair. "An electrothermal BSIM3 model for large-signal operation of RF power LDMOS devices." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 861-864 vol.2.

An electrothermal BSIM3 model for large-signal operation of RF power LDMOS devices has been developed. The physically-based model was carefully calibrated to pulsed current/voltage characteristics and bias-dependent capacitance measurements. Internal matching networks and influence from the package were included in a physical way. The implemented electrothermal coupling exhibited good numerical stability during large-signal operation and the model correlates well to measurements of RF functional characteristics.

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Nonlinear amplifier modeling taking into account HF memory frequency

F. Launay, Y. Wang, S. Toutain, S.T.D. Barataud, J.M. Nebus and R. Quere. "Nonlinear amplifier modeling taking into account HF memory frequency." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 865-868 vol.2.

A model to describe the nonlinear behavior of a power amplifier is proposed, which extends the power series expansion to take into account frequency dispersion of a single tone and a two-tone input signal. Behavioral model is commonly estimated according to CW measurements but, even if this model is accurate for one-tone signal, no predictions can be done for intermodulation products of a N-tones signal. This paper focuses on a nonlinear behavioral model which is divided in a dynamic gain and a balance filter. The dynamic gain consists in a nonlinear digital filter and a complex polynomial behavioral representation, the latter being extracted from a referenced frequency AM-AM and AM-PM characterization. The balance filter consists in a nonlinear generator, whose aim is to compensate phase and gain intermodulation products which are simulated by the dynamic gain. Our main contribution is to propose a new method to assess the model of the amplifier which can be extended to UNITS signals.

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Equivalent circuit of radiating longitudinal slots in dielectric filled rectangular waveguides obtained with FDTD method

R.V. Gatti, R. Sorrentino and M. Dionigi. "Equivalent circuit of radiating longitudinal slots in dielectric filled rectangular waveguides obtained with FDTD method." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 871-874 vol.2.

A rigorous FDTD characterization of a longitudinal radiating slot in a dielectric filled rectangular waveguide in terms of an equivalent shunt admittance is presented. The FDTD method allows one to account for a number of details that affect the antenna performance, such as the waveguide wall thickness, the presence of a finite or infinite flange, a dielectric layer over the slot. High numerical efficiency has been obtained by using Stegen's factorization of the slot admittance. Comparison with other methods (MoM) and with experimental results have shown very good agreement with FDTD simulations even in the computation of the resonant length, which is the most critical parameter. The proposed equivalent circuit allows for a fast and accurate analysis of a radiating slot in a frequency range of the order of 15%.

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Subjects

Custom hardware implementation of the finite-difference time-domain (FDTD) method

R.N. Schneider, M.M. Okoniewski and L.E. Turner. "Custom hardware implementation of the finite-difference time-domain (FDTD) method." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 875-878 vol.2.

Finite-Difference Time-Domain (FDTD) Analysis is a very popular method for solving electromagnetic problems. The algorithm is computationally Intensive and simulations can take several days to run on traditional, multiprocessor supercomputer platforms. Reducing the runtime of these simulations, by an order of magnitude or more, would greatly increase the productivity of FDTD users and open new avenues of research. A hardware implementation of a one-dimensional FDTD computational cell is presented, with the goal of accelerating three-dimensional computations by a factor of 10-100 times. A free-space, cavity resonator is used to successfully verify the FDTD simulation on hardware. Computational speed is very promising and is independent of the number of cells in the simulation. Larger simulations require more hardware. A typical simulation size (100/spl times/100/spl times/100) is hardware prohibitive, so future work will investigate hardware sharing methods.

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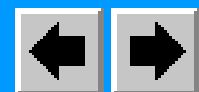
Subjects

Analysis of CMOS interconnections combining LE-FDTD method and SOC procedure

F. Alimenti, V. Palazzari, P. Placidi, G. Stopponi, A. Scorzoni and L. Roselli. "Analysis of CMOS interconnections combining LE-FDTD method and SOC procedure." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 879-881 vol.2.

This work describes the application of the Lumped Element-Finite Difference Time Domain (LE-FDTD) method to the rigorous analysis of CMOS interconnections. In particular the frequency-dependent line parameters are evaluated in a wide (DC to 100 GHz) bandwidth. To obtain very accurate results the Short-Open Calibration (SOC) procedure has been adopted. With such an approach, simple lumped generators and loads can be used to excite and terminate the structure under analysis, in substitution of more complex boundary conditions. The technique has been validated against experimental results from the literature showing a good agreement.

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Modeling and optimization of RF reconfigurable tuners with computationally efficient time-domain techniques

N. Bushyager, K. Lange, M. Tentzeris and J. Papapolymerou. "Modeling and optimization of RF reconfigurable tuners with computationally efficient time-domain techniques." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 883-886 vol.2.

Modern RF-MEMS device design is difficult due to the lack of tools capable of simulating highly integrated structures. This paper presents methods in which the FDTD technique can be used to model a reconfigurable RF-MEMS tuner. A new method of modeling a conductor intersecting a cell is presented. In addition, code parallelization and variable gridding are used to simulate the tuner. Results are presented showing the simulation and measurement results of the tuner.

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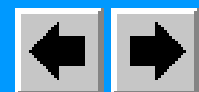
Subjects

Application of C-COM for microwave integrated-circuit modeling

K. Lan, S.K. Chaudhuri and S. Safavi-Naeini. "Application of C-COM for microwave integrated-circuit modeling." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 887-890 vol.2.

The concurrent complementary operators method (C-COM) is extended for the FDTD simulation of microwave integrated circuits for the first time. Fields in the boundary layers are computed twice with the dispersive boundary condition (DBC) and its complementary operator to truncate the FDTD lattices. The two simulations are averaged to annihilate the first order reflections from the truncated boundary. Numerical error analysis show that the reflections are further suppressed by at least 20 dB due to the implementation of complementary operators, and the setup of parameters becomes easier and more robust. A flexible and highly efficient absorbing boundary condition for guided wave problems is thus obtained through the combination of C-COM and DBC. Simulation results for a modified microstrip transmission line and a microstrip impedance transformer are given to validate this method.

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Comparison of the efficiency of electromagnetic solvers in the time- and frequency-domain for the accurate modeling of planar circuits and MEMS

L. Pierantoni, M. Farina, T. Rozzi, F. Coccetti, W. Dressel and P. Russer. "Comparison of the efficiency of electromagnetic solvers in the time- and frequency-domain for the accurate modeling of planar circuits and MEMS." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 891-894 vol.2.

In this contribution we present an accurate investigation of three different techniques for the modeling of complex planar circuits. The EM analysis is performed by means of different electromagnetic full-wave solvers in the time-domain and in the frequency-domain. The first one is the transmission line matrix (TLM) method. In the second one the TLM method is combined with the integral equation (IE) method. The latter is based on the generalized transverse resonance diffraction (GTRD). In order to test the methods we model different structures and compare the calculated S-parameters to measured results, with good agreement.

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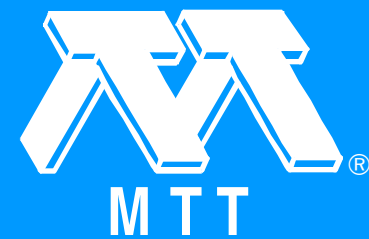


Abstracts

A 6 watt LDMOS broadband high efficiency distributed power amplifier fabricated using LTCC technology

Lei Zhao, A. Pavio, B. Stengel and B. Thompson. "A 6 watt LDMOS broadband high efficiency distributed power amplifier fabricated using LTCC technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 897-900 vol.2.

A novel new approach in designing high efficiency power distributed amplifiers for broadband wireless applications has been developed. This synthesis technique allows the designer to achieve power added efficiencies, during class B operation, greater than 50% while still preserving the low VSWR and broadband characteristics of distributed structures. The performance of these newly designed amplifiers can yield the same PAE and power output performance of narrow band, single-ended, reactively matched amplifiers, without the high sensitivity to manufacturing variations. This synthesis technique has been applied to develop LDMOS and PHEMT distributed power amplifiers for cellular base stations and portable communication applications.



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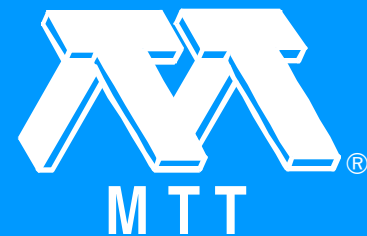
Subjects

Optimum bias conditions for linear broadband InGaP/GaAs HBT power amplifiers (2002 Vol. II [MWSYM])

M. Iwamoto, C.P. Hutchinson, J.B. Scott, T.S. Low, M. Vaidyanathan, P.M. Asbeck and D.C. D'Avanzo. "Optimum bias conditions for linear broadband InGaP/GaAs HBT power amplifiers (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 901-904 vol.2.

A design strategy for a linear broadband InGaP/GaAs HBT power amplifier is presented. This design takes advantage of the bias dependence of the nonlinear base-collector charge, expressed by the C_{BC}/V_{CE} and f_{t}/I_C characteristics of the device. Using this technique, it is shown that the second and third order distortions have separate optimum bias conditions, and furthermore, there is an inherent tradeoff in optimizing the second and third order distortions. This strong bias dependence of the nonlinear base-collector charge and the tradeoff between the different orders of distortion are verified on a 24 dBm 0.5-11 GHz distributed power amplifier. To minimize high frequency distortion in HBT amplifiers across a wide range of bias, it is imperative to linearize the base-collector charge, where flat C_{BC}/V_{CE} and f_{t}/I_C characteristics are ideally desired.





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High efficiency wideband 6 to 18 GHz PHEMT power amplifier MMIC

J.J. Komiak, Wendell Kong and K. Nichols. "High efficiency wideband 6 to 18 GHz PHEMT power amplifier MMIC." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 905-907 vol.2.

Design and performance of a power amplifier that has established new benchmarks for 6 to 18 GHz power is reported. The amplifier achieved 7.5 Watts max, 5.4 Watts average, 4 Watts min with 36 % max, 22 % average PAE and 12 dB of power gain from 6 to 18 GHz. This output power, bandwidth, and efficiency is superior to the best previously reported results. The amplifier is implemented in a fully selective 0.15 um double recess power PHEMT process.

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A broadband, push-pull power MMIC operating at K/Ka-band frequencies

J.M. Schellenberg. "A broadband, push-pull power MMIC operating at K/Ka-band frequencies." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 909-912 vol.2.

A 2-stage, push-pull power MMIC operating over the 20 to 36 GHz band is presented. With a $P_{\text{sub 1dB}}$ and $P_{\text{sub SAT}}$ of 0.51 W and 0.78 W respectively, this IC has demonstrated a 1-dB power bandwidth, at a minimum output power of 28 dBm, that extends from 22 to 31 GHz. This result represents the highest combination of output power and bandwidth reported from a power MMIC operating at K/Ka-band frequencies. The size of this IC with integrated baluns is a compact 1.5 /spl times/ 3.75 mm/sup 2/.

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A new amplifier power combining scheme with optimum efficiency under variable outputs

C.Y. Hang, Y. Wang and T. Itoh. "A new amplifier power combining scheme with optimum efficiency under variable outputs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 913-916 vol.2.

This paper presents a new power combining scheme, which has either one or four amplifiers on depending upon the levels of input signal. This approach realized by utilizing a unique combiner that is lossless and has constant gain under both scenarios. As a result, for the system where variable output power is required, this combining scheme can be used in an amplifier design with optimum efficiency. Measurement data show 15% power efficiency for the four-amplifier scenario and 28% for the single amplifier scenario at 13dBm input power. We also investigate the possibility of using this combiner in an envelope tracking amplifier.

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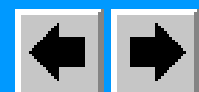
Subjects

W-band InP/InGaAs/InP DHBT MMIC power amplifiers

Yun Wei, Sangmin Lee, K. Sundararajan, M. Dahlstrom, M. Urteaga and M. Rodwell. "W-band InP/InGaAs/InP DHBT MMIC power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 917-920 vol.2.

We report W-band MMIC class A power amplifiers in InP/InGaAs/InP DHBT transferred-substrate technology. A cascode amplifier with 64 μm^2 emitter area exhibits a peak small-signal gain of 10 dB at 90 GHz and an output power of 9.5 dBm under 1 dB gain compression. An 8.5-dB-gain common-base amplifier with an emitter area of 128 μm^2 delivers 14 dBm output power at 85 GHz under 1 dB gain compression and 16.2 dBm (42 mW) saturated output power with an associated 4.6 dB gain. To our knowledge, this is highest reported output power for a W-band HBT power amplifier.

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RF performance and thermal analysis of AlGa_N/Ga_N power HEMTs in presence of self-heating effects

S. Nuttinck, E. Gebara, J. Laskar, B. Wagner and M. Harris. "RF performance and thermal analysis of AlGa_N/Ga_N power HEMTs in presence of self-heating effects." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 921-924 vol.2.

Power, linearity and noise performance of AlGa_N/Ga_N power HEMTs are measured at different gate-to-source bias conditions in order to study the influence of self-heating on RF performance. Additionally, a load-pull system, capable of measuring intermodulation distortion products under pulsed mode of operation, is implemented for the first time. This new system is used to investigate the impact of self-heating on power device linearity. Also, for the first time, the effect of the RF drive on thermal effects and power added efficiency (PAE) is investigated. This forms the basis of more accurate nonlinear models. Finally, thermal simulations of 2-finger Ga_N FETs are performed under pulsed and continuous regimes to determine the temperature distribution caused by a 5W/mm power dissipation density.



A 0.9-2.6 GHz broadband RF front-end for direct conversion transceivers

M. Kawashima, H. Hayashi, T. Nakagawa, K. Nishikawa and K. Araki. "A 0.9-2.6 GHz broadband RF front-end for direct conversion transceivers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 927-930 vol.2.

A broadband radio frequency (RF) front-end for direct conversion transceivers has been developed. The RF front-end consists of a broadband low-noise variable gain amplifier (LNVGA) and broadband quadrature mixers. The LNVGA achieves high linear characteristics by using a feedback circuit and broadband characteristics by not using reactance elements such as inductors or capacitors. The mixer achieves broadband characteristics through the incorporation of a in-phase power divider and a 45-degree power divider. The in-phase power divider achieves broadband characteristics through the addition of a compensation capacitor. The 45-degree power divider achieves broadband phase characteristics through the addition of capacity to increase the resonance point. From 0.9 GHz to 2.6 GHz, the LNVGA shows a noise figure of less than 2.1 dB and a gain of 28 /spl plusmn/ 1.6 dB. The mixer for a demodulator shows an amplitude error of less than 1.6 dB and a phase error of less than 3 degrees. The mixer for a modulator shows an image ratio of less than -30 dBc.



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Six-port direct digital receiver (SPDR) and standard direct receiver (SDR) results for QPSK modulation at high speeds

J.-C. Schiel, S.O. Tatu, Ke Wu and G. Bosisio. "Six-port direct digital receiver (SPDR) and standard direct receiver (SDR) results for QPSK modulation at high speeds." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 931-934 vol.2.

Comparative measurements on two direct down-conversion receivers are presented to investigate the performance of a six-port digital receiver (SPDR) with a standard direct receiver (SDR) using quadrature zero-IF mixers. The six-port prototype is fabricated in MHMIC format for a carrier frequency of 2.45GHz with QPSK digital modulation suitable for wireless local loop such as WLAN or MMDS systems. BER measurements on both receivers are presented in the presence of noise, adjacent channel and cochannel interference, local oscillator phase shift and sensitivity for 40 Mb/s data rate. MMIC design scheme of the six-port digital receiver can provide a robust, simple, low-cost design platform for use in mass-market communication systems for present and future multimedia broadband applications.





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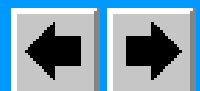
Subjects

Development of a low-IF receiver and a fixed wireless utility network

S. Thumaty, A. Pham and H. van Wyk. "Development of a low-IF receiver and a fixed wireless utility network." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 935-938 vol.2.

We present the design and development of a low-IF receiver and a fixed wireless utility network. This receiver is designed to achieve a dynamic range of 80 dB, a sensitivity of -105 dBm and a noise figure of 5 dB for a narrow band spread spectrum modulation scheme at 900 MHz. We demonstrate the feasibility of the low-IF receiver for low-cost implementation that alleviates the issue of 60 Hz power line in wireless electricity meter networks.

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A microwave communication link with self-heterodyne direct down conversion and system predistortion (2002 Vol. II [MWSYM])

Jin Park, Yuanxun Wang and T. Itoh. "A microwave communication link with self-heterodyne direct down conversion and system predistortion (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 939-942 vol.2.

A novel design of a microwave communications link operating at 5.8 GHz is presented based on self-heterodyne direct downconversion (SHDDC) and system predistortion. With the SHDDC scheme, the need of any local oscillators at the receive ends is eliminated, and the spectrum usage is minimized; however, the transmitter power efficiency is low, and there exists high mixer intermodulation levels in the receiver. To overcome these drawbacks, a system predistortion approach is proposed. A two-tone measurement is performed to validate the idea. It shows 6.83 dBc overall improvement in the signal-to-intermodulation ratio (SIMR) by applying a simple second-order predistortion technique. Further, successful transmission of a digitally modulated signal is also demonstrated.

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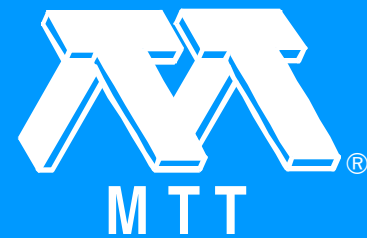


Abstracts

The danger of high-frequency spurious effects on wide microstrip line (2002 Vol. II [MWSYM])

F. Mesa and D.R. Jackson. "The danger of high-frequency spurious effects on wide microstrip line (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 945-948 vol.2.

It has been found that remarkably severe spurious effects can occur in the current excited on microstrip line at moderate to high frequency, when the strip is wide ($w/h > 3$). This newly observed effect occurs because one or more leaky modes approaches the branch point at $k/\text{sub } 0/$ in the complex longitudinal wavenumber plane. This effect only occurs when the strip is wide. This effect can be disastrous, since the continuous-spectrum part of the current then decays very slowly with distance from the source, so that the total strip current excited by the source exhibits spurious oscillations out to very large distances from the source. An approximate design rule for predicting this effect is given, which is accurate for wide strips ($w/h > 6$).



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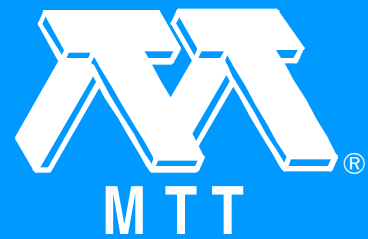


Abstracts

Frequency dependent characteristics of radiation from a voltage source on a covered microstrip line

W.L. Langston, J.T. Williams, D.R. Jackson and F. Mesa. "Frequency dependent characteristics of radiation from a voltage source on a covered microstrip line." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 949-952 vol.2.

The fields radiated from the currents induced on a covered microstrip transmission line by a finite-gap voltage source are presented. The character of these radiated fields has been examined in detail as the frequency is varied. It is shown that there is a smooth transition in the total radiation field from the spectral-gap region at lower frequencies to higher frequencies where a physical leaky mode exists. A characteristic leakage beam develops gradually as the frequency increases. When the leakage beam first develops, the observed radiation angle is greater than that predicted by the leaky mode alone. Crosstalk radiation can be significant even before the leaky mode becomes physical.



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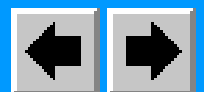
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Approximate analytical evaluation of the continuous spectrum in a substrate-superstrate dielectric waveguide (2002 Vol. II [MWSYM])

P. Baccarelli, P. Burghignoli, F. Frezza, A. Galli, G. Lovat and D.R. Jackson. "Approximate analytical evaluation of the continuous spectrum in a substrate-superstrate dielectric waveguide (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 953-956 vol.2.

In this work, an original closed-form approximate evaluation is performed for the continuous-spectrum field excited by an electric-current line source in a substrate-superstrate configuration, optimized for leaky-wave radiation. The validity of these results is shown for the near and the far field at different frequencies, including the frequency range in which the leaky wave is physical and the entire transition region through the spectral gap. This new closed-form result shows explicitly the nature of the continuous-spectrum field in the transition region, and provides insight into the nature of the fields on more complicated structures such as microwave integrated circuits.

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Significant contribution of nonphysical leaky mode to the fields excited by a practical source in printed-circuit transmission lines

M. Tsuji, S. Ueki and H. Shigesawa. "Significant contribution of nonphysical leaky mode to the fields excited by a practical source in printed-circuit transmission lines." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 957-960 vol.2.

We were the first to report for printed-circuit transmission lines that nonphysical improper real solutions have significant effect on physical total field excited by a practical source. We have recently studied such interesting and unexpected effects in more detail, and we have discovered here that nonphysical leaky solution also causes a significant effect on physical near field excited by a practical source, contrary to earlier belief.

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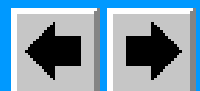
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Novel selected modes on the conductor-backed slotline

J. Zehentner, J. Machac and J. Mrkvica. "Novel selected modes on the conductor-backed slotline." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 961-964 vol.2.

This paper presents a detailed full-wave analysis of the conductor-backed slotline. The occurrence of an even dominant mode is revealed. This mode may propagate alone from dc up to the frequency at which the first leaky mode sets up. Nonphysical solutions of the dispersion equation and also the second leaky mode, taking power in the substrate, are identified. The first odd space leaky mode revealed on the CBSL enables an entirely uniplanar leaky wave antenna to be designed. The dispersion characteristics of particular revealed modes and their field distributions on the cross-sectional plane are also presented.

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A symmetry device to speed up circuit simulation and stability tests

S. Ramberger and T. Merkle. "A symmetry device to speed up circuit simulation and stability tests." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 967-970 vol.2.

A new simulation device is introduced that employs symmetry considerations in order to speed up network analysis of circuits with parallel branches. Such parallel branches are found e.g. in amplifiers with corporate combiners and push-pull oscillators. The device may be switched between two states, a symmetry and an antisymmetry state. The former is used in normal or even-mode operation and reduces the paralleled branches to a single branch, thus scaling down the time needed for the circuit set-up as much as the simulation time. The other state allows for rigorous odd-mode stability analysis when combined with a circulator stability test port. The device is easily implemented in standard circuit simulation programs.

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Feasible adjoint sensitivity technique for EM design optimization (2002 Vol. II [MWSYM])

N.K. Georgieva, S. Glavic, M.H. Bakr and J.W. Bandler. "Feasible adjoint sensitivity technique for EM design optimization (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 971-974 vol.2.

The adjoint variable method for frequency domain design sensitivity analysis is proposed for the optimization of wire and printed structures analyzed by the Method of Moments (MoM). We focus on the construction of the adjoint system using a feasible technique which requires only minor modifications of existing MoM codes. The solution to the adjoint problem is obtained with very little overhead once the original problem is solved. The gradient of the objective function is consequently computed through a single analysis regardless of the number of the design parameters. The concept is illustrated through the design of a Yagi-Uda array and a rectangular patch antenna using suitable MoM simulators.





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On passive time-domain macromodels of distributed transmission line networks

A. Dounavis, R. Achar and M. Nakhla. "On passive time-domain macromodels of distributed transmission line networks." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 975-978 vol.2.

Recently, several time-domain passive macromodeling algorithms were proposed for distributed transmission line networks. Most of them employ some kind of approximation in the frequency-domain to match the response up to a maximum frequency of interest and the behavior after the highest frequency is generally not considered. This can cause significant errors in transient responses (especially in the early-time period). In order to address this difficulty, we will present a new algorithm to reduce these high-frequency errors in time-domain macromodels, while preserving passivity. The proposed algorithm is very useful in eliminating the spurious ripples in the flat delay portion of transient responses of distributed transmission line networks without needing to increase the order of approximation.

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Fast and accurate C.A.D. of narrow band waveguide filters applying an electromagnetic segmentation method

D. Bariant, S. Bila, D. Baillargeat, S. Verdeyme and P. Guillon. "Fast and accurate C.A.D. of narrow band waveguide filters applying an electromagnetic segmentation method." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 979-982 vol.2.

This paper outlines a segmentation method dedicated to filter design applying a finite element software. This method is particularly efficient, simple, accurate and fast to design dual-mode band-pass filters using simple models. Any numerical electromagnetic software can be used to realize the segmentation. At the end of the procedure, all the dimensions of the filter (cavities and irises) are known. The filter can be built without any modification of these dimensions during the tuning. The different stages of the procedure are described in this paper. Experimental results show good agreement with theoretical ones.

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Coupling of large number of vias in electronic packaging structures and differential signaling

Houfei Chen, Qin Li, Leung Tsang and V. Jandhyala. "Coupling of large number of vias in electronic packaging structures and differential signaling." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 983-986 vol.2.

A method is presented for modeling the multi-interaction among large numbers of vertical vias in densely packaged integrated circuits. The analysis of the interior problem is based upon a cylindrical wave expansion of the magnetic field Green's function and the foldy-lax multiple scattering formula. The exterior problem of bent traces is analyzed using the MOM approach. A system matrix equation is obtained by combining the exterior and interior problem, the solution of which gives the propagation characteristics of the entire structure. Using an iterative solver, results are illustrated for problems of several thousand vias with moderate CPU and memory requirements. Also illustrated are the results for common and differential modes in differential signaling, including the effects of surrounding idle vias and shorting vias.

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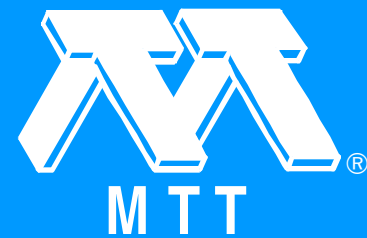


Abstracts

Full wave analysis of isolated pockets to improve isolation performances in silicon based technology

D. Bajon, S. Wane, H. Baudrand and P. Gamand. "Full wave analysis of isolated pockets to improve isolation performances in silicon based technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 987-990 vol.2.

This paper presents a versatile full wave analysis tool in which isolation pockets in IC's are readily introduced to perform intensive EM simulation including efficient introduction of via interconnects through metal levels. The obtained results are favorably compared to recent experimental published results.



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Novel technique for determining bias, temperature and frequency dependence of FET characteristics

A.E. Parker and J.G. Rathmell. "Novel technique for determining bias, temperature and frequency dependence of FET characteristics." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 993-996 vol.2.

A novel measurement of the dynamics of HEMT and MESFET behavior permits classification of dispersion effects and identifies operating regions that they affect. This reveals a simple structure to the otherwise complicated dynamic behavior that has concerned circuit designers. With this insight, it is possible to predict biases, temperatures and frequencies that dispersion will or will not affect. It is interesting to note that, for some devices, dispersion effects can be seen to exist at microwave frequencies and may therefore contribute to intermodulation distortion.

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Towards a unified method to implement transit-time effects in Pi-topology HBT compact models

M. Rudolph, F. Lenk, R. Doerner and P. Heymann. "Towards a unified method to implement transit-time effects in Pi-topology HBT compact models." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 997-1000 vol.2.

Four different approaches to include transit-time effects into π -topology HBT equivalent circuits are investigated in order to assess their compatibility with the physics-based T topology. The aim is to find an implementation that not only yields an exact model but also has a unique set of parameters in both the π and T cases. This is of prime importance for reliable parameter extraction and thus the physical significance of the model. It is achieved using a transcapacitance approach. The theoretical considerations are supported by a practical example comparing measured and modeled HBT behaviour.

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Measurement and modelling of static and dynamic breakdowns of power GaInP/GaAs HBTs

S. Heckmann, J.-M. Nebus, R. Quere, J.-C. Jacquet, D. Floriot and P. Auxemery.

"Measurement and modelling of static and dynamic breakdowns of power GaInP/GaAs HBTs."

2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1001-1004 vol.2.

The breakdown values of GaInP/GaAs HBTs have been strongly increased, keeping constant RF performance. A 67 V common base breakdown voltage (BV_{cb0}) is obtained associated with a 37 V collector emitter breakdown value (BV_{ce0}). Such devices have great potential for use in base stations as power amplifiers where 10 W (linear) and 100 W (compressed) output powers are needed. For such powers, transistors work close to the breakdown limit. Therefore, accurate modelling of both static and dynamic breakdown phenomena becomes important for the optimum design of reliable amplifiers. This is the purpose of this paper. The base-collector breakdown of a 16-finger HBT transistor has been characterised in the cases of constant base current and constant base voltage biasing conditions. An HBT model accounting for breakdown is presented and large signal load pull measurements reported.

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A simple practical technique for estimating the junction temperature and the thermal resistance of a GaAs HBT

M. Olavsbraten. "A simple practical technique for estimating the junction temperature and the thermal resistance of a GaAs HBT." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1005-1008 vol.2.

This paper shows a practical technique to find a good estimate of the junction temperature and the thermal resistance in a GaAs HBT. The technique is based on simple calculations from the physical dimensions of the HBT and the thermal material parameters, without using any specialized 3D thermal software or equipment for thermal measurements. This work should be of great value for circuit designers, who need an easy practical way of including good thermal values into models for accurate circuit simulations. Two different HBT's have been used to evaluate the technique presented. Evaluation involves comparing the junction temperature obtained by measurements performed at Caswell Technology with estimated values from the present technique.

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A novel extraction method for a fully electro-thermal large-signal model of HBT

Hyun-Min Park, R. Green and Songcheol Hong. "A novel extraction method for a fully electro-thermal large-signal model of HBT." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1009-1012 vol.2.

Large-signal modeling of power HBTs is demonstrated for accurate simulation of self-heating and ambient temperature effects and nonlinear behavior such as output power, gain expansion, and IMD. The extraction was done for an in-situ output-stage device from a power amplifier circuit. The physical relationship between the device current and the rate of change in the built-in potential with respect to the device temperature has been utilized for fully electro-thermal modeling. Measurements and simulations are compared for the verification of the model under DC conditions at various temperatures. Also, the gain expansion and the sweet spot under large-signal two-tone conditions have been characterized under various harmonic loads to assess the accuracy of the model.

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High performance silicon bipolar power amplifier for 1.8 GHz applications

F. Carrara, A. Castorina, A. Scuderi and G. Palmisano. "High performance silicon bipolar power amplifier for 1.8 GHz applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1015-1018 vol.2.

The potential of a high-performance low-cost silicon bipolar technology for high-efficiency low-voltage RF power amplifiers has been explored. To this end, a unit power cell has been developed by optimizing layout design, collector thickness and doping level. On-wafer load-pull measurements were performed which showed an excellent power-added efficiency of 83% at 1.8 GHz under a supply voltage of 2.7 V. The optimized unit power cell was employed to implement a 1.8 GHz three-stage monolithic power amplifier. The device achieved a 57% maximum power-added efficiency and 33-dB gain at a 34-dBm output power level while operating at 2.7 V.

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A 2.4 GHz high efficiency SiGe HBT power amplifier with high-Q LTCC harmonic suppression filter

A. Raghavan, Deukhyoun Heo, Moonkyun Maeng, A. Sutono, Kyutae Lim and J. Laskar. "A 2.4 GHz high efficiency SiGe HBT power amplifier with high-Q LTCC harmonic suppression filter." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1019-1022 vol.2.

We present a 2.4 GHz SiGe HBT power amplifier integrated with a harmonic suppression filter implemented in a high-Q multilayer low-temperature cofired ceramic (LTCC) substrate at the output. The power amplifier delivers a power of up to 27.5 dBm with a maximum power-added efficiency (PAE) of 47%. It has a power output of 27 dBm at an input power of 0 dBm with a PAE of 45%. The second and third harmonics are -44 dBc and -49 dBc, respectively, at this operating point. The power amplifier exhibits a linear gain of 35 dB and operates at a supply voltage of 3.3 V. To the best of our knowledge, this represents the best reported performance of a SiGe HBT power amplifier at 2.4 GHz and is comparable to performance previously achieved only with GaAs-based processes. The harmonic suppression filter and output match network have been implemented completely in LTCC without the use of external discrete components.





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The maximum operating region in SiGe HBTs for RF power amplifiers

A. Inoue, S. Nakatsuka, R. Hattori and Y. Matsuda. "The maximum operating region in SiGe HBTs for RF power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1023-1026 vol.2.

Microwave waveforms of SiGe HBTs have been directly measured. The maximum operating region has been experimentally investigated by sweeping the load lines and power of the input signal. The device is found to operate beyond the conventional BV_{ceo} , while GaAs HBTs cannot survive at that voltage. The conventional BV_{ceo} is found to limit the average V_c of the maximum load lines, but has no influence on the peak voltage. Another BV_{ceo} measured with a voltage generator is proposed to represent the avalanche breakdown instead of the conventional one.

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Implementation of RF power MOS in 0.18/ μm CMOS technology for single chip solution

Heng-Ming Hsu, Chih-Wei Chen, Jiong-Guang Su, Ta-Hsun Yeh, J.C.-H. Lin, J.Y.-C. Sun and Chun Hsiung Chen. "Implementation of RF power MOS in 0.18/ μm CMOS technology for single chip solution." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1027-1030 vol.2.

This paper presents a complete portfolio of silicon integrated RF power MOS using 0.18/ μm CMOS technology in the first time. The proposed structure of power MOS promises high breakdown voltage, and presents excellent RF characteristics. To guarantee the production level, a complete qualification testing is also included.

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Performance of GaAs on silicon power amplifier for wireless handset applications

N. Escalera, R. Emrick, S. Franson, B. Farber, G. Garrison, J. Holmes, S. Rockwell and B. Bosco. "Performance of GaAs on silicon power amplifier for wireless handset applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1031-1034 vol.2.

Recently RF devices formed by the epitaxial growth of GaAs on a Si substrate have been demonstrated. The RF performance of these new devices compares well with devices on a conventional GaAs substrate process. This new GaAs-on-Si technology has the potential for replacing expensive RF components such as power amplifiers with lower cost devices fabricated on GaAs-on-Si while still maintaining good DC-RF performance. This paper presents the RF performance of these GaAs/STO/Si devices and shows for the first time their viability as power amplifiers in wireless handsets.

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Broadband high-efficiency monolithic InGaP/GaAs HBT power amplifiers for 3G handset applications

H. Jager, A. Grebennikov, E. Heaney and R. Weigel. "Broadband high-efficiency monolithic InGaP/GaAs HBT power amplifiers for 3G handset applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1035-1038 vol.2.

In this paper, an approach to high efficiency power amplifier performance over a wide frequency range is discussed. Results for practical implementation of a multiband and multi-mode handset power amplifier are shown. Measurements demonstrate feasibility of the concept for WCDMA, DCS1800 and PCS1900 high-efficient operation. A PAE of better than 38% at 27 dBm output power and an ACLR of -37 dBc in WCDMA operation, as well as greater than 50% PAE at 30 dBm output power in the DCS1800 and PCS1900 band are documented.

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InGaP PHEMTs for 3.5GHz W-CDMA applications

E. Lan, E. Johnson, B. Knappenberger and M. Miller. "InGaP PHEMTs for 3.5GHz W-CDMA applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1039-1042 vol.2.

In this paper we present DC, small signal, and power characteristics of an InGaP PHEMT device using InGaP as barrier layer material. A comparison of intrinsic G_m , R_{ds} , C_{gs} , and C_{gd} with an AlGaAs PHEMT device showed that the InGaP PHEMT is very promising for microwave and RF linear power amplification. Operating from 12 V supplies, a 15.4 mm InGaP PHEMT device achieved 29.5 dBm output power with 12.1 dB associated gain and 25.6% power-added-efficiency at 3.5 GHz, while meeting the -40 dBc ACPR specification under W-CDMA stimulus.

Broadband highly integrated LTCC front-end module for IEEE 802.11a WLAN applications

C.-H. Lee, S. Chakraborty, A. Sutono, S. Yoo, D. Heo and J. Laskar. "Broadband highly integrated LTCC front-end module for IEEE 802.11a WLAN applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1045-1048 vol.2.

This paper presents the design, development and measurement of a highly-integrated and high linearity RF front-end module with integrated filter for IEEE 802.11a wireless LAN applications. The developed front-end MMIC includes LNA, PA, and SPDT switch integrated on a single chip in a commercial GaAs MESFET process. An embedded 3-D band pass filter has been integrated on the front-end module using LTCC technology. The performance of the front-end module is compliant to the HiPERLAN-I and IEEE 802.11a RF standards. The LNA exhibits 16.5 dB of gain, 2.1 dB of noise figure and IIP3 of 2.8dBm. The PA shows the 24 dBm output power and IM3 of better than 25dBc. The SPDT switch demonstrates 1.2 dB of insertion loss and 28dBm of input P1dB. To the best of our knowledge, this is the first report on C-band PA-LNA-Switch integrated on a single chip with embedded LTCC filter.

DCS 1800 base station receiver integrated in 0.25 μm CMOS

O. Boric-Lubecke, J. Lin and P. Gould. "DCS 1800 base station receiver integrated in 0.25 μm CMOS." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1049-1052 vol.2.

This paper describes the first CMOS chip implementation of a GSM base station receiver. This chip consists of two LNA's, switch, mixer, LO buffer amplifier/balun, and RF balun. A CMOS IF amplifier is packaged separately. The 0.25 μm CMOS receiver, biased at 3 V, meets DCS1800 specifications and achieves better linearity and noise figure than previously published BiCMOS receivers. Output IP3 (OIP3) of over 25 dBm was obtained for the complete receiver chain, with a noise figure of 3 dB, and gain of 25 dB. This is believed to be the highest OIP3 and lowest NF reported to date for a CMOS receiver that meets GSM base station specifications.



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Development of SOI based MMICs for wireless LAN applications

S. Pinel, S. Chakraborty, S. Venkataraman, R. Bhatia, S. Mandal, S. Nuttinck, B. Larson and J. Laskar. "Development of SOI based MMICs for wireless LAN applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1053-1056 vol.2.

Due to its improved RF performances over conventional CMOS, SOI technology is a promising candidate for front-end wireless transceiver circuits. This paper demonstrates the development of fully on-chip integrated SOI based MMICs for IEEE 802.11a standard. A modified BSIM model is developed to predict small signal RF behavior. The development of high Q on-chip inductor design and modeling is detailed. The low noise amplifier, implemented in a commercially available 0.35 μm SOI MOSFET process, is both input and output 50 Ohms matched and operates in C-band. It exhibits a forward gain (S21) of 10.5 dB with a noise figure of 4.5 dB while drawing 15 mA from a 1.8 V supply. The doubly balanced Gilbert cell topology mixer exhibits a peak gain of 7.5 dB and IIP3 of +11 dBm. It consumes about 11 mA from a 3.3 V supply. To the best of our knowledge this research is the first report of SOI based implementation of MMICs for C-band wireless applications.

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Design of high speed master-slave D-type flip-flop in InP DHBT technology (2002 Vol. II [MWSYM])

A.-E. Kasbari, P. Andre, A. Konczykowska, M. Riet, S. Blayac, H. Ouslimani and J. Godin.

"Design of high speed master-slave D-type flip-flop in InP DHBT technology (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1057-1060 vol.2.

In this paper, we present some design problems of the high speed master-slave D-type flip-flop (MS D-FF). Essential to long haul optical fiber communication systems, this circuit is critical since it operates at the highest clock frequency for a given bit rate. We discuss specific aspects of electrical design of such a circuit and underline some important points of the layout of gigabit circuits. The MS D-FF was fabricated in our self-aligned InP DHBT technology. On wafer measurements show correct operation at 40 Gb/s.

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A GaAs MHEMT distributed amplifier with 300-GHz gain-bandwidth product for 40-Gb/s optical applications

M.S. Heins, C.F. Campbell, M.-Y. Kao, M.E. Muir and J.M. Carroll. "A GaAs MHEMT distributed amplifier with 300-GHz gain-bandwidth product for 40-Gb/s optical applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1061-1064 vol.2.

A distributed amplifier with greater than 13.4 dB gain and 65 GHz bandwidth has been demonstrated using 0.15 μm metamorphic GaAs HEMT technology. The amplifier has an average noise figure of 3.1 dB from 2-40 GHz and an output 1-dB compression point of 11 dBm at 22 GHz. The group delay variation from 1 to 40 GHz is ± 7.5 ps. The amplifier may be biased with a single supply voltage, and consumes only 105 mW. With these characteristics, the amplifier is ideally suited for 40-Gb/s optical networks.

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Negative refractive index metamaterials supporting 2-D waves

A.K. Iyer and G.V. Eleftheriades. "Negative refractive index metamaterials supporting 2-D waves." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1067-1070 vol.2.

Recent demonstrations of negative refraction utilize three-dimensional collections of discrete periodic scatterers to synthesize artificial dielectrics with simultaneously negative permittivity and permeability. In this paper, it is shown that planar, two-dimensional L-C transmission line networks in a high pass configuration can demonstrate negative refraction as a consequence of the fact that such media support propagating backward waves. Simulations illustrating negative refraction and focusing at 2 GHz are subsequently presented.

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Characteristics of Ka band waveguide using electromagnetic crystal sidewalls

J.A. Higgins, H. Xin and A. Sailer. "Characteristics of Ka band waveguide using electromagnetic crystal sidewalls." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1071-1074 vol.2.

Electromagnetic crystal structures have been used as sidewalls in special waveguides for the frequency range 30 to 40 GHz. They have the effect of substituting high impedance surfaces in place of the normal conducting metal sidewalls. The objectives in so doing are to obtain uniform electric field across the width of the waveguide and to force the wave in the guide to adopt the nature of a TEM wave. The measured insertion loss of Ka band waveguides is found to be low. The dependence of transmission phase on the center frequency of sidewall resonance has been measured and indicates that tunable sidewall resonance will provide simple and low loss phase shifting systems.

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Terahertz pulse propagation in plastic photonic crystal fibers

H. Han, H. Park, M. Cho, J. Kim, I. Park and H. Lim. "Terahertz pulse propagation in plastic photonic crystal fibers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1075-1078 vol.2.

Guided-wave single-mode propagation of sub-ps terahertz (THz) pulses in a plastic photonic crystal fiber has been experimentally demonstrated for the first time to the best of our knowledge. The plastic photonic crystal fiber is fabricated from high density polyethylene tubes and filaments. The fabricated fiber exhibits low loss and relatively low dispersive propagation of THz pulses within the experimental bandwidth of 0.1 /spl sim/ 3 THz. The measured loss and group velocity dispersion are less than 0.5 cm/sup -1/ and -0.3 ps/THz/spl middot/cm above 0.6 THz, respectively.



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Radiation from ground plane photonic bandgap microstrip waveguides

N. Shino and Z. Popovic. "Radiation from ground plane photonic bandgap microstrip waveguides." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1079-1082 vol.2.

This paper presents an analysis of radiation of photonic bandgap (PBG) microstrip structures along with the pass and stopband behavior. Simulations are compared with measurements performed on a PBG microstrip waveguide with circular slots in the ground plane, designed to have a broad stop-band centered around 10 GHz. Radiation can be significant at some frequencies for a microstrip PBG and should be considered when designing filters, harmonic terminations and antenna feeds. Radiation of -3.4 dB was measured at 15 GHz relative to the input power in the passband. Measurement data agree well with simulations.

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Dispersion characteristics of EME microstrip at first higher order

Ching-Kuo Wu, Yu-Chiao Chen and C.-K.C. Tzuang. "Dispersion characteristics of EME microstrip at first higher order." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1083-1086 vol.2.

The dispersion characteristics of the electric-magnetic-electric (EME) microstrip at the first higher order are presented. The EME microstrip consists of composite metals paralleling the electric and magnetic surfaces, where the magnetic surface is made of an array of coupled inductors. The dispersion curves obtained by matrix-pencil analyses are validated experimentally by the measured radiation patterns. The line width is reduced by 47.5%, compared to that of the conventional microstrip for the same onset frequency of the leaky mode. The EME microstrip is potentially useful for compact microstrip leaky-mode array design.

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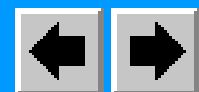
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PBG-enhanced inductor

Hsien-Shun Wu and C.-K.C. Tzuang. "PBG-enhanced inductor." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1087-1090 vol.2.

A novel inductor configuration, consisting of a two-dimensional photonic bandgap (PBG) periodical array in addition to the existing inductor, e.g., spiral inductor, is built, analyzed, and tested. Measurements show that a one-turn, 13.1 mm long spiral inductor (3 mm by 3 mm) placed on a PBG ground plane made of unit cells using coupled inductors of dimension 1.5 mm by 1.5 mm on Roger 4003/sup TM/ substrates can increase the inductance by 34%, reduce the series resistance by 45%, improve the Q-factor by 33%, and extend the peak Q-factor frequency by 14% as compared to the conventional spiral inductor of the same size. Dispersion characteristics of both PBG-enhanced and conventional spiral inductors are reported.

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Reduced size capacitive defect EBG resonators

Xun Gong, W.J. Chappell and L.P.B. Katehi. "Reduced size capacitive defect EBG resonators." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1091-1094 vol.2.

The concept of a capacitive defect in a periodic lattice is examined. An eigenvalue analysis has been performed to determine the resonant frequency of a capacitive section that forms a defect in an otherwise periodic lattice of metallic vias. This concept presented herein addresses one of the major concerns in a defect mode resonator scheme: the overall size of the structure. Theoretically by loading the cavity with a capacitive load, a size reduction up to a full order of magnitude can be achieved depending on the height of the capacitive post. Furthermore the Q remains relatively the same even with a substantial size reduction. However as a practical issue, the sensitivity of the resonant frequency limits the achievable reduction for a given set of fabrication tolerances. The sensitivity of the resonator frequency and the resonant quality factor of a capacitive defect resonator has been the focus of this study. In the evanescent defect EBG resonator presented herein, the second order resonance is not an integer multiple of the dominant resonant frequency thus resulting in a very clean spectrum. As an example of an application for this EBG resonator, multiple capacitive defects in a metallo-dielectric EBG substrate have been coupled to form a reduced size multipole filter.

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Advanced microwave modeling framework exploiting automatic model generation, knowledge neural networks and space mapping

V. Devabhaktuni, B. Chattaraj, M.C.E. Yagoub and Q.J. Zhang. "Advanced microwave modeling framework exploiting automatic model generation, knowledge neural networks and space mapping." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1097-1100 vol.2.

In this paper, we propose an efficient Knowledge based Automatic Model Generation (KAMG) technique, aimed at generating microwave neural models of highest possible accuracy using fewest accurate data. The technique is comprehensively derived to integrate three distinct powerful concepts, namely, automatic model generation, knowledge neural networks and space mapping. We utilize two types of data generators - fine data generators that are accurate and slow (e.g., CPU-intensive 3D-EM simulators); coarse data generators that are approximate and fast (e.g., inexpensive 2D-EM). Motivated by the space-mapping concept, the KAMG utilizes extensive approximate data but fewest accurate data to generate neural models that accurately match fine data. Our formulation exploits a variety of knowledge network architectures to facilitate reinforced neural network learning from both coarse and fine data. During neural model generation by KAMG both coarse and fine data generators are automatically driven using adaptive sampling. The proposed technique is demonstrated through examples of MOSFET, and embedded passives used in multi-layer PCBs.

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Neural based dynamic modeling of nonlinear microwave circuits (2002 Vol. II [MWSYM])

Jianjun Xu, M.C.E. Yagoub, Runtao Ding and Q.J. Zhang. "Neural based dynamic modeling of nonlinear microwave circuits (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1101-1104 vol.2.

A neural network formulation for modeling nonlinear microwave circuits is achieved in the most desirable format, i.e., continuous time-domain dynamic system format. The proposed dynamic neural network (DNN) model can be developed directly from input-output data without having to rely on internal details of the circuit. An algorithm is developed to train the model with time or frequency domain information. A circuit representation of the model is proposed such that the model can be incorporated into circuit simulators for high-level design. Examples of dynamic-modeling of amplifiers, mixer and their use in system simulation are presented.





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A systematic approach to a reliable neural model for pHEMT using different numbers of training data

M. Joodaki and G. Kompa. "A systematic approach to a reliable neural model for pHEMT using different numbers of training data." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1105-1108 vol.2.

A systematic approach is presented to achieve a reliable neural model for microwave active devices with different numbers of training data. The method is implemented for a small-signal bias depended modeling of pHEMT with different numbers of training data. The errors for different numbers of training data have been compared to each other and show that by using this method a reliable model is achievable even though the number of training data is considerably small. The method aims at constructing a model which can satisfy the criteria of minimum training error, maximum smoothness (to avoid the problem of overfitting), and simplest network structure.

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A novel design approach for microwave planar filters

S.F. Peik and R.R. Mansour. "A novel design approach for microwave planar filters." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1109-1112 vol.2.

This paper presents an efficient design approach for large planar filter circuits using very accurate full-electromagnetic simulations. This new hybrid optimisation technique combines the accurate - but expensive - full electromagnetic simulation with the inexpensive - but less accurate - cascaded circuit analysis. By altering the coupling matrix of the cascaded circuit simulation we attain the computational speed of the cascaded simulation, but the accuracy of the full-electromagnetic simulation. To reduce computational costs further, we introduce the multi-dimensional Cauchy method to the cascaded circuit simulation. The proposed techniques result in a considerable gain in design reliability and a significant reduction of computational cost when compared to conventional methods. The new method is demonstrated by the optimisation of a superconductive planar narrow-band 6-Pole filter for space applications. Using our optimisation scheme the computational costs can be cut to about 1.5% compared to a full-EM based optimisation.

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EM-simulator based parameter extraction and optimization technique for microwave and millimeter wave filters

P. Harscher, E. Ofli, R. Vahldieck and S. Arnari. "EM-simulator based parameter extraction and optimization technique for microwave and millimeter wave filters." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1113-1116 vol.2.

A novel hybrid optimization technique for microwave and millimeter wave filters is presented. The technique is based on a surrogate model represented by a minimum prototype filter network. All characteristic filter parameters like frequency shifts of and couplings between resonators are included. Accurate prototype parameters are extracted from S-parameter computation of the physical filter. In the best case only $n+1$ electromagnetic (EM) field simulations are necessary, where n is the number of geometry parameters. Optimization is performed in the parameter space of the surrogate model with the parameters of the ideal transfer function as target. This approach is very fast and requires only few field simulations.

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Computer-aided tuning of microwave filters using fuzzy logic (2002 Vol. II [MWSYM])

V. Miraftab and R.R. Mansour. "Computer-aided tuning of microwave filters using fuzzy logic (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1117-1120 vol.2.

The paper introduces an algorithm based on fuzzy logic for tuning microwave filters. The approach is demonstrated by considering two filters: one is slightly de-tuned and the other is highly de-tuned. In both cases, the approach proves to be very efficient in identifying the filter elements that cause the de-tuning. The fuzzy rules are extracted from sampled data. Expert rules can also be added. The algorithm can be applied to any microwave circuit tuning problem.

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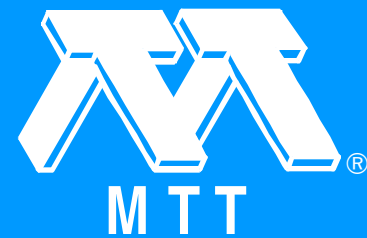


Abstracts

A general framework for SPICE-TLM interconnection

P.P.M. So and W.J.R. Hoefer. "A general framework for SPICE-TLM interconnection." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1123-1126 vol.2.

A general SPICE-TLM interconnection framework will be presented. The connection algorithm is based on the representation of the TLM network by equivalent Thevenin and/or Norton sources. The framework opens new and far-reaching possibilities for hybrid global microwave and high-speed digital circuit modeling in time domain because it integrates the extensive circuit and device models of SPICE into general three-dimensional field solutions in real time.



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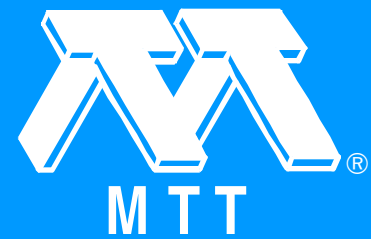
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FDTD study of surface waves in microstrip and patch structures

E. Semouchkina, G. Semouchkin, Wenwu Cao and R. Mittra. "FDTD study of surface waves in microstrip and patch structures." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1127-1130 vol.2.

The Finite Difference Time Domain (FDTD) method is employed to visualize surface wave propagation in microstrip line and patch structures. Signal distortion in microstrip lines caused by surface waves is studied in substrates with different permittivities. Electric and magnetic field components of surface waves, excited by different sources, are analyzed and different types of surface waves are identified. An efficient method to suppress surface wave propagation using low-K plugs inserted in higher-K substrates is demonstrated.

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Time domain field synthesis with 3D symmetric condensed node TLM

M.H. Bakr, P.P.M. So and W.J.R. Hoefer. "Time domain field synthesis with 3D symmetric condensed node TLM." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1131-1134 vol.2.

A novel time domain field synthesis approach based on 3D symmetric condensed node TLM will be described. The field distribution on the designable boundary parts is determined through a traditional TLM analysis of a starting geometry. Designable parameters are associated with a set of characteristic frequencies of the structure. The desirable values of these frequencies are determined using design specifications in the form of an equivalent lumped element circuit. A synthesis phase is then carried out for each parameter, during which the associated boundary parts are replaced by matched sinusoidal sources with the desirable value of the associated characteristic frequency. The designable parameter value is determined by observing the envelope of the standing electric/magnetic field pattern.

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Towards accurate time-domain simulation of highly conductive materials

Chenghao Yuan and Zhizhang Chen. "Towards accurate time-domain simulation of highly conductive materials." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1135-1138 vol.2.

Accurate simulation of highly conductive materials such as copper at RF and microwave frequency has presented a great challenge with the conventional FDTD method. The reason is that for a FDTD recursive computation to be accurate and stable, the FDTD time step has to be very small, leading to sometimes a prohibitively large number of iterations. In this paper, the recently developed unconditionally stable ADI-FDTD method is revised and applied to solve the problem. It is shown, through the examples of computation of body of rotational (BOR) cavities with highly conductive walls, that the highly conductive materials can now be accurately simulated. In addition, a general unconditionally stable cylindrical ADI-FDTD formulation is developed to facilitate the computation of cylindrical structures with conductive loss.

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Lumped device modeling with FDTD including packaging effects

Boon Ping Koh, I.J. Craddock, P. Urwin-Wright and C.J. Railton. "Lumped device modeling with FDTD including packaging effects." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1139-1142 vol.2.

A two-terminal device can be incorporated into FDTD using the Lumped Element FDTD (LE-FDTD) formulation, unfortunately, this method is not able to analyze accurately the packaging effects of the device. This is possible using Lumped Network FDTD (LN-FDTD) - however LN-FDTD requires a complicated pre-calculation for simple devices such as Schottky or varactor diode. Therefore, this paper presents a simple and effective state space approach to incorporate device packaging effects into FDTD algorithm. The new technique is validated by means of experimental measurements of a varactor-tuned patch antenna and the agreement between the predicted and actual responses is shown to be excellent.

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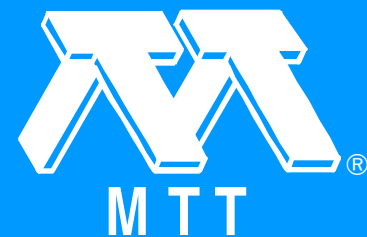


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A new 2-D image reconstruction algorithm based on FDTD and design sensitivity analysis (2002 Vol. II [MWSYM])

No-Weon Kang, Young-Seek Chung, Changyul Cheon and Hyun-Kyo Jung. "A new 2-D image reconstruction algorithm based on FDTD and design sensitivity analysis (2002 Vol. II [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1143-1146 vol.2.

In this paper, we propose a numerical algorithm to reconstruct the complex permittivity profile of unknown scatterers by using the FDTD technique and design sensitivity analysis (DSA). By introducing DSA and the adjoint variable method, we can calculate the derivatives of error functions with respect to complex permittivity variables, and reduce the computational cost. The proposed method is validated by application to the reconstruction of unknown 2-D scatterers which are illuminated by TM/sup 2/ with a Gaussian pulsed plane wave.



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Measurements on dielectric and radiation loss of flexible circular dielectric waveguides in Q-band

Ki Young Kim, Jong Ryul Sohn, Hyun Ju Seo, Jin-Won Han, Heung-Sik Tae and Jeong-Hae Lee. "Measurements on dielectric and radiation loss of flexible circular dielectric waveguides in Q-band." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1149-1152 vol.2.

In Q-band, dielectric losses and radiation losses of flexible circular PTFE waveguides are measured with parameters such as operating frequency, areas of the dielectric region in guiding cross sections, and radii of curvature. The dielectric losses of the rod and tube waveguides show relatively good agreement with theoretical results. The radiation losses of the guides, which current theory cannot predict in the regime of small radius of curvature, are measured from differences between insertion losses and the dielectric losses. The validity of our results can be explained by the fractional power flow ratios in each region of the waveguides.

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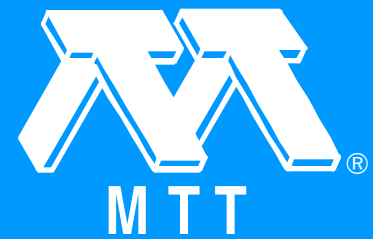
A technique for reducing the size of amplifiers using defected ground structure

Jong-Sik Lim, Young-Taek Lee, Jae-Hee Han, Jun-Seok Park, Dal Ahn and Sangwook Nam. "A technique for reducing the size of amplifiers using defected ground structure." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1153-1156 vol.2.

A defected ground structure (DGS) on the ground plane of transmission lines, such as microstrips and coplanar waveguides, provides slow-wave characteristics caused by its equivalent inductive and capacitive components. Due to this slow-wave effect, the electrical lengths of the microstrip lines, which are combined by DGS in matching networks, are longer than the original ones. Therefore, the physical length of microstrip line can be shortened by inserting a DGS in order to keep the original electrical length. The resultant lengths of the microstrip lines with DGS are only 54% and 56% of the original lines in input and output matching networks, respectively. Additionally, because the microstrip lines with DGS have rejection characteristics slightly at the harmonic band, while standard transmission lines have a very wide passband only, the magnitude of the second harmonic is less than that of the original amplifier. The technique for size reduction of amplifiers using DGS is also applied to a coplanar waveguide (CPW) amplifier. The resultant lengths of CPW lines combined by DGS in matching networks are only 50% of the original lengths.



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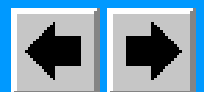
A new sandwich structure of photonic bandgap

Yunbo Pang and Baoxin Gao. "A new sandwich structure of photonic bandgap." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1157-1160 vol.2.

We propose a photonic bandgap (PBG) sandwich structure in which a periodic pattern of square metal pads is printed in the middle of the substrate. Neither drilling nor suspending the substrate is required, and the integrity of the ground plane is also kept. Several circuits with different locations of the periodic lattice are compared, and potential applications are demonstrated.



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Amplifier design using $\lambda/4$ high impedance bias line with defect ground structure (DGS)

Si-Gyun Jeong, Do-Kyeong Hwang, Yong-Chae Jeong and Chul-Dong Kim. "Amplifier design using $\lambda/4$ high impedance bias line with defect ground structure (DGS)." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1161-1164 vol.2.

In this paper, a new $\lambda/4$ bias transmission line that is added dumbbell-shaped defect ground structure (DGS) on ground plane of the conventional $\lambda/4$ bias transmission line is proposed. This DGS $\lambda/4$ bias transmission line maintains high impedance, but physical width is wider and length is shorter than that of the conventional bias line. If the proposed bias line is attached on signal transmission line, this bias line can reduce the 3rd harmonic signal as well as the 2nd harmonic signal. When the proposed bias line is adopted in power amplifier on IMT-2000 basestation transmitting band, the 3rd harmonic signal is reduced about 26.5 dB than the conventional structure.

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A derivation of a class of 3-port baluns from symmetrical 4-port networks

Yoke Choy Leong, Kian Sen Ang and Chee How Lee. "A derivation of a class of 3-port baluns from symmetrical 4-port networks." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1165-1168 vol.2.

This paper describes an approach in deriving the general conditions that need to be satisfied for a class of 3-port baluns. This is done by analyzing the behavior of a general symmetrical 4-port network when one of the ports is terminated with an arbitrary impedance. These conditions will be useful in devising new balun structures and in deriving exact design equations for such baluns. Examples will be presented for some known and new baluns in this class. These insights have also made the cascading of multisection baluns possible by specifying the overall requirements for the cascaded structures. Based on these results, a 3-section, Marchand-type, coupled-line balun has been designed and fabricated. Good agreements between simulation and measured results have been obtained, thereby verifying the validity of the design equations.

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An inverted coplanar coupler with integral microstrip interfaces and bias crossover

E.J. Crescenzi, Jr.. "An inverted coplanar coupler with integral microstrip interfaces and bias crossover." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1169-1172 vol.2.

An inverted coplanar 3 dB quadrature coupler was developed for application in hybrid power amplifiers. The structure was realized on an alumina substrate using conventional thick-film construction. It includes direct microstrip interfaces and a bias crossover, both of which support compact integration of power amplifier circuits. Designs for the PCS and UMTS communications bands achieved 0.2 dB insertion loss and directivities and return losses of nominally 25 dB.

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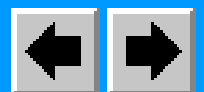
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Dividing and filtering function integration for the development of a band-pass filtering power amplifier

S. Avrillon, A. Chousseaud and S. Toutain. "Dividing and filtering function integration for the development of a band-pass filtering power amplifier." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1173-1176 vol.2.

Integration of amplifying and filtering functions, based on transversal structure principles, is one solution to develop miniaturized mobile communication devices. An architecture using power combination has been developed, combining the filter and the three branches power divider. The system is dual-band (0.9 GHz and 1.94 GHz). The filter is constituted by two looped Stepped Impedance Resonators (S.I.R.), symmetrically positioned on each side of the stopped feeding line. Power is equally divided thanks to coupling effects between output microstrip lines.

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Design method of a dual band balun and divider

Jung-Hyun Sung, Geun-Young Kim, Seok-Ho Son, Hyo-Jong Lee, Young-Joo Song, Yong-Woo Jeong, Hyung-Sik Park and Dal Ahn. "Design method of a dual band balun and divider." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1177-1180 vol.2.

This paper presents the design method and performance characteristics of a dual band balun. The design method for dual band balun is based on the lumped element equivalent circuit of quarter-wave transformer. By employing the proposed configuration and the derived formulas, dual band balun are designed, simulated, and manufactured. The proposed design method and equivalent circuit can make it easy to adapt to designing dual band balun and divider of ceramic multi-layer chip type. The dual band balun and divider are applied to wireless communication system.

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TFBAR filters for 2 GHz wireless applications

K.W. Kim, J.G. Yook, M.G. Gu, W.Y. Song, Y.J. Yoon and H.K. Park. "TFBAR filters for 2 GHz wireless applications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1181-1184 vol.2.

Thin film bulk acoustic resonators (TFBAR) using AlN with two electrodes have been used in the design of band pass filters at 2 GHz frequency bands. Both membrane and air-gap are used to suppress the over-mode phenomenon. Resonator modeling was performed based on measured frequency response of a single resonator with modified Butterworth-Van Dyke (MBVD) model. Electric coupling coefficient, k , is 0.2075 (4.3%) and Q is 577.18 for a single TFBAR. Additional TFBAR is used to improve out of band rejection in the conventional ladder topology and each contributes -3 dB suppression improvement at stop-band. Four different types of ladder filters were fabricated and modelled and revealed only -2 to -3 dB insertion loss for all the cases with bandwidth of around 52 MHz.



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Ferromagnetic composite-based and magnetically-tunable microwave devices

E. Salahun, G. Tanne, P. Queffelec, P. Gelin, A.-L. Adenot and O. Acher. "Ferromagnetic composite-based and magnetically-tunable microwave devices." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1185-1188 vol.2.

This article deals with a new generation of tunable microwave devices using ferromagnetic materials. The sensitivity of the device cut-off frequency to the dc magnetic field was investigated for two filtering resonators (stub resonator and Stepped Impedance Resonator). The stub resonator exhibited a frequency tunability of nearly 40% for a dc magnetic field strength of 250 Oe, whereas the linewidth remained unchanged. A 12.2% tunability of the SIR device was reached under 250 Oe applied.

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Field distributions in six-port gyroelectric semiconductor circulators with coplanar waveguide (CPW) feeders

Z.M. Ng, L.E. Davis and R. Sloan. "Field distributions in six-port gyroelectric semiconductor circulators with coplanar waveguide (CPW) feeders." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1189-1192 vol.2.

The magnetic field distributions of a CPW semiconductor junction circulator are computed at different frequencies for the first time. The results resemble the electric field distributions of a six-port microstrip ferrite junction circulator simulated using Ansoft HFSS. A broadband CPW semiconductor circulator centered at 60 GHz has been designed by tracking the perfect circulation curves from the region where $\text{Im}(\epsilon_{\text{eff}}) > 0$ up to the region where $\text{Im}(\epsilon_{\text{eff}}) < 0$.

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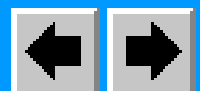
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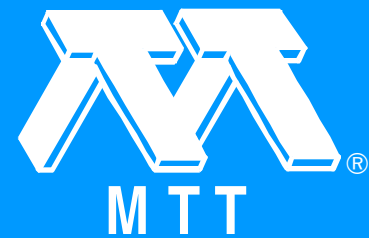
A novel microwave absorber with surface-printed conductive line patterns

M. Amano and Y. Kotsuka. "A novel microwave absorber with surface-printed conductive line patterns." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1193-1196 vol.2.

A novel microwave absorber with surface-printed conductive line patterns is proposed. The advantage of this absorber is to be able to control the matching frequency both toward a higher frequency or a lower frequency region and to offer twin-peaks characteristic using a conventional single material. The matching characteristics are investigated particularly for making a slim absorber by FDTD analysis and experiments. A slim absorber of 2 mm thickness at 2.45 GHz is presented by computer-aided design.

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Design of narrow-band tunable band-pass filters based on dual mode SrTiO/sub 3/ disc resonators

A. Deleniv, A. Eriksson and S. Gevorgian. "Design of narrow-band tunable band-pass filters based on dual mode SrTiO/sub 3/ disc resonators." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1197-1200 vol.2.

Design of four-pole band-pass tunable filters based on two dual mode STO disc resonators (0.5 mm thick, 7.0 mm in diameter) is reported. Chebishev filters without and with transmission zeroes are realized utilizing two degenerate TM/sub 110/ modes. Experimentally obtained Q-factor and resonant frequency of the disc resonators are used in filter simulations. The filters are designed for operation at 60 K with center frequency 0.5 GHz and bandwidth less than 2.0%. The tunability (fractional change in center frequency) of the filters is about 8%.

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Microwave characterization of thin film BST material using a simple measurement technique

Zhang Jin, A. Tombak, J.-P. Maria, B. Boyette, G.T. Stauff, A.I. Kingon and A. Mortazawi.

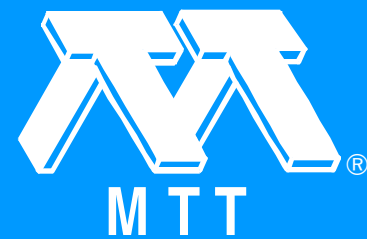
"Microwave characterization of thin film BST material using a simple measurement technique."

2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1201-1204 vol.2.

Thin film barium strontium titanate (BST) in the parallel plate capacitors is characterized at microwave frequencies using a simple measurement technique. Short standards are fabricated on the same wafer as the BST capacitors to remove the parasitics of pads, lines, discontinuities and electrodes. The dielectric constant of the patterned BST thin film in the parallel plate capacitor is found to be frequency independent up to 10 GHz. The average loss tangent of BST thin film for the sample under test is approximately 0.006 and also found to be frequency independent up to 10 GHz.

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High-Q millimeter-wave MEMS varactors: extended tuning range and discrete-position designs

L. Dussopt and G.M. Rebeiz. "High-Q millimeter-wave MEMS varactors: extended tuning range and discrete-position designs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1205-1208 vol.2.

This paper presents the design, fabrication and measurement of two high-Q micro-electro-mechanical (MEMS) varactors suitable for 20-60 GHz applications. The varactors are composed of a movable bridge placed in a shunt configuration on a coplanar waveguide line. The first design is an extended tuning range varactor showing a capacitance ratio of 1.46. The second design demonstrates a discrete-position varactor with a capacitance ratio of 1.90. Both designs result in a tuning voltage of 18-25 V and an excellent quality factor of 95-100 at 34 GHz ($C=80$ fF). The very high resonant frequency of the varactors makes them suitable for applications at microwave and millimeter-wave frequencies.

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Silicon micromachined RF MEMS resonators

K.M. Strohm, F.J. Schmuckle, B. Schauwecker, J.-F. Luy and W. Heinrich. "Silicon micromachined RF MEMS resonators." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1209-1212 vol.2.

A new resonator concept based on a three dimensional (3D) high resistivity silicon substrate filled cavity resonators is investigated. Fabrication is done using micromachining technologies. Two types of resonators are investigated, an "open-end" patch resonator and a "short circuit via" resonator. Both types show good agreement in simulated and measured resonance frequencies (within 2%). However, measured quality factors (50-70) are still lower than the simulated values and theoretical expectations.

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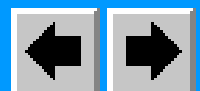
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Gas damping model for a RF MEM switch and its dynamic characteristics

T. Veijola, T. Tinttunen, H. Nieminen, V. Ermolov and T. Ryhanen. "Gas damping model for a RF MEM switch and its dynamic characteristics." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1213-1216 vol.2.

A compact model for a capacitive RF MEM switch with damping is presented. The damping model is based on analytic expressions for flow resistances due to the rarefied air flow in the gap and in the perforation holes. The complete switch model is constructed of elements resulting from the discretization of the beam deflection equation and has been implemented as a nonlinear electrical equivalent circuit. The model reproduces the beam displacement accurately. Comparison with measured transient on/off capacitance characteristics shows very good agreement.

[Click on title for a complete paper.](#)



Digital-type RF MEMS switched capacitors

J.B. Rizk and G.M. Rebeiz. "Digital-type RF MEMS switched capacitors." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1217-1220 vol.2.

This paper presents digital-type RF MEMS switched capacitors built in a coplanar waveguide (CPW) configuration. In this design, a MEMS shunt bridge is fabricated over an MIM capacitor. When the bridge is in the upstate position, the CPW line is loaded mainly by the up-state MEMS bridge capacitance. When the MEMS bridge is pulled down, the line is loaded by the MIM capacitor. As a result we obtain a digital-type switched capacitor suitable for 0.5-6 GHz operation. Switched capacitors of different values (300 fF, 600 fF, 750 fF, 1.5 pF, 2.25 pF) were fabricated and resulted in high-Q (>100) designs at 1 GHz. Also a 2-bit capacitor array was demonstrated. The values of Q are limited by metal-to-metal contact resistance (0.8 Ω /spl Ω) and the calibration accuracy of the method used.

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Series switch compatible with CMOS technology

Yongming Cai and P.B. Katehi. "Series switch compatible with CMOS technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1221-1224 vol.2.

Series MEMS switches with metal-to-metal contact have been fabricated to operate from DC to 40 GHz. Parylene is used as the structure material and polyamide as the sacrificial layer. The mechanical structure is of bridge type. The measured insertion loss is less than 0.5 dB from DC to 40 GHz, when switch is on. The isolation ranges from 40 dB at 2 GHz to 15 dB at 40 GHz, when the switch is off. A new way of planarizing the circuit surface was presented.

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Low-cost low actuation voltage copper RF MEMS switches

D. Balaraman, S.K. Bhattacharya, F. Ayazi and J. Papapolymerou. "Low-cost low actuation voltage copper RF MEMS switches." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1225-1228 vol.2.

This paper presents the design, fabrication and testing of capacitive copper RF MEMS switches with various hinge geometries, fabricated on high-resistivity silicon substrates. The switches were fabricated using a simple low-cost four-mask process and 0.6-1.0 μm thick membranes were made out of sputtered copper. The capacitive airgap in between the membrane and the signal line is 1.5-2.0 μm . The lowest actuation voltage measured on the fabricated switches is 9 V. The measured insertion loss of a fabricated switch and its associated transmission time was 0.9 dB (mainly contributed by the transmission line itself) and the isolation was measured to be 25 dB at 40 GHz.



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Atomic layer deposition (ALD) technology for reliable RF MEMS

N. Hoivik, J.W. Elam, S.M. George, K.C. Gupta, V.M. Bright and Y.C. Lee. "Atomic layer deposition (ALD) technology for reliable RF MEMS." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1229-1232 vol.2.

A nano-layer inorganic coating technology has been developed to protect RF MEMS from electrical shorting as well as long-term reliability failures due to charging or moisture. The combination of alumina dielectric and zinc-oxide conducting layers can be constructed one atomic layer at a time. At 177/spl deg/C, the released RF MEMS devices can be coated on a wafer or as a single device with conformal, inorganic coverage where the thickness and electrical conductivity can be controlled to meet desired values. With additional chemical treatment, the surface could be made hydrophobic to avoid moisture-induced stiction. The long-term reliability problem is the main barrier that impedes the growth of RF MEMS applications. This novel atomic layer deposition (ALD) technology can help in overcoming this limitation.

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Polyimide film based RF MEMS capacitive switches

R. Ramadoss, S. Lee, V.M. Bright, Y.C. Lee and K.C. Gupta. "Polyimide film based RF MEMS capacitive switches." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1233-1236 vol.2.

A new type of RF MEMS capacitive switch using polyimide film as the structural membrane layer has been developed. The dimensions of these switches range from a few hundred microns to a few millimeters and are convenient for integration with printed antennas. Fabrication and assembly of the polyimide film based switches are discussed. Electromechanical switch designs with actuation voltages as low as 73 V are presented. RF performance of the shunt-mounted switches on a CPW line has been demonstrated in the L-band with an insertion loss of less than 0.32 dB.

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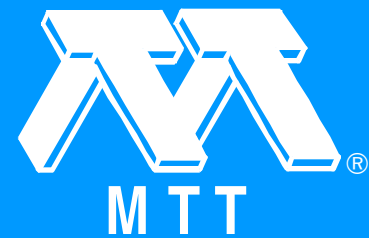
Distributed MEMS phase shifters on silicon using tapered impedance unit cells

B. Lakshminarayanan and T. Weller. "Distributed MEMS phase shifters on silicon using tapered impedance unit cells." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1237-1240 vol.2.

This paper presents results for one bit distributed coplanar waveguide (CPW) MEMS phase shifters that are designed to operate from 5-40 GHz on high resistivity silicon. The periodically loaded structures use 11 MEMS capacitors interconnected with tapered impedance transmission line. The phase shift of a one bit configuration is approximately 150/spl deg//dB at 25 GHz and 211/spl deg//dB at 35 GHz. The return loss in the up and down state is greater than 10 dB from 10-35 GHz.

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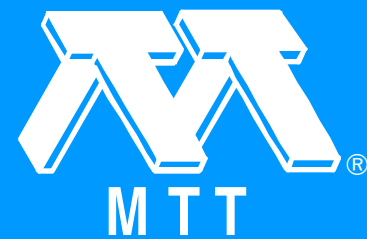
40 GHz monolithic integrated mixer in SiGe bipolar technology

S. Hackl, J. Bock, M. Wurzer and A.L. Scholtz. "40 GHz monolithic integrated mixer in SiGe bipolar technology." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1241-1244 vol.2.

Future broadband wireless services will use carrier frequencies in the range of 10 GHz to about 42 GHz. This raises the demand for low-cost components of key RF building blocks like LNAs, mixers, and oscillators for frequencies up to 42 GHz. This work describes an active mixer in a pre-production 0.4 μm SiGe bipolar technology with bandwidth in the range mentioned above. A gain of 25 dB and double-sideband noise figure of 15 dB is achieved at 40 GHz.

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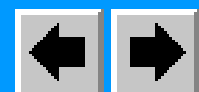
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Designing reliable high-power limiter circuits with GaAs PIN diodes

D.G. Smith, D.D. Heston, J. Heston, B. Heimer and K. Decker. "Designing reliable high-power limiter circuits with GaAs PIN diodes." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1245-1247 vol.2.

This paper presents the latest GaAs PIN diode rf reliability data. An acceleration factor predicting lifetime as a function of diode perimeter and rf power level is proposed. Power handling measurements of an improved PIN diode layout that provides superior performance for both power handling and small signal loss/bandwidth is presented. Finally the design principles for a high power limiter will be reviewed.

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A 94 GHz high performance quadruple subharmonic mixer MMIC

K. Kanaya, K. Kawakami, T. Hisaka, T. Ishikawa and S. Sakamoto. "A 94 GHz high performance quadruple subharmonic mixer MMIC." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1249-1252 vol.2.

A 94 GHz high performance quadruple subharmonic mixer (4/spl times/SHM) MMIC has been designed and fabricated for a down converter. The required LO frequency is only a quarter of RF frequency which is a half LO frequency of conventional double subharmonic mixers (2/spl times/SHM). The conversion gain and noise power were experimentally compared with that of a conventional subharmonic mixer. The quadruple subharmonic mixer showed the maximum conversion gain of -11.4 dB at an RF frequency of 94 GHz and a LO frequency of 23.5 GHz. The maximum noise power of -159 dBm/Hz was obtained at an IF frequency of 100 kHz. This noise measurement also suggests noise performance at low IF frequency depends not on the LO mixing frequency but on the 1/f noise of the Schottky barrier diode. The fabricated MMIC chip size is as small as 0.9 mm/spl times/1.4 mm. To our knowledge, these results are the best performances demonstrated from a quadruple subharmonic mixer MMIC in the W-band millimeter-wave range.

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Harmonic boosting for high performance mixers

S. Chakraborty, Ching-Lang Lin, B. Matinpour and J. Laskar. "Harmonic boosting for high performance mixers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1253-1256 vol.2.

We propose a novel harmonic boosting technique for development of high performance subharmonic mixers. This technique alleviates major problems associated with the use of 4th/ and higher order subharmonic mixers. By utilizing the odd-order harmonics of the main subharmonic LO, we demonstrate significant performance improvements while reducing the LO power. Measurements confirm a 6 dB savings in LO power level, up to 10 dB improvement in output P1dB and up to 6 dB improvement in conversion loss. Measurements also confirm that harmonic boosting does not degrade in-band LO leakage, IIP2 and dc offset levels, thus favoring its application in very-low-IF and direct conversion transceivers.

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Development of Ku-band Receiver/Downconverter for satellite transponders

Jin-Cheol Jeong, Yong Hei Lim, Byung-Jun Jang, In-Bok Yom and Seong-Pal Lee.

"Development of Ku-band Receiver/Downconverter for satellite transponders." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1257-1260 vol.2.

This paper presents the development of a Ku-band Receiver/Downconverter with the Noise figure of 1.83 dBmax and the conversion gain of 55 dB at the frequency range from 14/spl sim/14.5 GHz to 12.252/spl sim/12.752 GHz for Ku-band Satellite transponders. This Ku-band Receiver/Downconverter consists of a LNA module, a 2-pole combine image rejection filter, a Downconverter module, a 7-pole IF filter, and an IFAMP module. All components except the cavity type filters were assembled using a hybrid technology with 15 mil thin-film substrates. Its other performances show the C/IM3 of 45.67 dBcmax, group delay of 0.6 ns/36 MHz, and gain variation of 1.68 dBmax at -15/spl deg/C/spl sim/+65/spl deg/C of operating temperature range.

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The design of SiGe HBT LNA for IMT-2000 mobile application

Jeiyoun Lee, Geunho Lee, Guofu Niu, J.D. Cressler, J.H. Kim, J.C. Lee, B. Lee and N.Y. Kim.
"The design of SiGe HBT LNA for IMT-2000 mobile application." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1261-1264 vol.2.

This paper describes a SiGe HBT low noise amplifier (LNA) design for IMT-2000 mobile applications. The emitter degeneration technique for stability and the out-of-band-termination technique for improvement of IP3 (third order intercept point) are applied to SiGe HBT LNA design. This SiGe HBT LNA yields a noise figure of 1.2 dB, 16 dB gain, an input return loss of 11 dB, and an output return loss of 14.3 dB over the desired frequency range (2.11-2.17 GHz). When the RF input power is -23 dBm, the input third order intercept point (IIP3) of 8.415 dBm and the output third order intercept point (OIP3) of 24.415 dBm are achieved.



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THz radiation using high power, microfabricated, wideband TWTs

C.L. Kory, J.H. Booske, W.-J. Lee, S. Gallagher, D.W. van der Weide, S. Limbach and S. Bhattacharjee. "THz radiation using high power, microfabricated, wideband TWTs." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1265-1268 vol.2.

Microfabricated, miniature, folded waveguide traveling wave tube (FWG-TWT) devices are potential compact sources of wideband (10-20% instantaneous bandwidth), high power (0.01-1 W) THz radiation. We present theoretical analyses and numerical simulations indicating that a 560 GHz, 56 mW, 1% (intrinsic) efficiency oscillator is realistically achievable, and amplifiers with gains between 10 and 30 dB are feasible with circuit lengths of a few centimeters. We also discuss a scale-model experiment at 50 GHz to investigate an oscillator concept using a recirculated power feedback approach, and a 400 GHz proof-of-concept amplifier.

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Simulation and measurement results of 150 GHz integrated silicon IMPATT diodes

M. Luschas, R. Judaschke and J.-F. Luy. "Simulation and measurement results of 150 GHz integrated silicon IMPATT diodes." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1269-1272 vol.2.

The integration of IMPATT diodes and their housing in a single technology process is discussed in this paper. The integrated device is designed to improve reliability and reproducibility compared to conventional beam-lead diodes with quartz ring housing. In a single step, the diode with its housing is bonded onto a diamond heat sink. The device can be employed both in a waveguide resonator and in a planar oscillator circuit. Results presented here are obtained in a rectangular, reduced height waveguide resonator. RF-output power levels of more than 100 mW at 135 GHz and 45 mW at 150 GHz are reported.

A set of integrated circuits for 60 GHz radio front-end

M. Karkkainen, M. Varonen, J. Riska, P. Kangaslahti and V. Porra. "A set of integrated circuits for 60 GHz radio front-end." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1273-1276 vol.2.

This paper describes results obtained within the MMIC research activity at the Helsinki University of Technology (HUT). These MMICs were developed for a 60 GHz broadband radio front-end. A set of circuits is reported including power, low noise amplifiers, mixers and signal generation circuits. They have been fabricated with a commercially available 0.15 μm GaAs pseudomorphic HEMT technology. Finally, the performance of the circuits was measured at 60 GHz frequency: The power amplifier has 14 dBm output compression point and 15.5 dB small signal gain. The low noise amplifier exhibits 24 dB of gain with 3.5 dB noise figure and the up-conversion mixer circuit has 12.7 dB of conversion loss.



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Millimeter wave direct quadrature converter integrated with antenna for broad-band wireless communications

Ji-Yong Park, Seong-Sik Jeon, Yuanxun Wang and T. Itoh. "Millimeter wave direct quadrature converter integrated with antenna for broad-band wireless communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1277-1280 vol.2.

A compact quadrature modulator/demodulator integrated with a 40 GHz patch antenna for millimeter wave wireless applications is proposed. Anti-parallel diode sub-harmonic mixers are constructed for broad-band direct quadrature conversion. Overall phase and amplitude imbalance between the mixer I and Q output channels are less than 1.2/spl deg/ and 1 dB respectively. An average conversion loss of mixers of -14.6 dB is achieved in the frequency range from 39.75 GHz to 40.25 GHz. A communication link is built based on a pair of the proposed front-ends. Data transmission at up to 1 Gb/s data rate for QPSK modulation is successfully demonstrated.

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A novel HMSM photodetector with resonant cavity for short haul communications

Xiyang Chen, B. Nabet, F. Quaranta, A. Cola and M. Currie. "A novel HMSM photodetector with resonant cavity for short haul communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1281-1284 vol.2.

A novel RCE (resonant-cavity-enhanced) HMSM (Heterostructure Metal-Semiconductor-Metal) photodetector with Al/sub 0.24/Ga/sub 0.76/As/Al/sub 0.9/Ga/sub 0.1/As distributed Bragg reflector is presented. The photocurrent spectrum shows a clear peak at 850 nm wavelength with full width at half maximum (FWHM) of around 30 nm. The top reflector is a delta modulation doped Al/sub 0.24/Ga/sub 0.76/As that also acts as the barrier enhancement layer thus providing very low dark current values. I-V curve shows that there is a five-fold decrease in dark current, with bias less than 10 V and a factor of two increase in photocurrent as a result of delta doping. Time response measurements gives a 3 dB bandwidth of about 33 GHz. Combination of low dark current, fast response, wavelength selectivity, and compatibility with high electron mobility transistors makes this device especially suitable for short haul communications purposes.



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Effect of substrate modes in 40 Gbit travelling wave LiNbO/sub 3/ modulators

K. Goverdhanam. "Effect of substrate modes in 40 Gbit travelling wave LiNbO/sub 3/ modulators." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1285-1288 vol.2.

In this paper, substrate modes which influence the bandwidth of travelling wave LiNbO/sub 3/ Mach-Zehnder modulators are reviewed. Criteria for the appropriate choice of RF electrode geometry to minimize losses have been presented. Finally, the effect of backside metalization due to metallic packages has been discussed, along with suitable modifications to mitigate the losses due to the presence of the backside ground.

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Experimental results for a CW-mode optically controlled microwave switch with a carrier-confinement structure

Sangil Lee, Y. Kuga and R.A. Mullen. "Experimental results for a CW-mode optically controlled microwave switch with a carrier-confinement structure." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1289-1292 vol.2.

A new design for a CW-mode optically controlled microwave switch (CW-mode OMS) on a semiconductor coplanar waveguide (CPW) is investigated, which is based on a silicon (Si) substrate etching for both top and bottom to confine the optically generated free-carriers. We fabricate the CW-mode OMS with and without carrier-confinement structures using a micro-fabrication technique, and the insertion loss is measured and compared. With the new carrier-confined CW-mode OMS, we are able to obtain less than 2 dB of insertion loss which is an improvement of more than 5 dB from without the carrier-confinement structure. Also, more than 20 dB of the ON/OFF difference is obtained up to 20 GHz.

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Direct carrier modulation for wireless digital communications using an improved microwave-photonic vector modulator (MPVM) approach

S. Chandramouli, W.D. Jimison and E. Funk. "Direct carrier modulation for wireless digital communications using an improved microwave-photonc vector modulator (MPVM) approach." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1293-1296 vol.2.

This paper presents a demonstration of direct carrier modulation via the use of an improved microwave/photonic vector modulator (MPVM). This modulation approach is suitable for direct digital modulation of microwave and millimeter-wave signals and allows for tuning of the carrier frequency over wide bandwidths and dynamic reconfiguration of the modulation format. An all-optical control approach is used to achieve faster data rates and better carrier tunability than previously reported work in this area. Specifically, experimental results showing direct QPSK and 16 QAM modulation of carrier frequencies between 1.0 and 2.0 GHz with data rates to 8 Mbs are presented.

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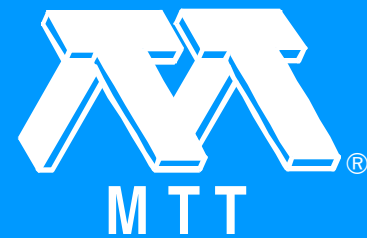


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A novel dual frequency rectenna for high efficiency wireless power transmission at 2.45 and 5.8 GHz

Young-Ho Suh and Kai Chang. "A novel dual frequency rectenna for high efficiency wireless power transmission at 2.45 and 5.8 GHz." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1297-1300 vol.2.

A dual frequency printed dipole rectenna has been developed at 2.45 and 5.8 GHz: (ISM bands) for the wireless power transmission. For operating at dual band, a new dual frequency uniplanar printed dipole antenna and a novel coplanar stripline (CPS) filter are developed. A device nonlinear analysis is used to select the diode with low junction capacitance to reduce the effect of frequency dependence. The measured conversion efficiencies achieved at free space are 84.4 and 82.7% at 2.45 and 5.8 GHz, respectively. The measured results agree very well with the theoretical analysis.



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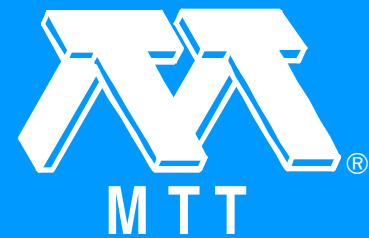
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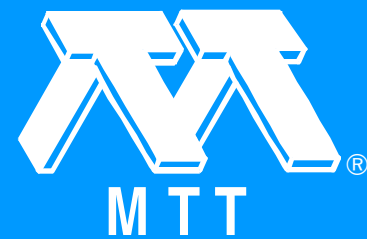
Optimization of the array parameters in waveguide-based spatial power combiners with hard horn feeds

M. Ozkar and A. Mortazawi. "Optimization of the array parameters in waveguide-based spatial power combiners with hard horn feeds." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1301-1304 vol.2.

A generalized scattering matrix (GSM) approach, which utilizes finite difference time domain (FDTD) and mode matching (MM) techniques, is used to analyze waveguide based spatial power combiners with hard horn feeds. The simulation results are experimentally verified for a complete spatial power dividing/combining system with a 3/spl times/3 patch antenna array and a hard horn. Different array parameters are varied in order to optimize a 3/spl times/3 spatial power combining array.

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Radio-wave beam shaping using holograms

J. Meltaus, J. Salo, E. Noponen, M.M. Salomaa, V. Viikari, A. Lonnqvist, T. Koskinen, J. Saily, J. Hakli, J. Ala-Laurinaho, J. Mallat and A.V. Raisanen. "Radio-wave beam shaping using holograms." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1305-1308 vol.2.

Millimetre-wave radio fields are shaped using both amplitude- and phase-type computer-generated holograms (diffractive elements). Methods for hologram element synthesis are described. Holograms that produce plane waves, radio-wave vortices, and Bessel beams at 310 GHz are fabricated and tested.

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How to increase locking range of coupled oscillator cells without lowering Q

Jinjin Shen and L.W. Pearson. "How to increase locking range of coupled oscillator cells without lowering Q." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1309-1312 vol.2.

The locking-range and phase error caused by the random free-running frequency distribution in coupled oscillator phased arrays are studied. A design method based on coupling optimization is proposed to improve the oscillator locking-range and thereby reduce the phase error. A qualitative analysis and experimental results are presented to demonstrate the viability of this method for improving the fabrication tolerance of coupled oscillator phased arrays.

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Subjects

Bandwidth improvement in a tile based spatial power amplifier

A. Al-Zayed, S. Ortiz and A. Mortazawi. "Bandwidth improvement in a tile based spatial power amplifier." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1313-1316 vol.2.

In this paper, an enhanced bandwidth tile-based spatial power-combining array structure based on a perpendicularly-fed antenna is given. This structure has the advantage of a minimal interaction between the radiated fields and the active devices. Additionally, increased stability is provided, while delivering a robust and reliable design. Dielectrically filled miniature horn arrays were employed for both the receiving and transmitting radiating elements of this 5/spl times/5 amplifier array. A peak gain of 15.8 dB at 9.9 GHz and a 3 dB bandwidth of 13% were measured. Gain, bandwidth and power measurements are consistent with simulation predictions.

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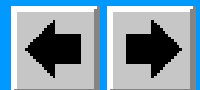
[Subjects](#)

A 10 GHz integrated class-E oscillating annular ring element for high-efficiency transmitting arrays

J.A. Hagerty and Z. Popovic. "A 10 GHz integrated class-E oscillating annular ring element for high-efficiency transmitting arrays." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1317-1320 vol.2.

An X-band oscillating element can be achieved in compact form with class-E operation and high directivity. An annular ring is used both as the radiating element and microstrip feedback circuit for the class-E amplifier. A maximum conversion efficiency of the DC power consumption to radiated copolarized power is 55% at 10 GHz with maximum effective radiated power of 23.6 dBm and total radiated power of 15.5 dBm. This active antenna element is shown to be a good candidate for high aperture efficiency spatial power combining.

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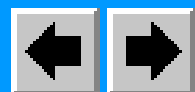
Subjects

A new millimeter-wave printed dipole phased array antenna using microstrip-fed coplanar stripline tee junctions

Young-Ho Suh and Kai Chang. "A new millimeter-wave printed dipole phased array antenna using microstrip-fed coplanar stripline tee junctions." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1321-1324 vol.2.

A new millimeter-wave printed twin dipole phased array antenna is developed at Ka-band using a microstrip-fed CPS tee junction. To accomplish a progressive phase shift, a tunable phase shifter controlled by piezoelectric transducer (PET) is used. Measured return loss of better than 15 dB is achieved from 30 to 31.5 GHz for a 1/spl times/8 array. The phased array antenna has a measured antenna gain of 14.4 dBi with 42/spl deg/ beam steering and more than 11 dB side lobe suppression across the scan.

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A novel broadband T/R module for phased array applications in wireless communications

Chunlei Wang, C.T. Rodenbeck, M.R. Coutant and Kai Chang. "A novel broadband T/R module for phased array applications in wireless communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1325-1328 vol.2.

A novel broadband T/R module with four channels used in a multi-frequency phased array transceiver for mobile satellite communications is presented in this paper. The T/R module is comprised of two receive channels at 12 and 21 GHz and two transmit channels at 10 and 19 GHz. Measured results indicate that the T/R module has excellent channel isolation of over 60 dB for the two low frequency channels and over 32 dB for the two high frequency channels, small gain and phase variations among the channels, good noise figures and 1 dB compression point output power. The module can be utilized as a building block for a multi-frequency phased array transceiver. A 4-element phased sub-array using 4 T/R modules has been demonstrated and shows that the T/R module works well.

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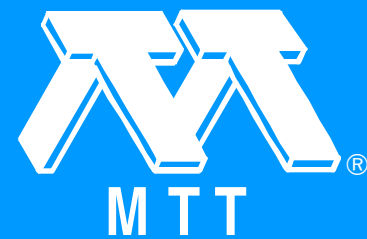


Abstracts

Multi-layer spatial angular filter with air gap tuner to suppress the grating lobes of microstrip patch arrays

Youngju Lee, Sung Hun Jeong, Wee Sang Park, Jae Seung Yun and Soon Ik Jeon. "Multi-layer spatial angular filter with air gap tuner to suppress the grating lobes of microstrip patch arrays." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1329-1332 vol.2.

In this paper, we propose a multi-layer spatial angular filter containing periodically high and low permittivity dielectric layers and air gap tuners to suppress the grating lobes of microstrip patch antennas. When the filter is applied to a 16/spl times/16 phased array with many grating lobes due to the 2.8 /spl lambda/ spacing between adjacent phase shifters, we show that the grating lobes, which induce interference among satellites, are completely eliminated outside the /spl plusmn/30/spl deg/ range.



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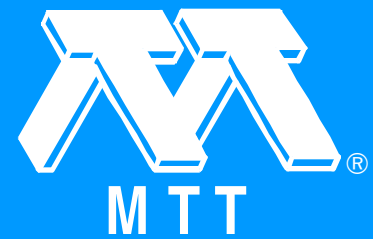
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Integrated MEM antenna system for wireless communications

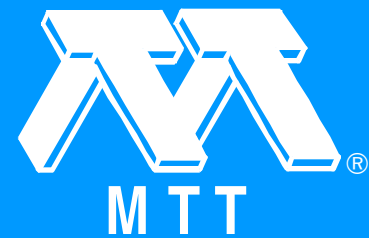
B.A. Cetiner, L. Jofre, C.H. Chang, J.Y. Qian, M. Bachman, G.P. Li and F. De Flaviis.

"Integrated MEM antenna system for wireless communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1333-1336 vol.2.

This paper presents the results on the fabrication and testing of a compact broadband antenna integrated with RF MEMS switches for wireless communications. The system consists of two individual broadband CPW fed antennas (having 50% bandwidth) sequentially addressed using low-loss RF-MEMS switches. The antennas, as well as, the RF-MEMS switches are fabricated on a glass substrate using surface micromachining batch processing method. The design and fabrication process of the system are outlined. The results showing the circuit and radiation characteristics are discussed in terms of radiation pattern reconfigurability and spatial and angular diversity capabilities.

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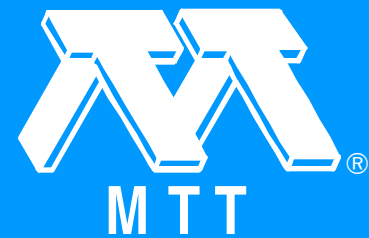
The design of T/R module for X-band APAA system used in satellite communications

Young-Bae Jung, Soon-Young Eom, Soon-Ik Jeon, Jae-Ick Choi and Han-Kyu Park. "The design of T/R module for X-band APAA system used in satellite communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1337-1340 vol.2.

This paper is concerned with the design of the X-band T/R module that is a key unit of the active phased array antenna (APAA) system for mobile satellite communications. In this module, the TX-part is primarily composed of 3-stage power amplifier having 4-watt output power, microstrip 4-bit phase shifter (MICPS) controlling 16 phase state and thermal compensation and power detection circuit. And, the RX-part composed of LNA using hetero junction FETs, MICPS and microstrip hairpin type BPF for TX power rejection. From the standpoint of mechanic design, focus is given to the T/RX isolation that is very important to prevent LNA saturation by TX leakage power. The T/R module achieved 35.6 dBm minimum P/sub 1/ dBc with 22 dB linear gain in TX-part, and 26.5 dB linear gain with 1.0 dB noise figure in RX-part.

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Experimental APAA for satellite communications

Soon Ik Jeon, Jae Ick Choi, Young Kyun Choi and Seung Hyeub Oh. "Experimental APAA for satellite communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1341-1343 vol.2.

In this paper, an APAA (Active Phased Array Antenna) for X-band satellite communications is introduced. The APAA can electronically steer its beam with wide range, ± 37 degrees. The system was designed experimentally before practical model design. It will be installed on the ship finally. To confirm its functional performance, it was tested on the motion simulator with the satellite RF simulator. The motion simulator can operate with the wide range 3D movement. The APAA has its M&C (monitoring and control) functions, which show the beam directions as well as the other status during its operating.

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A novel K-band frequency-controlled beam-steering quasi-Yagi array with mixing frequency compensation

T. Nishio, Yuanxun Wang, Yongxi Qian and T. Itoh. "A novel K-band frequency-controlled beam-steering quasi-Yagi array with mixing frequency compensation." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1345-1348 vol.2.

A new type of compact K-band frequency-controlled beam-steering array utilizing fixed progressive delay lines in combination with passive double-balanced MMIC mixers integrated with quasi-Yagi antenna elements is presented. The beam steering is carried out by simply changing the frequency of the LO and IF signals at the same time such that the radiation frequency keeps constant. The K-band (20 GHz) four-element array fabricated on the Alumina substrate demonstrates 40 degree scanning with an LO frequency change from 22 to 26.2 GHz by the short delay lines installed in the LO line and ensures broadband data transmission with well-defined radiation patterns.

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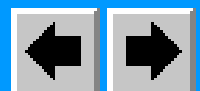
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A frequency autonomous retrodirective array transponder

K.M.K.H. Leong, R.Y. Miyamoto, Seong-Sik Jeon, Yuanxun Wang and T. Itoh. "A frequency autonomous retrodirective array transponder." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1349-1352 vol.2.

Retrodirective arrays are able to radiate a signal in response to a signal transmitted by an interrogator back toward the transmitter position with no a priori knowledge of the arrival direction. We present a novel architecture that enables the retrodirective array to respond to an interrogator at the same transmitted frequency with no previous knowledge of the transmission frequency. The frequency agile prototype array shows excellent retrodirectivity at various frequencies.

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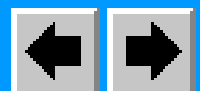
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Effects of local oscillator phase noise on interference rejection capability of CDMA receivers using adaptive antenna arrays

G.W. Slade. "Effects of local oscillator phase noise on interference rejection capability of CDMA receivers using adaptive antenna arrays." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1353-1356 vol.2.

It has been determined that the receiver local oscillator noise (or sampling timing jitter) sets a fundamental limit on the ability of the adaptive antenna array to reject strong inband interferers. This work briefly describes the theoretical background of the problem and provides some bounds on interference rejection as a function of local oscillator phase noise power in adaptive antenna arrays. With the insight gained from the theoretical exploration, an example numerical simulation of the problem is presented where a null is steered in the direction of the interferer and the resulting degradation in the desired signal is presented as a result of the "smearing" of the array null because of the noisy local oscillator.

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A balanced adaptive beamforming system for broadband wireless communications

Seong-Sik Jeon, Yuanxun Wang and T. Itoh. "A balanced adaptive beamforming system for broadband wireless communications." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1357-1360 vol.2.

A broadband analog beamformer is realized in the form of balanced variable attenuators using PIN diodes. The phase deviation due to change in junction capacitance of a PIN diode with respect to applied voltage is improved by using a balanced architecture in the design of the variable attenuator. Measurement shows flat phase transition and linear attenuation over the frequency range from 2.5 GHz to 3.0 GHz, which can provide giga bit data throughput for QPSK modulated signal.

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Impulse ground penetrating radar for nondestructive evaluation of pavements

Jeong Soo Lee, C. Nguyen and T. Scullion. "Impulse ground penetrating radar for nondestructive evaluation of pavements." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1361-1363 vol.2.

A novel impulse ground penetrating radar (GPR) has been developed and demonstrated for nondestructive evaluation of pavements. The GPR is completely fabricated using MICs. It has been used to measure the relative dielectric constants and thickness of various samples. Good agreement between the theoretical and measured results was achieved.

Click on title for a complete paper.



Reentrant resonators for microwave measurement units

V.B. Romodin and L.V. Shebalkova. "Reentrant resonators for microwave measurement units." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1365-1368 vol.2.

The method of the calculation of the reentrant resonator based on the rectangular waveguide with inductive diaphragms or posts is demonstrated. The possibility of applying such resonators as sensors for the uninterrupted technological processes is discussed in this paper. The sensors were designed and measured for two operating frequencies in L-band and X-band. The sensitivity of the sensors is sufficient to indicate the changing of the dielectric permeability and testing specimen diameter.

An adaptive multi-functional array for wireless sensor systems

R.Y. Miyamoto, K.M.K.H. Leong, Seong-Sik Jeon, Yuanxun Wang and T. Itoh. "An adaptive multi-functional array for wireless sensor systems." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1369-1372 vol.2.

Smart antenna and retrodirective array technologies are combined to establish a reconfigurable phased array communication system. The array serves as a retrodirective transponder with a LO frequency at 11.6 GHz. By changing the LO frequency to 2.9 GHz, the array can be reconfigured to a smart antenna enabling multi-user communications. The retrodirective transponder provides 20 dB circuit gain and 20 dB RF-IF Isolation exhibiting excellent retrodirectivity. When operating as a smart antenna, the receiver array successfully demodulates a QPSK modulated signal with circuit gain of 7 dB and E_b/N_0 for $BER=10^{-4}$ is approximately 12 dB without any error correction. In the retrodirective array mode, the system provides 20 dB.

Compact multibeam imaging antenna for automotive radars

B. Schoenlinner and G.M. Rebeiz. "Compact multibeam imaging antenna for automotive radars." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1373-1376 vol.2.

A compact multi-beam 77 GHz antenna has been developed for automotive applications. The antenna consists of a hemispherical Teflon lens with backside metallization, which is fed by endfire tapered slot antennas (TSAs) on a 127 μ m-thick Duroid/sup TM/ substrate. The TSAs are arranged in a circular arc covering 40/spl deg/ around the hemispherical lens. The measured patterns result in E and H-plane patterns with a 3 dB beamwidth of 5.5/spl deg/, a sidelobe level of -18 to -20 dB and a cross-polarization level of -19 dB. The calculated efficiency of this antenna system is 54%. The off-axis antenna patterns are identical to the broadside patterns due to the symmetrical structure of the antenna. The antenna can provide coverage using a circular feed array around the hemispherical Teflon lens.



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A new approach for RIN peak and phase noise suppression in microchip lasers

M. Csornyei, T. Berceli, T. Banky, T. Marozsak and P.R. Herczfeld. "A new approach for RIN peak and phase noise suppression in microchip lasers." 2002 MTT-S International Microwave Symposium Digest 02.2 (2002 Vol. II [MWSYM]): 1377-1380 vol.2.

This paper is concerned with the suppression of the relative intensity noise (RIN) peak and phase noise of a diode pumped Neodymium-doped Lithium Niobate (Nd:LiNbO/sub 3/) microchip laser. Relaxation oscillations result in about 15-20 dB noise peak above the flat noise at 350 kHz offset frequency. In case of high quality requirements this noise peak is significantly disturbing. In this paper a new approach is presented for the suppression of the RIN peak and phase noise in microchip lasers.

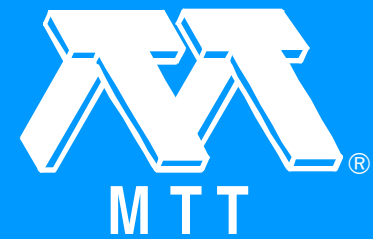
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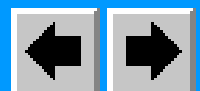
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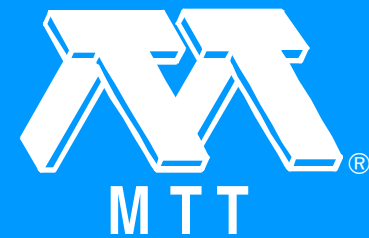
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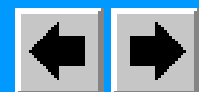
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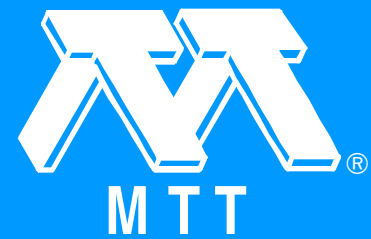
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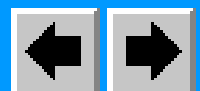
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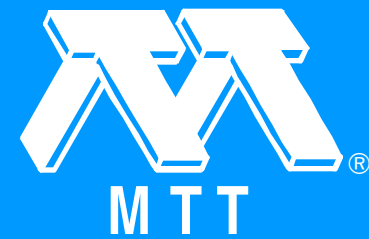
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Technical Program Schedule (2002 Vol. III [MWSYM])

"Technical Program Schedule (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): vi-xxii.



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Suppression of multi-path couplings in MCM with a flip-chipped SiGe-MMIC

T. Nishino, K. Maeda, M. Shimozawa, T. Ikushima, K. Sadahiro, T. Katsura, N. Suematsu, K. Itoh, H. Oohashi, T. Takagi and O. Ishida. "Suppression of multi-path couplings in MCM with a flip-chipped SiGe-MMIC." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1385-1388 vol.3.

Techniques to obtain a high isolation property in a multi-chip module (MCM) between pads of a SiGe-MMIC flip-chipped on a low temperature co-fired ceramic (LTCC) are discussed. In such an MCM, there are two coupling paths. One is a path through the LTCC and the other is a path through the MMIC. To improve the total isolation property, structures to reduce the two coupling paths are required because the paths of such leakage are not in series but in parallel. We examined the disposition of several kinds of ground patterns on the LTCC. Also, we devised a metal plate on a bias circuit as a shielding structure on the SiGe-MMIC. The effectiveness of the isolating structures was verified by measuring IIP2 in a receiver MCM with a direct conversion SiGe-MMIC. The IIP2 property has been improved successfully as well as the isolation property.

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Flip-chip mounted, Ku band power amplifier compliant with space applications

O. Vendier, J.-P. Fraysse, C. Schaffauser, M. Paillard, C. Drevon, J.-L. Cazaux, D. Floriot, N. Caillas-Devignes, H. Blanck, P. Auxemery, W. de Ceuninck, R. Petersen, N. Haese and P.-A. Rolland. "Flip-chip mounted, Ku band power amplifier compliant with space applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1389-1392 vol.3.

Following the trends of today's increased power density into power components arena, latest developments on advanced thermal management at component level are presented. Power flip chip technology was applied to commercial HB20P heterostructure bipolar transistor technology from UMS. Results of flip-chip mounted high power amplifier on Aluminum Nitride, packaged in a space compatible micro-package are discussed.

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W-band flip-chip interconnects on thin-film substrate

F.J. Schmuckle, A. Jentzsch, H. Oppermann, K. Riepe and W. Heinrich. "W-band flip-chip interconnects on thin-film substrate." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1393-1396 vol.3.

A flip-chip approach is presented using a thin-film microstrip line (TFMSL) on silicon as the carrier substrate. Thin-film technology allows one to employ cheap low-resistivity Si wafers without degrading MM-wave performance. By means of 3D EM simulation, an optimized interconnect is designed for the 77 GHz band. Measurements of test structures up to 100 GHz demonstrate the potential of this approach.

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A locally matching technique for broadband flip-chip transition design

Chun-Long Wang and Ruey-Beei Wu. "A locally matching technique for broadband flip-chip transition design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1397-1400 vol.3.

A locally matching technique is proposed in this paper to improve the wideband performance of a flip-chip transition. The gap width of the CPW line in the flip-chip bump pad region is enlarged for achieving larger inductance to compensate for the capacitance at the transition, making the approximate impedance close to $50 \text{ } \Omega$. An equivalent circuit is derived from the frequency response of the transition simulated by Sonnet and is used to control the resonance frequency of the structure. With a properly chosen value of the enlarged width, the resonant dip can be controlled to improve return loss over a band from DC to 60 GHz. Measurement data of the scaled structure is in good agreement with the simulation results, which validates the proposed design idea.

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Development of an organic wafer-level packaging platform for highly integrated RF transceivers

R. Ramachandran and A. Pham. "Development of an organic wafer-level packaging platform for highly integrated RF transceivers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1401-1404 vol.3.

We present the development of a novel organic-micromachined packaging scheme at the wafer level for highly integrated RF transceivers. This process enables the integration of on-chip passive devices and isolation structures at the wafer level. We demonstrate the development of inductors that achieve a Q-factor of about 61 at 1.7 GHz and on-chip isolation structures that provide an isolation of more than 50 dB in the GHz range.

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Design of inductors in organic substrates for 1-3 GHz wireless applications

S. Dalmia, F. Ayazi, M. Swaminathan, Sung Hwan Min, Seock Hee Lee, Woopoung Kim, Dongsu Kim, S. Bhattacharya, V. Sundaram, G. White and R. Tummala. "Design of inductors in organic substrates for 1-3 GHz wireless applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1405-1408 vol.3.

High Q inductors with maximum quality factors in the range of 180-60 have been obtained at frequencies in the 1-3 GHz band for inductances in the range of 1 nH to 20 nH using a low-temperature organic laminate build-up process. This is the first time such high Q inductors have been demonstrated in this technology. The different inductor designs, optimization schemes, and trade-offs between different topologies, have been discussed in this paper.

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Integrated inductors in the chip-to-board interconnect layer fabricated using solderless electroplating bonding

Yeun-Ho Joung, S. Nuttinck, Sang-Woong Yoon, M.G. Allen and J. Laskar. "Integrated inductors in the chip-to-board interconnect layer fabricated using solderless electroplating bonding." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1409-1412 vol.3.

Integrated inductors are typically formed either on-chip or embedded in the chip package or board. In this work, we explore the possibility of forming inductors in the chip-to-board interconnect layer. The solderless technique of electroplating bonding is used to simultaneously form inductor structures as well as chip-to-board interconnect. The use of the gap between the chip and substrate for inductors not only increases integration density, but also allows large magnetic cross-sectional areas to be achieved. To demonstrate the technology, 3- and 7-turn inductors 500 μm in height were fabricated. These inductors showed inductance values of 3.45 nH and 10.5 nH, respectively. The measured Q-factors of the 3- and 7-turn inductors were 70 and 55 respectively, which agreed very well with modeling results.

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Intrinsic noise characteristics of AlGa_N/Ga_N HEMTs

Sungjae Lee, V. Tilak, K.J. Webb and L.F. Eastman. "Intrinsic noise characteristics of AlGa_N/Ga_N HEMTs." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1415-1418 vol.3.

Intrinsic noise sources and their correlation in AlGa_N/Ga_N HEMTs are extracted and studied. Using three noise parameters obtained from microwave noise measurements and S-parameter data, two intrinsic noise sources and their correlation are specified by applying a noise deembedding technique, and their dependence on frequency and bias point is investigated.

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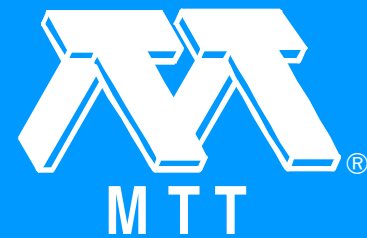


Abstracts

A 2.4-GHz/5-GHz CMOS low noise amplifier with high-resistivity ELTRAN(R) SOI-Epi/sup TM/ wafers

J. Kodate, M. Ugajin, T. Tsukahara, T. Douseki, N. Sato, T. Okabe, K. Ohmi and T. Yonehara. "A 2.4-GHz/5-GHz CMOS low noise amplifier with high-resistivity ELTRAN(R) SOI-Epi/sup TM/ wafers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1419-1422 vol.3.

The performance of radio frequency integrated circuits (RFICs) in silicon-on-insulator (SOI) technology can be improved by using a high-resistivity SOI substrate. We investigated the correlation between substrate resistivity and the performance of a low noise amplifier (LNA) on ELTRAN SOI-Epi wafers, whose resistivity can be controlled precisely. The use of high-resistivity ELTRAN wafers improves the Q-factor of spiral inductors, and increases the gain and narrows the bandwidth of the LNA.



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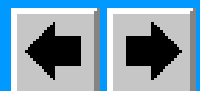
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A modified cascode type low noise amplifier using dual common source transistors

Sungmin Ock, Kichon Han, Jong-Ryul Lee and Bumman Kim. "A modified cascode type low noise amplifier using dual common source transistors." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1423-1426 vol.3.

A Low Noise Amplifier (LNA) based on a GaAs MESFET has been implemented with a modified cascode configuration using two common source transistors to achieve high gain and linearity, low noise figure and low power consumption. The circuit design concept is introduced and implemented. The measured performance of the LNA at 900 MHz includes a gain of 17 dB, noise figure of 1.6 dB, and IIP3 of 8.5 dBm using a supply of 4.7 mA and 2.7 V.



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Ku-band low noise MMIC amplifier with bias circuit for compensation of temperature dependence and process variation

K. Yamanaka, K. Yamauchi, K. Mori, Y. Ikeda, H. Ikematsu, N. Tanahashi and T. Takagi. "Ku-band low noise MMIC amplifier with bias circuit for compensation of temperature dependence and process variation." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1427-1430 vol.3.

In this paper, a Ku-band low-noise MMIC amplifier is presented, which is equipped with a bias circuit that compensates not only temperature dependence of the FETs' gain but also gain variation between chips due to process variations. The Ku-band low noise MMIC amplifier with proposed gate-bias circuit was designed and manufactured. It was proved that the proposed bias circuit reduced the temperature dependence of the two-stage MMIC amplifier's gain from 1.4 dB/100 K to 1.0 dB/100 K. The chip area consumed for the bias circuit is less than 10% of the total chip size of 1.17 mm². The gain variation between chips was reduced to 0.25 dB in RMS. This amplifier is suitable for active phased array applications.

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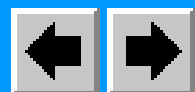
Subjects

A 7.9-9.7 GHz on-chip radar receiver front-end for future adaptive X-band smart skin array antennas

R. Malmqvist, M. Alfredsson, A. Gustafsson and A. Ouacha. "A 7.9-9.7 GHz on-chip radar receiver front-end for future adaptive X-band smart skin array antennas." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1431-1434 vol.3.

In this paper, we present a 7.9-9.7 GHz on-chip radar receiver front-end intended for a digital beamforming X-band smart skin phased array antenna. This agile single-chip receiver front-end could potentially enable a significant size and cost reduction of the microwave receiver modules in such an adaptive frequency hopping radar system. Measured results show a close to adequate performance.

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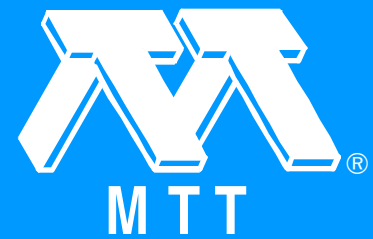
Subjects

Synthesis of advanced microwave filters without diagonal cross-couplings (2002 Vol. III [MWSYM])

R.J. Cameron, A.R. Harish and C.J. Radcliffe. "Synthesis of advanced microwave filters without diagonal cross-couplings (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1437-1440 vol.3.

Asymmetric filtering characteristics are frequently used for the design of microwave filters for the cellular telephony industry, particularly for the transmit/receive diplexers for base stations. Typically such filters have to be manufactured in large quantities at lowest possible cost. However, because of the asymmetric filtering characteristics, the designs often include diagonal cross couplings between non-adjacent resonators. In addition to the usual 'straight' couplings. Diagonal couplings tend to be mechanically difficult to manufacture and assemble, can be electrically awkward to tune and be sensitive to temperature, vibration etc. all of which drives up unit costs again. This paper introduces the methods for the synthesis of two novel filter network configurations which do not require diagonal couplings, but which nonetheless are able to realize asymmetric filtering functions.





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A method for the direct synthesis of cascaded quintuplets

T. Reeves and N. van Stigt. "A method for the direct synthesis of cascaded quintuplets." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1441-1444 vol.3.

A new lowpass prototype configuration for a cascaded quintuplet is presented. The cascaded quintuplet is a cross-coupled filter structure that is used in microwave filter topologies to realize three finite frequency transmission zeros. The lowpass prototype can be converted into the cascaded quintuplet format using a series of equivalent circuit transformations. The method permits the direct synthesis of an arbitrary number of in-line cascaded quintuplets from the filter impedance function.

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Parameter extraction for symmetric coupled-resonator filters (2002 Vol. III [MWSYM])

Heng-Tung Hsu, Zhenyu Zhang, K.A. Zaki and A.E. Atia. "Parameter extraction for symmetric coupled-resonator filters (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1445-1448 vol.3.

A new parameter extraction procedure for symmetric coupled-resonator filters is presented. Closed form recursive formulas are derived for the synthesis of all the filter parameters from known zeros and poles of the even- and odd-mode input impedance functions. The simple and straightforward procedure can eliminate complicated optimization routines and have extensive applications in design and tuning of filters.

[Click on title for a complete paper.](#)



Design procedure for waveguide filters with cross-couplings

J. Kocbach and K. Folgero. "Design procedure for waveguide filters with cross-couplings." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1449-1452 vol.3.

A new rigorous systematic design procedure for folded waveguide filters with cross couplings is presented. The procedure is a combination of a circuit model analysis and a full-wave method, and is based on tuning one dimension at a time for simple waveguide structures towards simple tuning goals. Through examples it is shown how the procedure can eliminate the need for global optimization. As a consequence of this process, the time needed for the realization of filters of this type is greatly reduced. Examples of filters designed using the described design process are given, including comparison with measurements.



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Dual-mode filters with grooved dielectric resonators for cellular-radio base stations

L. Accatino, G. Bertin, M. Mongiardo and G. Resnati. "Dual-mode filters with grooved dielectric resonators for cellular-radio base stations." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1453-1456 vol.3.

Dual-mode filters for cellular-radio base-stations require resonators with high unloaded Q-factor, wide spurious-free operating window and possibility of high coupling values either to input or between resonators. These features are obtained by employing a new cavity resonator loaded by a grooved ceramic disk. The groove, which may increase up to a full air gap, allows the insertion of probes and tuning/coupling screws where the field is stronger. Experimental results of an eight-pole transmit filter show the suitability of the proposed resonator for realizing cellular-radio base stations filters.

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A dual mode filter with trifurcated iris and reduced footprint

Ming Yu, D.J. Smith, A. Sivadas and W. Fitzpatrick. "A dual mode filter with trifurcated iris and reduced footprint." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1457-1460 vol.3.

This paper presents a novel configuration for dual mode filters operating in the TE/sub 11n/ modes. The use of the proposed configurations in the design of dual mode filters leads to a significant reduction in the filter footprint. Techniques to suppress the TE/sub 21n/ modes in a TE/sub 113/ cylindrical cavity filter are proposed by using a trifurcated iris arrangement. Simulated and experimental results are presented to verify the validity of the proposed configuration.



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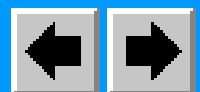
Method of spurious mode compensation applied to manifold multiplexer design

D. Bariant, S. Bila, D. Baillargeat, S. Verdeyme, P. Guillon, D. Pacaud and J.-J. Herren.

"Method of spurious mode compensation applied to manifold multiplexer design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1461-1464 vol.3.

This paper outlines an hybrid circuit/electromagnetic process dedicated to manifold design which take into account spurious modes in the frequency band. The procedure is applied to design an experimental Ku-band triplexer. The multiplexer model and the compensation method are described. Good agreement between theoretical results and measurements ones demonstrates the efficiency of the procedure.

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A new X-band 180/spl deg/ high performance phase shifter using (Ba, Sr)TiO/sub 3/ thin films

B. Acikel, T.R. Taylor, P.J. Hansen, J.S. Speck and R.A. York. "A new X-band 180/spl deg/ high performance phase shifter using (Ba, Sr)TiO/sub 3/ thin films." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1467-1469 vol.3.

In this paper, a new device topology has been proposed to implement parallel plate capacitors using BaSrTiO/sub 3/ (BST) thin films for microwave applications. The new device design simplifies the monolithic process and overcomes the problems associated with electrode patterning. An X-band 180/spl deg/ phase shifter has been implemented using new device layout. The circuit provided 240/spl deg/-phase shift with an insertion loss of only 3 dB at 10 GHz and room temperature. We have shown a figure of merit 93/spl deg//dB at 6.3 GHz and 87/spl deg//dB at 8.5 GHz. To our knowledge, these are the state of the art results for distributed phase shifters implemented using parallel plate or interdigital capacitors at room temperature.

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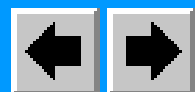
Subjects

A wide bandwidth monolithic BST reflection-type phase shifter using a coplanar waveguide Lange coupler

Dongsu Kim, Yoonsu Choi, M.G. Allen, J.S. Kenney and D. Kiesling. "A wide bandwidth monolithic BST reflection-type phase shifter using a coplanar waveguide Lange coupler." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1471-1474 vol.3.

A monolithic reflection-type phase shifter fabricated on BST/sapphire is presented here. The phase shifter consists of a coplanar waveguide (CPW) Lange coupler, meandered line inductors, and ferroelectric tunable capacitors. The CPW Lange coupler has a bandwidth of about 52% for 1-dB amplitude balance with center frequency of 2.7 GHz and the isolation is better than 18 dB in the frequency range of 1-3.7 GHz. The phase shifter using the CPW Lange coupler has a phase shift range of more than 90/spl deg/ with an insertion loss of better than 2 dB and a return loss of better than 14 dB in the frequency range of 1.85-2.56 GHz over a bias voltage range from 0 V to 160 V. A figure of merit of 89/spl deg//dB at 1.87 GHz and better than 44/spl deg//dB from 1.52 to 2.56 GHz was obtained with 160 V. Total size of the monolithic BST phase shifter is 11.2 mm/spl times/4.9 mm/spl times/0.43 mm.

Click on title for a complete paper.



Bandwidth and losses of 4-port ferrite coupled line circulators

Cham Kiong Queck and L.E. Davis. "Bandwidth and losses of 4-port ferrite coupled line circulators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1475-1478 vol.3.

For the first time, the bandwidth and the losses of a 4-port Ferrite Coupled Line (FCL) circulator are analysed and reported. A broadband hybrid coupler with an improved air-bridge has been designed for the circulator and the performance of a 4-port microstrip FCL circulator is predicted by cascading the S-matrices of the FCL and hybrid coupler using signal flow graphs. The possibility of realising a broadband circulator is investigated and it is found that there is a trade-off in performance between bandwidth and loss.



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Modeling and optimization of parallel line edge mode microstrip isolators

A.H. Aly and E.-B. El-Sharawy. "Modeling and optimization of parallel line edge mode microstrip isolators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1479-1482 vol.3.

This paper presents analysis and measurements of a new type of ferrite edge mode isolator. The new configuration includes a broadband termination at the path of the backward propagation. The new approach results in a nonreciprocal behavior that can be observed even without a lossy material. An insertion loss of 1.7 dB and isolation of 23 dB can be achieved using the new structure. Parametric study with particular emphasis on geometrical effects of the new structure is presented. Supporting experimental data is also presented to confirm the predicted performance of the new structure.

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SAW FEMs for GSM-based multi-band cellular phones with direct-conversion demodulation

M. Hikita, N. Matsuura, K. Yokoyama, N. Shibagaki and K. Sakiyama. "SAW FEMs for GSM-based multi-band cellular phones with direct-conversion demodulation." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1483-1486 vol.3.

Assuming DC demodulation, the required characteristics and new configurations for SAW front-end modules (FEMs) were investigated. Parallel connections between SAW filters and the pin diode reduce the number of circuit elements drastically. The developed module for EGSM/DCS dual-band achieved Tx insertion losses as small as 1.0 dB and 1.2 dB, and Rx insertion losses of 3.0 dB and 3.3 dB for EGSM and DCS, respectively. 30-40 dB attenuation particularly required for DC demodulation up to several GHz was achieved. Multi-band FEMs such as triple-band FEMs and so on were also investigated.

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Bulk acoustic wave resonators and filters for applications above 2 GHz

K.M. Lakin, J.R. Belsick, J.P. McDonald, K.T. McCarron and C.W. Andrus. "Bulk acoustic wave resonators and filters for applications above 2 GHz." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1487-1490 vol.3.

Bulk acoustic wave (BAW) devices are of interest for applications at higher microwave frequencies above 2 GHz. As frequencies increase, BAW devices require thinner films which decreases processing times and makes the technology more cost effective. However, the area of resonators and associated filters also decreases and begins to impact device performance and packaging requirements. This paper summarizes the technical requirements of BAW devices in the 2 to 20 GHz frequency range and shows specific results for resonators, ladder filters, and stacked crystal filters operating up to 20 GHz.

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Contactless probing of high-frequency electrical signals with scanning probe microscopy

W. Merlin. "Contactless probing of high-frequency electrical signals with scanning probe microscopy." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1493-1496 vol.3.

Circuit internal test techniques working in a contactless manner are necessary for failure analysis and design verification of high-speed and high-frequency circuits. A relative new technique is the scanning probe voltage measurement technique, a technique which is based on scanning probe microscopy. This paper gives an overview of the state-of-the-art of this technique and demonstrates some practical examples.

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Millimeter-wave network analyzers based on photonic techniques

T. Nagatsuma, N. Sahri, A. Hirata, Y. Royter and A. Sasaki. "Millimeter-wave network analyzers based on photonic techniques." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1497-1500 vol.3.

We report on active photonic probes which enable on-wafer measurements of electrical scattering parameters with a bandwidth exceeding 300 GHz. The probes employ a high-speed uni-traveling-carrier photodiode to optically generate the electrical stimulus and the electro-optic sampling technique to measure the electrical response signals. The probe modules are packaged using micro-optic technology and exhibit excellent optical characteristics. They are easy to use and enable reliable and reproducible measurements and should help to overcome the bandwidth-limitation of present all-electronic systems.

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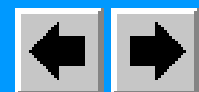
Subjects

Optoelectronic techniques for improved high speed electrical risetime

A.J.A. Smith, A.G. Roddie and P.D. Woolliams. "Optoelectronic techniques for improved high speed electrical risetime." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1501-1504 vol.3.

The NPL optoelectronic system for calibrating high-bandwidth sampling oscilloscopes is described, with emphasis on the importance of accurately defining the impulse response to enable the calibration of fast electrical pulse generators (risetime < 15 ps). The problems encountered in determining the waveforms of such pulse generators, particularly aberrations close to the transition and long-term settling, are discussed and a proposal for the application of electro-optic sampling to the measurement of electrical pulse generators is presented.

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Picosecond imaging circuit analysis of ULSI microprocessors

M.K. Mc Manus and P. Song. "Picosecond imaging circuit analysis of ULSI microprocessors." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1505-1508 vol.3.

Picosecond Imaging Circuit Analysis (PICA) is a high speed backside emission based tool used for timing analysis of ULSI circuits. It was invented at IBM in 1996, and has been used since then to help deliver microprocessors profitably. As a fault localization tool, PICA has been used to find and diagnose stuck at faults, races, shorts, and leaking devices as well as many other failure mechanisms. The combination of timing resolution on the order of 20 ps, and submicron spatial resolution enables the probing of many individual transistors in parallel in complex high speed circuit designs. The timing analysis from PICA can also be used to debug and improve designs while running chips at speed by measuring the timing at which transistors switch, and comparing the results to simulated values. Here we describe the technique as well as demonstrate its use during the debug of an I/O circuit defect found on the IBM System/390 G5 microprocessor.

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Electric-field observation of pico-pulse propagation on right-angle bends by miniature photoconductive near-field probe

Jongjoo Lee and Jounggho Kim. "Electric-field observation of pico-pulse propagation on right-angle bends by miniature photoconductive near-field probe." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1509-1512 vol.3.

The picosecond electric-pulse propagation characteristics on microstrip and coplanar waveguide right-angle bends have been successfully measured by mapping the time-dependent spatial electric near-field distributions. The measurement was performed using a 2-dimensional photoconductive (PC) electric near-field mapping system incorporating a new miniature PC electric-field probe, which was implemented on an optical fiber by coupling a PC switch on 1- μm -thick LT-GaAs epilayer to the end-facet of a 45- $^\circ$ bevel-edge optical fiber. The probe could measure the three orthogonal picosecond electric-field components separately with minimal loading effects. The measured field-images showed quite remarkable transient picosecond electric-pulse propagation phenomena at the right-angle bends, which cannot be measured using conventional test instruments.





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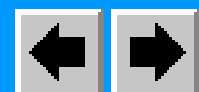
Subjects

Field-tunable probe for combined electric and magnetic field measurements

R.M. Reano, J.F. Whitaker and L.P.B. Katehi. "Field-tunable probe for combined electric and magnetic field measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1513-1516 vol.3.

A method to measure the magnitude and phase of electric and magnetic fields with a single probe is presented. The optically-based probe, consisting of a hybrid combination of gallium arsenide followed by terbium gallium garnet, employs the Pockels effect to measure electric fields and the Faraday effect to measure magnetic fields. Isolation between the two effects is achieved via external polarization optics, allowing the probe to be toggled between electric field and magnetic field sensitivity by switching the input optical polarization between two states. A demonstrated isolation of 22 dB is observed using a shorted microstrip transmission line as a test bed.

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A Ka-band perpendiculary-fed patch array for spatial power combining

S. Ortiz, A. Al-Zayed and A. Mortazawi. "A Ka-band perpendiculary-fed patch array for spatial power combining." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1519-1522 vol.3.

A Ka-band spatial power combining amplifier array employing a perpendicular feed structure is presented. The amplifier array utilizes perpendicularly-fed, aperture-coupled microstrip patch antennas with a unique feed structure for both the input and output antennas. This feed places the devices and antennas on separate planes, allowing for a smaller unit cell size, a simplified layout, and a minimum interaction between the devices and fields. A 7/spl times/7 passive and active amplifier array have been designed and fabricated at Ka-band. Experimental measurement results for both arrays are given.

Click on title for a complete paper.



A waveguide mode-converter feed for a 5-W, 34-GHz grid amplifier

Chun-Tung Cheung, J.B. Hacker, G. Nagy and D.B. Rutledge. "A waveguide mode-converter feed for a 5-W, 34-GHz grid amplifier." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1523-1526 vol.3.

We have demonstrated a compact waveguide mode converter that excites a combination of TE/sub 10/ and TE/sub 30/ modes for feeding a grid amplifier. The length of the mode converter is only 13 mm. The effective transmitter power (ETP) at 34 GHz is 5 W, with a gain of 5.5 dB and a power-added efficiency (PAE) of 21%. The supply voltage is 3 V, with a bias current of 5.6 A. These results are comparable to those reported earlier for the same grid-amplifier design measured in free space. A spurious oscillation with a broad radiation pattern was observed at 33.6 GHz with an effective isotropic radiated power (EIRP) of 23 mW. This oscillation was suppressed when the grid was operating at high power levels, and disappeared entirely at output powers above 4.5 W.



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A 10-GHz high-efficiency active antenna sub-array

S. Paji and Z. Popovi. "A 10-GHz high-efficiency active antenna sub-array." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1527-1530 vol.3.

This paper presents the design and implementation of a 10-GHz 4-element spatial power combiner. The GaAs-MESFET amplifiers are designed to operate in switched class-E mode, feeding dual-layer patch antennas. A Wilkinson combiner feed was designed for the input with 0.7 dB loss. The individual amplifiers operate at 64% drain efficiency and deliver 20.6 dBm output power. The total output power delivered from the active array is 26.6 dBm (0.46 W), for 20 dBm input power. The average drain efficiency of the amplifiers in the array is 70% and the power added efficiency is 57%.

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Quasi-optical E-band MEMS switching arrays

W.-K. Zhang, Fan Jiang, C.W. Domier and N.C. Luhmann, Jr.. "Quasi-optical E-band MEMS switching arrays." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1531-1534 vol.3.

This paper presents modeling, design, fabrication, and testing of an E-band MEMS based quasi-optical switching array. The quasi-optical MEMS switching array has been demonstrated with an isolation of better than 10 dB from 70/spl sim/85 GHz. The maximum demonstrated ON /OFF ratio is over 15 dB at 76 GHz.

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A circularly polarized rectifying antenna array for wireless microwave power transmission with over 78% efficiency

B. Strassner and Kai Chang. "A circularly polarized rectifying antenna array for wireless microwave power transmission with over 78% efficiency." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1535-1538 vol.3.

This paper reports a new circularly polarized (CP) high gain, high-efficiency rectifying antenna (rectenna) array designed in a coplanar stripline circuit. The array can maintain a constant DC output voltage regardless of its broadside orientation. Each antenna has a CP antenna gain of 11 dB and a better than 1 dB axial ratio fractional bandwidth of 4.7%. Coplanar stripline (CPS) band-reject filters (BRF) are used to suppress the re-radiated harmonics by more than 19 dB. At 5.61 GHz, using an array loading of 150 Ω , a 3x3 rectenna array achieves an RF-to-DC conversion efficiency of 78% and an axial ratio of 0.25 dB.

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A multi-element 150/300 GHz spatial power dividing/combining frequency doubler

B. Schumann, M. Hoft and R. Judaschke. "A multi-element 150/300 GHz spatial power dividing/combining frequency doubler." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1539-1542 vol.3.

A five-element frequency doubler at 300 GHz in a quasi-optical spatial power dividing/combining circuitry has been investigated. The individual frequency doublers are realized with GaAs-Schottky-diodes in waveguide technique with 4% efficiency. Holography is applied to achieve efficient power transfer to/from the active devices. Preliminary measurements are in good agreement with the expected system performance.

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Design of an LTCC integrated tri-band direct conversion receiver front-end module

R. Lucero, A. Pavio, D. Penunuri and J. Bost. "Design of an LTCC integrated tri-band direct conversion receiver front-end module." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1545-1548 vol.3.

This paper presents the results of a front-end receiver module integrating GSM/DCS/PCS band select functions and a direct conversion IC on a low temperature cofired ceramic (LTCC) substrate. The front-end-module (FEM) integrated a SP3T GaAs PHEMT switch for band selection, three SAW filters for pre-selection, and a direct conversion IC for down conversion of the RF signal. Integrated passives included a PCS balun, direct conversion IC matching elements and structures to improve the performance of differential SAW filters. The LTCC module contained 24 embedded passives and 15 surface mount components integrated on a 328 mil/spl times/586 mil, 19-layer multi-layer integrated circuit (MLIC). Receiver sensitivity was better than -114 dBm, the system noise figure was less than 9 dB, and the return loss characteristics measured at the antenna input port were better than 10 dB for all three bands. EM simulation was used to achieve first pass design success and the modeling approach yielded excellent agreement between measured and simulated results.

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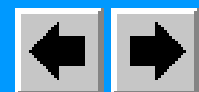
Subjects

An L-band, LTCC frequency doubler using embedded lumped element filters

R. Hurley and G. Sloan. "An L-band, LTCC frequency doubler using embedded lumped element filters." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1549-1552 vol.3.

We have demonstrated an L-band frequency doubler (1.5 GHz, 33% BW) using an LTCC (low temperature co-fired ceramic) substrate. Lumped element filters were embedded in an LTCC carrier, providing greater than 10:1 footprint reduction over a previous single-layer hybrid implementation.

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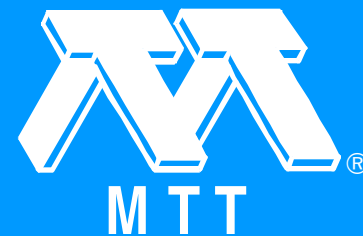
Subjects

3D integrated LTCC module using /spl mu/BGA technology for compact C-band RF front-end module

S. Pinel, S. Chakraborty, M. Roellig, R. Kunze, S. Mandal, H. Liang, C.-H. Lee, R. Li, K. Lim, G. White, M. Tentzeris and J. Laskar. "3D integrated LTCC module using /spl mu/BGA technology for compact C-band RF front-end module." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1553-1556 vol.3.

This paper presents a novel 3D integration approach for system-on-package (SOP) based solutions for wireless communication applications. This concept has been applied for the 3D integration of a C band Wireless LAN (WLAN) RF front-end module by means of stacking LTCC substrates using /spl mu/BGA technology. Characterization and modeling of RF vertical board-to-board transition, using /spl mu/BGA process are presented for the first time. Specific investigations for 5.8 GHz WLAN applications such as high performance embedded band-pass filter design, and a via-fed stacked cavity-backed patch antenna development are reported. GaAs MESFET-based Rx and Tx chipset is implemented in GaAs MESFET process and combined with the suggested package structure, demonstrating 3D integration concept suitable for C-band wireless communication applications.





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Low temperature cofired ceramic: an enabler of high power RF integrated amplifiers

P.-M. Piel, J. Estes, S. Marshall, G. Funk and A. Pavio. "Low temperature cofired ceramic: an enabler of high power RF integrated amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1557-1560 vol.3.

Multi-layer ceramic technologies have been viewed recently as an enabler to increase the electrical functionality in a cost effective manner for high power discrete transistors. High power applications have stringent requirements on conductor losses, thermal characteristics and repeatability of design. We present a characterization of these factors and a preliminary definition of the boundary conditions for use in RF integrated amplifiers.

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High performance RF passive integration on Si smart substrate

Dong-Wook Kim, In-Ho Jeong, Ho-Sung Sung, Tong-Ook Kong, Jong-Soo Lee, Choong-Mo Nam and Young-Se Kwon. "High performance RF passive integration on Si smart substrate." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1561-1564 vol.3.

To achieve cost and size reduction, we developed low cost manufacturing technology for RF substrate and high performance passive process technology for RF IPDs (Integrated Passive Devices). The fabricated substrate is conventional 6" Si wafer with SiO₂/sub 2/ thickness of 25 /spl mu/m on the surface. This substrate showed the very good insertion loss of 0.03 dB/mm at 4 GHz, including conductive metal loss, in case of 50/spl Omega/ coplanar transmission line (W = 50 /spl mu/m, G = 20 /spl mu/m). Using BCB (Benzo Cyclo Butene) interlayer and 10 /spl mu/m Cu plating process, we made a high Q circular spiral inductor on Si that had the record maximum quality factor of more than 120. The fabricated inductor library showed the maximum quality factor range of 30/spl sim/120 or more, depending on geometrical parameters and inductance values of 0.35/spl sim/31.5 nH. The small-size RF IPDs were fabricated on thick oxide Si substrate for the applications such as FEMs (Front End Modules) and high-speed wireless LANs and they showed very good performances. These substrate and passive process technologies will be widely utilized in hand-held RF module and system requiring low cost solution and strict volumetric efficiency.





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Micromachined low dispersion interconnects for optoelectronic array packaging

S.R. Banerjee and R.F. Drayton. "Micromachined low dispersion interconnects for optoelectronic array packaging." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1565-1568 vol.3.

A micromachined microstrip interconnect, partially shielded on the top surface, is designed, fabricated, and measured for use in optical array packaging applications. Field simulations show the interconnects to be highly isolated for an array pitch of 500 μm . S-parameter, relative phase constant, and attenuation curves are shown up to 40 GHz for 1 cm long 50-ohm designs. The structure exhibits 1.4 dB/cm of attenuation at 40 GHz and a phase constant that has only $\pm 0.5\%$ variation across the band. The micromachined partially shielded microstrip offers high isolation, low dispersion, and low attenuation that is necessary for arrayed interconnects.

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Use of a transparent conductive thin-film on a glass substrate in active integrated antenna arrays with double strong coupling

K. Oshima, N. Kidera, K. Niwano, K. Ikawa, R. Sonoda and S. Kawasaki. "Use of a transparent conductive thin-film on a glass substrate in active integrated antenna arrays with double strong coupling." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1569-1572 vol.3.

Active Integrated Antenna (AIA) arrays were fabricated on a glass substrate using a conductive thin film, which was thin enough to be transparent to realize a transparent RF component. It can be attached to a window glass keeping its visibility. This means a potential to develop to new applications in microwave communication. The AIA arrays, here, consist of CPW, double strong coupling and 2-element array. For the oscillation using the lossy transmission line, a backing conductor and a Partly Thickened Conductor (PTC) were used. It operated at 8.54 GHz with the in-phase mode and EIRP was 14.3 dBm.

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T-ray imaging: new possibilities in the far infrared

D.M. Mittleman. "T-ray imaging: new possibilities in the far infrared." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1575-1578 vol.3.

Since the initial demonstrations of T-ray imaging in 1995, there has been considerable progress in the development of this field. Many possible applications have been explored, and a commercial terahertz time-domain spectrometer is now operating in a manufacturing environment. In addition, several new imaging techniques which exploit the unique properties of the THz system have been developed. We describe one technique, which permits time-of-flight imaging with depth resolution well below the Rayleigh limit. We demonstrate the capability to resolve two reflecting surfaces separated by only a few percent of the coherence length of the THz radiation.

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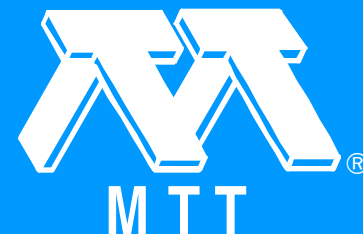


Abstracts

THz spectroscopy - techniques and applications

F.C. De Lucia. "THz spectroscopy - techniques and applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1579-1582 vol.3.

Spectroscopy and related applications have accounted for a large proportion of the work in the THz spectral region. These have included laboratory studies of the radiative and collisional properties of molecules, ions, and radicals, as well as field applications such as atmospheric remote sensing and molecular radio astronomy. This paper will review established techniques and discuss new approaches.



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Submillimeter-wave polarimetric compact ranges for scale-model radar measurements

M. Coulombe, J. Waldman, R. Giles, A. Gatesman, T. Goyette and W. Nixon. "Submillimeter-wave polarimetric compact ranges for scale-model radar measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1583-1586 vol.3.

Fully-polarimetric, wide-band compact radar ranges based on transceivers operating in the submillimeter-wave regime have been developed for obtaining radar measurements on scale models (nominally 1:16). These transceivers use fixed-tuned Schottky-diode mixers and varactor multiplier sources to obtain reasonably wide-band performance. Optically pumped gas lasers, combined with tunable microwave sideband generation in corner-cube-mounted Schottky diodes, have been implemented to extend the operating frequencies into the THz regime. A dielectric material fabrication and characterization capability has also been developed to fabricate custom anechoic materials for the ranges as well as scaled dielectric parts for the models and clutter scenes. The general approach to designing submillimeter-wave compact ranges and the particular details of systems operating at 524 GHz and 1.56 THz will be presented in this paper.

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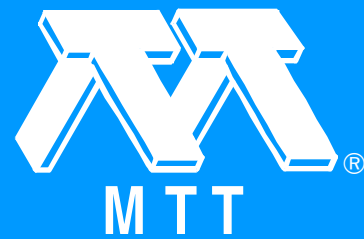


Abstracts

THz techniques in plasma diagnostics

B.H. Deng, C.W. Domier, A.J.H. Donne, K.C. Lee, N.C. Luhmann, Jr., E. Mazzucato, T. Munsat, H. Park and M. van de Pol. "THz techniques in plasma diagnostics." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1587-1590 vol.3.

THz techniques have been widely employed in magnetic fusion plasma diagnostics, including far infrared Interferometry, polarimetry, and scattering to measure plasma electron density profiles, magnetic field strength profiles, and density fluctuations, respectively. The high magnetic field strength and high plasma densities anticipated for next generation fusion devices will further extend the applicability of THz techniques to the diagnostics of electron temperature profiles and fluctuations by electron cyclotron emission imaging, and electron density profiles and fluctuations by imaging reflectometry.



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Remote detection of bioparticles in the THz region

E.R. Brown, D.L. Woolard, A.C. Samuels, T. Globus and B. Gelmont. "Remote detection of bioparticles in the THz region." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1591-1594 vol.3.

Recent measurements of the electromagnetic transmission through *Bacillus subtilis*, an innocuous anthrax substitute, have revealed absorption resonances in the THz region. A system-level analysis is carried out to show that at least one of the resonances (centered at 14.05 cm/sup -1/, or 421 GHz) is located at a frequency of low enough atmospheric absorption to be detectable by an active remote sensor - a differential absorption radar.

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Suspended resonators for filters-reduced $\lambda/4$ excitation of evanescent cavities using high dielectric constant feedlines (2002 Vol. III [MWSYM])

R.V. Snyder, E. Niver, Keehong Um and Sanghoon Shin. "Suspended resonators for filters-reduced $\lambda/4$ excitation of evanescent cavities using high dielectric constant feedlines (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1597-1600 vol.3.

A structure consisting of dielectric-loaded feed lines (such as surface wave lines similar to Goubau lines) and below-cutoff air-filled cavities can be used to form essentially L-C sections. The capacitance is due to electric field coupling from the feed line dielectric medium into the below-cutoff section. The inductance results from combining the inductors in the inductive tee-equivalent circuit for such below-cutoff sections. Dielectric loading is used to shorten the guide wavelength at the input to the evanescent section, increasing the effective input inductance. The dielectrically-loaded feed lines can comprise microstrip, CPW, CPS, Goubau lines (surface wave structures), waveguide, etc. The resulting resonant elements are usable at frequencies below 1 GHz, with small dimensions. If connected to the common ground plane, these L-C sections act as a transmission zero. If "floated", i.e. connected in the "hot" line rather than to the ground plane, the sections form bandpass circuits (transmission poles). The air-filled below-cutoff sections (evanescent mode) are placed in a supporting low-dielectric constant medium (air, Teflon or similar), with the open end in proximity to the dielectric portion of the feed line, and are thus termed "suspended".





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Lumped-element conductor-loaded cavity resonators

H. Salehi, R.R. Mansour and V. Dokas. "Lumped-element conductor-loaded cavity resonators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1601-1604 vol.3.

In this paper, we present a novel conductor-loaded cavity resonator having the form of L and C lumped-element resonators. The resonator is derived by modifying traditional split-ring resonators. The proposed lumped-element resonator offers more than 85% size reduction in comparison with split-ring resonators. In addition, the proposed resonator eliminates the need to use the dielectric support that is typically required for split-ring resonators. An 800 MHz 3-pole Chebyshev function filter was designed, built and tested. The experimental results obtained verify the validity of the proposed concept.

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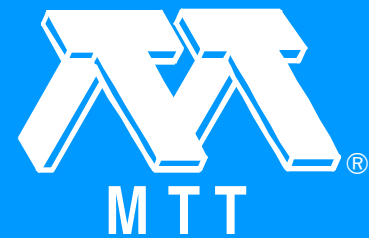
Novel coupling schemes for microwave resonator filters (2002 Vol. III [MWSYM])

U. Rosenberg and S. Amari. "Novel coupling schemes for microwave resonator filters (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1605-1608 vol.3.

The paper presents novel coupling schemes for microwave resonator filters. Some of these solutions contain more than one main path between the input and output. These paths may be interacting or non-interacting. In other solutions, only some of the direct (main) couplings are zero. It is shown that higher-order filter characteristics can be obtained from lower-order sections, which are connected in parallel between the source and the load, by proper superposition of the individual lower-order responses. Possible applications of these solution to actual design problems are discussed.

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Folded quarter-wave resonator filters with Chebyshev, flat group delay, or quasi-elliptical function response

Chi-Yang Chang, Cheng-Chung Chen and Hong-Jie Huang. "Folded quarter-wave resonator filters with Chebyshev, flat group delay, or quasi-elliptical function response." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1609-1612 vol.3.

This paper presents the design and realization of a new class of miniaturized microstrip filters using folded quarter-wave resonators. Various kinds of filter response are realized by proper arrangement of the resonator. The design rules for cross-coupled filters with quasi-elliptical function and flat group delay response are provided. The measured results match theoretical predictions well.

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Stepped impedance resonator bandpass filters with tunable transmission zeros and its application to wide stopband design

Jen-Tsai Kuo and E. Shih. "Stepped impedance resonator bandpass filters with tunable transmission zeros and its application to wide stopband design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1613-1616 vol.3.

Bandpass filters with a very wide stopband are designed using parallel coupled stepped impedance resonators (SIR), which have advantageous resonance harmonic characteristics. The singly loaded Q ($Q_{\text{sub si}}$) of a tapped SIR is derived, so that the relation between $Q_{\text{sub si}}$ and the position of the tap point can be established. It is known that a single resonator with tapped input can create an extra zero. It is found that, with proper tapping at the first and last SIR's of a bandpass filter, two zeros can be created and tuned independently over a wide frequency range. By exploiting both the advantageous resonance characteristics of SIR and tapped-line input, a bandpass filter with high selectivity and/or wide stopband can be realized. The experimental results show good agreement with the simulated prediction.

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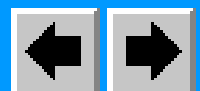
Subjects

A Ku-band low-loss stripline low-pass filter for LTCC modules with low-impedance lines to obtain plural transmission zeros

T. Ohwada, H. Ikematsu, H. Oh-hashii, T. Takagi and S. Ishida. "A Ku-band low-loss stripline low-pass filter for LTCC modules with low-impedance lines to obtain plural transmission zeros." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1617-1620 vol.3.

A Ku-band low temperature co-fired ceramic (LTCC) multi-layered stripline low-pass filter (LPF) is presented. By employing a low-impedance line as an inductive element in the resonator, plural transmission zeros can be obtained near passband. Therefore, the presented LPF realizes excellent attenuation characteristics despite a small number of resonators. The LPF has extremely low insertion loss and compact dimensions, an especially thin profile, and is suitable for RF-modules. An LPF with dimensions of 0.9 mm/spl times/0.9 mm/spl times/0.4 mm has been fabricated, and measured results show the validity of the proposed structure.

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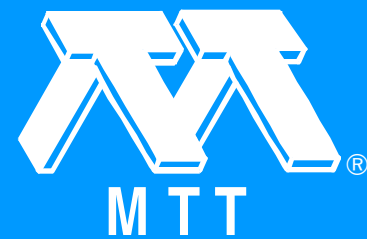
Design and analysis of novel compact inductor resonator filter

Gye-An Lee, M. Megahed and F. De Flaviis. "Design and analysis of novel compact inductor resonator filter." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1621-1624 vol.3.

Compact spiral inductor resonator filters using inductor type resonators are proposed. The design is based on the self-resonant frequency of the spiral inductors and electromagnetic coupling between the resonators. The filter is built and measurement results show good agreement with the simulation data. The filter design is flexible. The resonance frequency and bandwidth of the inductor resonator filter can be directly optimized from the physical arrangement of resonators. The compactness of the newly developed bandpass filter makes the design and integration of bandpass filters attractive for further development and applications in SOC and/or SIP.

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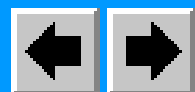
Subjects

Class E with parallel circuit - a new challenge for high-efficiency RF and microwave power amplifiers

A.V. Grebennikov and H. Jaeger. "Class E with parallel circuit - a new challenge for high-efficiency RF and microwave power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1627-1630 vol.3.

In this paper, a new circuit configuration of switched-mode tuned Class E power amplifiers with load network consisting of a parallel capacitance, a parallel inductance and a series resonant circuit tuned on the fundamental is defined using a detailed analytical description with a complete set of the design equations. The ideal collector voltage and current waveforms demonstrate a possibility of 100-percent efficiency. The circuit schematic of a parallel-circuit Class E power amplifier can be realized with lumped or transmission-line elements. Two examples of high power LDMOSFET and low-voltage HBT power amplifiers, utilizing a parallel-circuit Class E circuit configuration, are presented.

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Demonstration of a switchless Class E/F/sub odd/ dual-band power amplifier

F. Bohn, S. Kee and A. Hajimiri. "Demonstration of a switchless Class E/F/sub odd/ dual-band power amplifier." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1631-1634 vol.3.

A 250 W dual-band power amplifier belonging to the Class E/F switching amplifier family is presented. The amplifier operates in the 7 MHz and 10 MHz HAM bands, achieving 16 dB and 15 dB gain with power added efficiencies (PAE) of 92% and 87% in those bands, respectively. It utilizes dual-resonant passive input and output networks to achieve high-efficiency Class E/F/sub odd/ operation at both frequencies of operation, allowing the same passive networks to be used for both frequency bands without the use of band-select switches.

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Push/pull class-DE switching power amplifier

A. Alipov and V. Kozyrev. "Push/pull class-DE switching power amplifier." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1635-1638 vol.3.

The new class-DE of switching amplifiers is described. It combines the advantages of a push/pull class-D topology with some peculiarities of class-E operating, which allows one to exclude switching power losses. Transistors in a class-DE amplifier operate with underlappings, during which their shunt capacitances are recharged. Therefore it is possible to maintain high drain efficiency on higher frequencies, that is the operating frequency may be two to three times as large as in a push/pull class-D amplifier.

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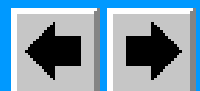
Subjects

Harmonic tuned PAs design criteria

P. Colantonio, F. Giannini, G. Leuzzi and E. Limiti. "Harmonic tuned PAs design criteria." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1639-1642 vol.3.

High efficiency power amplifier design criteria imply the synthesis of input and output networks with particular care on their harmonic behavior. In this paper, a simplified approach to clarify the relevance of such terminations is presented. In particular, design criteria to improve efficiency for high frequency application will be discussed. Finally, to validate the proposed analysis comparison between realised amplifiers are shown.

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Finite DC feed inductor in class E power amplifiers-a simplified approach

D.K. Choi and S.I. Long. "Finite DC feed inductor in class E power amplifiers-a simplified approach." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1643-1646 vol.3.

This report describes a method for using a finite DC feed inductor in place of an (infinite inductance) RF choke. In addition to providing the DC feed connection, the finite feed inductor can be used to perform two other functions needed in the class E power amplifier topology, namely, transformation of the 50 ohm load and reactive tuning. Since no assumptions are made about the shunt output capacitor, this result is independent of the capacitor's voltage dependence. The analysis results in simple, elegant, and easy to use design equations that, in the limit where the feed inductor approaches infinity, reverts to the case with the RF choke. The concept was demonstrated using a silicon LDMOS FET operating at 200 MHz.

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Active cancellation of switching noise for DC-DC converter-driven RF power amplifiers

H. Kobayashi and P.M. Asbeck. "Active cancellation of switching noise for DC-DC converter-driven RF power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1647-1650 vol.3.

The use of DC-DC converters to dynamically vary the supply voltage for RF power amplifiers in accordance with the transmitted power is an increasingly popular technique that can significantly improve the efficiency. However the DC-DC converter ripple noise may degrade the power amplifier output signals. In this paper, we demonstrate an active cancellation technique that can dramatically reduce the noise. The technique can be easily integrated into present systems employing DSP and DC-DC converters.

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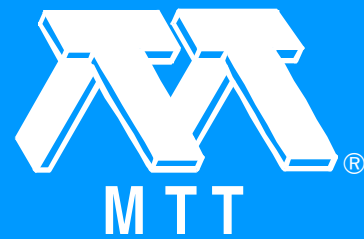


Abstracts

A novel EER transmitter using two-point delta-sigma modulation scheme for WLAN and 3G applications

Kang-Chun Peng, Je-Kuan Jau and Tzyy-Sheng Horng. "A novel EER transmitter using two-point delta-sigma modulation scheme for WLAN and 3G applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1651-1654 vol.3.

A novel transmitter architecture is proposed for wireless local area networks (WLAN) and 3rd/ generation (3G) mobile applications. The transmitter is based on the envelope elimination and restoration (EER) architecture applied with two-point delta-sigma modulator (TPDSM). It can integrate digital modulators and power amplifiers without mixers effectively. In addition, the power amplifier can deal with non-constant envelope modulations like QPSK highly efficiently.



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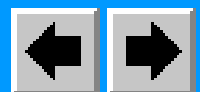
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Dielectric sleeve resonator techniques for variable-temperature microwave characterization of ferroelectric materials

R.G. Geyer, P. Kabos and J. Baker-Jarvis. "Dielectric sleeve resonator techniques for variable-temperature microwave characterization of ferroelectric materials." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1657-1660 vol.3.

Low-loss sleeve resonators can be used for accurate microwave dielectric characterization of rod-shaped test specimens. The test specimen is inserted into the dielectric sleeve resonator and placed centrally in a metal cavity. With the use of additional sleeve resonators having differing external diameters or permittivities, a single specimen can be characterized at multiple frequencies. Sleeve resonators can also be employed for accurate dielectric characterization of high-permittivity specimens having dielectric loss factors greater than 0.001. Closed-form solutions for TE/sub 0np/ resonant mode structure are given. Uncertainty relations for permittivity and dielectric loss are also shown, which demonstrate that when sample electric energy filling factors are greater than 0.4, relative uncertainties in measured permittivity and dielectric loss tangent are less than 1% and 4%, even for relative permittivities greater than 600. Example measurements are given that illustrate how this dielectric resonator system can be employed for dielectric characterization of ferroelectric materials at temperatures both near or far from their Curie temperatures.

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Error analysis of the unloaded Q-factors of a transmission-type resonator measured by the insertion loss method and the return loss method

Z. Ma and Y. Kobayashi. "Error analysis of the unloaded Q-factors of a transmission-type resonator measured by the insertion loss method and the return loss method." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1661-1664 vol.3.

Two types of measurement methods of the unloaded Q-factor of a microwave resonator, the insertion loss method and the return loss method, are reexamined theoretically and compared experimentally. An error formula is derived to estimate the errors between the unloaded Q-factors measured by the two different methods. Measured results of a stripline resonator verified the derived formula well, and proved that the return loss method is more accurate and reliable than the traditional insertion loss method.

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Comparing unloaded Q-factor of a high-Q dielectric resonator measured using the transmission mode and reflection mode methods involving S-parameter circle fitting

K. Leong, J. Mazierska, M.V. Jacob and D. Ledenyov. "Comparing unloaded Q-factor of a high-Q dielectric resonator measured using the transmission mode and reflection mode methods involving S-parameter circle fitting." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1665-1668 vol.3.

A comparative study of unloaded Q-factor measurements of a TE/sub 011/ mode sapphire dielectric resonator with unloaded Q-factor value of 731,000 at a frequency of 10 GHz and temperature of 65 K using two best Q-factor measurement methods are presented. The transmission (TMQF) and reflection methods are based on relevant multifrequency S-parameter measurements and circle-fitting procedures to compute the unloaded Q-factor of the resonator. For accurate comparison of the methods, a delay compensation procedure (introduced in the TMQF technique to remove delay due to noncalibrated cables) has been applied also to the reflection data.





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Removal of cable and connector dispersion in time-domain waveform measurements on 40 Gb integrated circuits

J. Scott, B. Behnia, M.V. Bossche, A. Cognata, J. Verspecht, F. Verbeyst, M. Thorn and D.R. Scherrer. "Removal of cable and connector dispersion in time-domain waveform measurements on 40 Gb integrated circuits." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1669-1672 vol.3.

A new instrument for time-domain characterization of circuits is illustrated. We measure output waveshape and rise time of two high-speed digital circuits on wafer, using a 50 GHz prototype of the new instrument. It uses vector error-correction to de-embed the component under test like a network analyzer but reads out in the time-domain after the fashion of an equivalent-time oscilloscope. With the calibration plane of the instrument set at the tips of the wafer probes, errors arising from dispersion in the connection hardware are removed. A further benefit of this instrument is that random jitter is removed without the convolution penalty usually incurred by averaging, so that anomalies such as pattern dependent jitter are exposed. The system risetime is 7 ps, compared to a system risetime of 12-13 ps for a conventional equivalent-time oscilloscope of the same bandwidth in the presence of wafer probes, bias networks, and cables.





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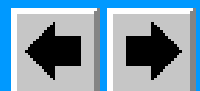
Subjects

Solid-state 8 GHz transient signal digitizer characterization

A. Ghis, P. Ouvrier-Bufferet, N. Rolland, A. Benlarbi-Delai, P.A. Rolland, D. Glay and D. Jaeger.
"Solid-state 8 GHz transient signal digitizer characterization." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1673-1676 vol.3.

A new technique leading to an accurate sampling of single shot high frequency signals is described. This technique provides 20 GHz sampling of electrical pulses up to 8 GHz bandwidth with a 60 dB dynamic range. The prototype of a transient digitizer involving this new principle is tested, with the goal of a new product development. We present the theory of the sampling operations, the outline of the prototype, the design and fabrication of an innovative set of specific GaAs MMICs, the assembling of the complete system and the first results obtained in performance characterization.

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A sampled-line reflectometer for submillimeter-wave measurements

S. Ulker and R.M. Weikle, II. "A sampled-line reflectometer for submillimeter-wave measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1677-1680 vol.3.

A reflectometer designed for operation at submillimeter wavelengths and based on the sampled-transmission line architecture is described. The reflectometer is a relatively simple implementation of the six-port network analyzer introduced by Engen (IEEE Trans. Microwave Theory Tech., vol. MTT-25, no. 12, pp. 1080-1083, 1979) and consists of a section of rectangular waveguide and an ensemble of Schottky diode power detectors. Design considerations for the instrument are described and measurements in the 270 GHz to 285 GHz range are presented and discussed.

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Sampling circuit on silicon substrate for frequencies beyond 50 GHz

P. Abele, M. Birk, D. Behammer, H. Kibbel, A. Trasser, P. Maier, K.-B. Schäd, E. Sonmez and H. Schumacher. "Sampling circuit on silicon substrate for frequencies beyond 50 GHz." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1681-1684 vol.3.

We have fabricated and measured a sampling circuit on high resistivity silicon substrate. The circuit incorporates a nonlinear transmission line to provide the sampling pulses. The sampling circuit was measured up to 50 GHz, with a voltage conversion loss lower than 11 dB and varying in this range by just 2.3 dB. This is the first presentation of a sampling circuit on silicon substrate with a corner frequency beyond 50 GHz.

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Implementing subcarrier-based control in optical networking

A.E. Willner. "Implementing subcarrier-based control in optical networking." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1687-1690 vol.3.

Optical subcarriers can be used for several different important applications in optical networks. This paper explores the implementation of optical subcarriers for control, monitoring, routing, and transmission in networks. Additionally, we discuss the limitations imposed on subcarriers by the optical fiber itself, such as RF fading caused by chromatic dispersion and polarization-mode dispersion.

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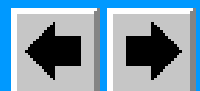
Subjects

Nonlinear distortion and crosstalk in microwave fiber-radio links

E.E. Funk, A.L. Campillo and D.A. Tulchinsky. "Nonlinear distortion and crosstalk in microwave fiber-radio links." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1691-1693 vol.3.

Dispersion and fiber nonlinearities are potentially significant sources of impairment in fiber-radio links. An experimental study of second harmonic distortion and WDM crosstalk in externally modulated microwave fiber-radio links indicates that these impairments are much more significant than previously observed at CATV frequencies below 1 GHz.

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Optical delivery of modulated millimetre-wave signals using free-running laser heterodyne with frequency drift cancellation

L.A. Johansson and A.J. Seeds. "Optical delivery of modulated millimetre-wave signals using free-running laser heterodyne with frequency drift cancellation." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1695-1697 vol.3.

A new millimetre-wave over fibre architecture is proposed and demonstrated using remote cancellation of phase and frequency fluctuations of two-laser heterodyne. A 36 GHz millimetre-wave carrier is optically delivered with -85 dBc/Hz noise level at 10 kHz offset. The system is used to demonstrate transmission of a 68 Mbit/s BPSK modulated 36 GHz signal through 25 km standard single-mode fibre.





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10- and 39-GHz-band InP/InGaAs HPT direct optical injection-locked oscillator ICs for optoelectronic clock recovery circuits

H. Kamitsuna, T. Shibata, K. Kurishima and M. Ida. "10- and 39-GHz-band InP/InGaAs HPT direct optical injection-locked oscillator ICs for optoelectronic clock recovery circuits." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1699-1702 vol.3.

This paper presents two kinds of direct optical injection-locked oscillator (DOILO) ICs, which utilize an InP/InGaAs HPT that is fully compatible with the high-performance InP/InGaAs HBT fabrication process. A 10-GHz-band DOILO achieves an ultra-wide locking range of 1401 MHz (bandwidth of 13.6 %), which is state-of-the-art for indirect and/or direct OILOs reported to date. A 39-GHz-band DOILO achieves a wide locking range of 768 MHz. Clock extraction from 10-Gbit/s NRZ optical data streams is achieved by combining a DOILO and a planar lightwave circuit Mach-Zehnder interferometer. Error-free performance is confirmed-for 2/sup 31/-1 PRBS data signal for clock and data recovery application.

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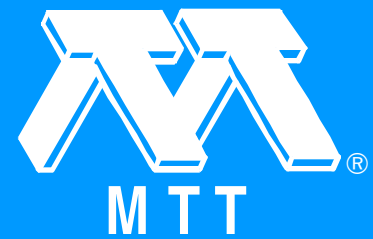
A WDM fiber-radio experiment incorporating a wavelength-self-tunable single-side-band filter

E. Vourch, D. Le Berre and D. Herve. "A WDM fiber-radio experiment incorporating a wavelength-self-tunable single-side-band filter." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1703-1706 vol.3.

Optical single-side-band (OSSB) sources compensate for deleterious chromatic dispersion effects in fiber-radio systems. A wavelength-self-tunable filter based on an iron doped indium phosphide photorefractive crystal is used to provide OSSB signals. The device is incorporated into the WDM fiber-radio transmission of two optical signals modulated at a 16 GHz frequency and carrying 140 Mbit/s data streams.

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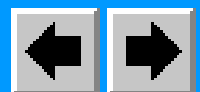
Subjects

A circuit model of traveling wave electroabsorption modulator

Jiyoun Lim, Sanghoon Jeon, Jaha Kim and Songcheol Hong. "A circuit model of traveling wave electroabsorption modulator." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1707-1710 vol.3.

A circuit model of a traveling wave electroabsorption modulator (TWEAM) in which optical and electrical waves are considered at the same time is proposed. The model represents the optical response of TWEAM with an equivalent circuit. This allows us to understand the relation between the electrical and the optical responses and helps to design the device structure for desired performances. The model is implemented in commercially available circuit simulators.

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Predistortion circuit design for II and III order simultaneous linearization in multiservice telecommunications apparatuses

L. Roselli, V. Borgioni, F. Zepparelli, M. Comez, P. Faccin and A. Casini. "Predistortion circuit design for II and III order simultaneous linearization in multiservice telecommunications apparatuses." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1711-1714 vol.3.

We have developed a completely analog, low-cost, multioctave predistortion circuit to compensate second- and third-order distortions in Radio-over-Fiber laser-based telecommunications equipment. The predistorter has been designed on the basis of both a circuit model of commercial DFB lasers and a complete compensation procedure previously developed. A first prototype has been realized and fully tested in the frequency range 500 MHz - 2 GHz, used with GSM, DCS and GPRS cellular services. Some modifications to the relevant architecture have led to a second final predistorter prototype able to reduce of about 9 to 15 dB both the laser second- and third-order harmonic distortion components falling within the DCS band (1710-1880 MHz).

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Compact LNA and VCO 3-D MMICs using commercial GaAs PHEMT technology for V-band single-chip TRX MMIC

K. Nishikawa, B. Piernas, K. Kamogawa, T. Nakagawa and K. Araki. "Compact LNA and VCO 3-D MMICs using commercial GaAs PHEMT technology for V-band single-chip TRX MMIC." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1717-1720 vol.3.

This paper presents compact V-band low-noise amplifier (LNA) and Ka-band voltage-control oscillator (VCO) 3-D MMICs for a V-band highly-integrated single-chip transceiver MMIC. 3-D MMICs are fabricated through the cooperation of commercial foundry GaAs pHEMT and 3-D interconnection processes. The LNA (chip size is 0.75 mm/sup 2/) achieves 15 dB gain and better than 3.3 dB noise figure from 50 GHz to 60 GHz. The VCO (chip size of 0.52 mm) achieves 11.5 dBm output power, 3.8 GHz oscillation frequency tuning range, and a phase noise of -102 dBc/Hz at 1 MHz offset and 28.6 GHz output signal. The cooperation 3-D MMIC technology with a high-performance commercial foundry technology promises low-cost, compact, and high performance millimeter-wave MMICs.

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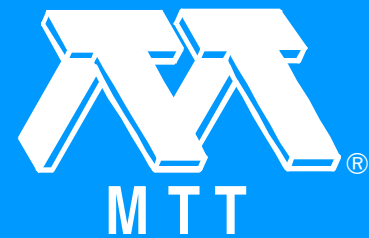
A 60 GHz millimeter-wave MMIC chipset for broadband wireless access system front-end

Y. Mimino, K. Nakamura, Y. Hasegawa, Y. Aoki, S. Kuroda and T. Tokumitsu. "A 60 GHz millimeter-wave MMIC chipset for broadband wireless access system front-end." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1721-1724 vol.3.

This paper presents a complete 60 GHz millimeter-wave MMIC chipset for broadband wireless access system. This chipset consists of a low noise amplifier, a power amplifier, an up-converter, a down-converter, a quadrupler and an SPDT switch. Frequency range of these MMICs is from 55 GHz to 64 GHz, this frequency covers the entire 60 GHz application band.

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A 60 GHz MMIC chipset for 1-Gbit/s wireless links

K. Fujii, M. Adamski, P. Bianco, D. Gunyan, J. Hall, R. Kishimura, C. Lesko, M. Schefer, S. Hessel, H. Morkner and A. Niedzwiecki. "A 60 GHz MMIC chipset for 1-Gbit/s wireless links." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1725-1728 vol.3.

This paper describes the development of a MMIC chipset for 60 GHz; radio links and radars. The chipset includes a low noise amplifier, an image rejection mixer, a frequency quadrupler, and a power amplifier. All were optimized to work together as a 1-Gbit/s radio link in the unlicensed 59 GHz to 64 GHz wireless band, although most are suitable for any application from 55 GHz to 70 GHz. These MMICs are fabricated in Agilent's advanced e-beam PHEMT process and have been demonstrated in fully operational 1-Gbit/s radio-links in field testing.

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A highly integrated MMIC chipset for 60 GHz broadband wireless applications

O. Vaudescal, B. Lefebvre, V. Lehoue and P. Quentin. "A highly integrated MMIC chipset for 60 GHz broadband wireless applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1729-1732 vol.3.

A full and flexible MMIC (monolithic microwave integrated circuit) chipset has been developed for 60 GHz broadband wireless applications. It is based on several circuits operating in the 55-65 GHz frequency range. The MMICs have been fabricated on commercially available 0.25 and 0.15 μm GaAs pHEMT processes. The chipset is focused on a MMIC multifunction chip (MFC) including a sub-harmonic mixer and an LO buffer allowing carrier 2/spl times/LO suppression and image rejection. Several frequency multipliers by 2, 3 and 4 have been produced for the LO supply chain and use balancing topologies leading to fundamental or even-harmonics suppression improvement. Finally, a complete family of low noise/medium power amplifiers is described. All the circuits have been designed in order to ease integration, to reduce size and to achieve the cost requirements for such systems.

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A compact 60 GHz sub-harmonically pumped mixer MMIC integrated with an image rejection filter

A. Yamada, Y. Amano, Y. Motouchi, N. Takahashi, E. Suematsu and H. Sato. "A compact 60 GHz sub-harmonically pumped mixer MMIC integrated with an image rejection filter." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1733-1736 vol.3.

In this paper we present a sub-harmonically pumped image-rejection mixer MMIC for antenna-integrated modules in the 60 GHz-band. The mixer MMIC consists of a mixing part and a filter part. The filter has two $\lambda/2$ microstrip resonators and has a mutual-inductive coupling and a capacitive one between its input and output ports, which results in transmission zeros near the pass band. In the mixing part an electrical short circuit for an LO signal is provided by the filter characteristics at an LO frequency instead of a conventional $\lambda/4$ -open-stub. The fabricated image-rejection mixer MMIC, of which size is only 1.0 mm $\times$ 1.5 mm, shows a conversion loss of 11 $\pm$ 13 dB and an image rejection ratio of more than 30 dB in a pass-band of 60 $\pm$ 1.1 GHz when an LO frequency is 29.5 GHz.

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GaAs HBT operating as integrated V- to W-band Gunn oscillator

M. Rudolph, R. Doerner and P. Heymann. "GaAs HBT operating as integrated V- to W-band Gunn oscillator." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1737-1740 vol.3.

Experimental results on GaAs HBT oscillators are presented exploiting the Gunn effect in the collector region. The HBTs are operated beyond $f_{\text{sub max}}$ as MMIC-compatible two-port transferred-electron devices (TEDs) oscillating at millimeter-wave frequencies. The oscillation frequency of a single device can be tuned in the range of 40-80 GHz, mainly depending on collector voltage. Maximum output power is 0.3 mW at 62 GHz. Phase noise can be considerably improved by subharmonic injection achieving values of -90 dBc/Hz @ 100 kHz.



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A rugged microstrip tapered balun printed dipole reference for SAR system verification

M. Richard, M. Kanda, C. DiNallo and C.K. Chou. "A rugged microstrip tapered balun printed dipole reference for SAR system verification." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1743-1746 vol.3.

Strict regulatory requirements for specific absorption rate (SAR) compliance testing around the world have increased the need for accurate and precise testing methodologies. Such requirements are also required to conform to quality management accreditation guidelines such as ISO/IEC 17025. Equipment calibration, environmental conditions, tissue simulating solution characteristics, and measurement setup all contribute to the accuracy of SAR measurement. System verification is one way to help assure accurate and precise measurements by verifying the measurement repeatability of a reference on a daily basis. A tuned 1/2 wave dipole is recommended for this standard. This study proposes a printed dipole as a reference for daily system verification that meets all the requirements of IEEE 1528, FCC Supplement C, and CENELEC EN 50361. The printed design adds the benefits of being more cost effective, robust, and easier to position for testing.

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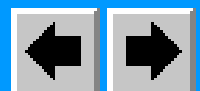
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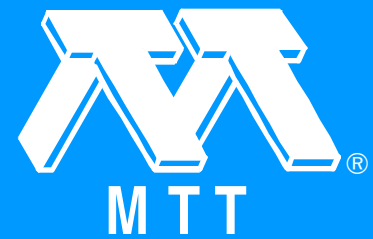
Subjects

Evaluation of human exposure in the vicinity of a base-station antenna using the multiple-region/FDTD hybrid method

P. Bernardi, M. Cavagnaro, S. Pisa and E. Piuzzi. "Evaluation of human exposure in the vicinity of a base-station antenna using the multiple-region/FDTD hybrid method." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1747-1750 vol.3.

In this paper, human exposure to the electromagnetic field radiated from a GSM radio-base station antenna operating in the 900-MHz frequency band has been analyzed. A hybrid multiple-region/FDTD method has been used to evaluate the field radiated by the antenna and the power absorbed in an accurate model of the exposed subject. The results show that field levels averaged on a surface equivalent to the left-to right vertical body section are well correlated with whole-body averaged specific absorption rate (SAR), while local SAR values are influenced by local peaks in the incident field. A comparison between the computational costs of MR/FDTD and pure FDTD shows that, with the application of appropriate compression techniques, the hybrid method becomes convenient, in terms of memory occupation, when the distance between the subject and the antenna is greater than 80 cm.





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Theoretical evaluation of UMTS/GSM electromagnetic fields on neuronal network response

F. Apollonio, M. Liberti and G. D'Inzeo. "Theoretical evaluation of UMTS/GSM electromagnetic fields on neuronal network response." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1751-1754 vol.3.

Understanding the modalities of the interaction of electromagnetic (EM) fields with biological material is a key point in the identification of possible induced effects. In the past, the authors proposed an integrated approach to model electromagnetic fields interaction with biological systems, in which the final biological target is a neuronal network. In this paper, they investigate the possible effects of EM signals related to UMTS and GSM standards on the neuronal network model.

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A parallel FDTD tool for the solution of large dosimetric problems: an application to the interaction between humans and radiobase antennas

L. Catarinucci, P. Palazzari and L. Tarricone. "A parallel FDTD tool for the solution of large dosimetric problems: an application to the interaction between humans and radiobase antennas." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1755-1758 vol.3.

A rigorous theoretical solution of the human exposure to the near-field of radiobase antennas requires a heavy computational effort. In this paper, we propose a full-wave solution based on the implementation of a finite-difference time-domain method on parallel computers, such as the APE-Quadrics SIMD machine with 512 processors. The cases of several GSM real antennas interacting with a numerical phantom proposed by the Visible Human Project are solved, demonstrating the amenability of the approach and its accuracy for a point-evaluation of all the relevant parameters (E and H fields, as well as SAR or local currents) with millimeter-resolution.





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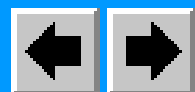
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Confocal microwave imaging for breast tumor detection: application to a hemispherical breast model

E.C. Fear and M. Okoniewski. "Confocal microwave imaging for breast tumor detection: application to a hemispherical breast model." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1759-1762 vol.3.

Confocal microwave imaging (CMI) has been proposed for breast imaging, and detects tumors by selectively focussing backscatter from the breast. Previous studies have employed simple cylindrical or planar breast models, or 2D breast models created from breast MRI scans. In this paper, we use a hemispherical breast model to examine tumor detection and localization in 3D. This model has more realistic features than the simple cylinder. Results indicate that extension of cylindrical CMI to 3D scans of more complex models appears feasible. Future work includes developing methods to accomplish a full breast scan with cylindrical CMI.

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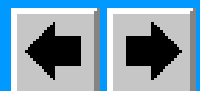
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Study of the activity of neurological cell solutions using complex permittivity measurement

M.R. Tofighi and A.S. Daryoush. "Study of the activity of neurological cell solutions using complex permittivity measurement." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1763-1766 vol.3.

Experimental results of the exposure of neurological cells to radio frequency are presented. The exposure is quantified by the mean of the complex permittivity of cell solutions as a function of frequency. A set-up is used for measurement of complex permittivity of live and dead neurological cell cultures from 20 to 40 GHz. Differences are observed between the two cultures and are compared against the expected measurement error. The statistical significance of these differences is also studied and reported in this paper.

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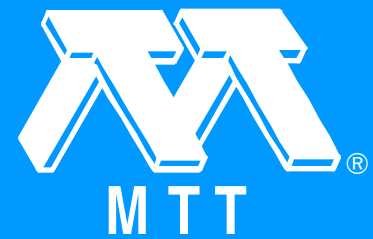
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A compact low-cost add-on module for Doppler radar sensing of vital signs using a wireless communications terminal

V. Lubecke, O. Boric-Lubecke and E. Beck. "A compact low-cost add-on module for Doppler radar sensing of vital signs using a wireless communications terminal." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1767-1770 vol.3.

A simple add-on module that allows the detection of human respiration and heart activity using an unmodified wireless telecommunications terminal is presented here. The module combines an antenna and mixing element to receive direct and back-scattered transmissions from the wireless terminal, and through Doppler radar principles produces an output signal proportional to the motion of the user's heart and chest. This signal can be used to monitor heart and respiration rates, and can potentially be relayed by the wireless terminal to a remote health monitoring facility via the existing telecommunications infrastructure. Module functionality is demonstrated here using a 2.4 GHz cordless telephone.





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Modeling of planar annular applicators for microwave thermotherapy

J. Carlier, V. Thomy, J.-C. Camart, L. Dubois and J. Pribetich. "Modeling of planar annular applicators for microwave thermotherapy." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1771-1774 vol.3.

In order to improve the external applicators used for microwave thermotherapy controlled by microwave radiometry in medical applications, we propose specific annular planar applicators developed for the heating. The final goal of this study is the realization of a honeycomb network for the treatment of larger areas and greater volumes.

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A two zero fourth order microwave waveguide filter using a simple rectangular quadruple-mode cavity

N. Boutheiller, P. Jarry, E. Kerherve, J.-M. Pham and S. Vigneron. "A two zero fourth order microwave waveguide filter using a simple rectangular quadruple-mode cavity." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1777-1780 vol.3.

In order to reduce the size of microwave waveguide filters, triple and quadruple mode filters in circular waveguide have been investigated intensively. However, the research for such filters in rectangular waveguide is still poor and the rare trials have led to complicated sensible structures with loaded cavities. This paper describes a fourth order filter with two transmission zeroes obtained with only one basic rectangular cavity and two irises. Neither coupling nor tuning screws are needed. The analysis at the discontinuities is performed by the moment method. The synthesis lies on an optimization method based on the genetic algorithm.

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26 GHz TM/sub 11/spl delta// mode dielectric resonator filter and duplexer with high-Q performance and compact configuration

A. Enokihara, H. Nanba, T. Nakamura, T. Ishizaki and T. Uwano. "26 GHz TM/sub 11/spl delta// mode dielectric resonator filter and duplexer with high-Q performance and compact configuration." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1781-1784 vol.3.

A novel structure of 26 GHz bandpass filters using TM/sub 11/spl delta// rectangular-mode dielectric cavity resonators is introduced. The resonator of high-permittivity ceramics shows a high quality factor (Q) value of 2600, which is roughly comparable to that of waveguide type ones, in spite of its small structure. A three-stage Tchebyscheff bandpass filter with 0.4% relative bandwidth was fabricated and the passband insertion loss was measured to be 1.7 dB. The filter has input/output ports of microstrip lines for the surface mounting. A duplexer, consisting only of two TM/sub 11/spl delta// mode filters and a microstrip T-junction, is also presented. These filter and duplexer have a configuration compact and easy to manufacture as well as the high-Q performance.

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Low-spurious coaxial-line bandpass filter with saucer-loaded stepped-impedance resonators

H. Uchida, Y. Furukawa and T. Ohwada. "Low-spurious coaxial-line bandpass filter with saucer-loaded stepped-impedance resonators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1785-1787 vol.3.

A low-spurious coaxial-line bandpass filter (BPF) with saucer-loaded stepped-impedance resonators (SAUSIRs) has been developed. The SAUSIR consists of a conventional stepped-impedance resonator (SIR) and a thin metal saucer loaded in the SIR to control higher-order resonant frequencies of the resonator. By adjusting the positions of the saucers in SAUSIRs, higher-order resonant frequencies of the SAUSIRs in BPF can be scattered in frequency domain without shifting dominant resonant frequency, which results in suppression of spurious responses of the BPF for wide frequency range. A fabricated 4-stage coaxial-line L-band BPF with SAUSIRs has realized spurious responses less than -50 dB up to about $10 f_{\text{sub } 0}$, where $f_{\text{sub } 0}$ is the center frequency of the BPF.

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60-GHz-band dielectric waveguide filters with cross-coupling for flip-chip modules

M. Ito, K. Maruhashi, K. Ikuina, T. Hashiguchi, S. Iwanaga and K. Ohata. "60-GHz-band dielectric waveguide filters with cross-coupling for flip-chip modules." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1789-1792 vol.3.

Small-size planar dielectric waveguide filters are presented for 60-GHz-band flip-chip modules. The filters have cross-coupling to introduce an attenuation pole for higher stop-band rejection. We develop two types of three-resonator filters: one has a medium bandwidth and the other has a narrow bandwidth. The former filter shows 1.1-dB insertion loss at a center frequency of 58.3 GHz and 33-dB suppression at a 3-GHz-higher separation. The latter filter shows 3.1-dB insertion loss at a center frequency of 58.4 GHz and a 10-dB-bandwidth of 2.7 GHz. The size of each filter is 3.4 mm/spl times/3.5 mm.

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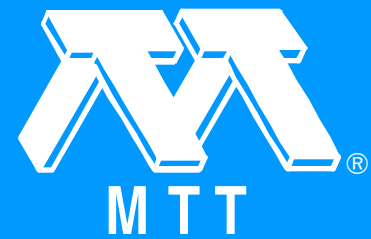


Abstracts

A novel compact coplanar filter

T. Paillot, P. Blondy, D. Cros and P.-Y. Guillon. "A novel compact coplanar filter." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1793-1796 vol.3.

A 30 GHz coplanar two pole filter is presented and consists of two quarter wavelength resonators. It has an original excitation structure based on magnetic coupling. To validate this approach a 2 pole, 10 percent relative bandwidth filter has been fabricated on fused silica. Low loss and good agreement between simulation and measurements have been achieved.



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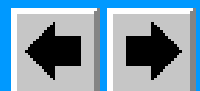
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Novel low-pass filter for broad-band spurious suppression

Moon-Que Lee, Keun-Kwan Ryu, In-Bok Yom and Seung-Pal Lee. "Novel low-pass filter for broad-band spurious suppression." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1797-1800 vol.3.

Novel microstrip-type low-pass filters are proposed to effectively suppress spurious response in stop-band. The proposed low-pass filter employs an open stub microstrip inserted by thin or thick film resistors in the place of a conventional open stub microstrip. The proposed low-pass filters was shown to suppress the spurious response by more than 20/spl sim/40 dB compared with conventional microstrip low-pass filters.

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Improvement of microstrip open loop resonator filter using aperture

Serksoon Im, Chulhun Seo, Jaehoon Kim, Youngwan Kim and Naesoo Kim. "Improvement of microstrip open loop resonator filter using aperture." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1801-1804 vol.3.

Apertures has been employed on the ground plane in the open loop resonator filter. The bandwidth has been widen maximally 40% and the passband ripple has been flatten compared with the conventional open loop resonator filter. The coupling spacing between loops has been widened to easily implement filter.

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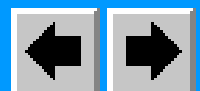
Subjects

Full wave optimization of stripline tapped-in ridge waveguide bandpass filters

M.A. El Sabbagh, Heng-Tung Hsu, K.A. Zaki, P. Pramanick and T. Dolan. "Full wave optimization of stripline tapped-in ridge waveguide bandpass filters." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1805-1808 vol.3.

A bandpass ridge waveguide filter, with input/output realized through tapped-in stripline is designed. Using rigorous mode matching technique the generalized scattering matrices of all the building blocks can be obtained. Design procedure is described and examples are given to demonstrate the features of the proposed coupling structure. The proposed structure shows a considerable reduction of the filter's total length.

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AlGaIn/GaN HFET amplifier performance and limitations

R.J. Trew. "AlGaIn/GaN HFET amplifier performance and limitations." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1811-1814 vol.3.

Wide bandgap semiconductor field-effect transistors based upon the AlGaIn/GaN heterostructure often demonstrate premature saturation and degradation of the RF output power, power-added efficiency, and gain as the device is driven into saturation. The effect is generally accompanied by 'current slump', where the dc current decreases with increasing RF drive. It is demonstrated that charge non-confinement in the 2DEG under large-signal conditions can produce source resistance modulation that degrades RF performance consistent with experimental data.



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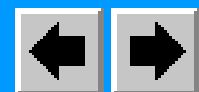
Subjects

A 36 W CW AlGaIn/GaN-power HEMT using surface-charge-controlled structure

T. Kikkawa, M. Nagahara, T. Kimura, S. Yokokawa, S. Kato, M. Yokoyama, Y. Tateno, K. Horino, K. Domen, Y. Yamaguchi, N. Hara and K. Joshin. "A 36 W CW AlGaIn/GaN-power HEMT using surface-charge-controlled structure." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1815-1818 vol.3.

We describe high power 36 W CW operation at 30 V using AlGaIn/GaN HEMTs on SiC. Surface-charge-controlled structure, consisting of n-type doped thin GaN cap layer on AlGaIn/GaN HEMT structure, is used to obtain high gate-drain breakdown voltage and to reduce current collapse. By optimizing threshold voltage of this structure, we obtained a maximum drain current of 1 A/mm and a gate-drain breakdown voltage over 200 V. A 24-mm-wide-gate chip showed output power of 45.6 dBm (36 W) at 2.2 GHz with a liner gain of 9.7 dB.

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Applications of SiC MESFETs and GaN HEMTs in power amplifier design

W.L. Pribble, J.W. Palmour, S.T. Sheppard, R.P. Smith, S.T. Allen, T.J. Smith, Z. Ring, J.J. Sumakeris, A.W. Saxler and J.W. Milligan. "Applications of SiC MESFETs and GaN HEMTs in power amplifier design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1819-1822 vol.3.

Very high power densities have been shown for both SiC MESFET and GaN HEMT devices. Both of these active devices benefit from the high breakdown voltages afforded by their wide-bandgap semiconductor properties. The GaN device also benefits from current densities as high as 1 A/mm. This high power density, along with good efficiency and linearity, provide an excellent base for future military and commercial power amplifier applications. High power densities are possible using narrow band power-matching networks. Although the gain-bandwidth limitation is exacerbated due to the high-impedance load lines required, high power design is possible even over multi-octave bandwidths.





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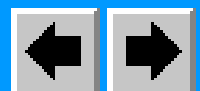
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Trapping effects in wide-bandgap microwave FETs

S.C. Binari, P.B. Klein and T.E. Kazior. "Trapping effects in wide-bandgap microwave FETs." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1823-1826 vol.3.

It is well known that trapping effects can limit the output power performance of microwave field-effect transistors. This is particularly true for the wide-bandgap devices. In this paper, we review the various trapping phenomena observed in SiC and GaN-based FETs that contribute to compromised power performance. For both of these material systems, trapping effects associated with both the surface and with the layers underlying the active channel have been identified.

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Broadband thermoelectric microwave power sensors using GaAs foundry process

A. Dehe, K. Fricke-Neuderth and V. Krozer. "Broadband thermoelectric microwave power sensors using GaAs foundry process." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1829-1832 vol.3.

The paper presents the first demonstration of an integrated MMIC compatible thermoelectric microwave power sensor for frequencies between 1 to 20 GHz using a standard GaAs foundry process. Two different types of sensors are described: an insertion sensor for the measurement of transmitted power through a coplanar waveguide and a termination sensor which measures the power dissipated in a 50 Ω load. The transmission sensor has a very low insertion loss of less than 0.3 dB and VSWR lower than 1.2. Due to their low time constant of approximately 1 μ s, these sensors are well suited for pulsed applications. The sensor exhibits an inherent linearity for large power levels and does not require any bias.

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Novel method for vector mixer characterization and mixer test system vector error correction

J. Dunsmore. "Novel method for vector mixer characterization and mixer test system vector error correction." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1833-1836 vol.3.

This paper presents a novel method for characterizing RF mixers, yielding magnitude and phase response for input match, output match, and conversion loss, and works for mixers which have reciprocal conversion loss and for which the image response can be filtered out. The characterized mixer is used to accomplish a full vector correction of a mixer test system, which can measure other mixers that are not reciprocal. A key contribution is phase and absolute group delay measurements of the mixer-under-test.

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Compensating differences between measurement and calibration wafer in probe-tip calibrations

G. Carchon, W. de Raedt and E. Beyne. "Compensating differences between measurement and calibration wafer in probe-tip calibrations." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1837-1840 vol.3.

Differences in probe-tip-to-line geometry and substrate permittivity between measurement and calibration wafer deteriorate measurement accuracy. In this paper, we compare the accuracy of several models for the probe-to-line transition based on measurements as well as 3-D simulations of various GaAs CPW lines. This shows that 3-D simulations may be used to determine the parasitics at the probe tip as an alternative to measurement based methods. In general, models using 4 error-parameters are preferred to the Y/sub p/- or TL-based model as they provide a higher accuracy while the same amount of measurements is required to implement them.

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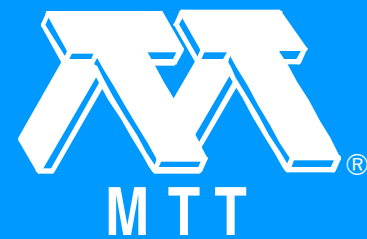


Abstracts

A study of the effect of envelope impedance on intermodulation asymmetry using a two-tone time domain measurement system

D.J. Williams, J. Leckey and P.J. Tasker. "A study of the effect of envelope impedance on intermodulation asymmetry using a two-tone time domain measurement system." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1841-1844 vol.3.

An error corrected two-tone time domain measurement system has been developed and combined with a low frequency active source and load-pull system to investigate the effects of all impedance terminations, IF and RF, on the linearity and efficiency of power transistors. Measured data is presented on a HBT biased in class B stimulated by-a two-tone signal while actively load pulling the low frequency IF component.



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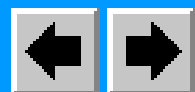
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Simulations of noise-parameter uncertainties

J. Randa. "Simulations of noise-parameter uncertainties." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1845-1848 vol.3.

This paper reports results for uncertainties obtained from a Monte Carlo simulation of noise-parameter measurements. The simulator permits the computation of the dependence of the uncertainty in the noise parameters on uncertainties in the underlying quantities. Results have been obtained for the effect due to uncertainties in the reflection coefficients of the input terminations, the noise temperature of the hot noise source, connector variability, the ambient temperature, and the measurement of the output noise. Representative results are presented for both uncorrelated and correlated uncertainties in the underlying quantities.

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A 94 GHz single-chip FMCW radar module for commercial sensor applications

A. Tessmann, S. Kudzus, T. Feltgen, M. Riessle, C. Sklarczyk and W.H. Haydl. "A 94 GHz single-chip FMCW radar module for commercial sensor applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1851-1854 vol.3.

A single-chip 94 GHz frequency modulated continuous wave (FMCW) radar module has been developed for high resolution sensing under adverse conditions and environments. The monolithic microwave integrated circuit (MMIC) includes a varactor tuned VCO with injection port, very compact transmit and receive amplifiers and a single-ended resistive mixer. To enable bidirectional operation of a single transmit-receive antenna a combination of a Wilkinson divider and a Lange coupler was integrated. The circuit features coplanar technology and cascode HEMTs for compact size and low cost. These techniques result in a particularly small over-all chip-size of only 2/spl times/3 mm/sup 2/. The packaged 94 GHz FMCW radar sensor achieved a tuning range of 6 GHz, an output power of 1 mW and a conversion loss of 5 dB. The RF performance of the radar module was successfully verified by real-time monitoring the time flow of a gas-assisted injection molding process.

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A 38/76 GHz automotive radar chip set fabricated by a low cost PHEMT technology

A. Werthof, H.J. Siweris, H. Tischer, W. Liebl, G. Jaeger and T. Grave. "A 38/76 GHz automotive radar chip set fabricated by a low cost PHEMT technology." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1855-1858 vol.3.

Two complex transmit MMICs have been developed for the conversion of a 38 GHz VCO signal to 76 GHz. They consist of a 38 GHz driver amplifier, a frequency doubler and 76 GHz output amplifiers. These MMICs achieve a saturated output power of 14 dBm at 76 GHz and a maximum conversion gain of 9 dB and 12 dB, respectively. The transmit chips are supplemented by a 38 GHz voltage-controlled oscillator with 1.5 GHz tuning bandwidth and 10 dBm output power. The developed MMICs are designed for flip-chip mounting and have been fabricated by a production oriented PHEMT technology. They are suited for low cost automotive radar systems.

Abstracts

A MMIC-based 75-110 GHz signal source

M. Morgan, S. Weinreb, N. Wadefalk and L. Samoska. "A MMIC-based 75-110 GHz signal source." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1859-1862 vol.3.

This paper describes the design, construction, and testing of a compact W-Band signal source module. The MMIC-based module is an active $\times 6$ frequency multiplier, requiring a 12.5 to 18.5 GHz, 2 mW input signal, which can be provided by any microwave synthesizer or other readily available oscillators. The design includes directional couplers with integrated millimeter-wave detectors on the output for power and reflection monitoring. Output power is voltage-controllable over a 10 dB dynamic range. Test results show 10 dB conversion gain at the maximum output power of about 20 mW across the band.



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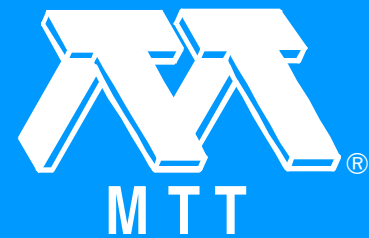
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A Gunn diode based surface mount 77 GHz oscillator for automotive applications

N. Priestley, K. Newsome, I. Dale and P. Norton. "A Gunn diode based surface mount 77 GHz oscillator for automotive applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1863-1866 vol.3.

Gunn diode cavity oscillators are currently used in the majority of ACC 77 GHz radar systems. These are bulky and normally require to be individually tuned. A substrate based voltage controlled oscillator has been developed, still using a Gunn diode; which has small size, is surface mount packaged and which retains the superior performance of a Gunn based oscillator over MMIC solutions. A good performance over temperature is achieved, due to the use of hot electron injection in the Gunn diode and the oscillator is voltage tuned by employing a varactor diode. The design, construction and performance are presented of a planar circuit based VCO which is suitable for high volume production.

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A comparison of W-band monolithic resistive mixer architectures

A.R. Barnes, P. Munday, R. Jennings and M.T. Moore. "A comparison of W-band monolithic resistive mixer architectures." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1867-1870 vol.3.

Three W-band resistive mixer architectures have been designed and their performance compared and contrasted. The mixers were fabricated using 0.1 μm gate length InP HEMT technology for improved conversion loss performance compared to GaAs pHEMT. In particular, a state of art 94 GHz sub-harmonic resistive mixer is reported with 9.5 dB conversion loss when operated with a LO drive level of 2 dBm.



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A micromachined finite coplanar line-to-silicon micromachined waveguide transition for millimeter and submillimeter wave applications

Yongshik Lee, J.P. Becker, J.R. East and L.P.B. Katehi. "A micromachined finite coplanar line-to-silicon micromachined waveguide transition for millimeter and submillimeter wave applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1871-1874 vol.3.

A finite ground coplanar (FGC) line-to-waveguide transition utilizing a novel, free-standing printed E-plane probe has been demonstrated in W-band (75-110 GHz). One way to improve the performance of such a transition and to extend its utility well into the submillimeter range is to thin the supporting substrate beneath the probe. This paper presents the W-band performance of a fully micromachined finite ground coplanar line-to-silicon diamond waveguide transition with the substrate beneath the probe entirely removed, thus forming a free-standing metal structure.

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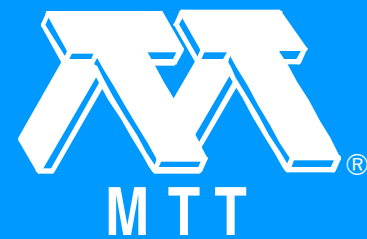


Abstracts

Hybrid analysis of three-dimensional structures by the method of lines using novel nonequidistant discretization

L.A. Greda and R. Pregla. "Hybrid analysis of three-dimensional structures by the method of lines using novel nonequidistant discretization." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1877-1880 vol.3.

Many microwave structures contain various elements with very big difference in their size. Exact modeling of such structures with equidistant discretization requires considerable numerical effort and large memory capacity. Alternative formulas for nonequidistant discretization are proposed. New difference operators for nonequidistant discretization are given. The accuracy of these operators is compared with the previous ones used with the Method of Lines. Numerical results of two microwave filters are presented to check the accuracy of the new algorithm.



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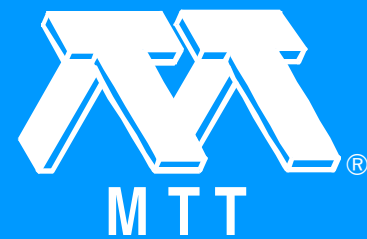
3D hybrid finite-difference method for lossy structures based on quasi-static field solutions

M. Kunze and W. Heinrich. "3D hybrid finite-difference method for lossy structures based on quasi-static field solutions." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1881-1884 vol.3.

A new 3D hybrid finite-difference (FD) method is presented that accounts for finite conductivity. The field gradients inside conductors and structural details are treated combining quasi-static field solutions with the full-wave analysis. In the quasi-static regime, the magnetic field computations and the corresponding source formulation needs special consideration. The hybrid method reduces computational efforts while maintaining accuracy of the conventional FD scheme. The new approach is verified for a MMIC coplanar short stub and airbridges.

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Accuracy limitations of perfectly matched layers in 3D finite-difference frequency-domain method

T. Tischler and W. Heinrich. "Accuracy limitations of perfectly matched layers in 3D finite-difference frequency-domain method." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1885-1888 vol.3.

The perfectly matched layer (PML) boundary condition is employed in conjunction with the 3D finite-difference frequency-domain method (FDFD) for S parameter calculation of microwave devices. We find a residual reflection error, which is related only to discretization at the PML interface. The paper presents a systematic investigation of this parasitic effect and its origin.

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Coupled Pade approximation-finite element method applied to microwave device design

B. Thon, D. Bariant, S. Bila, D. Baillargeat, M. Aubourg, S. Verdeyme, P. Guillon, F. Thevenon, M. Rochette, J. Puech, L. Lapierre and J. Sombrin. "Coupled Pade approximation-finite element method applied to microwave device design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1889-1892 vol.3.

In this paper, a fast and rigorous analysis method is presented, combining the Pade approximation and a finite element method. The method is applied to the design of two microwave devices: a narrow band bandpass filter and a broadband microwave module. The accuracy of this approach is demonstrated by the good agreement between the coupled Pade approximation-finite element analyses and the standard finite element ones, and also between the coupled Pade approximation-FE analysis and the experimental filter response.

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Electromagnetic modeling of interconnects for mixed-signal integrated circuits from DC to multi-GHz frequencies

A. Rong and A.C. Cangellaris. "Electromagnetic modeling of interconnects for mixed-signal integrated circuits from DC to multi-GHz frequencies." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1893-1896 vol.3.

This paper presents a numerically stable methodology for the electromagnetic analysis of three-dimensional interconnect structures from very low (almost dc) to multi-GHz frequencies. The proposed methodology is based on a generalized version of the partial element equivalent circuit interpretation of the electric field integral equation that utilizes triangular cells for the discretization of conductor surfaces and thus is capable of handling structures of arbitrary shapes. The numerical stability of the approximate problem at very low frequencies is achieved through capturing an appropriate tree of the network graph, yielding an enhanced circuit mesh analysis. Numerical experiments are used to demonstrate the numerical stability of the numerical methodology even for frequencies at which the structure under study is a minute fraction of the wavelength.

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An efficient integral equation solver for the electromagnetic modeling of highly-integrated planar RF/microwave circuits

V.I. Okhmatovski, J. Morsey and A.C. Cangellaris. "An efficient integral equation solver for the electromagnetic modeling of highly-integrated planar RF/microwave circuits." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1897-1900 vol.3.

An efficient methodology for the accurate calculation of closed-form Green's function in multilayered planar media is combined with the adaptive integral method (AIM) to provide a fast, iterative, full-wave solver for the analysis of complex planar integrated circuits. The computational complexity per iteration and memory requirements for the AIM-based electromagnetic solver scale as $O(N \log N)$ and $O(N)$, respectively, where N is the number of unknowns in the discrete model. The accuracy and efficiency of the solver is demonstrated through its application to the modeling of an integrated, planar circuit component.

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Simulation of resonant modes of rectangular DR in MIC environment using MPIE-MoM with combined entire-domain and sub-domain basis functions

Yaxun Liu, S. Safavi-Naeini, S.K. Chaudhuri and R. Sabry. "Simulation of resonant modes of rectangular DR in MIC environment using MPIE-MoM with combined entire-domain and sub-domain basis functions." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1901-1904 vol.3.

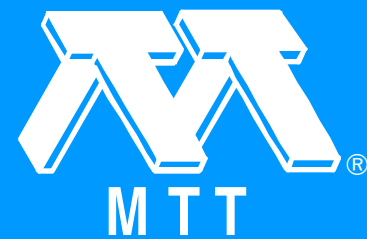
An efficient method-of-moments volume integral formulation using combined entire-domain and subdomain basis functions is proposed for simulating the resonant modes of a rectangular DR in an MIC environment. The formulation is based on the mixed-potential integral equation using Michalski's formulation-C Green's functions. The spatial-domain Green's functions are calculated by using the complex image method. Different from the simple sinusoidal entire-domain basis functions used by previous methods, an approximate solution for the resonant modes of rectangular DR in MIC environment based on Marcatili's method is used as the entire-domain basis function, while a set of tetrahedral basis functions are used as sub-domain basis functions. Since the main profile of the resonant mode can be represented well by the entire-domain basis function, only a small number of sub-domain basis functions are needed for further refinement of the representation. Compared with the method-of-moments formulations using only sub-domain or entire-domain basis functions, this method is much faster for the same accuracy. Numerical results are given and compared with other methods.



A tunable active MMIC filter for on-chip X-band radar receiver front-ends

R. Malmqvist, A. Gustafsson, M. Alfredsson and A. Ouacha. "A tunable active MMIC filter for on-chip X-band radar receiver front-ends." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1907-1910 vol.3.

A 7.9-9.7 GHz tunable active monolithic microwave integrated circuit (MMIC) filter intended for future on-chip X-band radar receiver front-ends is presented together with measured and simulated results. Typical measured filter data over the agile frequency band show a maximum gain of 11-16 dB, a noise figure of 6 dB, an input-referred third order intercept point of 0 dBm and 20-23 dB of out-of-band rejection at 2 GHz below the filter center frequency.



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Active impedance inverter: analysis and its application to the bandpass filter design

Young-Hoon Chun, Sang-Won Yun and Jin-Koo Rhee. "Active impedance inverter: analysis and its application to the bandpass filter design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1911-1914 vol.3.

In this paper the analytical approach to the realizability of the active inverters is described and a very stable active inverter using the conventional feedback network is also proposed. Based on the proposed analysis method active bandpass filters are designed and built at 850 MHz.

Measured results of two and three pole bandpass filters are presented as well as the theoretical results.

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A filter synthesis technique applied to the design of multistage broadband microwave amplifiers (2002 Vol. III [MWSYM])

J.-P. Rooney, R. Parry, I. Hunter and R.D. Pollard. "A filter synthesis technique applied to the design of multistage broadband microwave amplifiers (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1915-1918 vol.3.

A synthesis method for designing multistage broadband amplifiers based upon well known filter synthesis techniques is presented. Common low-pass approximations are used to synthesize the amplifier circuit. A proof of concept Butterworth low-pass two-stage amplifier was designed, simulated and measured, and achieved a flat gain performance of 1-4 GHz with a gain of 15 /spl plusmn/ 1 dB as predicted. A comparison is made with the distributed amplifier (DA) and the cascaded single stage distributed amplifier (CSSDA). Theoretically a larger gain bandwidth product is achieved using the synthesis technique.





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A super-compact super-broadband tapered uniplanar PBG structure for microwave and millimeter-wave applications

C. Caloz and T. Itoh. "A super-compact super-broadband tapered uniplanar PBG structure for microwave and millimeter-wave applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1919-1922 vol.3.

A novel uniplanar photonic bandgap (PBG) structure, consisting of a tapered array of stepped-impedance slot resonators, is introduced. This structure, which is of low cost and easy design/fabrication, exhibits a low-pass behavior, and is characterized by a super-compact size (much smaller than conventional PBGs), a huge gap (about 150%), an excellent insensitivity to circuitry location on top of it and a very low return loss (negligible radiation) in the stop-band. The working principle of the PBG is explained and its performances are demonstrated by simulation and measurement results for different configurations. Simple design guidelines are provided.

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A novel planar silicon waveguide filter at 45 GHz based on a periodic structure

B. Lenoir, P. Blondy, D. Baillargeat, S. Verdeyme, P. Guillon, E. Zheng, C. Tavernier and P. Papapolymerou. "A novel planar silicon waveguide filter at 45 GHz based on a periodic structure." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1923-1926 vol.3.

A novel planar silicon waveguide two-pole filter at 45 GHz with a 2.5% equiripple bandwidth is described in this paper. This filter is comprised of a periodic structure of holes that form coupled silicon resonators. We first describe the geometrical, physical and electrical characteristics of the periodic structure, the silicon resonator and the CPW I/O ports applying the Finite Element Method (FEM). Then a two-pole filter was designed and simulated at the IRCOM, and fabricated at the Georgia Institute of Technology. Measurements are presented.

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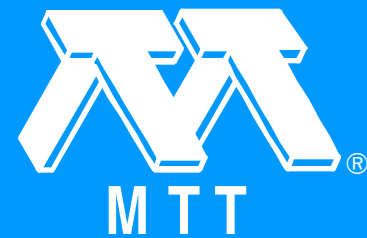


Abstracts

A folded coupled-line structure and its application to filter and diplexer design

Chih-Ming Tsai, Sheng-Yuan Lee, Chia-Cheng Chuang and Chin-Chuan Tsai. "A folded coupled-line structure and its application to filter and diplexer design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1927-1930 vol.3.

In this paper, a folded coupled-line structure which can create a transmission zero is studied. A rough estimate for the frequency of this transmission zero is also given. A compact second-order filter with the folded coupled-line structures and a skew-symmetric (zero-degree) feed structure is designed. The improved shape factor and out-of-band response of this new filter are compared with those of a conventional second-order filter. Finally, this new filter topology is applied to the design of a diplexer.



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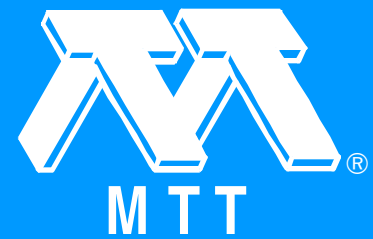
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Narrow-band, band-pass filters with zig-zag, hairpin-comb resonators

G.L. Matthaei. "Narrow-band, band-pass filters with zig-zag, hairpin-comb resonators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1931-1934 vol.3.

"Hairpin-comb" filters have been previously shown to have special properties which are advantageous for the design of compact, narrow-band, band-pass microstrip filters. Herein, a new "zig-zag" form of hairpin-comb filter is introduced which is shown to have additional important advantages for designing compact narrow-band filters. Examples with computed and measured results are presented.

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Multiple output photonic RF phase shifters for optically controlled radar systems

*H. Fetterman, Jeehoon Han, Hua Zhang, H. Erlig, D. Chang, Min-Cheol Oh and W. Steier.
"Multiple output photonic RF phase shifters for optically controlled radar systems." 2002 MTT-S
International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1937-1940 vol.3.*

Photonic RF phase shifters with independent multiple outputs have been fabricated using our novel polymer modulator technology. These integrated planar devices incorporated low crosstalk optical waveguide crossings, which were critical to the independent operation of RF phase outputs. The measured RF phase shift characteristics at 20 GHz were approximately linear up to $\pm 150^\circ$ with respect to DC control voltages. Also new systems, currently being developed, will provide more linear transfer function for the RF phase and relatively constant amplitude with four outputs. Compact optically controlled antenna systems based on this technology are presented.

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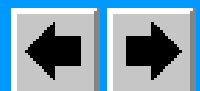
[Subjects](#)

Flexible beamformer and remoting head for optically controlled phased array antennas

N.A. Riza, S.A. Khan and M.A. Arain. "Flexible beamformer and remoting head for optically controlled phased array antennas." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1941-1944 vol.3.

A unique photonic beamformer and remoting head for array antennas in broadcast mode wireless communication is proposed enabling for the first time, flexible antenna array upgrades via software and flexible front-head attachments leading to user defined changes in number of antenna elements and carrier frequency. Initial experimental results are described.

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A novel 2N beams heterodyne optical beamforming architecture based on N/spl times/N optical Butler matrices

D. Madrid, B. Vidal, A. Martinez, V. Polo, J.L. Corral and J. Marti. "A novel 2N beams heterodyne optical beamforming architecture based on N/spl times/N optical Butler matrices." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1945-1948 vol.3.

A novel beamforming architecture based on optical Butler matrices is proposed and experimentally evaluated. The optical Butler matrix operating principle and the effects of fabrication inaccuracies on the beamformer radiation pattern are presented. The proposed architecture offers simultaneous multibeam generation capability. 40 GHz RF phase measurements are presented with low ripple and high linearity. Finally, an upgraded architecture is proposed which allows to double the number of beams (2N).

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Photonic true-time delay beamformer for broadband wireless access networks at 40 GHz band

B. Vidal, D. Madrid, J.L. Corral, V. Polo, A. Martinez, J.H. den Besten, F. Soares, J. Marti and M.K. Smit. "Photonic true-time delay beamformer for broadband wireless access networks at 40 GHz band." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1949-1952 vol.3.

The design parameters, sensitivity analysis and time delay measurements of a photonic true-time delay beamformer for broadband adaptive wireless access networks in the 40 GHz band are presented. The beamforming is achieved by using a multiwavelength laser in combination with a digital delay line based on optical switches and dispersive fibers.

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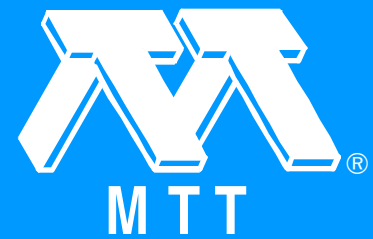


Optical mixing of antenna signals in WDM systems

B. Cabon, V. Girod and G. Maury. "Optical mixing of antenna signals in WDM systems." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1953-1956 vol.3.

We present here an original method for optical generation of microwave mixing on different multiplexed optical carriers : usually, mixing is achieved with active devices, here it is achieved with a passive optical device. Mixing on several multiplexed optical channels is obtained with the same device, a unique interferometer working on any wavelength range, and is neither limited in the number of optical carriers nor in the number of RF ports. Thus, the presented technique can be advantageously applied to radar signal processing in optical systems because this type of multiplexing cannot be obtained in the pure electrical domain.

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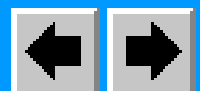
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Folded dual-mode HTS microstrip band pass filter

K.F. Raihn and G.L. Hey-Shipton. "Folded dual-mode HTS microstrip band pass filter." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1959-1962 vol.3.

A novel dual-mode HTS microstrip resonator is presented. Interdigitated capacitive networks replace the usual distributive coupling. Also, a novel symmetrically folded technique is used that reduces the physical size of the structure while minimizing unwanted coupling and maintaining well defined transmission zeros.

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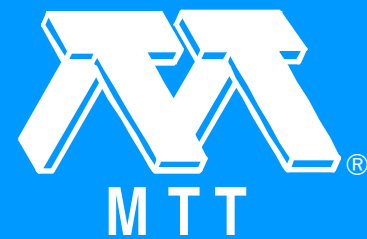
Ultra selective 22-pole, 10-transmission zero superconducting bandpass filter surpasses 50-pole Chebyshev rejection

G. Tsuzuki, Shen Ye and S. Berkowitz. "Ultra selective 22-pole, 10-transmission zero superconducting bandpass filter surpasses 50-pole Chebyshev rejection." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1963-1966 vol.3.

An ultra selective filter for 3G and 4G wireless application is presented. The demonstrated filter consists of twenty-two resonators and five cross couplings that produce ten transmission-zeros. The filter was designed at 1950 MHz center frequency with a 20 MHz bandwidth to meet existing 3G wireless applications. The measured data from the filter exhibited excellent selectivity, steeper than 30 dB/100 kHz skirt slope and 90 dB rejection at 350 kHz from the band edge. This filter surpasses the rejection of a 50-pole Chebyshev filter. To design a large number of resonators in a limited wafer area, a new compact resonator was developed. The filter was fabricated using a YBCO thin film on a 2-inch MgO wafer.

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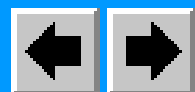
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A low-loss 5GHz bandpass filter using HTS coplanar waveguide quarter-wavelength resonators

Zhewang Ma, H. Suzuki, Y. Kobayashi, K. Satoh, S. Narahashi and T. Nojima. "A low-loss 5GHz bandpass filter using HTS coplanar waveguide quarter-wavelength resonators." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1967-1970 vol.3.

A novel low-loss high temperature superconductor (HTS) filter is proposed by using coplanar waveguide quarter-wavelength resonators. A 4-pole Chebyshev bandpass filter with a center frequency 5.0GHz and a 0.01dB-ripple fractional bandwidth 3.2% is designed and fabricated using a YBCO film deposited on a MgO substrate. The frequency response of the filter measured at 60K agrees very well with the theoretical prediction. The measured insertion loss is 0.22dB, the lowest reported so far for HTS coplanar waveguide filters.

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Tuning superconducting microwave filters by laser trimming

N.J. Parker, S.W. Goodyear, D.J.P. Ellis and R.G. Humphreys. "Tuning superconducting microwave filters by laser trimming." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1971-1974 vol.3.

At present, superconducting filters are usually tuned using screws, but there are many reasons to seek an alternative. Laser trimming is an attractive choice. A laser trimming system is described that can tune a high temperature superconductor microstrip filter while it is cooled and connected to a network analyser. Software has been written to control the system, fit measured data and modify a filter design to account for unintended couplings. The residual material left after trimming $\text{YBa}/\text{sub } 2/\text{Cu}/\text{sub } 3/\text{O}/\text{sub } 7-\text{spl delta}/$ has been shown to have negligible microwave loss. The system has been used to tune a simple three-resonator filter.

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Design of sapphire rod resonators to measure the surface resistance of high temperature superconductor films

T. Hashimoto and Y. Kobayashi. "Design of sapphire rod resonators to measure the surface resistance of high temperature superconductor films." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1975-1978 vol.3.

Sapphire rod resonators of three types, as proposed in the IEC/TC90/WG8, have been commonly used to measure the surface resistance R_{surf} of high temperature (high- T_c) superconducting (HTS) films. One is called an open-type resonator, where a sapphire rod having diameter D and length L is placed between two parallel HTS films, and the other is called a closed-type resonator, where the sapphire rod is set in a cavity constructed from two HTS films and a copper ring having diameter d and height h . Some mode charts for these resonators are calculated from the rigorous analysis based on the mode matching method, taking account of an uniaxial-anisotropic characteristic of a sapphire rod. An optimum dimension of a sapphire rod resonator is designed from the mode charts so as to separate the TE_{011} mode from the other modes. Moreover, it is verified that the radiations of the leaky state TM modes influence the unloaded Q_u values of the open-type resonator. As a result, the closed-type sapphire resonator having a dimension ratio $X^2 = (D/L)^2$ of 4 and diameter ratio $S = d/D$ of 4 should be used.

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Shunt capacitor approximation for HTS microstrip circuit design

Shen Ye. "Shunt capacitor approximation for HTS microstrip circuit design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1979-1982 vol.3.

This paper presents a novel technique of using loop transmission lines to approximate shunt capacitors for microstrip type circuit design. The size of the surface area may be effectively reduced and greater layout flexibility can be achieved. This is particularly useful in HTS thin film microstrip circuit design because of its extreme low loss and limited substrate sizes. A 5-pole AMPS 1 MHz bandstop filter is shown as an example.

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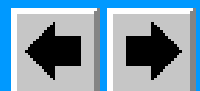
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TE-mode propagation properties of the coupled planar Kerr-like nonlinear waveguides

Jian-Guo Ma. "TE-mode propagation properties of the coupled planar Kerr-like nonlinear waveguides." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1985-1988 vol.3.

For the first time, a closed form expression of coupled Kerr-like nonlinear planar waveguides is derived for both guided and surface waves. The wave propagation properties along the Kerr-like nonlinear waveguides are investigated analytically. The results show that the propagation properties depend on the permitted transmission powers and the initial excitation conditions. All the possible solutions can co-exist in the waveguide structures without mode-coupling.

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Generation of wideband electromagnetic response through a Laguerre expansion using early time and low frequency data

T.K. Sarkar, J. Koh and M. Salazar-Palma. "Generation of wideband electromagnetic response through a Laguerre expansion using early time and low frequency data." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1989-1992 vol.3.

The objective of this paper is to generate an ultrawideband and long temporal response for three-dimensional structures. This is accomplished through the use of a hybrid method that involves generation of early time and low frequency information for the electromagnetic structure of interest utilizing available electromagnetic codes. Early time and low frequency data are mutually complementary and contain all the necessary information for an ultrawideband response for a sufficient record length. The time domain response is modeled as a Laguerre series expansion. The frequency domain response is also expressed in an analytic form using the same expansion coefficients used in modeling of the time domain response. The data in both domains are used to solve for the polynomial coefficients in a data fitting procedure. Once these coefficients are known, the available data are simultaneously extrapolated in both domains. This approach is attractive because expansions with a few terms give good extrapolation in both time and frequency domains.

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New design of high-Q sapphire resonator with distributed Bragg reflector

O. Piquet, D. Cros, S. Verdeyme, P. Guillon and M.E. Tobar. "New design of high-Q sapphire resonator with distributed Bragg reflector." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1993-1996 vol.3.

In this paper, new sapphire resonator designs based on Bragg reflectors are presented. This study is based on the method of lines and is shown to be in good agreement with experiment. The resonant frequencies, field distribution and quality factors can be calculated by this method. An initial design using a TE/sub 01/spl gamma// mode in a sapphire ring resonator is presented. A Q-factor of 100,000 was measured. We show that with further optimization a Q-factor about 200,000 is possible.

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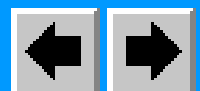
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Ferrite filled reflector mode converter for axially corrugated waveguides

A.J. Viitanen and T.M. Uusitupa. "Ferrite filled reflector mode converter for axially corrugated waveguides." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 1997-2000 vol.3.

The mode transformation effect is considered for axially tuned corrugated waveguides. Recently, this effect for transmitted fields was introduced by using a certain kind of material which couples the propagating fields. In this paper, a reflector type mode converter based on ferrite material is proposed. The properties of ferrite can be changed by using a static magnetic field, which allows the possibility for tuning to obtain an optimal mode transformation in reflection. The properties of transverse fields in reflection are considered.

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New transmission line structure with suppressed eddy current effects

M. Peter, H. Hein, F. Oehler and P. Baureis. "New transmission line structure with suppressed eddy current effects." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2001-2004 vol.3.

A new transmission line structure is presented which features suppression of eddy currents and skin-effect. This results in lower loss and lower frequency dependence of line parameters. Transmission lines were fabricated in a standard digital CMOS process with 3 metal layers and low resistance substrate. Measurements were performed and the successful reduction of eddy currents in the metal conductors could clearly be identified.

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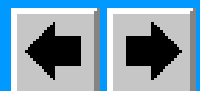
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An analytical method for the microwave imaging of cylindrically stratified media

M.J. Akhtar and A.S. Omar. "An analytical method for the microwave imaging of cylindrically stratified media." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2005-2008 vol.3.

An analytical method for the imaging of cylindrically stratified media is presented. The proposed method is based on the direct problem formulation of cylindrical dielectric objects using the concept of radial transmission line theory. This direct equation is then inverted to obtain a closed-form solution of the radially varying permittivity profile in terms of its value at the interface and the Hankel transform of the reflection coefficient data. A technique to obtain the value of the permittivity at the air-dielectric interface from the multi frequency scattering data is also presented here. A number of examples have been considered and a good agreement between the actual and the reconstructed profiles show that the proposed technique is suitable for both continuous and discontinuous profiles.

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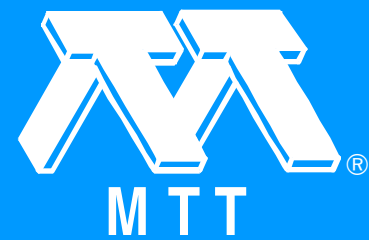
Resonant tunneling of microwave energy in thin film multilayer metal/dielectric structures

A. Eriksson, A. Deleniv and S. Gevorgian. "Resonant tunneling of microwave energy in thin film multilayer metal/dielectric structures." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2009-2012 vol.3.

Multilayer metal/dielectric structures, typically consisting of sub-micrometer thickness dielectric and metal layers (two or more), are highly transparent at microwave frequencies, if properly designed. The high transparency is due to the resonant tunneling of microwave power through metal layers, provided that they are thinner than the skin depth, and the metal/dielectric layers are designed (dielectric constant, thickness, conductivity, lateral dimension) to provide a coherent phase distribution. A method, combining axial and radial resonance conditions, is used to optimize the multilayer electrodes in a circular parallel-plate disk resonator and achieve substantial quality factor enhancement in comparison with thick metal electrodes.

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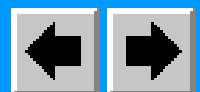
Subjects

High functionality mode transformers with bandwidth control and mode selectivity

Ming-Chuan Yang and K.J. Webb. "High functionality mode transformers with bandwidth control and mode selectivity." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2013-2016 vol.3.

We propose high functionality field transformation in irregular rectangular waveguide structures. Multiresolution optimization allows good convergence and a stepped wall profile provides for a large number of degrees of freedom. The resulting structures are compact, with dimension of a few wavelengths, and can have functionality not achievable through periodic means. For illustration, we have designed frequency-dependent mode converters, mode-selective reflectors, and multiple mode converters, where more than one mode is converted simultaneously, all with virtually 100% efficiency. Non-uniqueness affords design selection based on the frequency response.

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Frequency parameterization of open structures by modal decomposition using finite elements and spherical modes

Y. Adane, A. Gati, M.F. Wong and V.F. Hanna. "Frequency parameterization of open structures by modal decomposition using finite elements and spherical modes." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2017-2020 vol.3.

This paper presents an extension of the modal decomposition technique for the frequency parameterization of open structures. Modal decomposition based on the computation of the poles and modes of 3D geometries allows us to achieve broadband characterization of a microwave structure. So far, the technique is restricted to closed structures. With the help of spherical modes for the outer region of open structures, full-wave 3D models parameterized in frequency can be obtained. These models can be derived efficiently from a few rigorous computations at given frequencies using the finite-element method.

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Novel wave effects on anisotropic and ferrite planar slab waveguides in connection with singularity theory

A.B. Yakovlev and G.W. Hanson. "Novel wave effects on anisotropic and ferrite planar slab waveguides in connection with singularity theory." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2021-2024 vol.3.

The characteristic interactions of discrete modes supported by planar isotropic and anisotropic dielectric and ferrite slab waveguides are analyzed using singularity and critical point theory, leading to a rigorous and complete explanation of all modal interactions. For an anisotropic planar waveguide having an arbitrarily-orientated optical axis, it is shown that mode coupling is controlled by the presence of an isolated Morse critical point accompanied by a pair of complex-conjugate frequency-plane branch points. The interaction of space-wave leaky modes on a grounded anisotropic slab is studied by investigating the evolution of complex frequency-plane branch point singularities as the orientation of the optical axis varies. Space-wave leaky modes of a biased grounded ferrite slab waveguide are studied in connection with different types of branch-point singularities, resulting in the observation of novel wave effects on ferrite slabs. The general theory is presented, and numerical results are provided for some specific waveguides.

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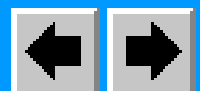
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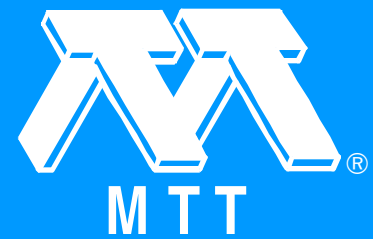
FEM-based reduced-order model for steady-state skin-effect analysis in lossy lines

F. Bertazzi, F. Carbonera, M. Goano and G. Ghione. "FEM-based reduced-order model for steady-state skin-effect analysis in lossy lines." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2025-2028 vol.3.

A quasi-static finite element technique is proposed for the accurate and efficient computation of the frequency-dependent characteristic parameters of lossy transmission lines having electrodes of arbitrary cross-section on multi-layered, planar or non-planar substrates. A novel formulation of the magneto-quasi-static problem is combined with a robust fast frequency-sweep technique based on the numerical generation of problem-matched basis functions. The proposed technique enables to accurately model the frequency-dependent penetration of electromagnetic fields inside lossy conductors with a reduced set of problem-specific functions. Extensive comparisons are provided between state-of-the-art full-wave finite element method and the present technique: excellent agreement is demonstrated with the full-wave solution, at a fraction of its computational cost.

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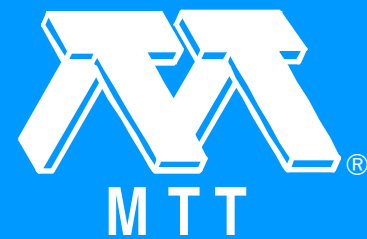
Modified RWG basis functions for analysis of periodic structures

P.S. Simon. "Modified RWG basis functions for analysis of periodic structures." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2029-2032 vol.3.

Modifications to the popular Rao-Wilton-Glisson (RWG) triangle subdomain basis functions are described that allow their use in analyzing periodic structures where the electric or magnetic surface current must be allowed to flow across unit cell boundaries. Examples of frequency selective surfaces with this requirement include strip grids and meanderline polarizers.

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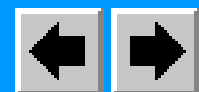
[Subjects](#)

Line-integral formulation of the hybrid MM/FEM technique

V. Crino, C. Tomassoni and M. Mongiardo. "Line-integral formulation of the hybrid MM/FEM technique." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2033-2036 vol.3.

We apply a line-integral formulation to the hybrid mode-matching/FEM Technique for the analysis of discontinuities with waveguides of arbitrary cross-section. The line-integral formulation is used instead of standard surface integrals, not only for the evaluation of coupling integrals but also for normalization integrals computation. In this way a noticeable advantage is gained in terms of numerical efficiency, particularly when accurate solutions are sought for. Numerical examples validate the proposed approach.

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Efficient calculation of effective material parameters in metamaterials using FDTD and a modal approach

R. Schuhmann and T. Weiland. "Efficient calculation of effective material parameters in metamaterials using FDTD and a modal approach." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2037-2040 vol.3.

We present an efficient modal approach in combination with the Finite Integration Technique (FIT) - a generalized FDTD-like method - to analyze resonant structures. Rather than performing time-consuming time-stepping of long transients, the eigenmodes of the spatial discretization operators are utilized to extract frequency-domain parameters of the simulated devices. As an application we calculate averaged material parameters of recently proposed so-called metamaterials, which show a distinctive resonant behavior with negative permittivity and permeability in a certain frequency range.

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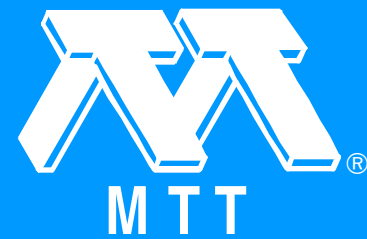


Abstracts

An efficient technique for the iterative solution of large dense matrices arising in method of moments simulation of MMIC problems

V.V.S. Prakash and R. Mittra. "An efficient technique for the iterative solution of large dense matrices arising in method of moments simulation of MMIC problems." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2041-2044 vol.3.

This paper presents a novel technique referred to herein as MNM for efficient iterative solution of MoM matrices over a broad frequency range. It utilizes a combination of techniques to reduce the number of iterations required to generate the solution including a special choice of the initial guess, and efficient preconditioning. Numerical results are presented to illustrate the application of the MNM to representative microwave circuit analysis problems.



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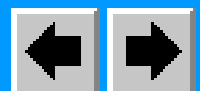
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Multiple scattering among vias in planar waveguides using SMCG method

Chung-Chi Huang, Leung Tsang and Chi Hou Chan. "Multiple scattering among vias in planar waveguides using SMCG method." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2045-2048 vol.3.

Large scale full-wave solution of multiple scattering among cylindrical vias in planar waveguides is modeled using Foldy-Lax equations. Solution of the Foldy-Lax equations with large number of unknowns is done efficiently using the sparse-matrix canonical-grid method. In the method, interactions among vias are decomposed into strong interactions part and weak interactions part where the calculation can be carried out using 2D-FFT after the locations of the vias have been translated onto the uniform grids. The final solution of the Foldy-Lax equations is calculated by iterative method with matrix-vector multiplication speeded up by the 2D-FFT operation. The results show $O(N \log N)$ CPU efficiency and $O(N)$ memory efficiency and make large scale via problem possible for computer simulation.

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Development of an unconditionally stable full-wave 2D ADI-FDTD method for analysis of arbitrary waveguiding structures

Changning Ma, Zhizhang Chen and An-ping Zhao. "Development of an unconditionally stable full-wave 2D ADI-FDTD method for analysis of arbitrary waveguiding structures." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2049-2052 vol.3.

This paper presents the development of unconditionally stable full-wave 2D ADI-FDTD method for analysis of characteristics of arbitrary uniform waveguiding structures. The method is derived by assuming the field variation of $e^{j\beta z}$ along the z-direction and multiplying the field equations with an additional factor j in the recently developed 3-dimensional ADI-FDTD algorithm. In difference from the conventional full-wave 2D FDTD, it does not require that the time step be bounded by the stability condition. As a result, much CPU time and memory can be saved. The dispersion relation of the method is also presented and is used to determine effects of discretization parameters on the accuracy. To validate the method, a boxed microstrip line on an anisotropic sapphire substrate is calculated and the results are compared with those obtained with other methods.

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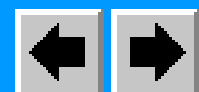
[Subjects](#)

Direct EM based optimization of advanced waffle-iron and rectangular combline filters

F. Arndt and J. Brandt. "Direct EM based optimization of advanced waffle-iron and rectangular combline filters." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2053-2056 vol.3.

A fast hybrid mode-matching (MM)/finite-element (FE) method is applied for the direct EM based optimization of advanced waffle-iron filters and coax-fed rectangular combline filters. The proposed technique, which combines the efficiency of the MM with the flexibility of the FE technique, achieves the direct EM based optimization of these components within typically an overnight run on a PC. The CAD method is verified by measurements.

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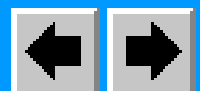
Subjects

A new time domain near field to far field transformation for FDTD in two dimensions

Feng Xu, Wei Hong and Xiaowei Zhu. "A new time domain near field to far field transformation for FDTD in two dimensions." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2057-2060 vol.3.

An algorithm of 2-D near field to far field transformation for the finite difference time-domain (FDTD) method is proposed in this paper. The transient far field response of a two-dimensional structure is obtained straightforwardly in the time domain without Fourier transformation. The abnormal integral for time in 2-D time domain Green function is transformed to a normal form by means of analytic method. Besides, by use of quantifying the positions of equivalent sources and arranging the time series, the calculations of the time integrals of equivalent sources are converted to the calculation of matrix-vector multiplying. A good agreement between both results has been observed.

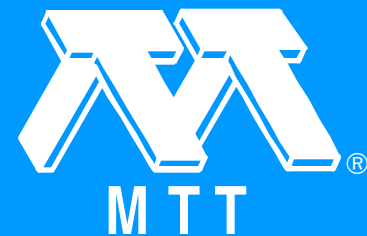
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2-D envelope finite element (EVFE) technique - implementation of PML and dispersive medium

Weijun Yao, Yuanxun Wang and Tatsuo Itoh. "2-D envelope finite element (EVFE) technique - implementation of PML and dispersive medium." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2061-2064 vol.3.

An implementation of perfect matched layer (PML) boundary conditions for 2-D envelope finite element (EVFE) techniques is proposed. The performance of PML is tested for different excitation modes and number of layers. It shows overall 50 dB absorption with a 16 layers absorber. Furthermore, the extended EVFE formulation for structures containing dispersive medium is also presented. Numerical results generated show good agreements with analytical results.



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Efficient transient simulation of transmission lines

M. Condon. "Efficient transient simulation of transmission lines." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2065-2068 vol.3.

The paper focuses on revealing the salient structural aspects of a new transmission-line model with a view to exploiting them for gains in efficiency and accuracy. The new transmission-line model has as its basis the Telegraphers Equations but the manner of solution is what distinguishes the new approach from existing transmission-line simulation techniques. The technique is based on identifying natural modes of oscillation on the transmission line. The result is a model structure which can be tailored to the accuracy requirements of a simulation and which is amenable to tuning to fit measured admittance data.

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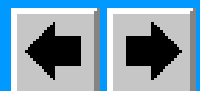
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Inductance formula of a square spiral inductor on grounded substrate by duality and synthetic asymptote

W.C. Tang and Y.L. Chow. "Inductance formula of a square spiral inductor on grounded substrate by duality and synthetic asymptote." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2069-2072 vol.3.

This paper gives a simple CAD formula for inductance of square spiral inductor with grounded substrate, by duality and synthetic asymptote. The average error of the formula is less than 2%. The formula also gives good physical insights to the layout design of the inductor spiral.

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Electromagnetic/Circuit co-optimization of lumped component and physical layout parameters using generalized layout components

J. Sercu and F. Demuynck. "Electromagnetic/Circuit co-optimization of lumped component and physical layout parameters using generalized layout components." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2073-2076 vol.3.

This paper describes the concept of a generalized parametric layout component which enables one to simultaneously optimize the physical layout variations together with lumped passive and active component parameters. This is realized by a seamless integration of a electromagnetic simulator within a circuit simulation and optimization tool. The electromagnetic S-parameter model is generated dynamically for each set of layout component parameters, as selected by the optimizer. An electromagnetic model database keeps track of the generated S-parameter models for later reuse. This concept is illustrated in the design of an RF board low noise amplifier circuit.

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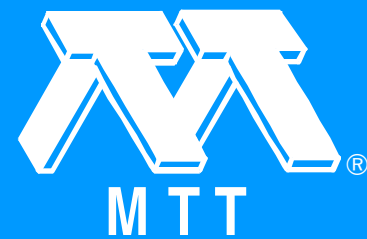
CAD of multipactor-free waveguide components for communication satellites

M. Ludovico, L. Accatino, G. Zarba and M. Mongiardo. "CAD of multipactor-free waveguide components for communication satellites." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2077-2080 vol.3.

Power handling capabilities of satellite waveguide components are limited by multipactor discharge which, so far, has received scarce attention in terms of a model for design purposes. We describe a procedure, based on the knowledge of the field distribution inside the considered component, for calculating the minimum power above which the multipactor risk becomes significant. It is shown that the proposed technique allows to avoid over-restrictive specifications and is useful for quantitative evaluation of multipaction prevention techniques. Experimental results and examples confirm the procedure validity.

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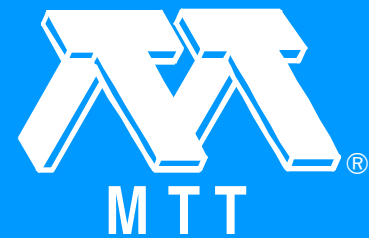
Subjects

CAD of waveguide structures with production based radii at arbitrary double (E-H) plane steps and junction ports

J.M. Reiter, R. Beyer and U. Rosenberg. "CAD of waveguide structures with production based radii at arbitrary double (E-H) plane steps and junction ports." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2081-2084 vol.3.

The introduction of an enhanced Boundary Contour Mode Matching (BCMM) approach is shown to provide accurate and efficient analysis of waveguide structures with curved shapes at double (E-H) plane discontinuities of junctions and steps. Such geometries take account of the capabilities of state-of-the-art CNC milling production techniques, commonly used for integrated waveguide subsystems. The method is based on direct expansion of the electromagnetic fields of the double-plane discontinuities into the modes of the connecting rectangular waveguides and additionally in case of junctions into cylindrical cavity modes. Validation of the approach has been proven by several component designs, that exhibit almost coincidence of computed and measured responses. The results of a special 4-pole filter design at 10 GHz using bypass couplings for a tailored asymmetric response and a 3 dB E-plane short-slot coupler, operating at 32 GHz, are presented as quite different examples.





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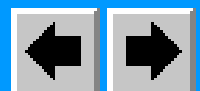
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Electrothermal modeling of multi-fingered PHEMTs applying a global approach

E. Byk, D. Lopez, D. Baillargeat, S. Verdeyme, R. Quere, R. Sommet, P. Guillon, E. Laporte and M. Soulard. "Electrothermal modeling of multi-fingered PHEMTs applying a global approach." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2085-2088 vol.3.

In this paper, a global method is proposed to characterize the electrothermal behavior of multi-fingered Pseudomorphic High Electron-Mobility Transistors (PHEMTs). The method is based on the coupling of circuit, electromagnetic and thermal softwares. It is shown that scaling rules have just to be applied for intrinsic performances of a transistor when extrinsic elements and thermal effects are rigorously taken into account.

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Accurate computer aided design of interdigital filters applying a coupling identification method

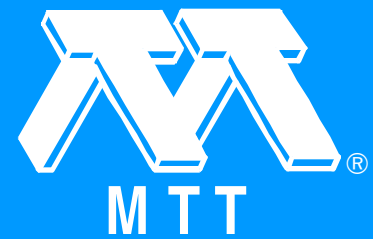
C. Saboureau, S. Bila, D. Baillargeat, S. Verdeyme and P. Guillon. "Accurate computer aided design of interdigital filters applying a coupling identification method." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2089-2092 vol.3.

Interdigital filters are found to be difficult to adjust because of improper couplings that occur at high frequency. To solve this problem, a new optimization method for the design of high frequency interdigital filters is presented in this paper. This optimization method uses an accurate computer aided design method, based on the identification of each resonator coupling including parasitic ones. In order to show the feasibility of such a method an example of a 3.1 GHz band-pass filter around 18.95 GHz is studied.

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Language design requirements for VHDL-RF/MW/sup TM/

J. Willis and J. Johnson. "Language design requirements for VHDL-RF/MW/sup TM/." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2093-2095 vol.3.

This paper describes design requirements for VHDL-RF/MW/sup TM/. The resulting language design addresses distributed and full-wave interconnect models, frequency-domain modeling and parasitic interactions so as to maintain full conceptual and representational compatibility with VHDL, VHDL-AMS, Verilog, Verilog-AMS and SPICE.

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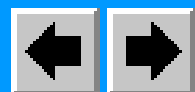
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CAD of integrated passives on printed circuit boards through utilization of multiple material domains

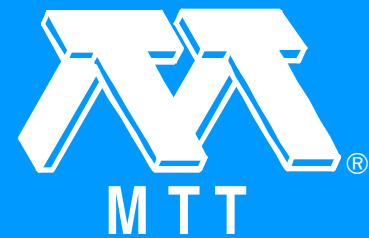
P. Draxler. "CAD of integrated passives on printed circuit boards through utilization of multiple material domains." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2097-2100 vol.3.

With the addition of microvia and other organic layer technologies, integrated passives on Printed Circuit Boards (PCB) are a possible way to reduce the cost and size of designs in FR4 and similar panelized manufacturing processes; however, the actual deployment of this design methodology has been limited by CAD tools and current design methodologies. In this paper, a CAD methodology for PCB's is presented that defines correlated component representations in two material stratifications. One is similar to the current SMT component approach whereas the other is an integrated passives approach. By specifying the materials carefully and creating a mapping of components between the two physical domains, a product development methodology is described that combines the best characteristics of both domains while minimizing risk.

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EM-based optimization exploiting partial space mapping and exact sensitivities (2002 Vol. III [MWSYM])

J.W. Bandler, A.S. Mohamed, M.H. Bakr, K. Madsen and J. Sondergaard. "EM-based optimization exploiting partial space mapping and exact sensitivities (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2101-2104 vol.3.

We present a family of robust techniques for exploiting sensitivities in EM-based circuit optimization through Space Mapping (SM). We utilize derivative information for parameter extractions and mapping updates. We exploit a Partial Space Mapping (PSM) concept where a reduced set of parameters is sufficient for parameter extraction optimization. Upfront gradients of both EM (fine) model and coarse surrogates can Initialize possible mapping approximations. Illustrations include a two-section 10:1 impedance transformer and a microstrip bandstop filter.

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ANN and EM based models for fast and accurate modeling of excitation loops in combline-type filters

A. Borji, D. Busuioc, S. Safavi-Naeini and S.K. Chaudhuri. "ANN and EM based models for fast and accurate modeling of excitation loops in combline-type filters." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2105-2108 vol.3.

A fast hybrid model for accurate modeling of excitation loops and taps in a class of coupled coaxial cavity filters is presented. The model consists of a lumped element equivalent circuit and a set of fast parametric models including an EM based model for mutual coupling and a neuromodel for parasitic inductance and capacitance of the coupling device. This model provides an ideal tool in synthesis and optimization of combline-type filters and diplexers to minimize the return loss and reduce the cost of post fabrication tunings.

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IC package and bonding wire modeling software and its application to RFIC design

K. Goto, A. Dec, Y. Horio, K. Suyama and H. Akima. "IC package and bonding wire modeling software and its application to RFIC design." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2109-2112 vol.3.

This paper presents an IC package and bonding wire modeling software which generates an equivalent lumped circuit model from physical information of IC package and bonding wires. The resulting model takes into account the effects of frequency-dependent resistance, capacitance, as well as self and mutual inductance. The accuracy of the modeling approach has been verified using a 20-pin lead-less plastic chip carrier package. Furthermore, the application of the IC package characterization software to the design of a 700 MHz CMOS VCO has also been demonstrated.

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Constrained EM-based modeling of passive components

T. Dhaene, J. De Geest and D. De Zutter. "Constrained EM-based modeling of passive components." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2113-2116 vol.3.

An adaptive algorithm is developed for constrained modeling of general passive components. The algorithm builds compact, multidimensional, analytical circuit models and represents the scattering parameters of the passive components as a function of its geometrical parameters and as a function of the frequency. Multiple constraints, or relationships between the geometrical parameters, may exist. The model generation algorithm combines iterative sampling and modeling techniques. It groups a number of full-wave electromagnetic (EM) simulations in one multidimensional analytic model. The modeling accuracy level is user-defined. The analytical circuit models can easily be implemented and used in commercial circuit simulators. The models provide EM-accuracy and generality at traditional circuit simulation speed.



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Microwave noise sources in AlGaAs/GaAs HBTs

P. Sakalas, M. Schroter, P. Zampardi, H. Zirath and R. Welse. "Microwave noise sources in AlGaAs/GaAs HBTs." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2117-2120 vol.3.

Scattering and noise parameters of AlGaAs/GaAs HBTs from Conexant with 30 and 35% of Al mole content were measured and modeled. De-embedding of the pad parasitics was accurately performed by using a "two step" method and small-signal modeling. Small-signal hybrid π /Pi type model parameters were extracted from "cold" and "hot" HBT measurements. Thermal, hot electron and correlated base and collector current shot noises were included in the noise model, which accounted well for the measured noise parameters. From the resolution of noise sources It was found that minimum in noise figure at 5 GHz stems from the correlation of base and collector shot noise. Al content in the alloy does not influence the high frequency noise properties of the AlGaAs/GaAs HBTs.





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A practical small-signal equivalent circuit model for RF-MOSFETs valid up to the cut-off frequency

H. Kawano, M. Nishizawa, S. Matsumoto, S. Mitani, M. Tanaka, N. Nakayama, H. Ueno, M. Miura-Mattausch and H.J. Mattausch. "A practical small-signal equivalent circuit model for RF-MOSFETs valid up to the cut-off frequency." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2121-2124 vol.3.

The non-quasistatic contribution to the Y-parameters is shown to be much smaller than usually expected. This is especially true for advanced pocket-implant MOSFET technologies being developed for RF devices. Therefore, a simple and practical equivalent-circuit model valid up to the cut-off frequency becomes possible. The small interdependence of the different model elements allows an explicit and sequential extraction of the individual element values.

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The equivalent circuit modeling of defected ground structure with spiral shape

Chul-Soo Kim, Jong-Sik Lim, Sangwook Nam, Kwang-Yong Kang, Jong-Im Park, Geun-Young Kim and Dal Ahn. "The equivalent circuit modeling of defected ground structure with spiral shape." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2125-2128 vol.3.

We proposed the newly etched DGS (Defected Ground Structure) with a spiral shape in metallic ground plane and the equivalent circuit modeling applied to a spiral DGS for the microstrip line. The proposed spiral DGS can provide steep rejection characteristics with the one and only spiral. The equivalent circuit for the spiral DGS is derived by means of three-dimensional field analysis methods. To represent spurious resonance, the equivalent circuit of a spiral DGS is consisted of an Inductor and a shorted stub with step impedance. The circuit parameters are extracted from a simple circuit analysis method. Experimental results show excellent agreements with circuit simulation results in wide band and the validity of our circuit modeling for the spiral DGS.



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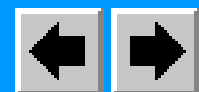
Subjects

HBT small signal T and π model extraction using a simple, robust and fully analytical procedure

P.J. Tasker and M. Fernandez-Barciela. "HBT small signal T and π model extraction using a simple, robust and fully analytical procedure." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2129-2132 vol.3.

A simple and fully analytical procedure is proposed in this paper for the direct extraction of the HBT small signal equivalent circuit model, whether it be the T- or hybrid π -topology, from DC and single-frequency s-parameter measurements. DC data is required since it is possible to show that direct extraction from single frequency s-parameters is not possible, without prior knowledge of one parameter. The extraction procedure developed is based on the prior knowledge of dc current gain, β_{dc} . Excellent results have been obtained when applied to InGaP/GaAs and InP based HBTs.

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Completely consistent 'no-charge' PHEMT model including DC/RF dispersion

C.J. Wei, Y.A. Tkachenko, J. Gering and D. Bartle. "Completely consistent 'no-charge' PHEMT model including DC/RF dispersion." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2133-2136 vol.3.

A new large-signal PHEMT model based on independent fitting of DC currents, RF currents, and capacitances is developed. Unlike conventional models, it does not contain charge terms and therefore, avoids the problem of path-dependence in the charge-integration of capacitances. Similar consideration is given to the dispersion of conductances. Since each nonlinear element of the model corresponds to an element of the small-signal equivalent circuit, the model shows complete consistency over the bias range of the model's extraction. The model features accuracy, and simplicity of extraction. It is especially useful for PHEMTs or MESFETs with dispersion.

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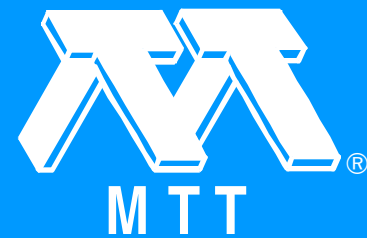


Abstracts

An empirical HBT Large Signal Model for CAD

I. Angelov, K. Choumei and A. Inoue. "An empirical HBT Large Signal Model for CAD." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2137-2140 vol.3.

Extensive measurements were performed at different temperatures on GaAs HBT's in order to obtain a simple Large Signal Model usable in CAD. The model was experimentally evaluated by DC, S and Power Spectrum measurements and good correspondence was obtained between measurements and experiment.



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A new large-signal InP/InGaAs single HBT model including self-heating and impact ionization effects

Taeho Kim and Kyoungsoon Yang. "A new large-signal InP/InGaAs single HBT model including self-heating and impact ionization effects." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2141-2144 vol.3.

A new large-signal model of InP/InGaAs single heterojunction bipolar transistors (SHBTs) has been developed which includes self-heating and impact ionization effects. The model is based on the conventional Gummel-Poon large-signal BJT model. The self-heating and impact ionization effects observed from InP-based SRBTs were modeled through a macro modeling approach. In order to take into account the dependence of impact ionization on the applied voltage and thermal effect, a feedback current source and a temperature dependent voltage source were used in the model as a function of junction temperature, $I_{\text{sub C}}$ and $V_{\text{sub CB}}$. The model implemented in HP-ADS is verified by comparing the simulated and measured data in DC, multi-bias small-signal S-parameters and large-signal microwave power characteristics.

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Large-signal circuit-based time domain analysis of high frequency devices including distributed effects

M. Waliullah, S.M. El-Ghazaly and S. Goodnick. "Large-signal circuit-based time domain analysis of high frequency devices including distributed effects." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2145-2148 vol.3.

A fully distributed equivalent circuit model for MESFET is presented in this paper. The distributed circuit model incorporates sufficient number of segments to account for accurately wave propagation effects along device width. For the first time, distributed model having several segments is analyzed in time domain, which has the capability to evaluate large signal behavior. For a given MESFET, passive equivalent circuit elements are extracted from full wave simulation of the passive part as coplanar-coupled transmission lines using finite difference time domain technique. Active equivalent circuit elements are obtained from full hydrodynamic simulation with Curtice large signal model. The two equivalent circuits are combined together to form the basic unit segment. Several high frequency and high power characteristics of transistors are investigated and compared with previously published results.

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The "Smoothie" data base model for the correct modeling of non-linear distortion in FET devices

V. Cuoco, M.P. van den Heijden and L.C.N. de Vreede. "The "Smoothie" data base model for the correct modeling of non-linear distortion in FET devices." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2149-2152 vol.3.

Currently available data base model implementations fail to correctly model intermodulation products at small to medium signal power levels. In this paper we present the "Smoothie" data base model for FET devices. The model is implemented within Agilent's Advanced Design System (ADS) and is based on the smoothing splines approximation of the device Y-parameters. All four the main functions (i.e. the port currents and charges) are found by analytical integration of the Y-parameters smoothing spline approximations. The use of the smoothing splines approximation compared to the conventional spline interpolation reduces the influence of measurement noise and yields to well behaved continuous higher order derivatives, which are essential in the simulation of circuit linearity. By choosing a proper set of splines control parameters, the user can influence the tradeoff between closeness and smoothness of the approximation. In this work we give an overview of the capabilities of "Smoothie" and compare it to the HP Root data base model.

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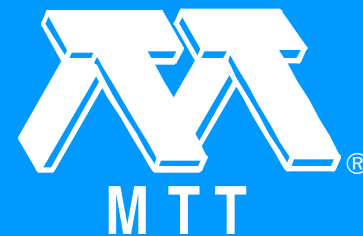


Abstracts

The assessment of output digital spectra in quasi enhancement-mode pHEMTs by a modified large-signal model

Shih-Cheng Yang, Chih-Wei Wang, Cheng-Kuo Lin, Hsien-Chin Chiu and Yi-Jen Chan. "The assessment of output digital spectra in quasi enhancement-mode pHEMTs by a modified large-signal model." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2153-2156 vol.3.

A modified quasi enhancement-mode pHEMTs RF large-signal model is presented which achieves a good agreement with the device performance. This model is based on the Curtice model, by modifying the formula to have a detailed description about non-linear microwave behaviors. The output digital spectra of quasi enhancement-mode pHEMTs can be well predicted by this model, including the ACPR and non-linear spectra regrowth characteristics.



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Extraction of a polynomial LDMOS model for distortion simulations using small-signal S-parameter measurements

J. Vuolevi, J. Aikio and T. Rahkonen. "Extraction of a polynomial LDMOS model for distortion simulations using small-signal S-parameter measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2157-2160 vol.3.

A method based on measured S-parameters for extracting a polynomial electro-thermal model of a 30W RF power transistor is presented. Once the package is de-embedded, the model for the intrinsic transistor can be calculated and distortion can be simulated. Simulated results match well with the measured values, revealing both thermal and electrical bandwidth dependencies of 3rd order intermodulation distortion (IM3). Component-wise Volterra analysis also shows that IM3 distortion is dominated by the nonlinearities of the input capacitance and gm in LDMOS type of transistors.

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Direct observation of loadlines in MESFET by using average RF gate and drain currents

C.C. Meng, C.H. Chang, J.F. Kuan and G.W. Huang. "Direct observation of loadlines in MESFET by using average RF gate and drain currents." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2161-2164 vol.3.

A device at a given bias point can experience different gain compression mechanisms for different loadline impedances. The observation of loadline impedance for power MESFETs using experimental average RF gate and drain currents at 1dB gain compression point is demonstrated in this paper. We found that there is a distinct signature in average RF gate and drain currents to characterize each gain compression mechanism. By using this novel method, circuit optimization of power amplifiers can be easily achieved.

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Implementation of a scalable and statistical VBIC model for large-signal and intermodulation distortion analysis of SiGe HBTs

M. Ramana Murty, K.M. Newton, S.L. Sweeney, D.C. Sheridan and D.L. Hareme.

"Implementation of a scalable and statistical VBIC model for large-signal and intermodulation distortion analysis of SiGe HBTs." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2165-2168 vol.3.

This work examines for the first time the utility of the VBIC model for the analysis of 2-tone intermodulation distortion behavior of SiGe HBTs. The model takes into account all important effects for accurate modeling of large signal behavior including self-heating, weak-avalanche multiplication, quasi-saturation effects, and all device capacitances. Periodic-Steady State and Harmonic Balance simulations are performed and the model is validated by load-pull measurements.

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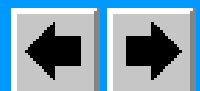
[Subjects](#)

Repeat measurements and metrics for nonlinear model development

K.A. Remley, J.A. Jargon, D. Schreurs, D.C. DeGroot and K.C. Gupta. "Repeat measurements and metrics for nonlinear model development." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2169-2172 vol.3.

We develop a method to study nonlinear models using metrics in conjunction with repeat measurements. We illustrate this procedure by investigating the performance of three types of measurement-based nonlinear circuit models using two different metrics.

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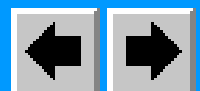
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Simulation of RF circuits driven by modulated signals without bandwidth constraints

J.C. Pedro and N.B. Carvalho. "Simulation of RF circuits driven by modulated signals without bandwidth constraints." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2173-2176 vol.3.

A new nonlinear analysis technique of RF circuits subject to modulated signals is discussed. As the envelope and carrier are uncorrelated, the circuit is modeled by a multi-rate partial differential equation. The carrier response is then simulated with harmonic-balance for each envelope time-step, without imposing any restrictions to signal bandwidth.

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Global coupled EM-electrical-thermal simulation and experimental validation for a spatial power combining MMIC array (2002 Vol. III [MWSYM])

W. Batty, C.E. Christoffersen, A.B. Yakovlev, J.F. Whitaker, M. Ozkar, S. Ortiz, A. Mortazawi, R. Reano, K. Yang, L.P.B. Katehi, C.M. Snowden and M.B. Steer. "Global coupled EM-electrical-thermal simulation and experimental validation for a spatial power combining MMIC array (2002 Vol. III [MWSYM])." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2177-2180 vol.3.

The first fully coupled electromagnetic-electro-thermal global simulation of a large microwave subsystem, here a whole spatial power combining MMIC array, is described. The modeling effort is supported by parallel developments in electro-optic and thermal measurement. The CAD tools and experimental characterisation described, provide a unique capability for the design of quasi-optical systems and for the exploration of the fundamental physics of spatial power combining devices.

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Analysis and elimination of parametric oscillations in monolithic power amplifiers

A. Anakabe, J.-M. Collantes, J. Portilla, J. Jugo, A. Mallet, L. Lapierre and J.-P. Fraysse.

"Analysis and elimination of parametric oscillations in monolithic power amplifiers." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2181-2184 vol.3.

This work describes an analysis and design methodology for eliminating parametric oscillations in microwave power amplifiers. Large-signal stability analyses based on system pole-zero identification techniques are proposed to guide the design process towards a stable circuit. In order to demonstrate the proposed approach, parametric oscillations of a Ku-band MMIC power amplifier have been eliminated, while maintaining the original performances of the circuit.

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Nonlinear analysis of a microwave fractional synthesizer

S. Sancho, J. Chuan and A. Suarez. "Nonlinear analysis of a microwave fractional synthesizer." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2185-2188 vol.3.

In this work, the nonlinear analysis of a fractional phase-locked loop with 2.4 GHz output frequency is presented. The nonlinear simulation uses a realistic description for the phase-frequency detector and the loop filter. The phase-error compensation for beat-note spurious reduction is analyzed, predicting the attenuation values for practical and theoretically improved compensation signals. The influence of different loop parameters on the beat note spurious is also studied, through the application of the Poincare map. This technique has also enabled the determination of the phase-locked ranges, delimited by chaotic phenomena. The phase-locked loop has been manufactured and experimentally characterized.

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A universal parameterized nonlinear device model formulation for microwave circuit simulation

C.E. Christoffersen, S. Velu and M.B. Steer. "A universal parameterized nonlinear device model formulation for microwave circuit simulation." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2189-2192 vol.3.

A new parameterized nonlinear device model formulation is described that enables the same computer code to be used in any circuit analysis type with no charge conservation issues. The parametric description provides great flexibility for the design of nonlinear device models. The number of parameters or state variables required is the minimum necessary and can be chosen to achieve robust numerical characteristics. An example illustrates charge conservation problems that can occur in the transient simulation of microwave circuits if the models are not correctly formulated.

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Characterization of intermodulation distortion in multicarrier transmission systems

K. Naishadham. "Characterization of intermodulation distortion in multicarrier transmission systems." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2193-2196 vol.3.

This paper proposes the analysis of intermodulation distortion in a multicarrier system, using a method which exploits the relationship between measured nonlinear performance and the signal characteristics of the second and third-order distortion products. This method, based on a power series expansion, is applicable to situations involving many non-harmonically related tones, where harmonic balance analysis becomes impractical.

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M-ary PSK signal power spectrum at the output of a nonlinear power amplifier

F. Launay, Y. Wang and S. Toutain. "M-ary PSK signal power spectrum at the output of a nonlinear power amplifier." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2197-2200 vol.3.

This paper proposes a simple accurate method to estimate the output wideband M-PSK spectrum, which is spreaded by a nonlinear power amplifier. The amplifier is modelled by a complex power series extracted from CW measurements. Some papers relate spectral regrowth assuming that the input signal is Gaussian. An other contribution derives a closed form expression between the output covariance function and the input QPSK-OQPSK signal according to cumulant properties for a third order polynomial model. Even if the generalization to higher order is straightforward, high order cumulant statistic expressions are quite tedious and difficult to exploit. In this paper a simple closed-form expression between input signal and output signal spectrum that can be applied to any M-PSK signal for any order of a memoryless nonlinear model is derived. Different pulse waveforms are simulated to test this closed form expression.

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A semi-lumped balun fabricated by low temperature co-fired ceramic

Ching-Wen Tang and Chi-Yang Chang. "A semi-lumped balun fabricated by low temperature co-fired ceramic." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2201-2204 vol.3.

A new chip-type multi-layer ceramic balun is presented in this paper. This balun is designed in the ISM band and fabricated using low temperature co-fired ceramic (LTCC) technology. It involves the semi-lumped concept and the multi-layer structure to realize the LTCC-MLC balun. The symmetric structure provides the excellent characteristics of phase balance and amplitude balancing. Measured results of the LTCC-MLC balun match well with the computer simulation.

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Low-cost flip-chip alternatives for millimeter wave applications

J. Heyen, J. Schroeder and A.F. Jacob. "Low-cost flip-chip alternatives for millimeter wave applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2205-2208 vol.3.

This paper discusses alternative flip-chip approaches in the millimeter wave frequency range. In comparison to common stud bumping or gold plating techniques at these frequencies, this contribution deals with bump formation by micro balls and conductive adhesives (polymeric bumps). In the latter process special bump shaping is supported by introducing an additional photoresist process. The photoresist also serves as an underfill for the flip-chip device. Utilizing these bumping techniques, flip-chip test systems in coplanar waveguide (CPW) design were fabricated and then characterized via S-parameter measurements at W-band.

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X-band microstrip bandpass filter using photoimageable thick-film materials

C.Y. Ng, M. Chongcheawchamnan, M.S. Aftanasar, I.D. Robertson and J. Minalgiene. "X-band microstrip bandpass filter using photoimageable thick-film materials." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2209-2212 vol.3.

The rapid growth in commercial microwave technology, particularly for wireless communication, has created a demand for low-cost, high quality microwave fabrication technologies that are also suitable for high volume production. Modern thick-film materials are well placed to meet these requirements, in that they offer low conductor and dielectric losses, with good surface finishes and the ability to realise fine conductor geometries. This paper studies the feasibility of realizing microwave bandpass filters using thick-film photoimaging techniques. This enhanced thick-film technology can realise very narrow line width and spacing, giving performance comparable to the more expensive thin-film techniques. This is an inexpensive and mature technology, which looks set to revolutionize the manufacturing of microwave and MM-wave circuits in the near future. The fabricated filter achieved an insertion loss of only 0.7 dB over the frequency range of 9-11 GHz.

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Novel lumped-element coplanar waveguide-to-coplanar stripline transitions with low-pass and high-pass characteristics

Yo-Shen Lin and Chun Hsiung Chen. "Novel lumped-element coplanar waveguide-to-coplanar stripline transitions with low-pass and high-pass characteristics." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2213-2216 vol.3.

Novel lumped-element coplanar waveguide-to-coplanar stripline transitions are proposed, using the planar lumped-elements to realize the low-pass and high-pass filter responses. Simple equivalent-circuit models are also established, from which the characteristics of various lumped-element transition structures are examined. Specifically, a low-pass lumped-element transition with 3 dB cutoff frequency at 3.2 GHz and a high-pass lumped-element transition with 3 dB cutoff frequency at 1.6 GHz can be achieved.

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RF-microwave multi-band design solutions for multilayer organic system on package integrated passives

M.F. Davis, S.-W. Yoon, S. Mandal, N. Bushyager, M. Maeng, K. Lim, S. Pinel, A. Sutono, J. Laskar, M. Tentzeris, T. Nonaka, V. Sundaram, F. Liu and R. Tummala. "RF-microwave multi-band design solutions for multilayer organic system on package integrated passives." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2217-2220 vol.3.

We present multi-band design solutions for integrated passives using multilayer organic (MLO) process technology for RF and microwave System on Package (SOP) module development. The components developed in this technology include embedded high-Q compact inductors and filters designed in three frequency bands: S, C and Ku applicable for Bluetooth, MMDS, IEEE802.11a WLAN and satellite communications. Measured inductor Q-factor as high as 182 and Self-Resonant-Frequency (SRF) as high as 20 GHz, which represents the highest Q in its frequency range reported to date in a multilayer technology, have been demonstrated. A time domain electromagnetic modeling technique is also used to characterize the passive devices.





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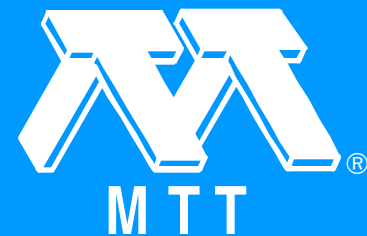
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Coupling between microstrip lines with finite width ground plane embedded in polyimide layers for 3D-MMICs on Si

G.E. Ponchak, E. Dalton, E.M. Tentzeris and J. Papapolymerou. "Coupling between microstrip lines with finite width ground plane embedded in polyimide layers for 3D-MMICs on Si." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2221-2224 vol.3.

Three-dimensional circuits built upon multiple layers of polyimide are required for constructing Si/SiGe monolithic microwave/millimeter-wave integrated circuits on CMOS (low resistivity) Si wafers. Thin film microstrip lines (TFMS) with finite width ground planes embedded in the polyimide are often used. However, the closely spaced TFMS lines are susceptible to high levels of coupling, which degrades circuit performance. In this paper, Finite Difference Time Domain (FDTD) analysis and experimental measurements are used to show that the ground planes must be connected by via holes to reduce coupling in both the forward and backward directions.





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A novel directional coupler for PCB and LTCC applications

A. Sawicki and K. Sachse. "A novel directional coupler for PCB and LTCC applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2225-2228 vol.3.

A new coupled-line directional coupler, convenient for PCB and LTCC applications, is proposed. The coupler covers -10 dB to -2.7 dB coupling coefficient, being always theoretically compensated. The novel structure is not sensitive to lateral misalignment of conductive layers, and not sensitive to thickness and dielectric permittivity tolerances of applied dielectric substrates. Promising experimental results are presented.

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High performance spiral inductors embedded on organic substrates for SOP applications

S.H. Lee, S. Min, D. Kim, S. Dalmia, W. Kim, V. Sundaram, S. Bhattacharya, G. White, F. Ayazi, J.S. Kenney, M. Swaminathan and R.R. Tummala. "High performance spiral inductors embedded on organic substrates for SOP applications." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2229-2232 vol.3.

This paper presents the design, measured data, and systematic analysis of spiral embedded inductors fabricated on standard organic substrates using low-cost, large-area MCM-L technology. Several configurations for inductors were investigated to optimize the inductor layout dimensions such as conductor width, number of turns, inner diameter, spacing between inductor and ground, and inductor area. A maximum Q of 100 was measured for a 3.6 nH inductor at 1.8 GHz on an organic substrate with a self resonance frequency of 10.6 GHz within an inductor core area of 0.72 mm/sup 2/. The effects of configurational variables on inductor characteristics such as quality factor, self-resonance frequency, and inductance are discussed. High-Q inductors embedded on organic substrates can find numerous RF and microwave system-on-package (SOP) applications, such as VCOs, IF/RF bandpass filters, LNAs, etc., in which IC chips are flip-chip mounted on the package substrate.

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A novel signal processing approach for microwave Doppler speed sensing

N. Weber, S. Moedl and M. Hackner. "A novel signal processing approach for microwave Doppler speed sensing." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2233-2235 vol.3.

Systems for ground speed measurement usually determine a peak in the measured microwave spectrum of a reflected Doppler-shifted transmit signal. Ground speed is calculated from the frequency offset of this peak and the incident angle between the microwave antenna and ground. In this paper a Doppler measurement system is described that does not need to know the exact angle under which the antenna is radiating and receiving the signal with respect to ground if a specific condition is met. Furthermore, no Janus antenna configuration is needed for this system.

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Ultra-fast broadband EMI measurement in time domain using classical spectral estimation

F. Krug and P. Russer. "Ultra-fast broadband EMI measurement in time domain using classical spectral estimation." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2237-2240 vol.3.

In this paper, a novel ultra-fast, broadband time domain EMI measurement system is described. Measurements were performed in the 30-1000 MHz range. The signals from the antenna are digitized and processed by computer in order to obtain Fast-Fourier Transform (FFT) as well as Welch and Bartlett Periodograms. Correction of errors originating from the frequency characteristics of antenna, cable and oscilloscope is made by digital signal processing. With the presented time domain measurement system, the measurement time can be reduced by a factor of 10. The results obtained with the described system have been compared with measurements performed with a conventional EMI receiver. Over the whole frequency range from 30 to 1000 MHz the deviations have been below 3 dB.

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An accurate complex behavior test bed suitable for 3G power amplifiers characterization

S. Boumaiza and F.M. Ghannouchi. "An accurate complex behavior test bed suitable for 3G power amplifiers characterization." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2241-2244 vol.3.

In this paper, we propose a realistic, accurate, versatile and thermal-free complex behavior test bed suitable for 3G power amplifier characterization. The measurement results, using the proposed test bed of a 90 W peak power amplifier based on a Motorola-LDMOS class-AB amplifier, are presented for several signals excitations (W-CDMA, CDMA2000, 8-Tones). These results show large discrepancies with those obtained by a vector network analyzer (HP-8510C) with a CW excitation for both AM/AM and AM/PM curves. This test bed can also be used for the investigation of the memory effect in RF power amplifiers. This paper presents some measurements that point out this capability. This system has potential benefits in the area of non-linear behavior modeling of power amplifiers and synthesis of accurate predistortion function for linearization purposes.

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A new satellite repeater amplifier characterization system for large bandwidth NPR and modulated signals measurements

A. Mallet, F. Gizard, T. Reveyrand, L. Lapierre and J. Sombrin. "A new satellite repeater amplifier characterization system for large bandwidth NPR and modulated signals measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2245-2248 vol.3.

Power consumption and dissipation of satellite payloads for space telecommunication systems are mainly due to power amplifiers. To increase system capacity with limited bandwidth, multicarrier operations are required. Linearity is specified to limit the signal distortion by the nonlinear power amplifiers. In order to minimize power consumption under those linearity requirements, accurate measurements have to be performed. The NPR is well known as the figure of merit for the intermodulation distortion performance of amplifiers in telecommunications. In this paper, the development of an accurate large bandwidth NPR measurement system is presented. It enables characterizations up to Ka band (17-21 GHz and 27-31 GHz for space telecommunications applications with typically 250 MHz bandwidth). Measurements made on power amplifiers have been used to optimize operating conditions.

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Quantitative extraction and compensation of excess inductance: case study of a digital attenuator chip

S.C. Choi, D.H. Kwon, K.H. Kim and S.W. Hwang. "Quantitative extraction and compensation of excess inductance: case study of a digital attenuator chip." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2249-2252 vol.3.

The excess inductance of the conductor connecting the ground pins of the MMIC and the ground plane is extracted from a simplified procedure of measurement and optimization. The method is applied to a digital attenuator chip with a positive bias circuit. The addition of bypass capacitors with the value compensating the extracted excess inductance of the conductor clearly improves the performance of the chip.

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Vector corrected noise temperature measurements

M.H. Weatherspoon, L.P. Dunleavy, A. Boudiaf and J. Randa. "Vector corrected noise temperature measurements." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2253-2256 vol.3.

A new one-port technique for measuring noise temperature is presented that uses receiver noise parameters for error correction. Improved accuracy in one-port measurements of noise temperature made with commercial systems is demonstrated without using isolators. Equations for correcting mismatch errors are developed as part of the available vector noise temperature equation. Results, presented for a C-band solid-state cold noise source and a pair of microwave solid-state noise diodes, are shown to be in good agreement with radiometric measurements of the same sources.

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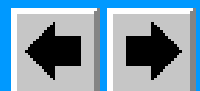
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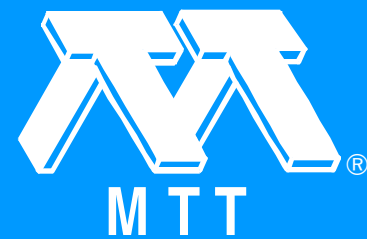
Sensitivity analysis of calibration standards for fixed probe spacing on-wafer calibration techniques [vector network analyzers]

A.M.E. Safwat and L. Hayden. "Sensitivity analysis of calibration standards for fixed probe spacing on-wafer calibration techniques [vector network analyzers]." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2257-2260 vol.3.

In vector network analyzer calibration, it is clear that the uncertainty in the standard definition leads to inaccurate measurement. We investigate the sensitivity of different on-wafer calibration techniques to probe positioning. Calibration comparison derived error-bounds are calculated for various cases differing only by a single change in probe/standard overlap.

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Estimation of deep-seated profile of temperature distribution inside biological tissues by means of multifrequency microwave thermograph

B. Stec, A. Dobrowolski and W. Susek. "Estimation of deep-seated profile of temperature distribution inside biological tissues by means of multifrequency microwave thermograph." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2261-2264 vol.3.

This paper presents problems related to thermal radiation of human bodies in the microwave range in relation to diagnosis of breast carcinoma. A mathematical model of thermal radiation transmission through tissues is introduced and methods of measurement of temperature and the depth and size of a heat source, by means of multifrequency microwave thermography, are described. Theoretical considerations are supplemented by results of experiments.

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A bioelectromagnetic overview of the Universal Mobile Telecommunication System (UMTS)

M. Cappelli and L. Tarricone. "A bioelectromagnetic overview of the Universal Mobile Telecommunication System (UMTS)." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2265-2268 vol.3.

The large-scale introduction of the Universal Mobile Telecommunication System (UMTS) must be forwarded by a suitable evaluation of possible effects of its radiowave signals on end-users. For this purpose, a rigorous characterization of its radio-signals must be performed from a radioprotection point of view, spectral and power behaviour being among the most important issues. In this paper UMTS radiowave signals are accurately investigated. An algorithm is proposed for the numerical generation of such signals, so that real operating conditions can be accurately simulated, and bioelectromagnetic interactions studied. Results demonstrate the accuracy of the proposed algorithm, as well as the amenability of the attained signals to model the bioelectromagnetic interaction up to cellular scales.

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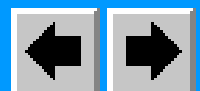
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3D scalar microwave image reconstruction algorithm

P.M. Meaney, Qianqian Fang, S.D. Geimer, A.V. Streltsov and K.D. Paulsen. "3D scalar microwave image reconstruction algorithm." 2002 MTT-S International Microwave Symposium Digest 02.3 (2002 Vol. III [MWSYM]): 2269-2272 vol.3.

We have recently implemented a microwave imaging algorithm which incorporates scalar 3D wave propagation while reconstructing a 2D dielectric property profile. This is a preliminary step in reaching a full 3D image reconstruction approach but allows us to investigate important issues associated with speed of reconstruction and problem size. Key concepts developed during our 2D system evaluations have also proved to be translatable to the 3D approach and have accelerated the overall implementation.

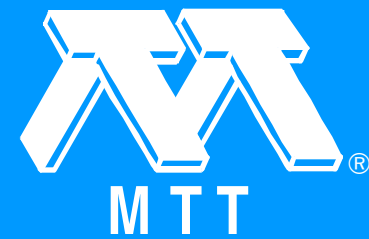
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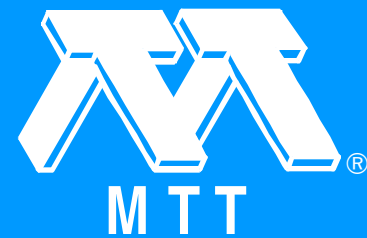
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Front Cover (2002 [RFIC])

"Front Cover (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): i-ii.



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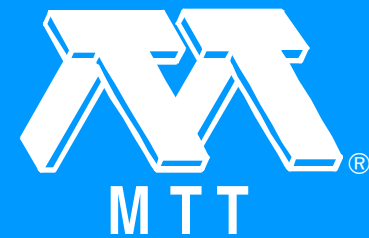
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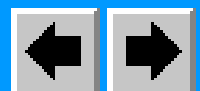
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The world-wide wireless web

B. Abdi and E. Maass. "The world-wide wireless web." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 3-6.

The world-wide wireless web is the promise of delivering the desktop experience to the mobile society. This is a promise of seamless connectivity and multimedia interactivity while on the move. This promise is driving convergence of demand for high speed wireless data with the demand for greater convenience, greater access, and greater, more visual and dynamic content, all without compromising the security and bit error rate performance that we have come to expect in the wired world.

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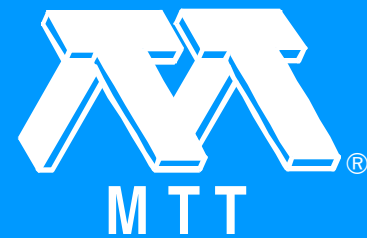


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From "cellphone" to "remote control on life": how wireless communications will change the way we live over the next 20 years

W. Webb. "From "cellphone" to "remote control on life": how wireless communications will change the way we live over the next 20 years." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 7-11.

Wireless communications might be said to have "come of age", with the number of wireless phones in some countries surpassing the number of fixed phones, and wireless operators having much greater market value than fixed operators. At the same time, many new technologies are about to be introduced including third generation mobile, wireless LANs, BlueTooth-based personal area networks, high speed fixed wireless solutions and more. New services such as mobile access to the Internet, e-commerce from a mobile, video phones and others are being trialled and deployed. With all these developments, the direction that the future will take is not readily apparent. Based on detailed research this paper proposes a future based on the integration of multiple disparate networks.



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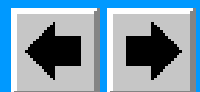
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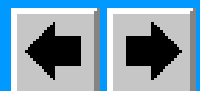
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Requirements for high performance RF/UHF ICs and possible solutions

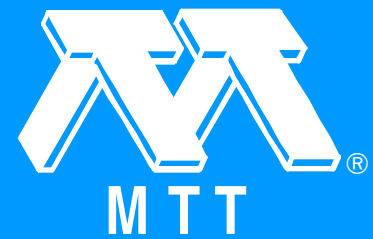
U.L. Rohde. "Requirements for high performance RF/UHF ICs and possible solutions." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 13-17.

One of the most difficult situations is the operating mode of a base station. As it gets bombarded with signals, it emits a lot of power at the same time. This paper addresses the key problem areas, which are mixers, amplifiers, and oscillators and shows some possible IC-based solutions.

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Direct conversion receiver design for mobile phone systems - challenges, status and trends

F. Ali. "Direct conversion receiver design for mobile phone systems - challenges, status and trends." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 21-22.

This presentation will give an overview of the design issues related to the implementation of direct conversion receiver for mobile phones, provide the current status and discuss future trends.

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RF local oscillator path for GSM direct conversion transceiver with true 50% duty cycle divide by three and active third harmonic cancellation

R. Magoon and A. Molnar. "RF local oscillator path for GSM direct conversion transceiver with true 50% duty cycle divide by three and active third harmonic cancellation." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 23-26.

An RF local oscillator frequency path for a multi-band GSM direct conversion transceiver is described that makes use of a novel true 50% output duty cycle divide by 3 circuit and provides active third harmonic cancellation through means of phase recombination of the divider's outputs.

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W-CDMA SiGe TX-IC with high dynamic range and high power control accuracy

H. Joba, Y. Takahashi, Y. Matsunami, K. Itoh, S. Shinjo, N. Suematsu, D.S. Malhi, D. Wang, K. Schelkle and P. Bacon. "W-CDMA SiGe TX-IC with high dynamic range and high power control accuracy." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 27-30.

This paper demonstrates the SiGe TX-IC for W-CDMA mobile terminals. For the TX-IC, a novel architecture of a variable gain amplifier is proposed to improve dynamic range and power control accuracy. With the 0.5 μm SiGe BiCMOS technology, this TX-IC achieved over 100 dB dynamic ranges within $\pm 1.5\text{dB}$ accuracy over all temperatures. Output power of 7 dBm can be achieved by employment of P-MOSFET current mirror type self bias control circuit for the driver amplifier. Measurement results also satisfy the specification defined by 3GPP.

A direct-conversion W-CDMA front-end SiGe receiver chip

D.Y.C. Lie, J. Kennedy, D. Livezey, B. Yang, T. Robinson, N. Sornin, T. Beukema, L.E. Larson, A. Senior, C. Saint, J. Blonski, N. Swanberg, P. Pawlowski, D. Gonya, X. Yuan and H. Zamat. "A direct-conversion W-CDMA front-end SiGe receiver chip." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 31-34.

A W-CDMA direct-conversion front-end receiver chip consisting of a low-noise amplifier (LNA), a dual-gain RF variable-gain amplifier (RF-VGA), two direct-down-conversion mixers, a I/Q quadrature generator, and a base-band five-gain-stage VGA is designed and manufactured in a 0.25 μm IBM SiGe BiCMOS production process. A very low DC offset value ($<300 \mu\text{V}$) is measured at the output of the mixers as the LO signal is fed into the chip at twice the RF frequency. An extremely low local oscillator (LO) leakage of -105 dBm is measured at the LNA input, partly due to the excellent LO-to-RF isolation provided by the RF-VGA and the direct-conversion mixers. The measured cascaded noise figure for the chip (including the SAW filter) is 4.3 dB at the maximum gain mode, and the IIP2 and IIP3 are $+37$ and -16.5 dBm , respectively. The I/Q channels exhibit a small mismatch in magnitude ($<0.1 \text{ dB}$) and in phase ($1/\text{spl deg}/-1.5/\text{spl deg}$). The chip draws 24.9 mA from a 2.85 V supply. The overall chip performance meets all the essential parameters of W-CDMA receiver front-end specs.



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Highly integrated, dual band/tri-mode SiGe BiCMOS transmitter IC for CDMA wireless applications

M. Reddy, D. Yates, Chang-Hyeon Lee, G. Taskov, P. Mudge, T. Robinson, L. Li, B. Agarwal and Sung-Sik Hwang. "Highly integrated, dual band/tri-mode SiGe BiCMOS transmitter IC for CDMA wireless applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 35-38.

A highly integrated transmitter IC fabricated in Conexant's 0.35 μm SiGe BiCMOS process and packaged in a 6 mm /spl times/ 6 mm Land Grid Array (LGA) package provides dual band/tri-mode transmitter functionality in a CDMA handset meeting TIA/EIA 98-D specifications. This chip upconverts the I/Q baseband signals to RF in two stages and delivers the amplified RF signal to the power amplifier. It consists of the following stages: an I/Q modulator, VHF VCO, VHF PLL, IF VGA, UHF LO buffer, UHF PLL, 3 wire serial interface, RF image reject upconverter, a cellular PA driver and dual PCS drivers. It is designed to deliver 8 dBm in CDMA mode in Cellular band, 11 dBm in AMPS mode and 9 dBm in CDMA mode in PCS band at 90 mA, 88 mA and 108 mA respectively at nominal supply and temperature. It also provides IF dynamic range of 80 dB in the IF VGA and RF Gain dynamic range of 20 dB in Cellular band and 15 dB in PCS band. The IC operates from a supply ranging from 2.7 V to 3.3 V and a temperature range of -30C to 85C.

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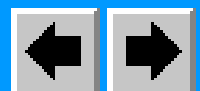
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Efficiency improvement techniques at low power levels for linear CDMA and WCDMA power amplifiers

T. Fowler, K. Burger, Nai-Shuo Cheng, A. Samelis, E. Enobakhare and S. Rohlfing. "Efficiency improvement techniques at low power levels for linear CDMA and WCDMA power amplifiers." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 41-44.

Power amplifiers are significant contributors to current consumption within mobile phones resulting in continued focus on design techniques to improve power amplifier efficiency. The techniques presented here use variable bias current and supply voltage, which allow enhanced efficiency at low power levels, and variable load impedance, which provides tradeoffs for optimum linearity and efficiency as a function of power level and battery voltage.

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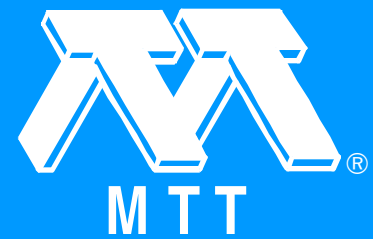
An overview of efficiency enhancements with application to linear handset power amplifiers

J. Staudinger. "An overview of efficiency enhancements with application to linear handset power amplifiers." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 45-48.

A consequence of high spectral efficiency provided by second and third generation cellular systems is the requirement for linear power amplifiers in the transmitter unit of the mobile handset. The battery nature of the mobile phone emphasizes high amplifier efficiency for extending talk time and battery life. This represents an inherent trade-off between amplifier efficiency and linearity. Recent efforts have focused on considering alternative approaches with the goal of improving the efficiency/linearity performance trade-off compared to traditional single-ended Class A/B topologies. Some alternative approaches are examined here.

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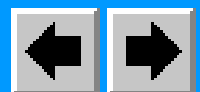
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Switched-mode tuned high-efficiency power amplifiers: historical aspect and future prospect

A.V. Grebennikov. "Switched-mode tuned high-efficiency power amplifiers: historical aspect and future prospect." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 49-52.

In this paper, an analytical overview of theory and practice of the switched-mode RF and microwave tuned class-E power amplifiers are presented,. Well-known and unknown different circuit configurations, equation-based parameters and waveforms are given and discussed.

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A broadband monolithic S-band class-E power amplifier

R. Tayrani. "A broadband monolithic S-band class-E power amplifier." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 53-56.

This paper describes what is believed to be the first successful design and fabrication of a highly efficient broadband monolithic class-E power amplifier that operates at S-band and employs a 0.3 μm pHEMT device. The amplifier measured performance shows a peak Power Added Efficiency (PAE) of 90% and a peak output power of greater than 23 dBm at 3.25 GHz.

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1/f noise of NMOS and PMOS transistors and their implications to design of voltage controlled oscillators

K.K. O, Namkyu Park and Dong-Jun Yang. "1/f noise of NMOS and PMOS transistors and their implications to design of voltage controlled oscillators." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 59-62.

Low frequency noise of NMOS and PMOS transistors in a 0.25 μm foundry CMOS process with a pure SiO_2 gate oxide layer is characterized for the entire range of MOSFET operation. Surprisingly, the measurement results showed that surface channel PMOS transistors have about an order of magnitude lower 1/f noise than NMOS transistors especially at $V_{\text{GS}} - V_{\text{TH}} < 0.4 \text{ V}$. The data were used to show that a VCO using all surface channel PMOS transistors can have 14 dB lower close-in phase noise compared to that for a VCO using all surface channel NMOS transistors.

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A 900 MHz low phase noise CMOS quadrature oscillator

J. Cabanillas, L. Dussopt, J.M. Lopez-Villegas and G.M. Rebeiz. "A 900 MHz low phase noise CMOS quadrature oscillator." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 63-66.

A novel method for designing quadrature oscillators is presented. The technique is based on differential coupling at the second harmonic frequency of two separate oscillators. The desired coupling is obtained using an integrated transformer which is attached to the common-mode nodes of two differential oscillators. A 900 MHz prototype has been implemented in a 0.35 μm /m CMOS process. The oscillator core consumes 3 mA of current from a 1.7 V DC supply and results in an output power of -9 dBm per oscillator, and a measured phase noise of -116, -133 and -138 dBc/Hz at 100 kHz, 600 kHz and 1 MHz from the carrier, respectively. The proposed method is ideal for oscillators operating at 2.5 GHz, 3.5 GHz and 5 GHz.



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A 0.18 μm CMOS 2.45 GHz, low-power quadrature VCO with 15% tuning range

D. Leenaerts, C. Dijkmans and M. Thompson. "A 0.18 μm CMOS 2.45 GHz, low-power quadrature VCO with 15% tuning range." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 67-70.

This work demonstrates the feasibility of a fully integrated LC-resonator based quadrature VCO for low power operation at 2.45 GHz, having a 15% tuning range due to a combination of analog and digital tuning techniques. The VCO dissipates 7.2 mW and fulfills the Bluetooth requirements. The design has been realized in a 0.18 μm CMOS technology.

Click on title for a complete paper.



A 1.8-V 6/9-GHz switchable dual-band quadrature LC VCO in SiGe BiCMOS technology

Hyunchol Shin, Zhiwei Xu and M.F. Chang. "A 1.8-V 6/9-GHz switchable dual-band quadrature LC VCO in SiGe BiCMOS technology." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 71-74.

This paper presents a quadrature VCO that can be reconfigured between 6 and 9 GHz frequency bands. The dual-band VCO comprises a 6 GHz LC VCO, two 1/2-dividers, two mixers, and two 3 GHz notch filters. The 9 GHz output is generated based on a fractional frequency multiplication method by mixing the 6 GHz VCO output with its divide-by-two signal. The VCO, implemented in a 0.18 μm SiGe BiCMOS technology, shows a fast switching time of 3.6 nsec. The measured VCO phase noises are -106 dBc/Hz and -104 dBc/Hz at 1 MHz offset for 6 and 9 GHz modes, respectively, while draining 10.8 mA from a 1.8 V supply.

A 1 V 3.8-5.7 GHz differentially-tuned VCO in SOI CMOS

N. Fong, J.-O. Plouchart, N. Zamdmer, Duixian Liu, L. Wagner, C. Plett and G. Tarr. "A 1 V 3.8-5.7 GHz differentially-tuned VCO in SOI CMOS." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 75-78.

A 1 V 3.8-5.7 GHz VCO was designed and fabricated in a 0.13 μm SOI CMOS process. This VCO features differentially-tuned accumulation MOS varactors that (a) provides 40% frequency tuning when biased between 0 to 1 V, and (b) rejects common-mode noise such as flicker noise. At 1 MHz offset, the phase noise is -121.67 dBc/Hz at 3.8 GHz, and -111.67 dBc/Hz at 5.7 GHz. The power dissipation is between 2.3 to 2.7 mW depending on the centre frequency. When V_{DD} is reduced to 0.75 V, the VCO only dissipates 0.8 mW at 5.5 GHz.



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Design of high-speed fiber optic datalinks

T. Mader. "Design of high-speed fiber optic datalinks." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 81-84.

Fiber-optic datalinks operating at rates of OC-48 (2.5 Gb/s), OC-192 (10 Gb/s), OC-768 (40 Gb/s), and 10 Gigabit Ethernet (10.3 Gb/s) utilize high-speed broadband electronic components, and require a combination of microwave, high-speed digital, and fiber-optic design techniques. In this paper, an overview of such high-speed fiber optic devices is given, concentrating on "Metro" (metropolitan area network) 10 Gb/s applications, as this is currently an active area of industry activity. Tradeoffs between different high-speed process technologies are discussed, as well as trends in the industry.

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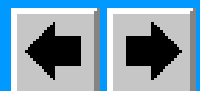
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A 37/spl sim/50 GHz InP HBT VCO IC for OC-768 fiber optic communication applications

Liyang Zhang, R. Pullela, C. Winczewski, J. Chow, D. Mensa, S. Jaganathan and Ruai Yu. "A 37/spl sim/50 GHz InP HBT VCO IC for OC-768 fiber optic communication applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 85-88.

This paper reports a 50 GHz voltage-controlled-oscillator (VCO) integrated circuit (IC) designed for OC-768 fiber optic communication applications. Implemented with a 140 GHz f/sub t/ InP HBT technology, the VCO IC is designed based on a modified Colpitts configuration with a unique resonator to maximize the tuning range. Tuned by a single-ended voltage, the VCO exhibits 37/spl sim/50 GHz (30%) tuning range over a tuning voltage range of 1.2 V.

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Amplifier array for 12 parallel 10 Gb/s optical-fiber links fabricated in a SiGe production technology

A. Schild, H.-M. Rein, J. Mullrich, L. Altenhain, J. Blank and K. Schrodinger. "Amplifier array for 12 parallel 10 Gb/s optical-fiber links fabricated in a SiGe production technology." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 89-92.

A transimpedance amplifier array for 12 parallel optical-fiber channels each operating at 10 Gb/s is presented. It stands out for the following features: high gain (transimpedance 25 k/spl Omega/ in the limiting mode), high input sensitivity and wide input dynamic range (input current swing from 20 to 240 /spl mu/A/sub p-p/), constant output voltage swing (differential 0.5 V/sub p-p/ at 50 /spl Omega/ load) and low power consumption (1.4 W) at a single supply voltage (5 V). Each channel has its own offset current control circuit. To the best of the authors' knowledge, the total throughput of 12 /spl times/ 10 Gb/s = 120 Gb/s is the highest value reported for a single-chip amplifier array.

Front-end CMOS chipset for 10 Gb/s communication

A.K. Petersen, K. Kiziloglu, Ty Yoon, F. Williams, Jr. and M.R. Sandor. "Front-end CMOS chipset for 10 Gb/s communication." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 93-96.

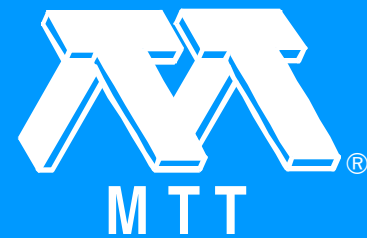
A 10 Gb/s communication chipset is realized for the first time in 0.18 μm generic CMOS. It comprises (all fully differential): (i) a transimpedance amplifier: gain=1300 Ω , bandwidth 9 GHz; optical. (ii) a limiting amplifier: t_{rise} , $t_{\text{fall}} < 23$ ps; sensitivity=5 mV at BER=10⁻¹². (iii) a laser driver: adjustable I_{bias} (up to 40 mA) and I_{mod} (up to 35 mA), driving a laser module with $Z_{\text{in}}=50 \Omega$.

Abstracts

Application of quasi-static method of moments for the design of OC-192 and OC-768 fiber optic integrated circuits

C.-W.P. Huang, Jian-Wen Bao, N. Dwarakanath and S. Al-Kuran. "Application of quasi-static method of moments for the design of OC-192 and OC-768 fiber optic integrated circuits." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 97-100.

A novel global layout modeling technique based on a quasi-static method of moments (MoM) analysis for the design of 10 and 40 Gbit/sec fiber optic integrated circuits is presented. Theory of the quasi-static MoM technique is reviewed and validated for millimeter wave applications. This technique enables rigorous circuit/layout co-simulation with minimum computational resources compared with traditional electromagnetic solvers. Excellent agreement between simulated and measured results is found in both time and frequency domains.



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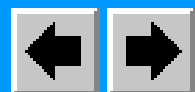
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CMOS components for 802.11b wireless LAN applications

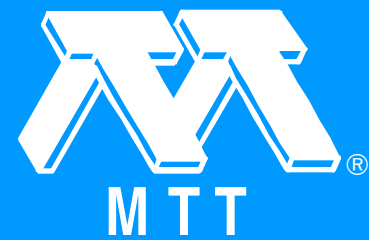
K.K. O, Xi Li, Feng-Jung Huang and W. Foley. "CMOS components for 802.11b wireless LAN applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 103-106.

2.4-GHz CMOS low noise amplifier, mixer, local oscillator buffer, differential power amplifier, and T/R switch for 802.11b WLAN applications have been implemented using MOS transistors. A single chip 2.4-GHz transceiver for WLAN with integrated power amplifier, switches, and other RF components will be possible in a 0.25- μm CMOS technology. More importantly, it appears that the CMOS solution will be highly competitive in the 2.4-GHz WLAN market.

A 3 V, 0.35 μ m CMOS Bluetooth receiver IC

Wenjun Sheng, Bo Xia, A. Emira, Chunyu Xin, A.Y. Valero-Lopez, Sung Tae Moon and E. Sanchez-Sinencio. "A 3 V, 0.35 μ m CMOS Bluetooth receiver IC." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 107-110.

This paper presents a monolithic low-IF Bluetooth receiver. The highlights of the receiver include a low-power active complex filter with a non-conventional tuning scheme and a high performance mixed-mode GFSK demodulator. The chip was fabricated on a 6.25 mm² die using TSMC 0.35 μ m standard CMOS process. -82 dBm sensitivity at 1e-3 BER, -10 dBm IIP3 and 15 dB noise figure were achieved in the measurements.



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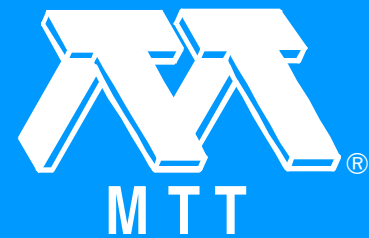
Integrated CMOS transceivers using single-conversion standard IF or low IF RX for digital narrowband cordless systems

A. Jerng, A. Truong, D. Wolday, E. Unruh, E. Landi, L. Wong, R. Fried and S. Gibbons.
"Integrated CMOS transceivers using single-conversion standard IF or low IF RX for digital narrowband cordless systems." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 111-114.

This paper describes a 0.25 μm CMOS transceiver operating in the 902-928 MHz ISM band for US Narrowband Digital Cordless Telephony. The DS9RF31 transceiver, intended for TDD systems, meets all specifications while providing a low cost, small the size solution. The transmitter uses open-loop FSK modulation and the receiver uses a single-conversion image-reject architecture followed by an IF chain and demodulator that provides output data to a baseband IC for further processing. One version of the chip uses a standard 10.7 MHz IF with discrete channel filters. A second version (DS9RF32) integrates the IF channel filter by using a low-IF of 1.36 MHz.

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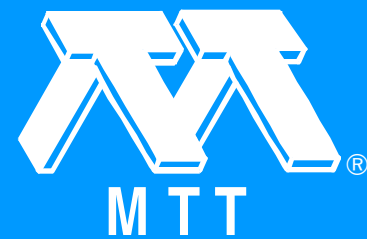
A highly integrated, versatile GPS receiver for E911 applications

L. Wilz, T. Shie, J. Young and T. Hancock. "A highly integrated, versatile GPS receiver for E911 applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 115-118.

This paper presents the design of a highly integrated GPS receiver for hand held and other applications. The IC consists of a complete GPS receiver with an integrated multi-mode fractional-N synthesizer. It is one of the most highly integrated GPS receiver ICs presented to date with unmatched flexibility and performance. The receiver chip is fabricated in a 0.35 μm /m silicon BiCMOS process and packaged in a 48 pin 7 mm/spl times/7 mm land grid array chip scale package.

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A SiGe transceiver chipset for 100 Mbps/1 Gbps digital communication over cable system

A. Alexanian, M. Wu, A. Burgess, Y. Wei and X. Zhang. "A SiGe transceiver chipset for 100 Mbps/1 Gbps digital communication over cable system." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 119-122.

In this paper we present the design and performance of transmit and receive SiGe RFICs that offer a complete RF transceiver solution to broadband digital communications over CATV cable system. The transceiver design is based on 16 QAM with direct modulation/demodulation approach, and which supports data speeds of 100 Mbps and 1 Gbps, using the frequency bandwidth of 900 MHz to 2.45 GHz. The Tx chip integrates DAC, Clock, LO, IQ modulator and RF transmitter, which offers linear output power of 7 dBm and 1 dBm at 1 GHz and 2 GHz, respectively. An output noise floor of -115 dBm/Hz is also achieved. The Rx chips consist gain-switching LNA, RF VGA, RF slope equalizer, IQ demodulator, as well as clock, RF LOs, carrier recovery, AGC, clock recovery and ADC. With maximum gain setting, the entire Rx chain has a 20 dB noise figure, which is critical in providing necessary dynamic range for such broadband communication. The VCO circuit on Tx/Rx chips is capable of switching between 4 separated frequencies with phase noise of -110 dBc/Hz at 100 kHz offset-carrier frequency. The chip-set has been successfully integrated into Narad Broadband Access Network (NBAN) system, which is currently under system test.



Automatic synthesis of a 2.1 GHz SiGe low noise amplifier

Gang Zhang, A. Dengi and L.R. Carley. "Automatic synthesis of a 2.1 GHz SiGe low noise amplifier." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 125-128.

A 2.1 GHz low noise amplifier in a 0.5 μm 47 GHz SiGe BiCMOS process was synthesized and sent to fabrication. The circuit was synthesized to simultaneously meet multiple design specifications including noise figure, gain, power, impedance match, intermodulation, compression, stability with a state-of-art simulation-based circuit synthesis tool. The synthesis setup took about two days, and the synthesis run took about 2 hours on a pool of 10 networked SUN workstations. Noise figure of 1.2 dB, power gain of 16 dB, IIP3 of -6 dB, S11 of less than -15 dB, were achieved with 3.7 mA bias current at 2.5 V power supply. Data generated during synthesis was processed to show design trade-offs among competing performance goals. The trade-off between optimum noise match and input impedance match is discussed.



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Highly linear SiGe BiCMOS LNA and mixer for cellular CDMA/AMPS applications

V. Aparin, E. Zeisel and P. Gazzero. "Highly linear SiGe BiCMOS LNA and mixer for cellular CDMA/AMPS applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 129-132.

BiCMOS LNA and mixer designed for cellular CDMA/AMPS applications are described. The circuits exhibit very high linearity thanks to low-impedance low-frequency input terminations. The LNA achieves +12.2 dBm IIP3, 16.3 dB gain and 1.5 dB NF with 7.7 mA current in the high-gain high-linearity mode. The mixer achieves +14.7 dBm IIP3, 10.9 dB conversion power gain and 6.7 dB SSB NF with 8.4 mA current in the CDMA mode.

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An even harmonic type direct conversion SiGe-MMIC receiver for W-CDMA mobile terminals

E. Taniguchi, M. Shimosawa, T. Ikushima, K. Sadahiro, T. Katsura, K. Maeda, K. Itoh, N. Suematsu, T. Takagi and O. Ishida. "An even harmonic type direct conversion SiGe-MMIC receiver for W-CDMA mobile terminals." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 133-136.

An even harmonic type direct conversion MMIC receiver for W-CDMA mobile terminals in SiGe HBT technology is described. A 2-stage low noise amplifier (LNA) and two self biased anti-parallel diode pairs (APDPs) for even harmonic mixer (EH-MIX) are integrated into a single chip. The LNA employed dual bias feed circuit to improve the output power and linearity. The EH-MIX can obtain high IIP2 by using APDP. Noise performance of Schottky barrier diode (SBD) for APDP fabricated in SiGe process is lower than that of conventional SBD in the market. Both fabricated LNA and EH-MIX demonstrated high RF performances, and they are applicable to RF front-end of W-CDMA mobile terminals.

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A 2.6 V GSM/PCN dual band variable gain low noise RF down conversion mixer

Bonkee Kim, Kyung-Suc Nah, Tae-Won Ahn, Han-Il Lee, Je-Kwang Cho and Byeong-Ha Park.
"A 2.6 V GSM/PCN dual band variable gain low noise RF down conversion mixer." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 137-140.

As a building block for a GSM/PCN dual band RF transceiver IC, a low noise variable gain RF down conversion mixer is designed and fabricated using a 15 GHz-f/sub T/, 0.5 /spl mu/m 3-metal 2-poly BiCMOS process. Careful consideration is paid to the low noise performance of the mixer. Moreover, using constant-impedance input/output stages, RF input and IF output return losses are maintained under -16 dB for both high and low gain modes. Measured gain and DSB noise figure of the mixer are 10.9 dB and 9.1 dB, respectively, for GSM band, and 9.6 dB and 8.1 dB, respectively, for PCN band. Gain difference between high and low gain modes is 11 dB and 11.8 dB for GSM and PCN, respectively. Total DC currents are 13 mA for GSM and 11.5 mA for PCN from a 3 V supply voltage. Mixer performance is maintained with supply voltage down to 2.6 V.

A +2.4/0 V controlled high power GaAs SPDT antenna switch IC for GSM application

K. Numata, Y. Takahashi, T. Maeda and H. Hida. "A +2.4/0 V controlled high power GaAs SPDT antenna switch IC for GSM application." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 141-144.

We have developed a high-power-handling and low-voltage-controlled GaAs single-pole dual-throw (SPDT) antenna switch for GSM application. The switch circuit configuration has a capacitor at the antenna terminal and two resistors between the transmitter (Tx) and receiver (Rx) terminals and the control terminals. This circuit enables the DC voltages of the Tx terminal and the Rx terminal to be separated from each other, resulting in a high-power-handling operation at a lower control voltage than that for the conventional switch. The developed SPDT switch demonstrated a handling power of 37.5 dBm and an insertion loss of 0.37 dB with a control voltage of +2.4/0 V.

A 2-18 GHz wideband high dynamic range receiver MMIC

D.C. Bannister, C.A. Zelle and A.R. Barnes. "A 2-18 GHz wideband high dynamic range receiver MMIC." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 147-149.

In this paper, a 2 to 18 GHz wideband receiver MMIC for EW applications is presented. The receiver comprises a balanced cascode travelling wave LNA, a wideband active balun and a cold-FET ring mixer. The MMIC was fabricated using the TriQuint GaAs pHEMT process, using 0.25 μm gate length devices. The measured conversion gain is greater than 7.8 dB between 3 GHz and 20 GHz. The RF input return loss is better than 10 dB between 3 GHz and 21.5 GHz. The receiver requires a drain bias voltage of 5 V and draws a drain current of approximately 260 mA. This wideband receiver is believed to be the first fully integrated single-chip receiver MMIC covering the 2 to 18 GHz frequency band.



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A 3-33 GHz PHEMT MMIC distributed drain mixer

Kuo-Liang Deng and Huei Wang. "A 3-33 GHz PHEMT MMIC distributed drain mixer." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 151-154.

A compact wide-band GaAs PHEMT MMIC distributed drain mixer covering RF frequencies from 3 to 33 GHz is reported. The measured results show that the conversion loss of the distributed drain mixer is better than 4 dB over the frequency range at an LO power of 13 dBm without IF amplification. Using the matching circuit in the output of the FETs, LO-to-IF and LO-to-RF isolations are better than 19 dB from 3 to 33 GHz. This mixer utilizes a simple distributed topology with single-gate HEMTs and achieves very broad band performance comparable to cascode or dual-gate distributed mixers. The overall chip size of this MMIC is only 1.7/spl times/1 mm/sup 2/.

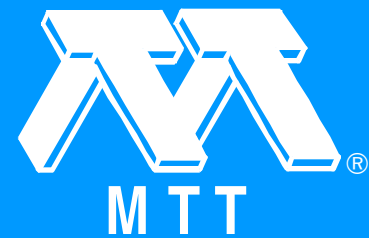
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Ka-band direct digital receiver using 0.25 /spl mu/m GaAs PHEMTs

S. Ovidiu Tatu, E. Moldovan, G. Brehm, Ke Wu and R.G. Bosisio. "Ka-band direct digital receiver using 0.25 /spl mu/m GaAs PHEMTs." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 155-158.

A new direct conversion wideband (26 GHz - 28.5 GHz) six-port millimeter wave receiver using MMIC technology is proposed to meet the needs of mass-market wireless communications. This six-port receiver is designed to operate without the need for precise power reading and the use of digital signal processor (DSP) that is usually required in other receivers. The proposed receiver architecture is chosen to satisfy requirements of hardware receiver used in QPSK communications. The receiver contains one MMIC module consisting of a wide band six-port junction with four RF Schottky detectors, a receiver front-end and a base band module composed of video amplifiers and I&Q decoder. The maximum bit rate, at least 100 Mbs, is determined solely by the limiting speed of ancillary video amplifiers and analogue decoder. This new hardware receiver is proposed as a robust, rugged, low cost receiver for use in wide Ka-band wireless mass market QPSK communications such as LMDS services that are a prime example of communication equipment requiring such receivers. BER results are presented in the presence of noise and local oscillator (LO) phase shift.



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A single-chip 24 GHz receiver front-end using a commercially available SiGe HBT foundry process

E. Sonmez, A. Trasser, K.-B. Schad, R. Abele and H. Schumacher. "A single-chip 24 GHz receiver front-end using a commercially available SiGe HBT foundry process." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 159-162.

The authors have demonstrated a fully integrated receiver frontend addressing the ISM-Band at 24 GHz utilizing a standard SiGe HBT MMIC process with a relaxed emitter scaling of 1.2 μm , for the first time. Extremely compact circuit design and layout techniques are applied to a mature Si/SiGe technology, resulting in a low-cost integrated circuit enabling consumer-oriented systems at Ka band. The integrated components are a preamplifier, a mixer with an IF buffer and a local oscillator. The conversion gain is determined to be 16.3 dB for an intermediate frequency of 100 MHz.

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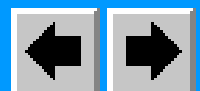
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Low power, high speed PLL fabricated in UTSi/sup (R)/ process

G.C. Wu, D. Kelly, D. Staab and P. Denny. "Low power, high speed PLL fabricated in UTSi/sup (R)/ process." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 165-168.

A CMOS phase locked loop (PLL) design achieves GHz performance, low phase noise, low spurious side-bands and extremely low power (1V, 1GHz, and <1mA of current.) The design is fabricated in 0.5/spl mu/m UTSi/sup (R)/ SOI process which has been previously described [Reedy, 1999].

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A 2V, 2.3/4.6 GHz dual-band CMOS frequency synthesizer

Wei-Zen Chen, Jia-Xian Chang, Ying-Jen Hong, Meng-Tzer Wong and Chien-Liang Kuo. "A 2V, 2.3/4.6 GHz dual-band CMOS frequency synthesizer." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 169-172.

This paper describes the design of a CMOS frequency synthesizer for 2.3/4.6 GHz wireless applications. This synthesizer provides dual band output signals by means of a novel frequency doubling technique. Output frequency of the proposed synthesizer ranges from 1.87 GHz-2.3 GHz and 3.74 GHz-4.6 GHz. Fabricated in a 0.35 μm CMOS process, this chip consumes a total power of 80 mW from a single 2 V supply. Chip size is 3210 μm^2 .

A low jitter 5.3-GHz 0.18-/spl mu/m CMOS PLL based frequency synthesizer

S. Ali and F. Jain. "A low jitter 5.3-GHz 0.18-/spl mu/m CMOS PLL based frequency synthesizer." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 173-176.

A 5.3-GHz CMOS phase locked loop (PLL) based frequency synthesizer is reported. The PLL operates as an integer-N frequency synthesizer using a ring-type voltage controlled oscillator (VCO). The PLL based synthesizer operates from 4.9 to 5.3-GHz and achieves a phase noise of -121.9 dBc/Hz at 10-MHz offset frequency from the carrier for maximum oscillation frequency of 5.3-GHz. The ring VCO works from 4.21 to 5.46-GHz with a maximum power consumption of 4.7-mW. A completely ripple-free VCO control voltage is obtained using a current mirror current source in a charge pump loop filter. The PLL is implemented with TSMC 0.18-/spl mu/m technology for GSM applications. The output rms jitter is 0.3% of the oscillator period. The total power consumption of this synthesizer is only 10-mW from a 1.8 V power supply.

Design considerations in a BiCMOS dual-modulus prescaler

F. Dulger, E. Sanchez-Sinencio and A. Bellaouar. "Design considerations in a BiCMOS dual-modulus prescaler." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 177-180.

Design considerations in a dual modulus divide by 32/33 prescaler with a 0.6/spl mu/m BiCMOS process are presented. Care was taken to design the ECL-based circuits to operate with as low supply voltage and current consumption as possible. The phase noise contribution of the integrated bandgap bias network is demonstrated through simulations. The tradeoff between the power consumption and the phase noise is pointed out and some guidelines are provided to improve the noise performance. Measurements confirm the functionality of the prescaler with a 2.5V supply drawing around 2.3mA at 2.35 GHz with an input sensitivity between -24dBm and 12dBm. The circuit operates with a supply voltage down to 2.1V but with limited input sensitivity.



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Time delay considerations in high-frequency phase-locked loops

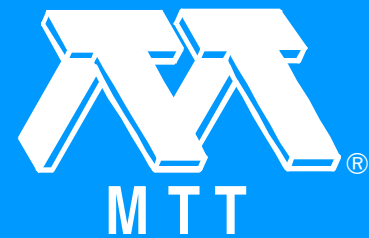
J. Buckwalter and R.A. York. "Time delay considerations in high-frequency phase-locked loops." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 181-184.

The time-delayed phase-locked loop (PLL), model predicts drastically different behavior not accounted for in a conventional PLL model. Three results in particular are identified. A critical gain exists for which the equilibrium point becomes a limit cycle. An optimal gain exists that minimizes the acquisition time of the PLL to an external signal. Finally, changes in stability occur first at zero frequency detuning for a given gain and time delay. Verification of this behavior in a 1.5 GHz PLL with reasonable circuit parameter values is demonstrated.

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The MSM5100/sup TM/ cdma2000 + AMPS + gpsOne/sup TM/ + Bluetooth multimode ASIC for 3G handsets

B.K. Butler, King-Chung Lai, K. Saints and B. Meagher. "The MSM5100/sup TM/ cdma2000 + AMPS + gpsOne/sup TM/ + Bluetooth multimode ASIC for 3G handsets." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 186A-186F.

The MSM5100 ASIC forms the heart of a high-featured cdma2000 3G handset that is gpsOne position location capable. The gpsOne technology meets the accuracy requirements set by the FCC for E911 Phase II. This ASIC performs baseband processing for the spectrum of air interfaces supported: IS-2000 Release 0, IS-95A/B, AMPS, GPS, and Bluetooth 1.1. The ASIC itself is both a merging effort of two previous ASIC designs, MSM3300 and MSM5000, and the addition of new functionality. The new functionality includes USB speed enhancements and increased IS-2000 physical layer support. Also, several new VLSI challenges were met in creating this product, including our product in the 0.18 um process and integrated voltage regulators. Altogether, the MSM5100 makes a significant leap forward in 3G handset functionality.

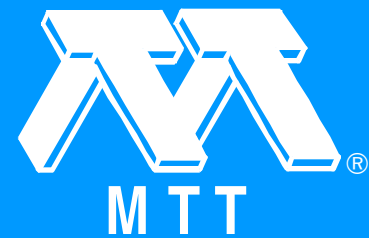
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A re-configurable receiver architecture for 3G mobiles

B. Minnis and P. Moore. "A re-configurable receiver architecture for 3G mobiles." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 187-190.

A re-configurable, highly-integrated receiver architecture is described for use in 3rd/4th generation mobile handsets. It is intended for dual-mode UMTS and GSM operation but should be capable of operating in other modes such as CDMA2000. The receiver achieves its adaptability by using a single down-conversion approach to either a zero IF or a near-zero IF and then digitizing as much of the IF signal chain as possible. Notwithstanding its reconfigurability, system simulations indicate that the receiver should achieve state-of-the-art performance.



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A highly integrated 0.25 μm BiCMOS chipset for 3G UMTS/WCDMA handset RF sub-system

D. Brunel, C. Caron, C. Cordier and E. Soudee. "A highly integrated 0.25 μm BiCMOS chipset for 3G UMTS/WCDMA handset RF sub-system." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 191-194.

The complete active portion of the 3G UMTS/WCDMA cellular handset RF sub-system is achieved with three RFICs. This chipset comprises a fully integrated ZIF receiver including RF VCO/PLL and UNITS clock generation, a fully Integrated direct conversion like transmitter including RF VCO/PLL, and a 25 dBm average power amplifier including power detection circuitry. The three RFICs use the same baseline 0.25 μm BiCMOS technology opening possibilities to even higher integration level. This chipset is targeted at handset class 3 and 4 (PA is class 4 compatible only) European and Japanese 3 G UMTS and WCDMA standards.





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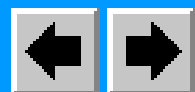
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A CMOS transmit/receive IF chip-set for WCDMA mobiles

U. Dasgupta, Wooi Gan Yeoh, Chun Geik Tan, Sheng Jau Wong, H. Mori, R. Singh and M. Itoh. "A CMOS transmit/receive IF chip-set for WCDMA mobiles." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 195-198.

A transmit/receive IF chip-set integrating modulator/demodulator and AGCs for WCDMA mobiles in 0.35 μm CMOS process is presented. Circuit innovations that achieve linear-in-dB gain control for wide-dynamic range AGCs with compensation against temperature and process variations to meet stringent specifications overcoming the limitations of CMOS technology are reported.

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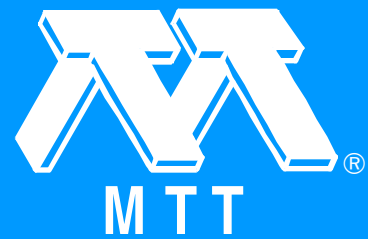


Abstracts

4G RF systems on chip or on module?

D. Belot. "4G RF systems on chip or on module?." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 199-202.

The present trend in the RF communications is to integrate as far as possible the function within a chip. Obviously the cost of a function mainly depends on the number of external components. The matter of this paper is to evaluate the limit of the integration looking at the economic topics and technical possibilities.



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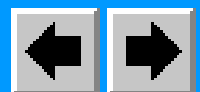
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Gain controllable very low voltage (≤ 1 V) 8-9 GHz integrated CMOS LNAs

T.K.K. Tsang and M.N. El-Gamal. "Gain controllable very low voltage (≤ 1 V) 8-9 GHz integrated CMOS LNAs." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 205-208.

This paper presents the design and experimental results of two CMOS low-voltage low noise amplifiers intended for future wireless applications, and featuring a new and very simple gain control mechanism. Implemented in a standard 0.18 μm CMOS process, and operating from a supply voltage of 1 V, the 8 GHz LNA exhibits a power gain of 13.7 dB and a noise figure of 3.2 dB, while the 9 GHz LNA achieves a forward transmission S_{21} of 12.2 dB and a noise figure of 3.7 dB. Both circuits have a gain tuning range of over 10 dB, and can operate from a supply voltage as low as 0.7 V.

Step gain amplifier with impedance unchanged in gain control

M. Tanabe, T. Fukuda and K. Nishii. "Step gain amplifier with impedance unchanged in gain control." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 209-212.

A novel gain control method without impedance alternation in a gain control action has been developed. The method was based on the traditional current switch gain control scheme. A low gain mode has not only a DC feed-through as in the conventional method but also an RF feed-through with an RC network and a common-base transistor. An implemented differential Low Noise Amplifier exhibited the complete suppression of the impedance alternation effect. The details of the circuit topology are presented in this paper.



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Enhancement mode PHEMT low noise amplifier with LNA linearity control (IP3) and mitigated bypass switch

S. Kumar, M. Vice, H. Morkner and L. Wayne. "Enhancement mode PHEMT low noise amplifier with LNA linearity control (IP3) and mitigated bypass switch." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 213-216.

A new LNA has been designed using single supply enhancement mode PHEMT process for WCDMA and other wireless application up to 6 GHz. The LNA has direct CMOS logic controllable integrated bypass-mitigated switch and LNA linearity (IP3) control switch. Two different kind of logic controls (0/3 V, 3/0 V) switch has been design for bypass-mitigated switch. In high linearity mode the LNA draws 8.5 mA current and has 15 dB gain, 1 dB noise figure, -6 dBm IP/sub 1dB/, 7.3 dBm IIP3 with I/O return loss >11 dB. In low linearity mode the LNA draws 3.5 mA current and has 14 dB gain, 1.1 dB noise figure,, -6.5 dBm IP/sub 1dB/, 2 dBm IIP3 with I/O return loss >11 dB. The LNA bypass-mitigated switch has <3.5 dB insertion loss and NF, I/O return loss >11 dB and draws negligible current with 3/0 V logic, /spl sim/200 /spl mu/A for 0/3 V logic. Due to well-behaved match of LNA in High Linearity/Low Linearity/Bypass modes, this LNA has minimum mismatch effect for duplexers; and filters in a receiver system.

Click on title for a complete paper.



Low noise, high linearity, wide bandwidth amplifier using a 0.35 μm SiGe BiCMOS for WLAN applications

J. Sadowy, I. Telliez, J. Graffeuil, E. Tournier, L. Escotte and R. Plana. "Low noise, high linearity, wide bandwidth amplifier using a 0.35 μm SiGe BiCMOS for WLAN applications." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 217-220.

In this paper, we present the design of an integrated low noise amplifier (LNA) for WLAN applications in the 6 GHz range using a low complexity SiGe BiCMOS technology. The SiGe HBTs used in the design feature a typical cut-off frequency " f_t " of 45 GHz and a typical maximum oscillation frequency " f_{max} " of 60 GHz. The LNA exhibits a 17 dB power gain with a 1.4 GHz bandwidth and a noise figure lower than 2.5 dB. The 1 dB compression point is -18 dBm and the third order intercept point referred to the input is -7 dBm. We have furthermore observed a good accuracy between simulations and measurements. Finally, we have defined a new figure of merit involving the noise measure and the DC power consumption that shows that our design features a performance at the state of the art.



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A 5.8-GHz two-stage high-linearity low-voltage low noise amplifier in a 0.35- μm CMOS technology [WLANS]

Ren-Chieh Liu, Chung-Rung Lee, Huei Wang and Chorng-Kuang Wang. "A 5.8-GHz two-stage high-linearity low-voltage low noise amplifier in a 0.35- μm CMOS technology [WLANS]." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 221-224.

A 5.8-GHz two-stage high-linearity low-voltage CMOS low-noise amplifier (LNA) has been developed in a 0.35- μm pure digital CMOS technology without any additional mask or post-processing steps. A two-stage architecture is used to simultaneously optimize the gain and noise performance. Based on the modified CMOS model valid for RF range, the LNA with fully on-chip input, output and inter-stage matching was designed to verify the two-stage LNA architecture. This LNA chip achieves measured results of 3.2-dB NF, +6.7-dBm IIP3 and -3.7-dBm output P/sub 1dB/ at 5.8 GHz. A figure-of-merit for linearity (output IP3/P/sub DC/) of 1.2 is achieved, which is believed to be among the best reported for a CMOS low-noise amplifier operating at 5-6 GHz ISM band. The effective circuit area is only 0.63 /spl times/ 0.46 mm/sup 2/.



A 14.5 GHz, 0.35 /spl mu/m frequency divider for dual-modulus prescaler

E. Tournier, M. Sie and J. Graffeuil. "A 14.5 GHz, 0.35 /spl mu/m frequency divider for dual-modulus prescaler." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 227-230.

This paper reports on structures of frequency divider to be used in the first stage of a dual modulus prescaler. A divider by 2, the prescaler elementary cell, has been designed and characterized. A 4/5 divider is presented as a natural extension of the divider by 2. A first realization has been characterized. We show that an asynchronous structure can overcome the synchronous structure frequency limitations.

A high sensitivity static 2:1 frequency divider up to 19 GHz in 120 nm CMOS

H.-D. Wohlmuth, D. Kehrer and W. Simburger. "A high sensitivity static 2:1 frequency divider up to 19 GHz in 120 nm CMOS." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 231-234.

A completely integrated 19 GHz static 2:1 frequency divider in 120 nm CMOS is presented. The divider operates up to 19 GHz and features an enhanced input sensitivity of 0 dBm over a broad input band of 15 GHz. The circuit draws 44 mA from a single 1.5 V supply. To drive 50 Ω loads up to 9.5 GHz, an output buffer is also included in the divider circuit.

A low-power 20 GHz static frequency divider with programmable input sensitivity

C.S. Vaucher and M. Apostolidou. "A low-power 20 GHz static frequency divider with programmable input sensitivity." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 235-238.

A low-power frequency divider (divide-by-8) is described which operates up to frequencies in excess of 20 GHz with a supply voltage of 2.7 V. The circuit is implemented in a standard bipolar Silicon technology with a maximum $f_{sub T}$ of 37 GHz. The total power dissipation is 57 mW, with 11 mW dissipated in the first divider stage. An innovative implementation of a Toggle flip-flop enables the input sensitivity to be adapted as a function of the input frequency, extending the operation range with respect to standard techniques. An AC simulation model for evaluation of the high frequency performance as a function of design parameters is introduced.

36 GHz dual-modulus prescaler in SiGe bipolar technology

H. Knapp, M. Wurzer, J. Bock, T.F. Meister, G. Ritzberger and K. Aufinger. "36 GHz dual-modulus prescaler in SiGe bipolar technology." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 239-242.

Presents a dual-modulus prescaler with divide ratios of 256 and 257. The circuit uses static divider stages and differential current-mode logic. AND-gates are merged with flip-flops to achieve high operating frequencies at low power consumption. The prescaler operates with input frequencies ranging from below 1 GHz up to 36.4 GHz. It consumes 34.2 mA from a 3 V supply. The circuit is manufactured in a 0.4 μm SiGe bipolar technology.

A GSM/EDGE dual-mode, 900/1800/1900-MHz triple-band HBT MMIC power amplifier module

K. Yamamoto, T. Asada, S. Suzuki, T. Miura, A. Inoue, S. Miyakuni, J. Otsuji, R. Hattori, Y. Miyazaki and T. Shimura. "A GSM/EDGE dual-mode, 900/1800/1900-MHz triple-band HBT MMIC power amplifier module." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 245-248.

This paper describes a 3.5-V operation HBT MMIC power amplifier module for use in GSM/EDGE dual-mode, 900/1800/1900-MHz triple band handset applications. With diode switches and a band select switch built on the MMIC, the module delivers a P/sub out/ of 35.5 dBm and a PAE of about 50% for GSM900, a 33.4-dBm P/sub out/ and a 45% PAE for GSM1800/1900. While satisfying an error vector magnitude (EVM) of less than 4% and a receive-band noise power of less than -83 dBm/100 kHz, the module also delivers a 29.5 dBm P/sub out/ and a PAE of over 25% for EDGE900, a 28.5 dBm P/sub out/ and a PAE of over 25% for EDGE1800/1900.



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A 20 mA quiescent current CV/CC parallel operation HBT power amplifier for W-CDMA terminals

S. Shinjo, K. Mori, H. Ueda, A. Ohta, H. Seki, N. Suematsu and T. Takagi. "A 20 mA quiescent current CV/CC parallel operation HBT power amplifier for W-CDMA terminals." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 249-252.

A novel constant voltage/constant current (CV/CC) parallel operation HBT power amplifier (PA) configuration is proposed. By combining two HBT's having different base bias circuits for each (one is CV and the other is CC), non-linearity at large back-off region can be canceled out. Therefore, both low quiescent current and enough ACPR performance can be achieved. The fabricated CV/CC parallel operation HBT PA demonstrates extremely low quiescent current of 20 mA and ACPR of less than -38 dBc at the output power range up to 27.5 dBm.

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A new "active" predistorter with high gain using cascode-FET structures

Moon-Suk Jeon, Junghyun Kim, Hyunil Kang, Sanghwa Jung, Jaehak Lee and Youngwoo Kwon.
"A new "active" predistorter with high gain using cascode-FET structures." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 253-256.

An MMIC-compatible miniaturized "active" predistorter using cascode FET structures is presented. The predistorter has gain expansion and negative phase deviation characteristics required to compensate for the distortion of typical power amplifiers. Unlike the previously reported predistorters, the predistorter of this work is capable of providing gain as high as 7-17 dB, eliminating the need for additional buffer amplifiers. This makes our approach well suited to MMIC implementation. Analysis of gain and phase deviation was also conducted. From the analysis, the origin of nonlinear distortion of predistorter was found to be $G_{\text{sub m}}$ of the upper FET and $R_{\text{sub ds}}$ of the lower FET. The predistorter of this work was applied to linearize a 2-GHz MMIC power amplifier for CDMA handset applications. ACPR improvement of 5 dB was achieved.

Integrated distributed amplifier with passive-free input driver

B. Stengel and B. Thompson. "Integrated distributed amplifier with passive-free input driver." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 257-260.

High efficiency amplifier operation (class-D, E and S) conceptually approaches an ideal switched transistor model. Driver signals are of sufficient level to ensure that the devices are saturated and cut off during the proper parts of the RF cycle. Conventional sine wave input signals are generated with lower efficiency cascaded power gain stages. Deep sub-micron CMOS technology and improved power device input terminal parameters, have created a novel opportunity for a new switching signal driver design approach. This can be extended to distributed power amplifier application to replace the passive lumped transmission line input network with an integrated active solution.



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Integrated even harmonic type direct conversion receiver for W-CDMA mobile terminals (2002 [RFIC])

K. Itoh, T. Yamaguchi, T. Katsura, K. Sadahiro, T. Ikushima, R. Hayashi, F. Ishizu, E. Taniguchi, T. Nishino, M. Shimosawa, N. Suematsu, T. Takagi and O. Ishida. "Integrated even harmonic type direct conversion receiver for W-CDMA mobile terminals (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 263-266.

This paper is the first demonstration of the overall performance of the integrated even harmonic type direct conversion receiver (EH-DCR) with the RAKE receiver. The configuration of the integrated EH-DCR and its evaluation results based on the 3GPP definition are indicated. The RX LTCC module with the SiGe RX-IC, and BiCMOS ABB-IC are developed to achieve high integration of the receiver with filters. The integrated EH-DCR with low second order distortion can achieve high sensitivity and selectivity of the W-CDMA receiver, even with interference due to the transmitting signal. Described evaluation results satisfy the specifications defined by 3GPP. This paper clarifies effectiveness of the integrated EH-DCR for the third generation mobile terminals.

Click on title for a complete paper.



An analog baseband chain for a UMTS zero-IF receiver in a 75 GHz SiGe BiCMOS technology (2002 [RFIC])

W. Schelmbauer, H. Pretl, L. Maurer, B. Adler, R. Weigel, R. Hagelauer and J. Fenk. "An analog baseband chain for a UMTS zero-IF receiver in a 75 GHz SiGe BiCMOS technology (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 267-270.

A zero-IF receiver for UMTS realized by using an advanced 0.35 μm SiGe BiCMOS process with 75 GHz transit frequency is presented. The focal point is the analog baseband chain consisting of a low-noise buffer (LNB), a fully integrated channel selection filter, programmable gain amplifiers (PGA) and circuits to reduce the effects of DC-offsets. The whole chain is able to provide a voltage gain from -14 dB up to 50 dB in 1 dB steps and 43 dB adjacent channel selectivity. The total receiver current consumption for a supply voltage of 2.7 V is less than 45 mA, whereby the baseband chain consumes 15 mA.

A 2-GHz RF front-end transceiver chipset in CMOS technology for PCS and IMT-2000 applications (2002 [RFIC])

Yong-Sik Youn, Nam-Soo Kim, Jae-Hong Chang, Young-Jae Lee and Hyun-Kyu Yu. "A 2-GHz RF front-end transceiver chipset in CMOS technology for PCS and IMT-2000 applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 271-274.

This paper describes RF front-end transceiver chipset for the dual-mode operation of PCS and IMT-2000. The transceiver chipset has been implemented in a 0.25 μm single-poly five-metal CMOS technology. The receiver IC consists of a LNA and a down-mixer, and the transmitter IC integrates an up-mixer. Measurements show that the transceiver chipset covers the wide RF range from 1.8 GHz for PCS to 2.1 GHz for IMT-2000. The LNA has 2.5/spl sim/2.8 dB NF, 13/spl sim/12 dB gain and 6/spl sim/4 dBm IIP3. The down mixer has 15.5/spl sim/16.0 dB DSB NF, 15/spl sim/13 dB power conversion gain and 2/spl sim/0 dBm IIP3. The up mixer has 0/spl sim/-2 dB power conversion gain and 6/spl sim/3 dBm OIP3. With a single 3.0 V power supply, the LNA, down-mixer, and up-mixer consume 5 mA, 30 mA, and 25 mA, respectively.



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System analysis of a W-CDMA base-station PA employing adaptive digital predistortion (2002 [RFIC])

C. Potter. "System analysis of a W-CDMA base-station PA employing adaptive digital predistortion (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 275-278.

An analysis is presented of the implementation requirements for a linear power amplifier (PA) incorporating a predistortion lineariser. It is shown that the statistical distribution of the W-CDMA envelope affects the linearity requirement of the PA when viewed as a function of instantaneous power. Where there is a low probability of a given level, the acceptable non-linearities are higher than at the most probable level. Consequently, a minimum linearity profile is derived that is consistent with meeting the ACLR, PCDE and EVM system requirements. This can be exploited to produce a simpler and more efficient PA while still meeting its specifications.

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Ku-band MMIC's in low-cost, SMT compatible packages (2002 [RFIC])

H.C. Huang, A. Ezzeddine, A. Darwish, B. Hsu, J. Williams and S. Peak. "Ku-band MMIC's in low-cost, SMT compatible packages (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 281-284.

mm-wave components are very expensive due to the high package and assembly cost. This paper describes a 0.25 μm PHEMT Ku-band 2-watt PA, and a 2.2 dB NF LNA MMIC in a low-cost SMT package (\$2.00). The package has excellent thermal resistance, 0.5 C/W, return loss (20 dB), and input/output isolation (40 dB), from DC-40 GHz. We believe this is the first time such a package design is published.

Click on title for a complete paper.



ESD protection of RF circuits in standard CMOS process (2002 [RFIC])

K. Higashi, A.O. Adan, M. Fukumi, N. Tanba, T. Yoshimasu and M. Hayashi. "ESD protection of RF circuits in standard CMOS process (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 285-288.

The tradeoffs in the ESD protection device for RFCMOS circuits are described, and the characteristics of an SCR-based ESD structure are presented. The parasitic capacitance of the ESD structure is reduced to ~ 150 fF. 3 kV HBM and 750 V CDM are achieved in a LNA working at 2.5 GHz with NF<4dB, applicable for Bluetooth wireless transceiver.



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Novel BiCMOS compatible, short channel LDMOS technology for medium voltage RF & power applications (2002 [RFIC])

A. Litwin, O. Bengtsson and J. Olsson. "Novel BiCMOS compatible, short channel LDMOS technology for medium voltage RF & power applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 289-292.

We describe a very short channel, 0.15 μm , LDMOS transistor, with a breakdown voltage of up to 45 V, manufactured in a standard 0.35 μm BiCMOS process. At 1900 MHz and a 12 V supply voltage the 0.4 mm gate width device gives 100 mW output power P_{out} at a drain efficiency of 43%. It has a transducer power gain of more than 20 dB and a current gain cutoff frequency, f_{T} , of 13 GHz. The maximum available gain cutoff frequency, f_{MAX} , is 27 GHz. The LDMOS process module does not affect the performance or models of other devices. We present for the first time a simple way to create high voltage, high performance LDMOS transistors for RF power amplifier use even in a very downscaled silicon technology.

Click on title for a complete paper.



Electromagnetic coupling effects in RFCMOS circuits (2002 [RFIC])

A.O. Adan, M. Fukumi, K. Higashi, T. Suyama, M. Miyamoto and M. Hayashi. "Electromagnetic coupling effects in RFCMOS circuits (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 293-296.

The electromagnetic isolation and coupling characteristics of basic structures, namely metal pads, spiral inductors, and spiral-transistors, implemented in a core-logic CMOS process are evaluated and modeled. The models provide design guidelines on the isolation characteristics of guard-rings and shield layers for RF cross-talk suppression between circuit blocks. The importance of electromagnetic coupling to layout interconnects is demonstrated.



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Ultra low-power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless application (2002 [RFIC])

A. Cidronali, G. Collodi, M. Camprini, V. Nair, G. Manes, J. Lewis and H. Goronkin. "Ultra low-power VCO based on InP-HEMT and heterojunction interband tunnel diode for wireless application (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 297-300.

The monolithic integration of tunneling diodes (TDs) with other semiconductor devices such as HEMTs or HBTs, creates novel quantum functional nonlinear devices and circuits with unique properties: the Negative Differential Resistance (NDR) and the extremely low DC power consumption. In this paper we present an InP-HEMT/spl bsol/TD based voltage controlled oscillator operating in the 6 GHz band suitable for wireless applications. The circuit draws a current of 1.75 mA at 500 mV and generates an output power of -16 dBm. The maximum tuning range is 150 MHz and the single sideband-to-carrier ratio (SSCR) is of -105 dBc/Hz at 5 MHz.

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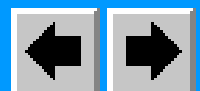
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Modeling of passive elements with ASITIC (2002 [RFIC])

A.M. Niknejad. "Modeling of passive elements with ASITIC (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 303-306.

Passive elements are key building blocks in realizing fully integrated low cost RF transceivers. The analysis and modeling of passive elements is critical in the design and optimization of building blocks, especially when the quality of passive elements determines the overall achievable performance. Analysis of passive elements near the silicon substrate, though, necessitates solving Maxwell's equations. Furthermore, simulation of passive elements in tools such as SPICE requires lumped-element equivalent circuit models derived through optimization. ASITIC is a software tool that aids the RF designer in the process of design and simulation of such structures.

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Modeling of frequency dependent losses in two-port and three-port inductors on silicon (2002 [RFIC])

T. Kamgaing, T. Myers, M. Petras and M. Miller. "Modeling of frequency dependent losses in two-port and three-port inductors on silicon (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 307-310.

New compact model forms for two-port and three-port symmetric inductors fabricated on silicon are discussed in this paper. These new models incorporate a frequency independent RL network that mimics the skin effect behavior of transmission lines on conductive substrates and can accurately predict the inductive behavior as well as the one-port single-ended and the one-port differential Q of these devices at microwave and millimeter wave frequencies. The new models are validated on inductors fabricated in a thick plated copper process.

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Characterization and modeling of on-chip inductor substrate coupling effect (2002 [RFIC])

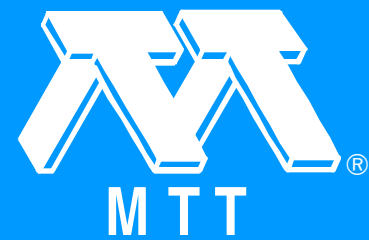
Chuan-Jane Chao, Shyh-Chyi Wong, Chia-Jen Hsu, Ming-Jer Chen and Len-Yi Leu.

"Characterization and modeling of on-chip inductor substrate coupling effect (2002 [RFIC])."
2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 311-314.

The substrate coupling effects of two adjacent coplanar spiral inductors are characterized and modeled. The noise magnitude between two 45 μm -away inductors can be reduced by 6.83 dB by using guard-ring surrounding each inductor, and improved by 10.28 dB further by adding patterned ground polysilicon shield beneath at 3 GHz. The inductor with patterned polysilicon shield beneath shows improved quality factor and noise isolation. Moreover, a macro model is presented for modeling quality factor and inductance of on-chip spiral inductor and associated neighboring inductor's coupling noise effect.

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Characterization and modeling of small-signal substrate resistance effect in RF CMOS (2002 [RFIC])

Yo-Sheng Lin, Shey-Shi Lu, Tai-Hsing Lee and Hsiao-Bin Liang. "Characterization and modeling of small-signal substrate resistance effect in RF CMOS (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 315-318.

A novel theory based on dual-feedback circuit methodology is proposed to explain the kink phenomenon of scattering parameter S_{22} in deep submicrometer MOSFETs. Our results show that the output impedance of MOSFETs intrinsically shows a series RC circuit (for low substrate resistance) or a "shifted" series RC circuit (for very high substrate resistance) at low frequencies, and a parallel RC circuit at high frequencies. It is this inherent triple characteristic of the output impedance that causes the appearance of double kinks phenomenon of S_{22} in a Smith chart. Our model can not only predict the behavior of S_{22} , but also calculate all S-parameters accurately. Experimental data of 0.25- μ m-gate MOSFETs are used to verify our theory. Excellent agreement between theoretical values and experimental data was found.

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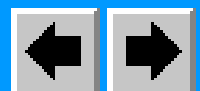
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A new methodology for the computation of the substrate parasitics of octagonal inductors (2002 [RFIC])

W. Tatinian, P. Pannier and R. Gillon. "A new methodology for the computation of the substrate parasitics of octagonal inductors (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 319-322.

The paper provides a method for the computation of the substrate parasitics of symmetrical octagonal inductor, using a set of equivalent structures. This method has been tested on a wide range of inductors and the error due to computation is lower than the one due to the topology of the model itself.

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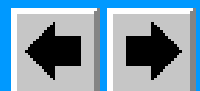
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Review of SiGe process technology and its impact on RFIC design (2002 [RFIC])

A. Das, M. Huang, J. Mondal, D. Kaczman, C. Shurboff and S. Cosentino. "Review of SiGe process technology and its impact on RFIC design (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 325-328.

Reviews recently published SiGe BiCMOS technologies for RFIC design. Performance and integration trends in SiGe HBTs are discussed. Performance of passive devices, such as an inductor, plays a key role in RF design. We review approaches to realize high Q inductor on a Si substrate. Finally, interaction of HBT performance with design is illustrated through LNA design.

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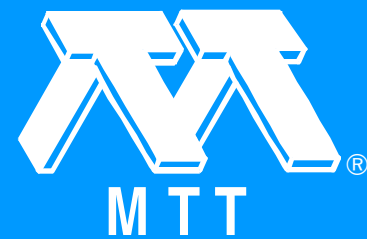
High performance circuits in 0.18 μm SiGe BiCMOS process for wireless applications (2002 [RFIC])

Peihua Ye, B. Agarwal, M. Reddy, L. Li, J. Cheng, P.C. Mudge, E. McCarthy and S.L. Lloyd.
"High performance circuits in 0.18 μm SiGe BiCMOS process for wireless applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 329-332.

Silicon germanium bipolar CMOS (SiGe BiCMOS) process technology is gaining increasing popularity for RF circuits in wireless applications due to high performance, low cost, high yield and higher levels of integration with mixed signal and digital CMOS circuits. Four test circuits were designed and fabricated in Conexant's 0.18 μm SiGe BiCMOS process to evaluate the performance benefits provided by this state of the art process technology. The RF performance achieved in this process clearly makes this a process of choice for future RFIC products.

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Low-frequency noise figures-of-merit in RF SiGe HBT technology (2002 [RFIC])

Jin Tang, Guofu Niu, Zhenrong Jin, J.D. Cressler, Shiming Zhang, A.J. Joseph and D.L. Hareme. "Low-frequency noise figures-of-merit in RF SiGe HBT technology (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 333-336.

We present the first systematic experimental and modeling results of corner frequency ($f_{\text{sub C}}$) and the corner frequency to cutoff frequency ratio ($f_{\text{sub C}}/f_{\text{sub T}}$) for SiGe HBTs in a commercial SiGe RF technology. The $f_{\text{sub C}}/f_{\text{sub T}}$ ratio is examined as a function of biasing current for SiGe HBTs featuring multiple collector doping profiles (breakdown voltages) and multiple SiGe profiles.

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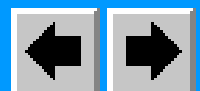
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COM2 enhanced graded base SiGe technology for high speed applications (2002 [RFIC])

T. Ivanov, M. Carroll, S. Moinian, M. Mastrapasqua, A. Frej, A. Chen, C. King, A. Hamad, E. Martin, S. Shive, T. Esry, C. Lee, R. Johnson, T. Sorsch, K. Banoo, P. Smith and W. Cochran. "COM2 enhanced graded base SiGe technology for high speed applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 337-340.

The COM2 Enhanced Graded Base SiGe modular BiCMOS technology has been developed. It is based on the COM2 digital CMOS process. The technology achieves peak $F_t=100$ GHz, peak $F_{max}=101$ GHz, peak $/spl beta/=186$ and $BV_{cex}=2.05$ V. F_t - BV_{cex} product of 205 and good across wafer uniformity are demonstrated.

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Advanced passive devices for enhanced integrated RF circuit performance (2002 [RFIC])

D. Coolbaugh, E. Eshun, R. Groves, D. Harame, J. Johnson, M. Hammad, Z. He, V. Ramachandran, K. Stein, S. St Onge, S. Subbanna, D. Wang, R. Volant, X. Wang and K. Watson. "Advanced passive devices for enhanced integrated RF circuit performance (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 341-344.

State of the art passive devices have been developed for optimum RF circuit performance. These devices include a hyperabrupt junction varactor with tunability (C_{max}/C_{min}) of 3.3, an accumulation mode MOS varactor, high capacitance nitride metal-insulator-metal capacitors, a BEOL TaN resistor and very high Q inductors with a peak Q of 28 at 3.5 GHz. VCO simulations using several of these elements show a significant reduction in VCO gain variation, phase noise, and power consumption.

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A robust high voltage Si LDMOS model extraction process to achieve first pass linear RFIC amplifier design success (2002 [RFIC])

J.A. Pla and D. Bridges. "A robust high voltage Si LDMOS model extraction process to achieve first pass linear RFIC amplifier design success (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 347-350.

A robust model extraction procedure was developed for a high voltage Si LDMOS RFIC process to achieve first pass linear RFIC amplifier design success. The model extraction process utilizes pulsed isothermal small-signal S-parameter measurements and extracted large-signal Root Models at three different temperatures to extract model parameters for Motorola's Electro-Thermal (MET) FET analytical model. Large-signal model validation was performed against loadpull measurements under 1-tone and 2-tone stimuli. Also, the models were developed into a design kit within Agilent/sup (R)/ EEsof/sup (R)'s ADS/sup (R)/ (Advanced Design System) to design a wide-band 30 Watt power amplifier IC which achieved first pass design success.

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Large-signal modeling of GaN FET and nonlinearity analysis using Volterra series (2002 [RFIC])

S.S. Islam and A.F.M. Anwar. "Large-signal modeling of GaN FET and nonlinearity analysis using Volterra series (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 351-354.

A large-signal model is reported to investigate the nonlinearities of a GaN MESFET. The model developed accounts for the observed current collapse and frequency dispersion of output resistance and transconductance and uses Volterra series technique to determine the nonlinearities. Calculated $f_{sub T}$ and $f_{sub max}$ of a 0.8 μm /spl times/150 μm /spl GaN MESFET are 6.5 GHz and 13 GHz, respectively, and are in close agreement with their measured values of 6 GHz and 14 GHz, respectively. For a 1.0 μm /spl times/150 μm /spl FET operating at 1 GHz, 1-dB compression point and output referred third-order intercept point (OIP3) are 18 dBm and 25.3 dBm, respectively. The corresponding quantities are 19.6 dBm and 30.5 dBm for a 0.6 μm /spl times/150 μm /spl FET at same frequency. Similar Improvements in third-order intermodulation (IM3) for shorter gate length devices are reported.





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Direct parameter extraction on RF-CMOS (2002 [RFIC])

F.X. Pengg. "Direct parameter extraction on RF-CMOS (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 355-358.

A good knowledge of all parameters of the models used with circuit simulation is one of the major prerequisites for a successful design. This is particularly true for the design of analog RF circuits. An efficient and accurate method to directly extract the parameters needed for accurate modeling of transistors in a standard CMOS sub-micron technology for RF-applications is presented. The paper concentrates on the extraction procedure, with emphasis on its simplicity, hence excluding fitting or optimization, and on the accuracy of its results. The extracted parameters are applied to a first order nonquasistatic model and the simulation results compared with measurements. Excellent agreement between simulations and measurements up to 50 GHz is achieved.

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Low frequency noise characterization and modeling of microwave bipolar devices: application to the design of low phase noise oscillator (2002 [RFIC])

L. Bary, G. Cibiel, I. Telliez, J. Rayssac, A. Rennane, C. Boulanger, O. Llopis, M. Borgarino, R. Plana and J. Graffeuil. "Low frequency noise characterization and modeling of microwave bipolar devices: application to the design of low phase noise oscillator (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 359-362.

This paper addresses advanced low frequency noise measurements and modeling of SiGe HBTs. Results have been implemented into a nonlinear Gummel Poon model which has been validated through the design of a DRO made of an integrated SiGe negative resistance in the 10 GHz range. We have obtained phase noise of -105 dBc/Hz at 10 kHz offset, which is close to the state of the art, and we have demonstrated a design technique that provides an accurate phase noise prediction.

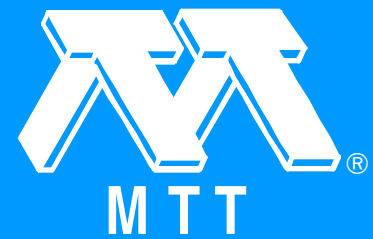


Linearity analysis of CMOS for RF application (2002 [RFIC])

Sanghoon Kang, Byounggi Choi and Bumman Kim. "Linearity analysis of CMOS for RF application (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 363-366.

The linearity of CMOS is analyzed. Transconductance and output conductance are two dominant nonlinear sources of CMOS. Capacitances and substrate leakage network do not generate any significant distortions. But they reduce the output impedance for the best linearity and the power in at a high frequency and the output conductance nonlinearity is significantly at a high frequency. Up to a few GHz, the output conductance is the dominant nonlinear source, and at a higher frequency, the transconductance is the dominant nonlinearity source. OIP3 is reduced by the effects of those components. OIP3s are calculated for various gate length processes. CMOS linearity is dependent only on current density and drain bias voltage but is not dependent on gate length.

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RF power devices for wireless communications (2002 [RFIC])

C.E. Weitzel. "RF power devices for wireless communications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 369-372.

A wide variety of semiconductor devices are used in wireless power amplifiers. This paper will review the advantages and disadvantages of these devices for handheld and infrastructure applications.

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SiGe/Si power HBTs for X- to K-band applications (2002 [RFIC])

S. Mohammadi, Zhenqiang Ma, Jaehoon Park, P. Bhattacharya, L.P.B. Katehi, G.E. Ponchak, S.A. Alterovitz, K.M. Strohm and J.-F. Luy. "SiGe/Si power HBTs for X- to K-band applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 373-376.

High performance power SiGe/Si HBTs at X-band (8.4 GHz), Ku-band (12.6 GHz) and K-band (18 GHz) have been demonstrated. Under continuous wave operation, a single 20-finger Si/Si/sub 0.75/Ge/sub 0.25//Si (emitter area of 1200 /spl mu/m/sup 2/) HBT, biased in class AB, delivers 28.5 dBm (700 mW) of RF output power at X-band, 25.5 dBm (350 mW) at Ku-band and 22.5 dBm (180 mW) at K-band. These represent the state-of-the-art power performance of SiGe-based HBTs at frequencies above X-band. An in-depth analysis of the power performance of HBTs with different geometry and configuration is also presented, which will eventually serve as a design guide for SiGe/Si power HBTs at different frequency of operation.

RF power characteristics of SiGe heterojunction bipolar transistor with high breakdown voltage structures (2002 [RFIC])

T. Matsuno, K. Nishii, S. Sonetaka, Y. Toyoda and N. Iwamoto. "RF power characteristics of SiGe heterojunction bipolar transistor with high breakdown voltage structures (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 377-379.

The collector profile dependences of RF power characteristics of SiGe HBT have been studied. A selectively ion implanted collector (SIC) structure with a thick and lightly doped collector layer showed good RF power characteristics including the adjacent-channel-power-ratio characteristics for middle class power around output power of 16 dBm while maintaining BV/sub CEO/ over 5 V. The maximum BVCEO of 9 V was obtained using the same process only by removing the SIC structure. Both structures are available to fabrication of multi-stage RF power amplifier on to one chip by single process.

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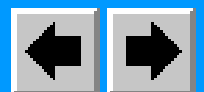
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Design techniques for improved microwave performance of small outline packages (2002 [RFIC])

D. Jessie and L. Larson. "Design techniques for improved microwave performance of small outline packages (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 381-384.

General techniques to improve the microwave performance of plastic leaded packages have been developed. These techniques result in an improvement of the bandwidth and reduction of losses in the structure. The techniques were applied to an SSOP8 configuration, and the useful frequency range was extended from 6 GHz to well above 10 GHz.

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Spiral inductor performance in deep-submicron bulk-CMOS with copper interconnects (2002 [RFIC])

W.B. Kuhn, A.W. Orsborn, M.C. Peterson, S.R. Kythakyapuzha, A.I. Hussein, Jun Zhang, Jianming Li, E.A. Shumaker and N.C. Nair. "Spiral inductor performance in deep-submicron bulk-CMOS with copper interconnects (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 385-388.

This paper reviews design considerations for spiral inductors in bulk CMOS and reports investigations carried out in a commercial 0.18 μm process using 6-layer copper metallization. Quality factors of approximately 8 are measured for 10 nH spirals operating between 1 and 2 GHz. Comparisons of Q and self-resonant frequency are provided for a variety of construction variables including with/without a patterned ground shield, metal-6 only versus stacking layers 3 thru 6, dense versus sparse vias, wide versus narrow traces, and with/without metal-fill.

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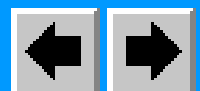
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A 6.5-mW receiver front-end for Bluetooth in 0.18- μm CMOS (2002 [RFIC])

F. Beffa, R. Vogt, W. Bachtold, E. Zellweger and U. Lott. "A 6.5-mW receiver front-end for Bluetooth in 0.18- μm CMOS (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 391-394.

This paper describes the design of a low-IF receiver front-end for Bluetooth fabricated in a 0.18 μm CMOS technology. The chip includes an LNA and an image-reject mixer and provides a down-conversion gain to the 2 MHz IF of 21.4 dB, an image rejection of 28 dB and a NF of 13.9 dB consuming only 6.5 mW at 1.8 V.

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An active SiGe sub-harmonic direct-conversion receiver front-end design for 5-6 GHz band applications (2002 [RFIC])

R. Svitek, D. Johnson and S. Raman. "An active SiGe sub-harmonic direct-conversion receiver front-end design for 5-6 GHz band applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 395-398.

This paper describes a packaged SiGe RF front-end design for use in the Unlicensed National Information Infrastructure (U-NII) bands. The front-end is based on a sub-harmonic direct-conversion architecture and is composed of an LNA, I and Q x2 sub-harmonic mixers (SHMs), and an LO conditioning chain. The receiver is completely differential and is designed for operation from a 3.3 V supply. Simulated performance shows >25 dB conversion gain, 6.8 dB noise figure (cascode LNA), 0/spl deg/ I/Q phase imbalance, and 39.1 mA total current consumption. To the authors' knowledge, this is the first 5-6 GHz SiGe active sub-harmonic direct-conversion receiver design presented in literature.

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Soft breakdown and hot carrier reliability of CMOS RF mixer and redesign (2002 [RFIC])

Qiang Li, Wei Li, Jinlong Zhang and J.S. Yuan. "Soft breakdown and hot carrier reliability of CMOS RF mixer and redesign (2002 [RFIC])." *2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC])*: 399-402.

In this paper, CMOS RF down-conversion mixer circuit hot-carrier (HC) and soft breakdown (SBD) reliability estimation and redesign is presented. First of all, MOS transistor reliability under analog operation was evaluated by experiment. The mixer circuit operation conditions for the occurrence of HC and SBD are analyzed, and circuit performance model are presented to relate the device degradation to circuit performance degradation. Finally, we propose mixer circuit redesign strategies, which reduce the HC and SBD problem. Simulation shows improved noise performance with the similar gain, IIP3 and power consumption.



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High-Q copper inductors on standard silicon substrate with a low-k BCB dielectric layer (2002 [RFIC])

Xiao Huo, K.J. Chen and P.C.H. Chan. "High-Q copper inductors on standard silicon substrate with a low-k BCB dielectric layer (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 403-406.

High-Q Cu inductors using low-k benzocyclobutene (BCB) dielectric as an interface layer have been fabricated on a standard CMOS-grade silicon substrate. Metal ohmic loss and substrate loss, the two major factors that degrade the Q-factors of on-chip inductors, are suppressed by the employment of electroplated copper and the BCB dielectric, respectively. Quality-factor as high as 25 was obtained for a 1 nH inductor at 2 GHz. The inductor fabrication process is low-cost and low-temperature, making it suitable for a post-IC process for high-performance RFIC's and MMIC's.

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Geometry and bias current optimization for SiGe HBT cascode low-noise amplifiers (2002 [RFIC])

Qingqing Liang, Guofu Niu, J.D. Cressler, S. Taylor and D.L. Hareme. "Geometry and bias current optimization for SiGe HBT cascode low-noise amplifiers (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 407-410.

This work presents a new design methodology for inductively-degenerated cascode low-noise amplifiers using advanced epitaxial-base SiGe HBTs. Noise figure, gain, and IIP3 are calculated using calibrated linear circuit analysis and a Volterra series methodology as a function of the two major design variables: emitter geometry and biasing current. An optimum SiGe HBT LNA design point which balances input impedance match, high IIP3, noise figure, gain, and power consumption is obtained from calculated noise figure, gain, and IIP3 contours as a function of bias current and geometry. Simplified analytical expressions of IIP3, gain, and noise figure are presented to give additional insight. The optimum LNA design point for the 50 GHz SiGe HBT process technology under study yields a 2 GHz LNA with 15.8 dBm IIP3, 18 dB gain, 1.15 dB noise figure, and a $|s_{11}|$ less than -20 dB for a biasing current of 7.5 mA. The calculated results show good agreement with HP Advanced-Design-System simulations. The design tradeoffs illuminated by this optimization methodology are highlighted and discussed.

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High linearity low-k BCB-bridged AlGaAs/InGaAs power HFETs (2002 [RFIC])

Hsien-Chin Chiu, Ming-Jyh Hwu, Shih-Cheng Yang and Yi-Jen Chan. "High linearity low-k BCB-bridged AlGaAs/InGaAs power HFETs (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 411-414.

A novel low-k BCB (benzocyclobutene) bridged and passivated process for AlGaAs/InGaAs doped-channel power FETs with high reliability and linearity was characterized and developed. In this study, we applied the low-k BCB-bridged interlayer to replace the conventional air-bridged process and the SiN/sub x/ passivation technology of the 1 mm wide power device fabrication. This novel process technique demonstrates a lower power gain degradation under a high input power swing, and exhibits an improved adjacent channel power ratio (ACPR) than the air-bridged ones due to its lower gate leakage current. The power gain degradation ratio of BCB-bridged devices under a high input power operation ($P_{\text{sub in}} = 5 \text{ dBm}/10 \text{ dBm}$) is 0.51 dB/dBm, and this value is 0.65 dB/dBm of conventional air-bridged devices.

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Performance of a CMOS Bluetooth transceiver IC with copper RF passives (2002 [RFIC])

M.T. Doan, Q. Yin, K.E. Sze, P.B. Khannur, S.C. Rustagi, S. Jinglin, Pang, D. Foo and A.B. Ajikuttira. "Performance of a CMOS Bluetooth transceiver IC with copper RF passives (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 415-418.

On-chip copper inductors, MIM capacitors and precision resistors in a novel, low-cost process are described. A CMOS transceiver for Bluetooth was realized with these new RF passive components and compared with the same IC realized in a commercial 0.35 μm CMOS process with Al metalization. In a low-noise amplifier (LNA), a gain improvement of around 5 dB and a noise-figure reduction of 1.2 dB were observed. For the image-reject mixer (IRM), the conversion gain improved by 3.5 dB. The output power of the power amplifier (PA) increased by 1.5 dB. For the phase locked loop (PLL) frequency synthesizer, the settling time was reduced to almost half.

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Effects of dummy patterns and substrate on spiral inductors for sub-micron RF Ics (2002 [RFIC])

Jae-Hong Chang, Yong-Sik Youn, Hyun-Kyu Yu and Choong-Ki Kim. "Effects of dummy patterns and substrate on spiral inductors for sub-micron RF Ics (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 419-422.

In today's sub-micron CMOS technologies, dummy patterns are necessary to obtain the desired metal density for uniform etching. This paper shows the effect of the dummy patterns on the quality factor of the inductor. The effects of the polysilicon ground shield and p-doped substrate on inductor performance have also been investigated. As the distance of between dummy and inductor is increased, the quality factor is less influenced by eddy current loss due to the dummy. Also we can achieve $Q = 13$ at 3 GHz and $L = 6.05$ nH using a patterned ground shield with slotted polysilicon layers in a commercial standard 0.18 μm CMOS technology.

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Schottky junction transistors for micropower RFICs (2002 [RFIC])

J. Spann, Zhiyuan Wu, P. Jaconelli, Jinman Yang and T.J. Thornton. "Schottky junction transistors for micropower RFICs (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 423-426.

Results are presented from measurements and numerical simulations of Schottky junction transistors, a new type of micropower device capable of operating at GHz frequencies in the sub-threshold regime. Detailed measurements of the DC characteristics of a 2 μm gate length device agree well with numerical simulations. Measurements of transconductance and gate capacitance suggest that this relatively long gate length device will have a cut-off frequency of 126 MHz, which is again consistent with the numerical simulations. When projected to gate lengths of 0.1 μm , cut-off frequencies in excess of 10 GHz are predicted for drain currents of less than 1 μA .

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ESD protection design for 900-MHz RF receiver with 8-kV HBM ESD robustness (2002 [RFIC])

Ming-Dou Ker, Wen-Yu Lo, Chien-Ming Lee, Chia-Pei Chen and Hong-Sing Kao. "ESD protection design for 900-MHz RF receiver with 8-kV HBM ESD robustness (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 427-430.

This paper presents a state-of-art ESD protection design for an RF circuit with a human-body-model (HBM) ESD robustness of 8 kV. By including a turn-on efficient power-rails clamp circuit into the RF circuit, the ESD clamp devices of the RF input pin are operated in the forward-biased conduction, rather than the traditional junction breakdown condition. Therefore, the dimension of ESD devices for the RF input pin can be further downsized to reduce the input capacitance loading for the RF signal. This design has been successfully applied in a 900 MHz RF receiver and fabricated in 0.25 μm CMOS process with a thick top metal layer. The experimental results have confirmed that its ESD robustness is as high as >8 kV under the HBM ESD test.



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Improvements to performance of spiral inductors on insulators (2002 [RFIC])

D. Kelly and F. Wright. "Improvements to performance of spiral inductors on insulators (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 431-433.

The performance of spiral inductors on insulating substrates is far superior to ones fabricated in bulk CMOS or BiCMOS processes. In spite of this, SOI inductors are generally not satisfactory for very low noise or low insertion loss circuits. This work studies high frequency effects on current density in inductors and discusses improvements in metallization and layout. Based on this research, a 5.5 nH inductor has been fabricated on sapphire with a 540 /spl mu/m diameter and 4.5 /spl mu/m thick aluminum, resulting in a quality factor of 25 at 2 GHz.

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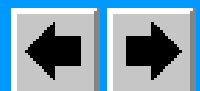
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Octave tunable, highly linear, RC-ring oscillator with differential fine-coarse tuning, quadrature outputs and amplitude control for fiber optic transceivers (2002 [RFIC])

M.A.T. Sanduleanu, D. van Goor and H. Veenstra. "Octave tunable, highly linear, RC-ring oscillator with differential fine-coarse tuning, quadrature outputs and amplitude control for fiber optic transceivers (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 435-438.

This paper presents a low-voltage, RC-ring oscillator for fiber optic transceivers (SDH/SONET applications). It has one octave coarse tuning range, differential tuning inputs, quadrature outputs and a linear fine-control. A replica biasing circuit regulates the common-mode voltage and the amplitude at the output. The oscillator has been realized in a pre-production 70 GHz f/sub T/, SiGe BiCMOS process (QUBIC4G). The tuning range covered with process and temperature variations is 3.4-6.8 GHz. At 6.6 GHz oscillation frequency the measured phase noise is -92 dBc/Hz at 3 MHz; offset from the carrier. The typical power consumption of the VCO core is 80 mW from a 2.5 V power supply and the area is 0.3 mm/sup 2/.



A 2.45GHz fully-differential CMOS image-reject mixer for Bluetooth application (2002 [RFIC])

P.B. Khannur and Koh Soo Ling. "A 2.45GHz fully-differential CMOS image-reject mixer for Bluetooth application (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 439-442.

The design of a 2.45GHz image-reject mixer (IRM) for Bluetooth application using low-cost 0.35 μ m, double-poly four-metal standard CMOS process with the metal-insulator-metal (MIM) capacitor option is described. The proposed design uses Hartley architecture with temperature compensation to significantly reduce the gain variation with temperature (-40/spl deg/C to +85/spl deg/C). In-house extracted models were used for active and passive components to achieve image rejection ratio (IRR) better than 45dB, input referred third-order intercept point (IIP3) better than -7dBm, voltage conversion gain better than 20dB and noise figure less than 20dB under all process, temperature, and voltage supply conditions. The intermediate frequency (IF) is 2MHz. The circuit operates from a 3V /spl plusmn/ 10% supply and draws 10.4mA.



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Super compact RFIC inductors in 0.18 μm CMOS with copper interconnects (2002 [RFIC])

H. Feng, G. Jelodin, K. Gong, R. Zhan, Q. Wu, C. Chen and A. Wang. "Super compact RFIC inductors in 0.18 μm CMOS with copper interconnects (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 443-446.

Design of super compact on-chip inductors with deep-shrunk dimension of 22 μm /spl times/23 μm , as opposed to several hundreds μm by several hundreds μm , is reported. Implemented in a 6-metal all-copper 0.18 μm CMOS process, a flat inductor value of 10 nH up to 4 GHz, satisfactory to many typical RFIC applications, is achieved. The aggressive shrinkage reduces parasitic capacitance substantially and makes it realistic and cost-effective to realize single-chip RFICs in very deep sub-micron technologies. A new inductor model is proposed for accuracy. A 2.4 GHz LNA circuit with on-chip matching using the compact inductor is demonstrated.

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High performance single supply power amplifiers for GSM and DCS applications using true enhancement mode FET technology (2002 [RFIC])

E. Glass, M. Shields and A. Reyes. "High performance single supply power amplifiers for GSM and DCS applications using true enhancement mode FET technology (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 447-450.

Two high performance single supply power amplifier IC products have been developed for GSM and DCS applications using true enhancement mode FET technology. At $V_D=3.2V$, under CW conditions, the GSM IC supplies +35.5 dBm output power at 58% PAE and the DCS IC supplies +33.5 dBm at 46% PAE. These ICs have low leakage currents similar to HBT and LDMOS and do not require the use of a drain switch. In addition, due to a high threshold voltage ($V_{th}=+0.6V$), they exhibit excellent RF isolation at $V_{ref}=0.1V$ and $P_{in}=+5$ dBm and do not require on-chip attenuators.





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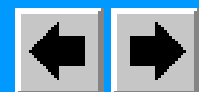
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Integrated 2.4 GHz CMOS quadrature VCO with symmetrical spiral inductors and differential varactors (2002 [RFIC])

Baoyong Chi and Bingxue Shi. "Integrated 2.4 GHz CMOS quadrature VCO with symmetrical spiral inductors and differential varactors (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 451-454.

A 2.4 GHz CMOS quadrature VCO is presented. By using symmetrical inductors and differential varactors, the circuit has been integrated into a single chip completely. The principles of this VCO are described. A prototype is fabricated in 0.25 μm single-poly five-metal CMOS standard digital process. The measured results show that the proposed VCO could generate quadrature LO signals with a tuning range of more than 300 MHz and phase noise -104.33 dBc/Hz at 600 kHz offset/spl ogr/2.41 GHz (when only one port of differential outputs is measured). It consumes 21 mA when VDD=2.5 V (Including 8 mA output buffers). Die area is only 0.83/spl times/0.68 mm/sup 2/. This VCO could be used in many integrated wireless transceivers.

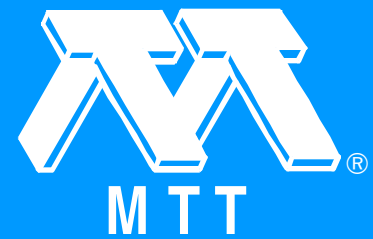
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A fully monolithic SiGe quadrature voltage controlled oscillator design for GSM/DCS-PCS applications (2002 [RFIC])

D. Cordeau, J.-M. Paillot, H. Cam, G. De Astis and L. Dascalescu. "A fully monolithic SiGe quadrature voltage controlled oscillator design for GSM/DCS-PCS applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 455-458.

This paper describes the design and optimization in terms of phase noise of a fully monolithic SiGe voltage controlled oscillator (VCO) with quadrature outputs. The proposed circuit is made of two cross-coupled differential VCOs, with integrated resonator, to ensure the quadrature outputs. The quadrature VCO core runs on 13 mA from a 2.7 V power supply. The simulated phase noise is about -140 dBc/Hz at 3 MHz frequency offset almost all over the tuning range. The oscillator is tuned from 1.44 GHz to 1.76 GHz with a tuning voltage varying from 0 to 3 V.



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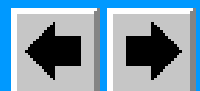
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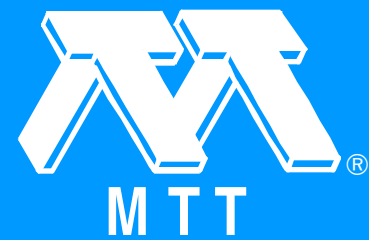
Hot carrier and soft breakdown effects on VCO performance (2002 [RFIC])

Enjun Xiao and J.S. Yuan. "Hot carrier and soft breakdown effects on VCO performance (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 459-462.

This paper systematically investigates the hot carrier and soft-breakdown induced performance degradation in a CMOS voltage-controlled oscillator used in phase locked loop frequency synthesizers. After deriving the closed-form equations to predict phase noise and VCO gain, we relate VCO RF performance such as phase noise, tuning range and gain of VCO subject to electrical stress. The circuit degradations predicted by analytical model equations are verified by SpectraRF simulation using parameters extracted from the experimental data of 0.16 μm CMOS technology.

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A 1.5-V 4-GHz dynamic-loading regenerative frequency doubler in a 0.35- μ m CMOS process (2002 [RFIC])

J.M.C. Wong and H.C. Luong. "A 1.5-V 4-GHz dynamic-loading regenerative frequency doubler in a 0.35- μ m CMOS process (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 463-466.

This paper proposes a new topology of a frequency doubler using a dynamic-loading technique to achieve higher operating frequency, larger output swing, larger bandwidth and lower phase noise compared to traditional designs. Implemented in a standard 0.35- μ m digital CMOS process and at a 1.5-V supply, the proposed frequency doubler measures a maximum operating output frequency of 4 GHz with a bandwidth of 2.4 GHz while consuming a power of 3.7 mW. The single-ended output amplitude is ranging from -3.0 to -6.5 dBm, and the phase noise is as low as -111 dBc/Hz @ 500kHz offset.

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Very low phase-noise fully-integrated coupled VCOs (2002 [RFIC])

H. Jacobsson, B. Hansson, H. Berg and S. Gevorgian. "Very low phase-noise fully-integrated coupled VCOs (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 467-470.

With the aim of achieving very low phase noise, two area and power consumption efficient methods of coupling two or more identical VCOs are presented. To verify the principles, a set of fully integrated, coupled VCOs of the cross-coupled differential pair type, was manufactured in a commercial SiGe HBT technology. The measured phase noise at 100 kHz offset frequency was -106 dBc/Hz at 6 GHz using two coupled VCOs and -103 dBc/Hz at 12 GHz using four coupled VCOs. A phase noise reduction of 1-6 dB was achieved relative to a single VCO of the same topology. In one of the two methods, output signals are additionally obtained in quadrature.



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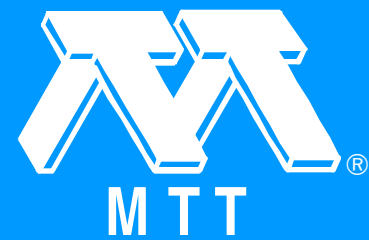
Wide-tuning-range dual-VCOs for cable modem receivers (2002 [RFIC])

K. Stadius and K. Halonen. "Wide-tuning-range dual-VCOs for cable modem receivers (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 471-474.

A double-conversion receiver for cable modem applications requires a wide-tuning-range VCO with low phase noise characteristics for the first LO generation. Achieving simultaneously low phase noise and large tuning range from a monolithic VCO is an exceptionally challenging task. The design aspects of wideband monolithic LC-VCO are tackled in this paper with the boundaries set by a 0.9- μm SiGe HBT technology. Two dual-VCO implementations are presented and a method for buffering the VCO signal without loading the LC-resonator is proposed. Both simulation and experimental results are given.

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A 5.8 GHz fully integrated low power low phase noise CMOS LC VCO for WLAN applications (2002 [RFIC])

J. Bhattacharjee, D. Mukheijee, E. Gebara, S. Nuttinck and J. Laskar. "A 5.8 GHz fully integrated low power low phase noise CMOS LC VCO for WLAN applications (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 475-478.

A fully integrated low power and low phase noise 5.8 GHz VCO is designed and fabricated in standard 0.24 μm single-poly, 5-metal digital CMOS process. The VCO-core draws 2 mA of current from a 2.5 V supply. Measured phase noise at 1 MHz offset from the center frequency is -112 dBc/Hz. It has a tuning range of 810 MHz with low phase noise performance throughout the tuning range. It meets the requirements for IEEE802.11a WLAN standard. Low power and low phase noise have been achieved simultaneously by the use of np complementary cross-coupled topology. The novel orientation of the inductor pair used in the design minimizes the effect of any unwanted common-mode magnetic coupling that may arise from other on-chip inductors in an integrated environment.

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A 5 GHz fast-switching CMOS frequency synthesizer (2002 [RFIC])

Xiaomin Yang, T. Wu and J. McMacken. "A 5 GHz fast-switching CMOS frequency synthesizer (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 479-482.

A 5 GHz PLL-based frequency synthesizer for wireless LAN applications is presented in this paper. The proposed PLL is designed using 0.25 μm CMOS technology with 3.3 V power supply. The enlarged VCO tuning range gives extra bandwidth to achieve a reduced locking time. The buffer amplifier provides additional gain to compensate the smaller VCO output amplitude level. The phase noise at 1 MHz offset is -120 dBc/Hz, and the power consumption is 30 mW.

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A Wilkinson power divider on a low resistivity Si substrate with a polyimide interface layer for wireless circuits (2002 [RFIC])

J. Papapolymerou, G.E. Ponchak and E.M. Tentzeris. "A Wilkinson power divider on a low resistivity Si substrate with a polyimide interface layer for wireless circuits (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 483-486.

A 3-dB Wilkinson power divider on a low resistivity silicon substrate (20 /spl Omega/-cm) with a polyimide interface layer is presented for the first time. The divider utilizes Finite Ground Coplanar (FGC) line technology, and operates at a center frequency of 15 GHz. Low insertion loss and high return loss and isolation is achieved by using a 20 /spl mu/m thick polyimide interface layer on top of the silicon wafer, and a line geometry that minimizes field interaction with the lossy Si substrate. The attenuation of the FGC lines is comparable with that of thin film microstrip lines on similar substrates. Experimental and full-wave analysis results are provided.

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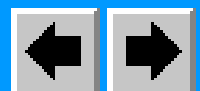
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Development and verification of a new non-linear MOSFET model (2002 [RFIC])

H. Romdane, E. Bergeault and B. Huyart. "Development and verification of a new non-linear MOSFET model (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 487-489.

A new non-linear model of Si MOSFET transistor based on a device characterization using DC and small-signal scattering parameter measurements is proposed. It is shown that interpolation of measured data and look up tables provide an extensive description of the extrinsic and intrinsic MOSFET non-linearities. Model verification is achieved by comparing simulations and on-wafer measurements of S parameters at a typical bias point.

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Design and analysis of a multi-layer transformer balun for silicon RF integrated circuits (2002 [RFIC])

H.Y.D. Yang, L. Zhang and J.A. Castaneda. "Design and analysis of a multi-layer transformer balun for silicon RF integrated circuits (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 491-494.

In this paper, we present the design and analysis of an on-chip transformer balun for silicon RFICs. Both the primary and secondary spread over four metal layers along a common symmetric axis to reduce the overall area, maintaining reasonable quality factor. A five port transformer balun circuit model is developed to facilitate the device simulation. A 4:11 transformer balun is fabricated and tested. It is ideal for LNAs to enhance the gain with optimum noise figure.

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Smoothing gate capacitance models for CMOS radio frequency and microwave integrated circuits CAD (2002 [RFIC])

J. Dobes. "Smoothing gate capacitance models for CMOS radio frequency and microwave integrated circuits CAD (2002 [RFIC])." 2002 Radio Frequency Integrated Circuits (RFIC) Symposium 02. (2002 [RFIC]): 495-498.

Convergence problems for both voltage- and charge-controlled models of MOSFET gate capacitances are often a limiting factor of CAD tools. In paper, an idea of exponential smoothing of model discontinuities is proposed. The method is demonstrated by smoothing the discontinuity of Meyer's model at zero drain-source voltage. The updated model is tested on flip-flop circuit by an advanced algorithm.

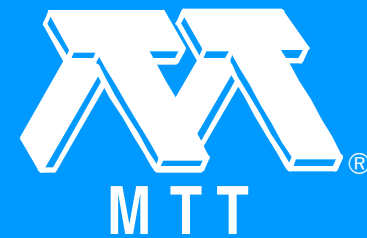
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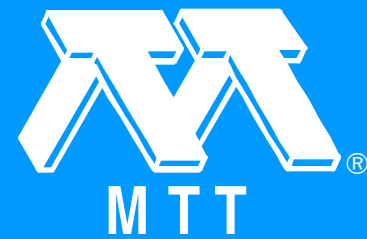
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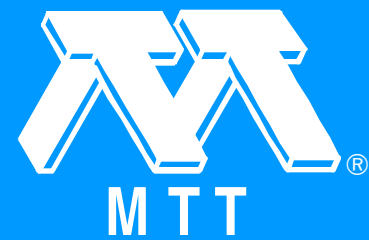
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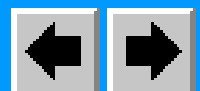
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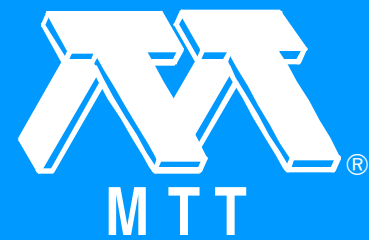
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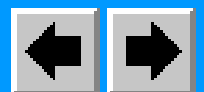
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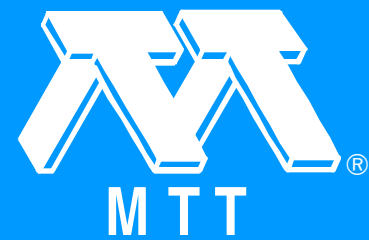
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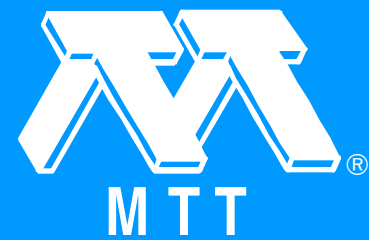
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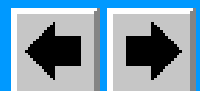
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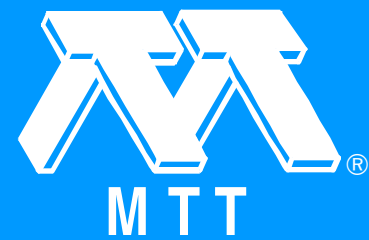
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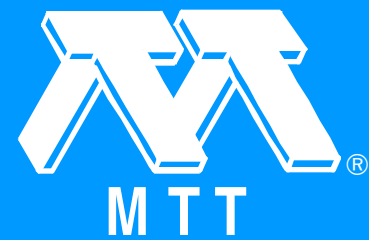
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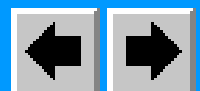
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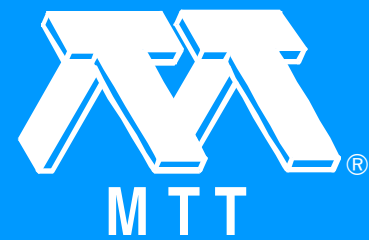
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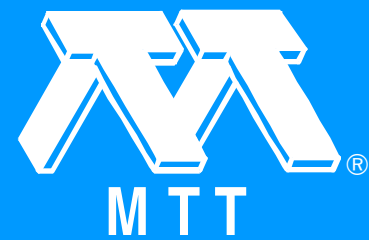
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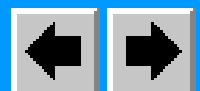
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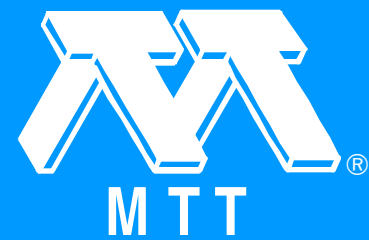
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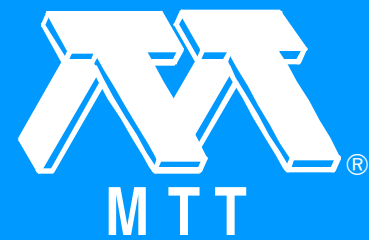
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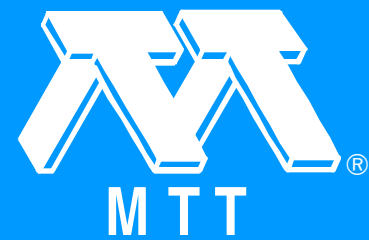
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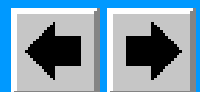
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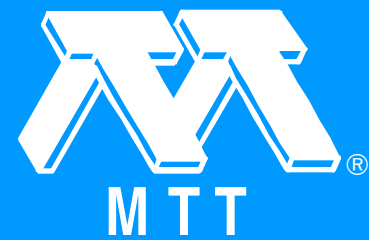
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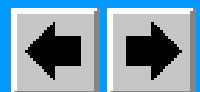
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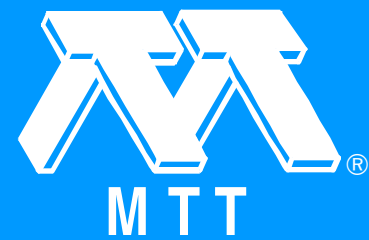
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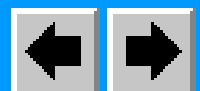
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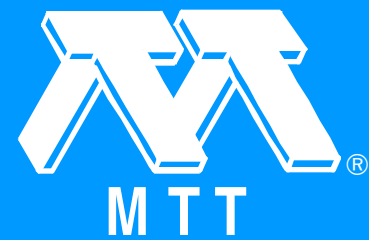
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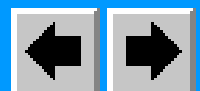
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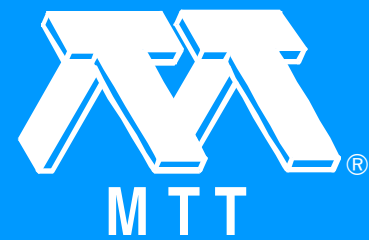
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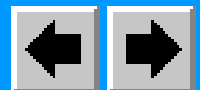
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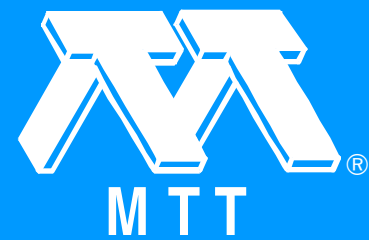
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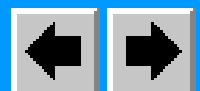
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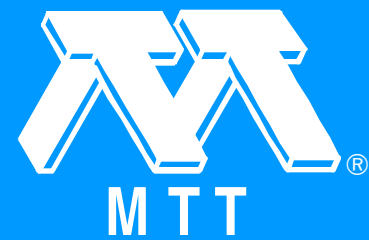
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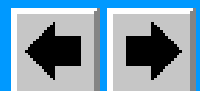
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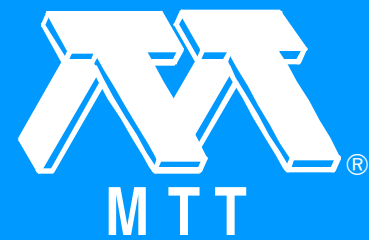
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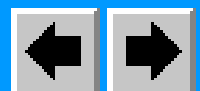
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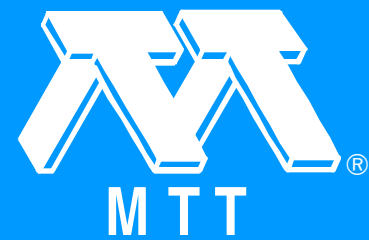
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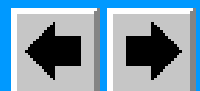
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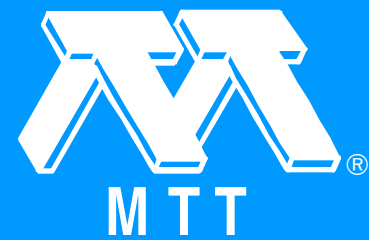
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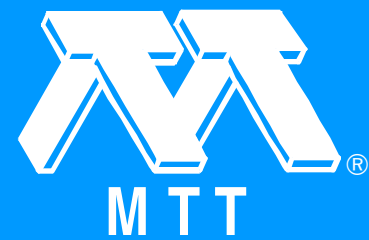
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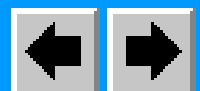
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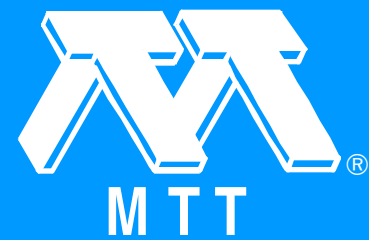
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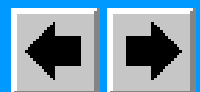
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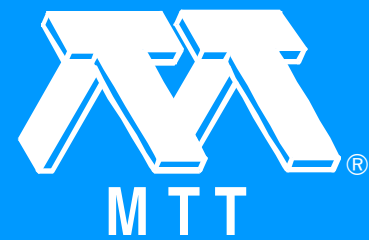
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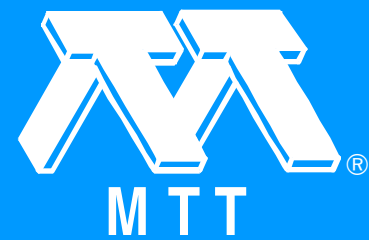
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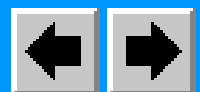
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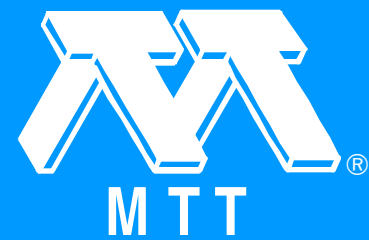
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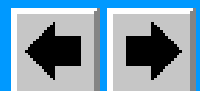
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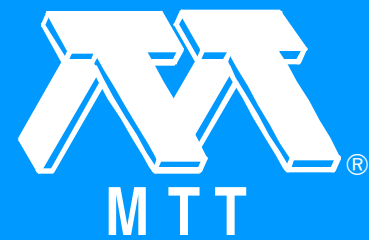
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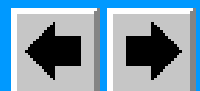
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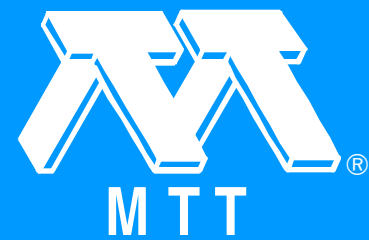
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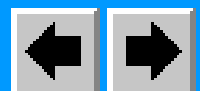
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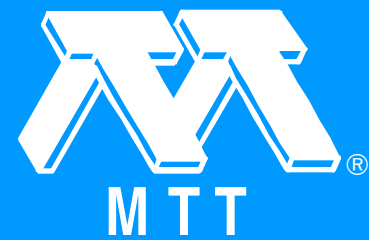
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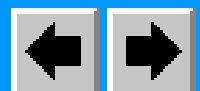
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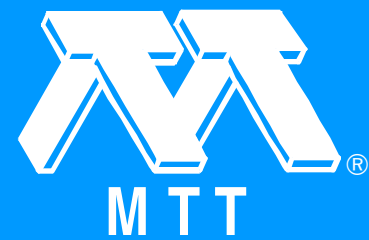
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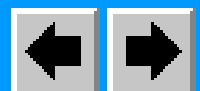
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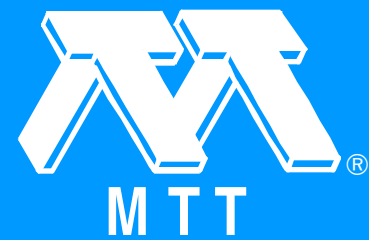
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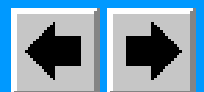
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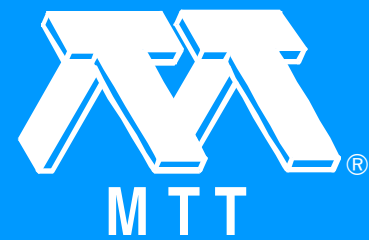
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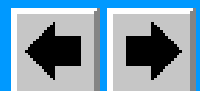
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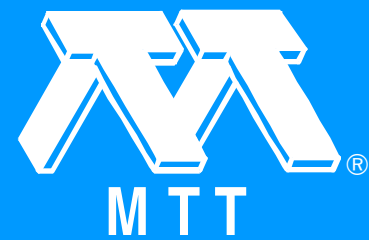
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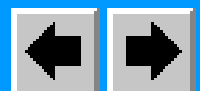
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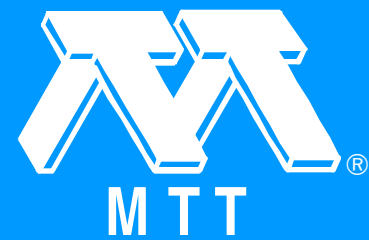
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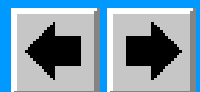
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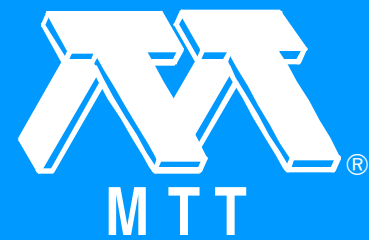
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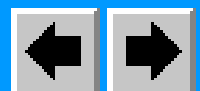
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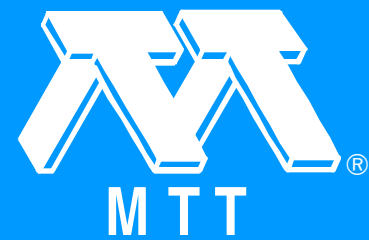
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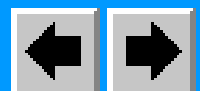
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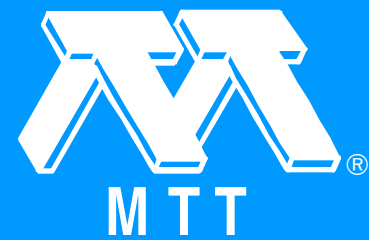
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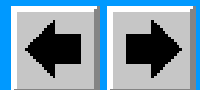
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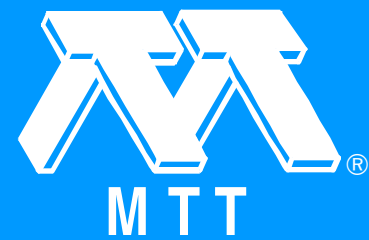
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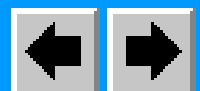
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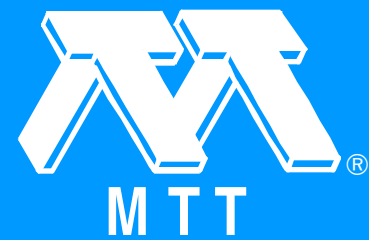
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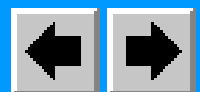
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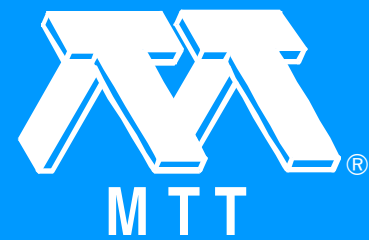
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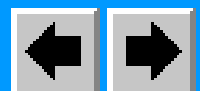
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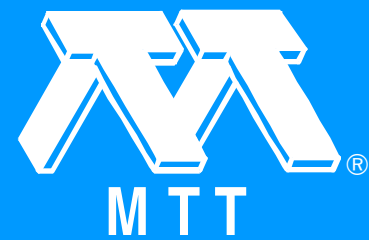
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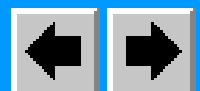
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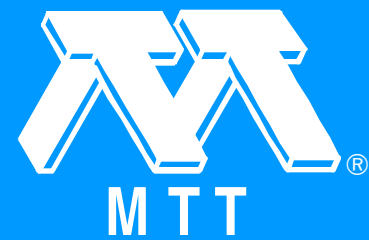
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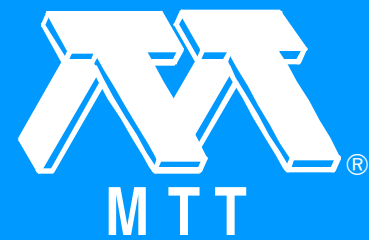
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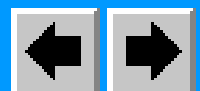
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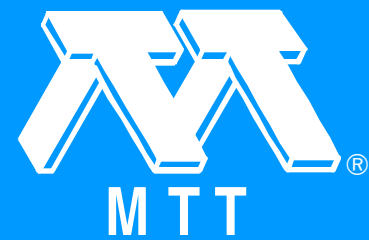
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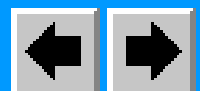
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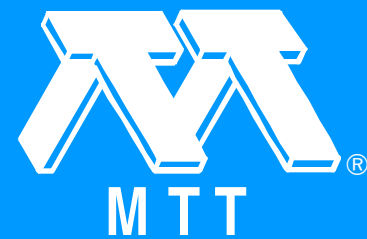
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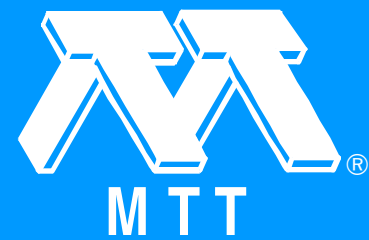
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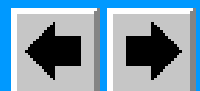
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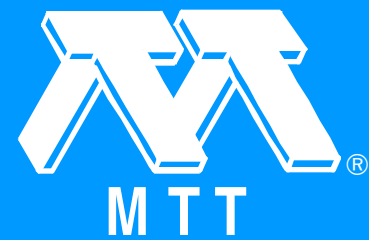
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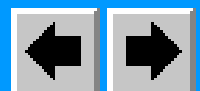
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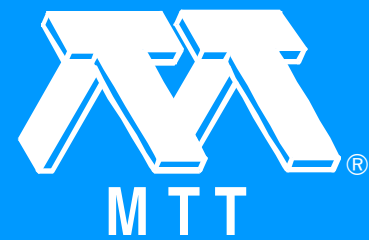
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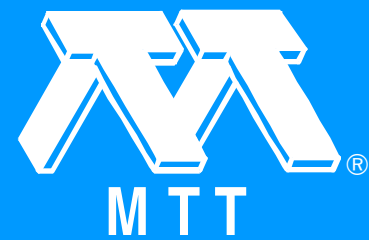
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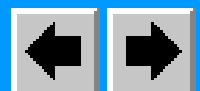
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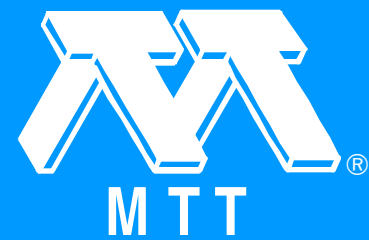
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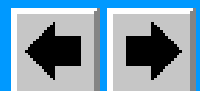
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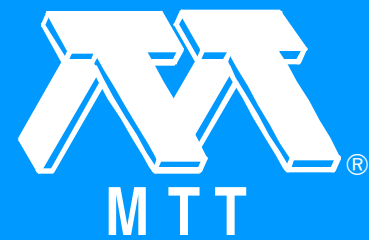
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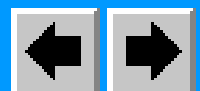
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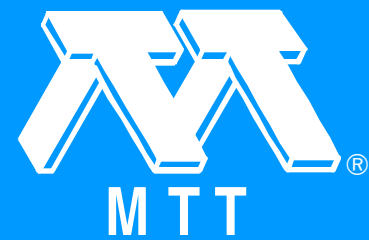
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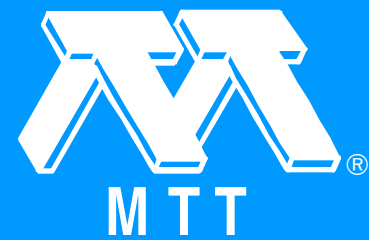
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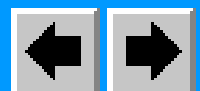
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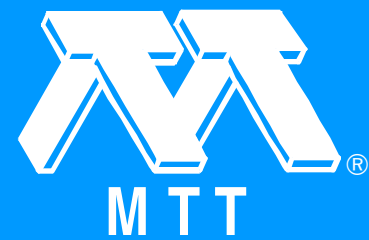
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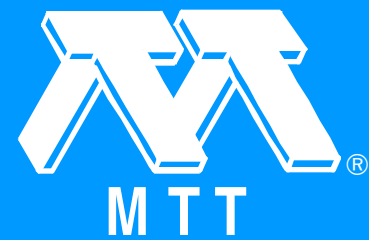
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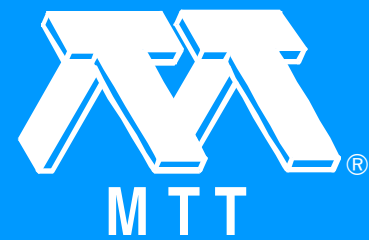
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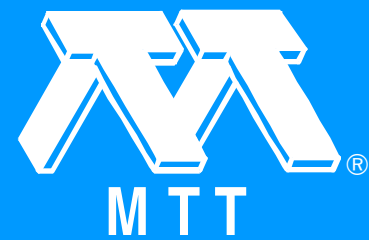
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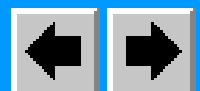
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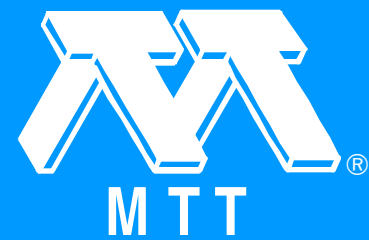
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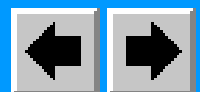
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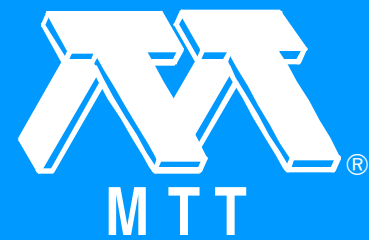
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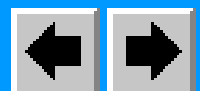
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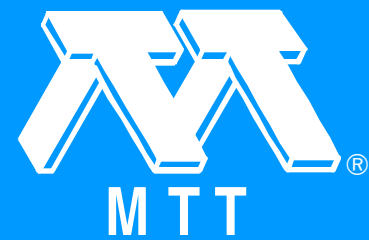
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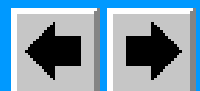
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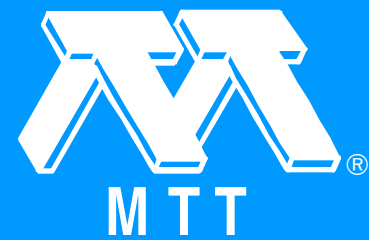
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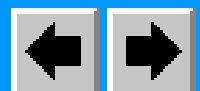
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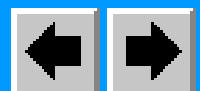
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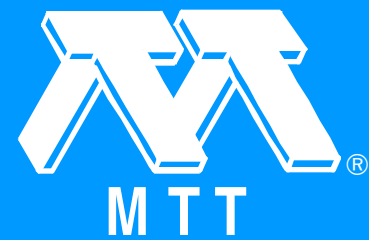
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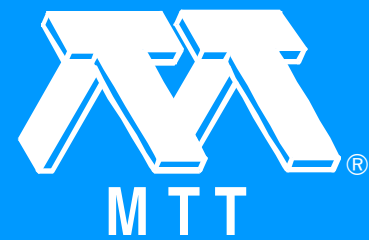
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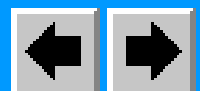
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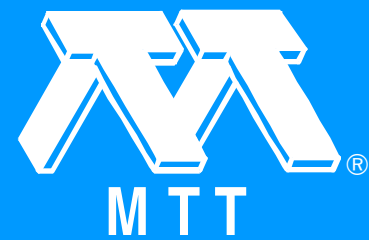
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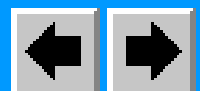
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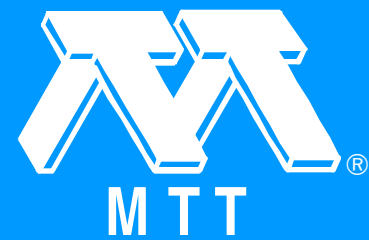
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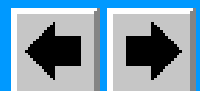
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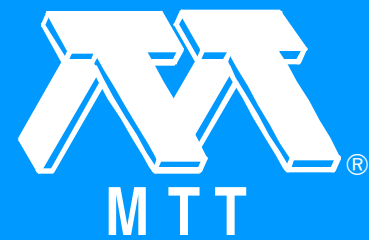
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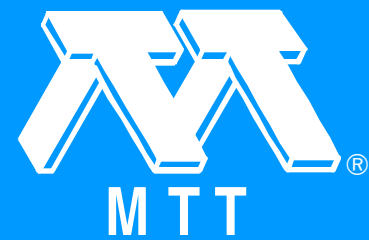
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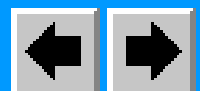
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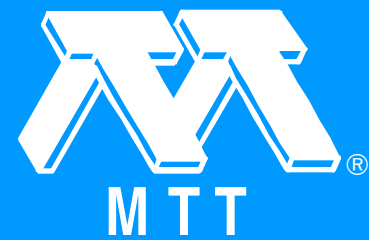
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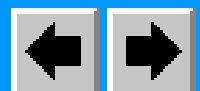
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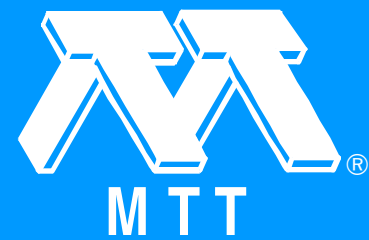
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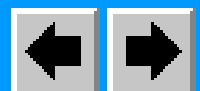
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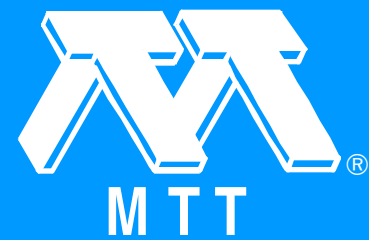
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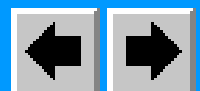
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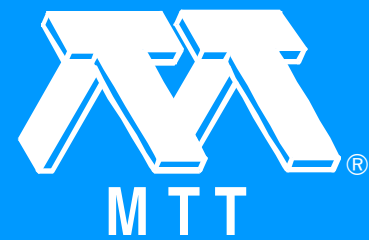
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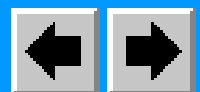
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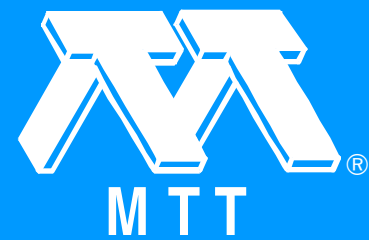
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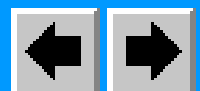
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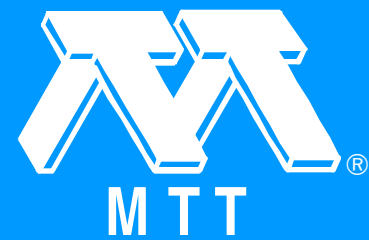
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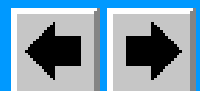
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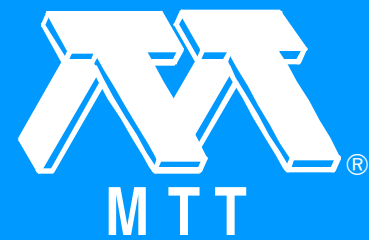
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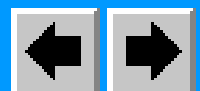
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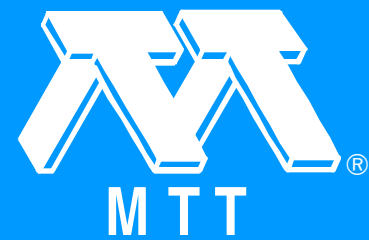
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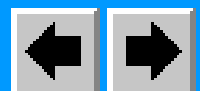
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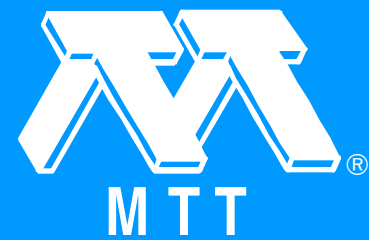
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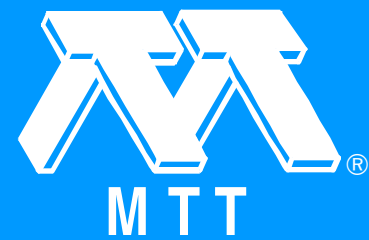
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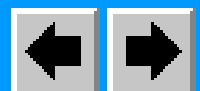
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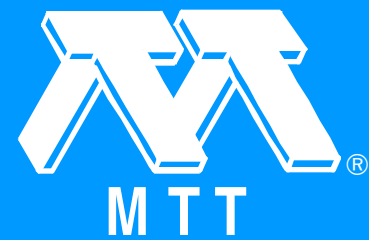
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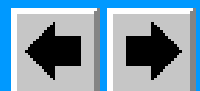
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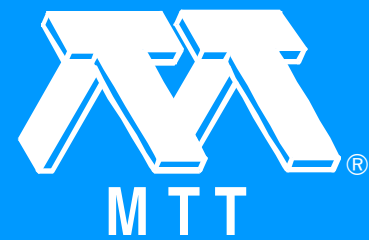
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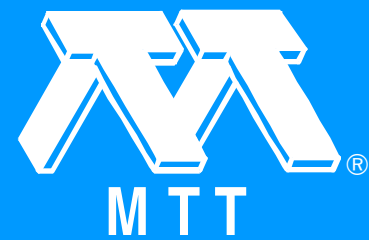
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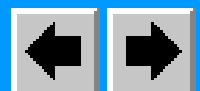
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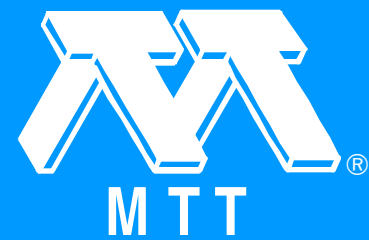
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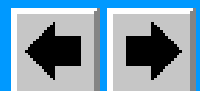
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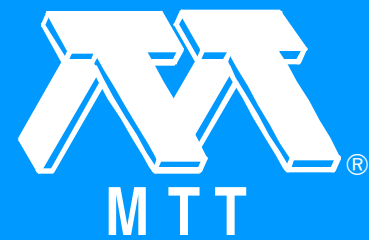
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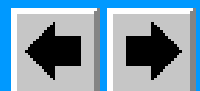
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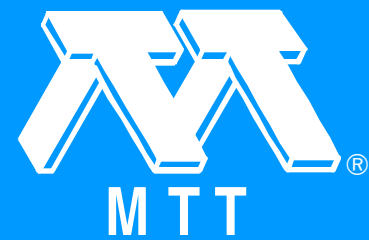
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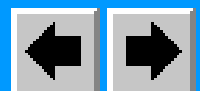
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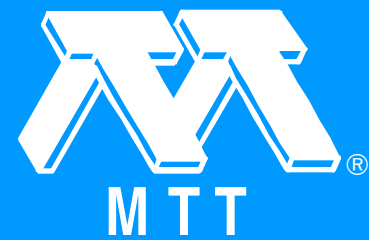
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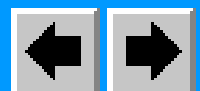
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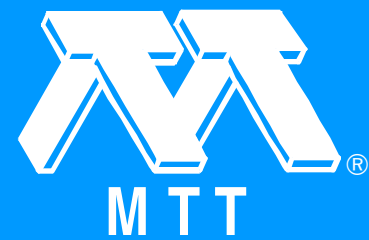
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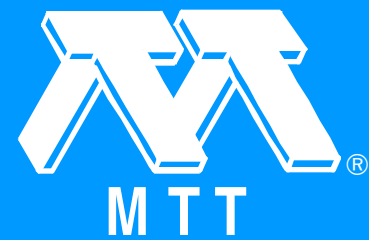
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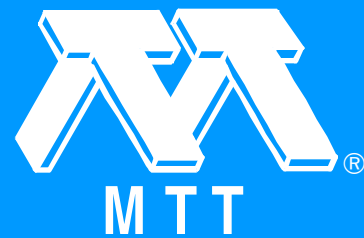
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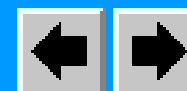


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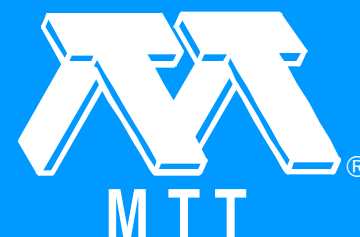
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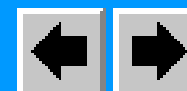


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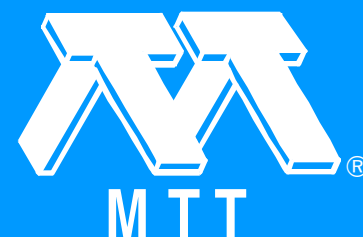
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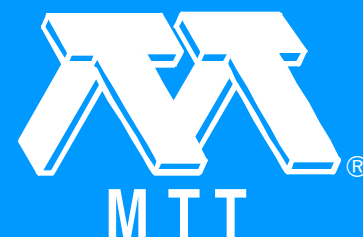
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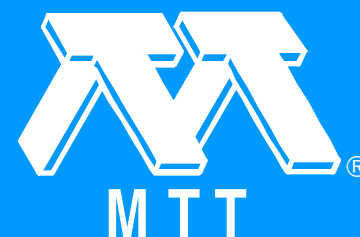
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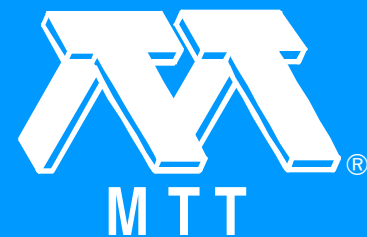
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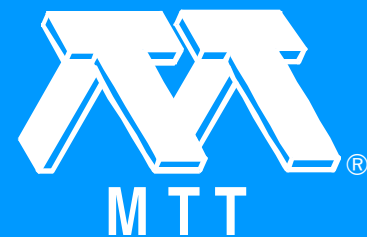
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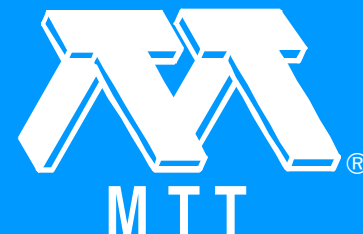
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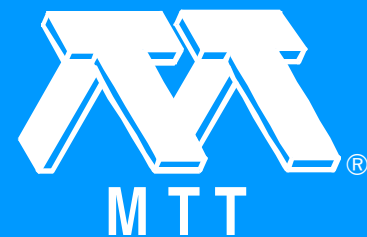
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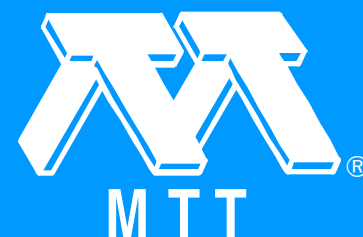
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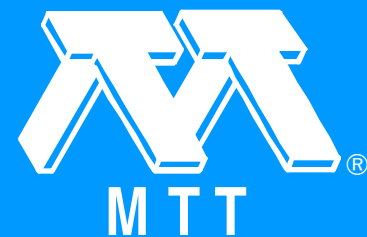
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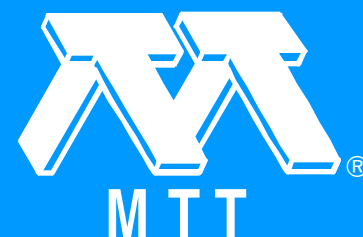
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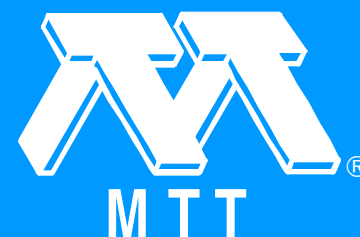
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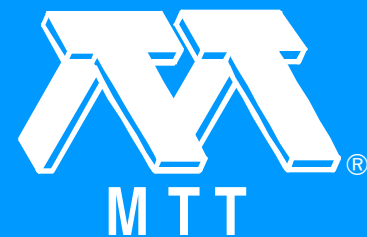
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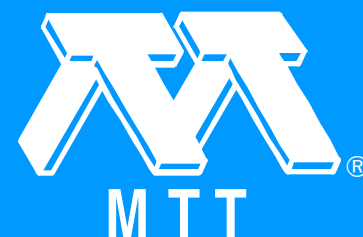
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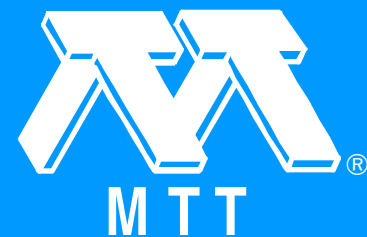
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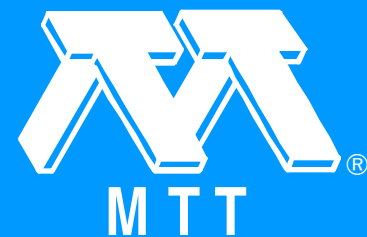
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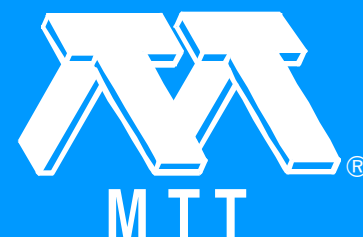
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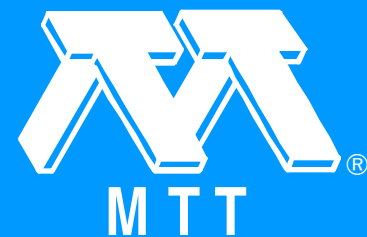
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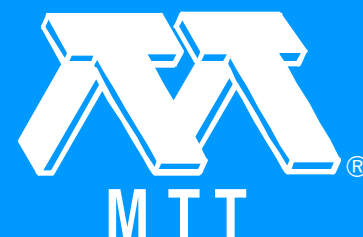
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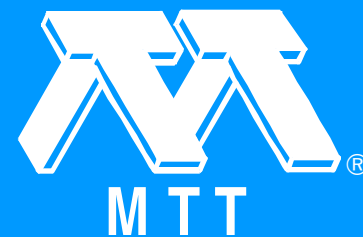
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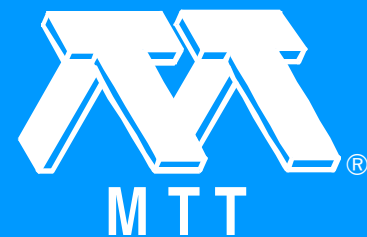
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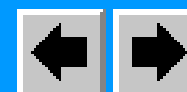
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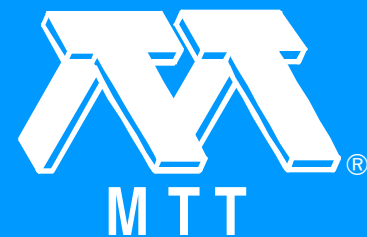
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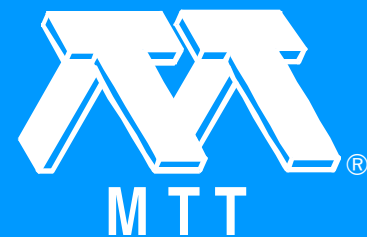
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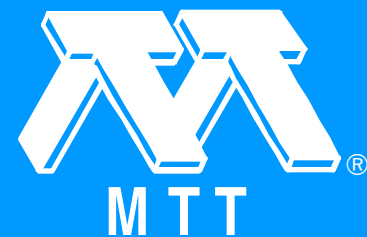
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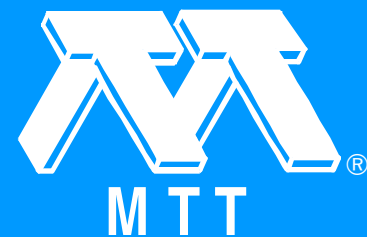
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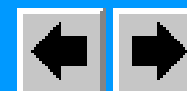


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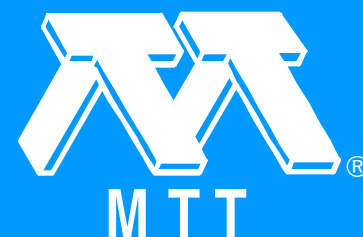
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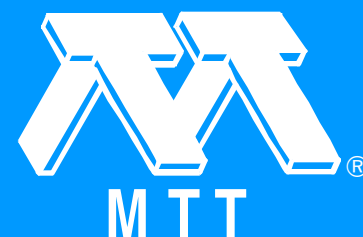
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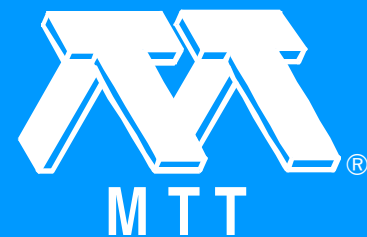
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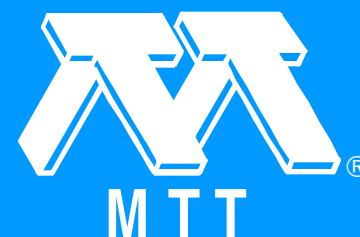
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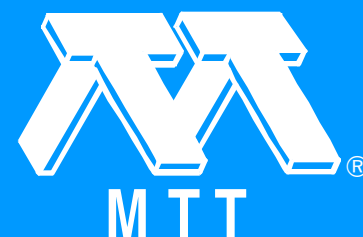
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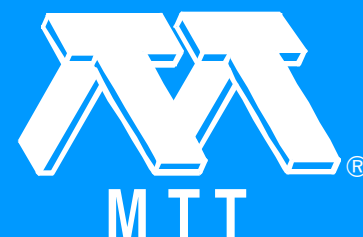
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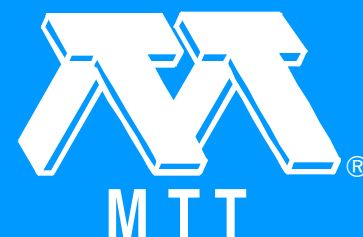
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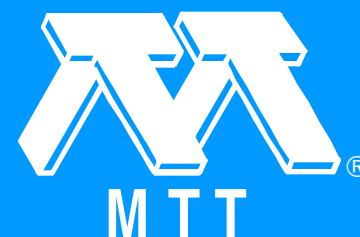
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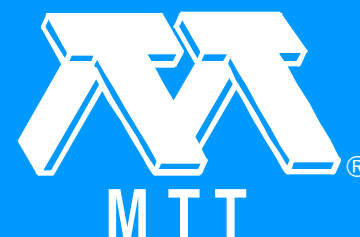
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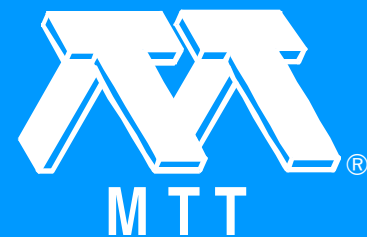
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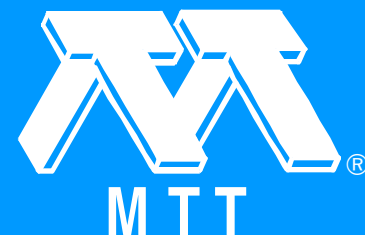
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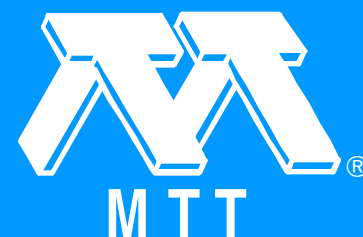
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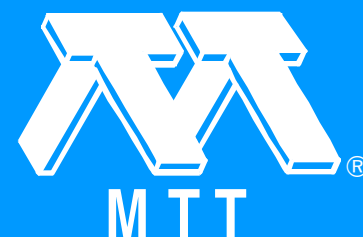
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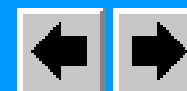


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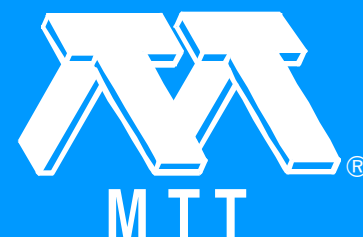
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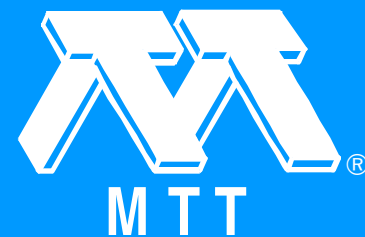
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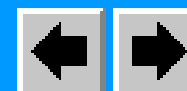


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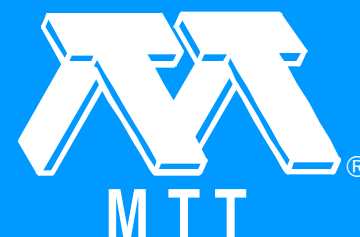
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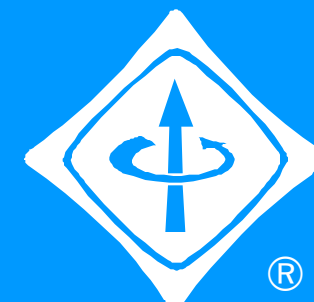
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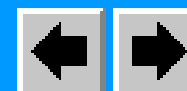


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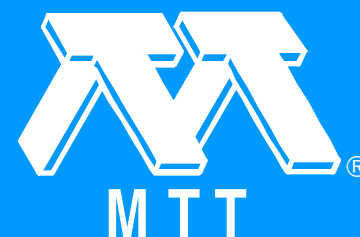
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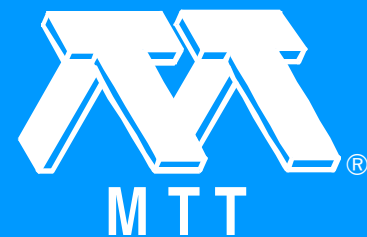
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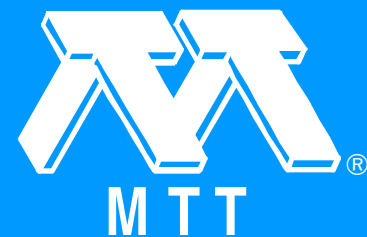
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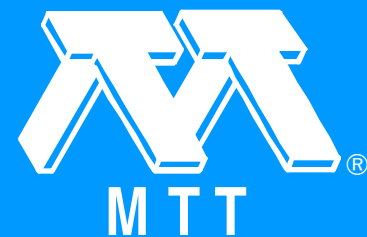
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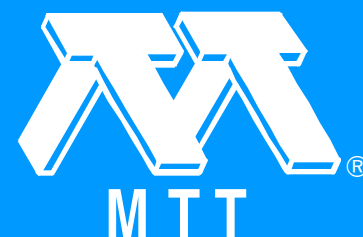
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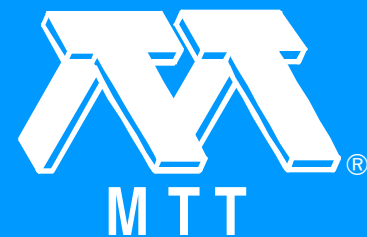
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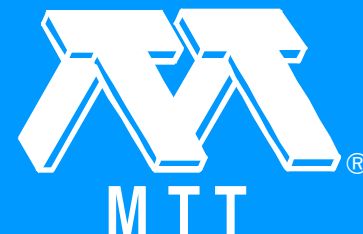
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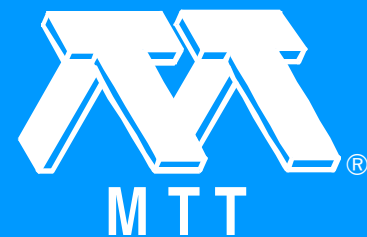
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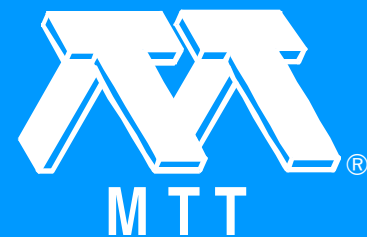
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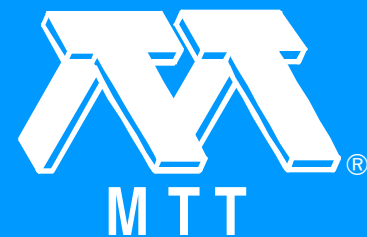
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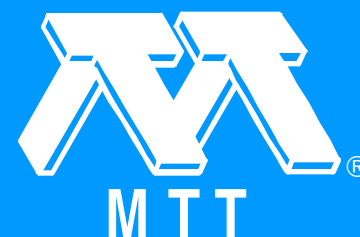


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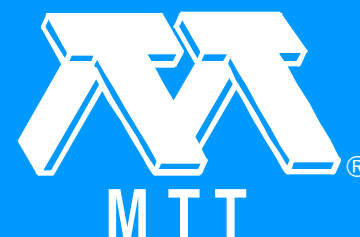
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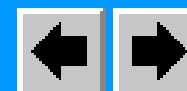


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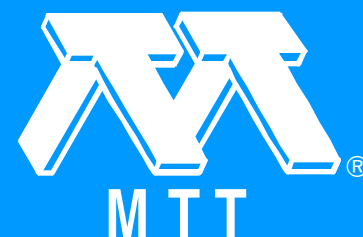
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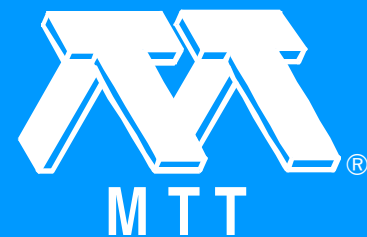
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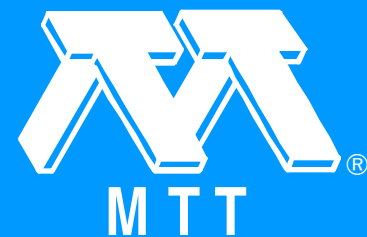
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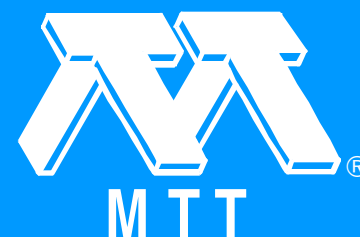
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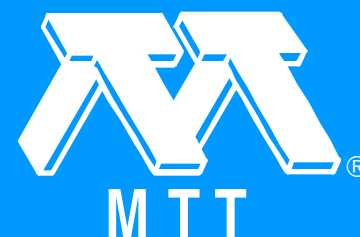
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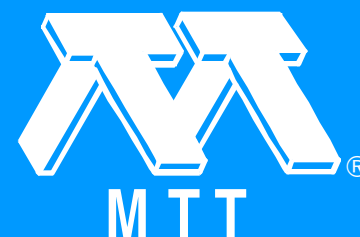
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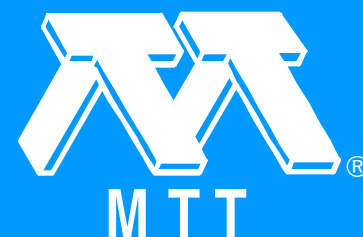
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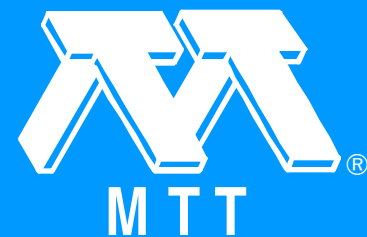
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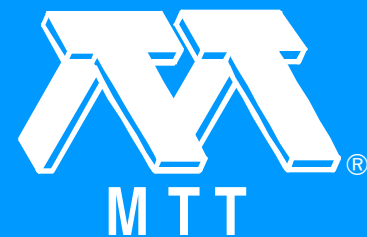
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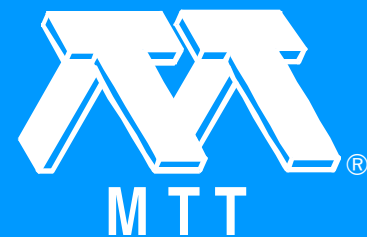
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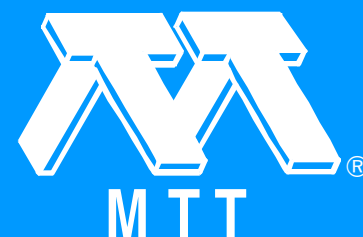
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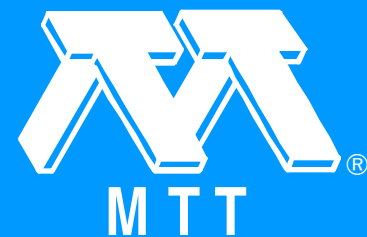
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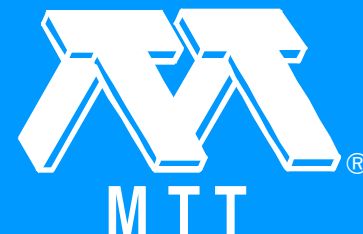
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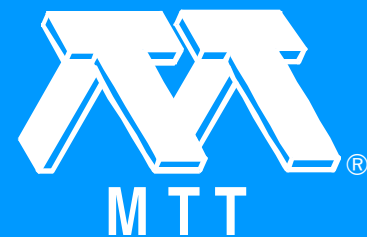
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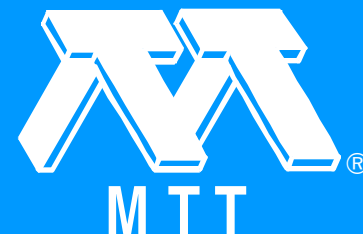
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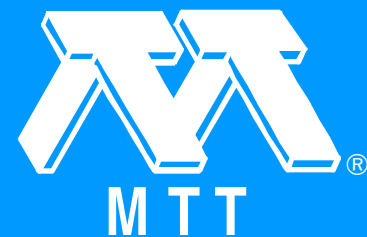
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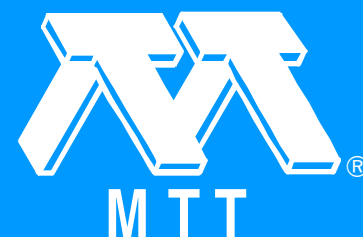
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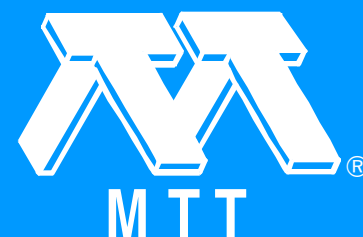
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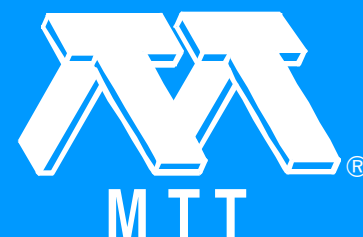
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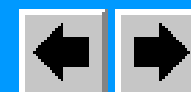
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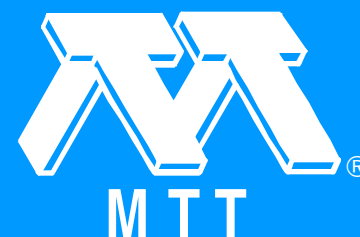
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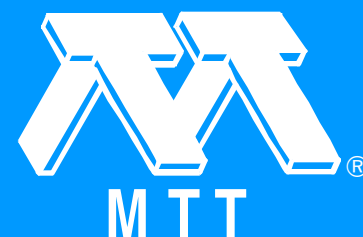
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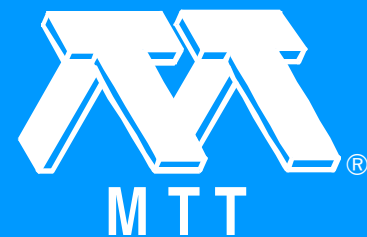
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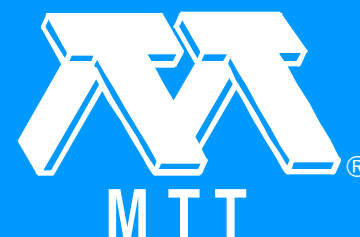
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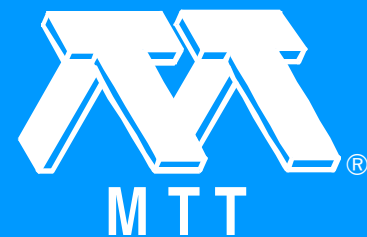
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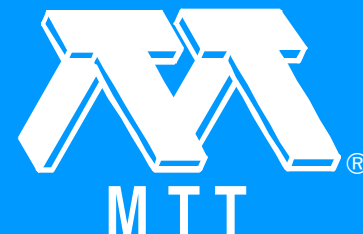
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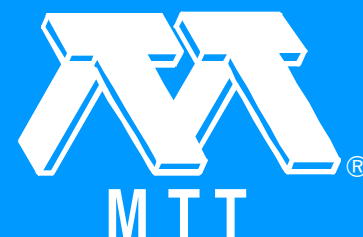
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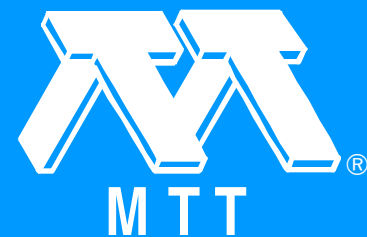
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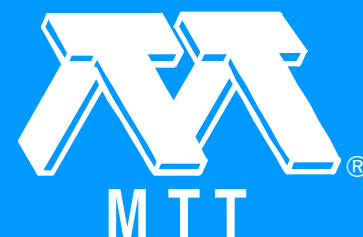
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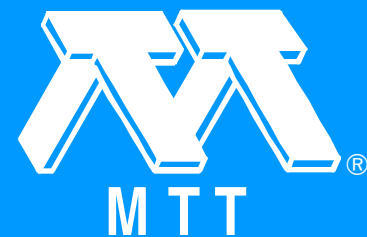
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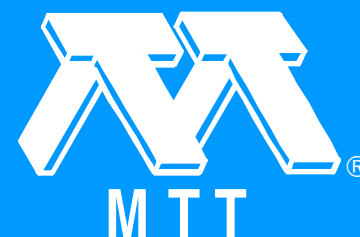
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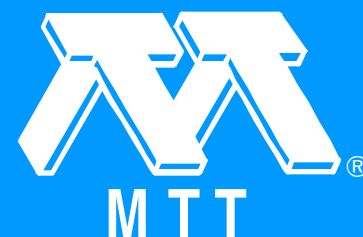
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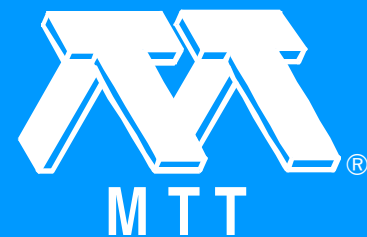
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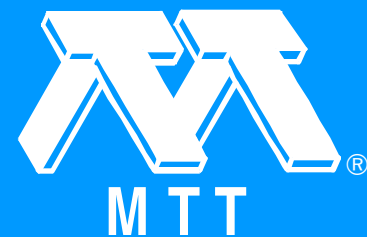
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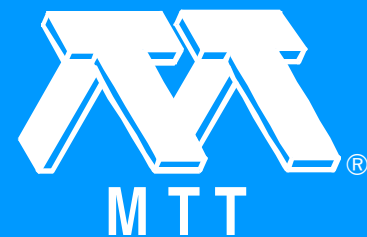
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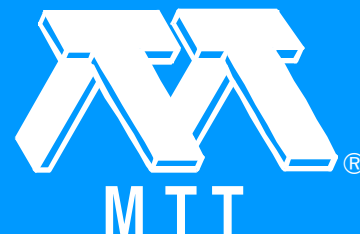
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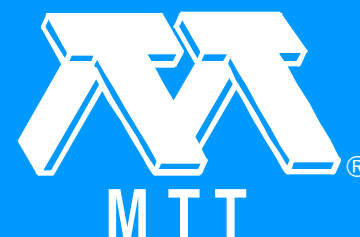
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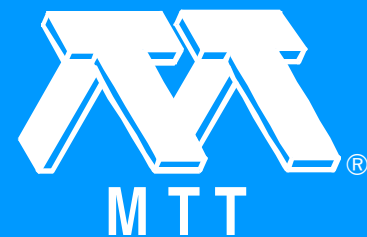
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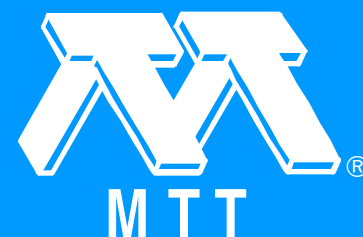
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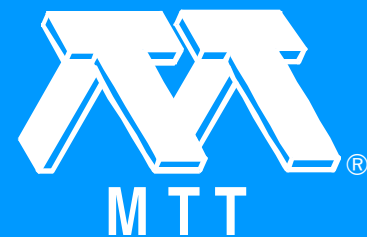
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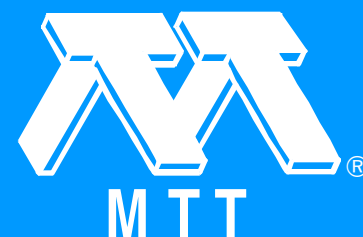
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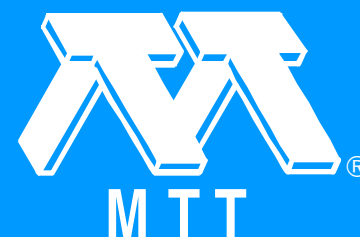
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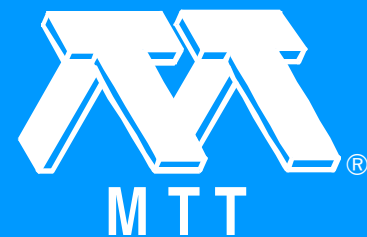
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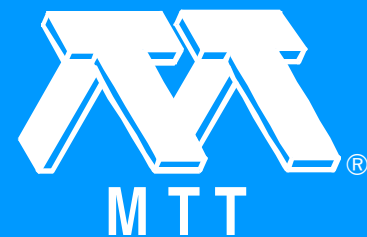
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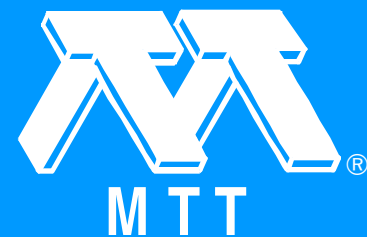
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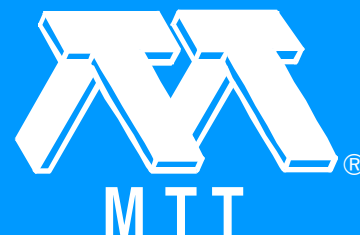
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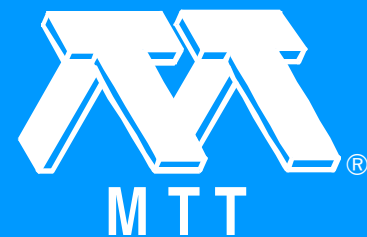
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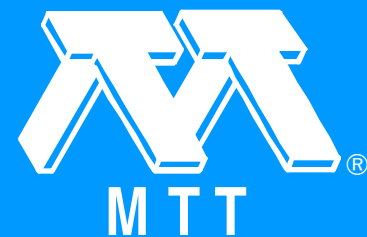
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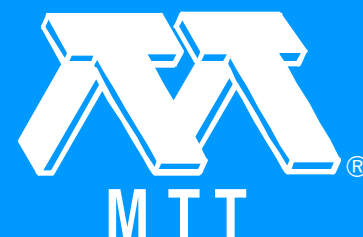
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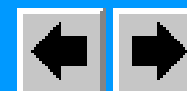


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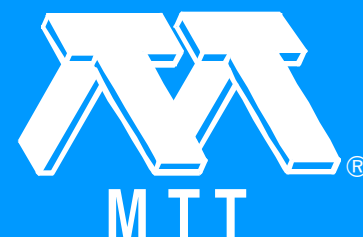
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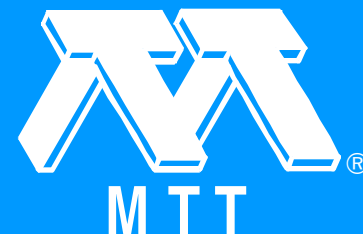
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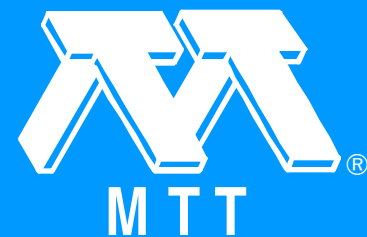
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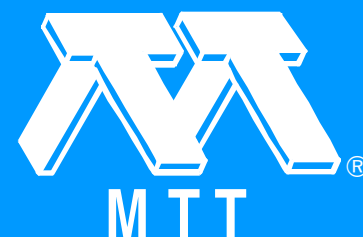
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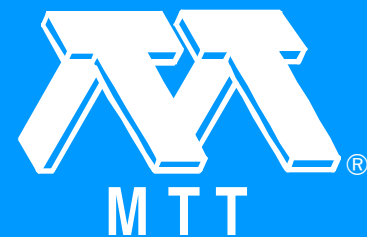
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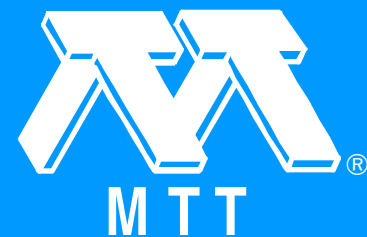
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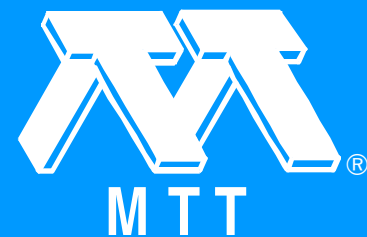
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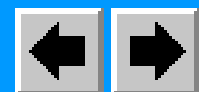
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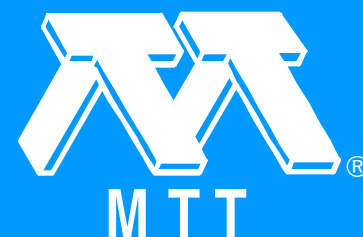
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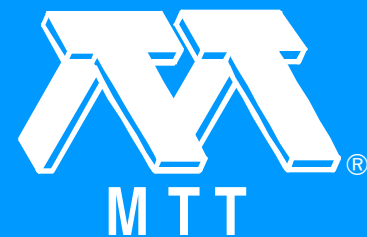
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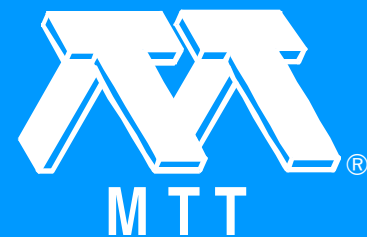
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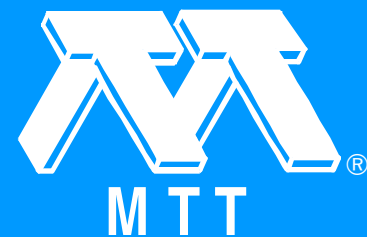
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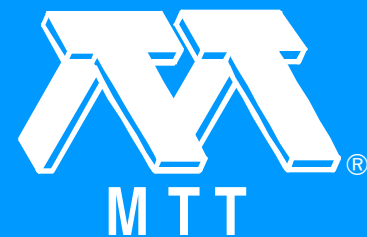
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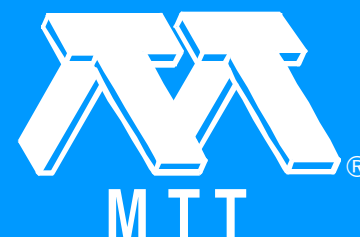
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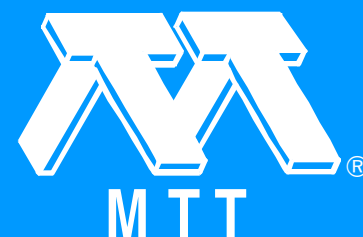
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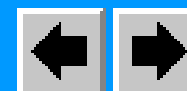


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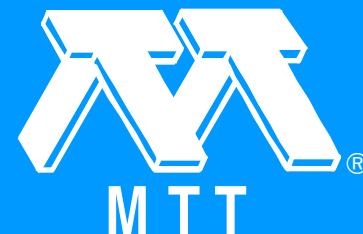
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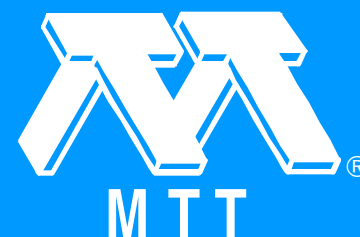
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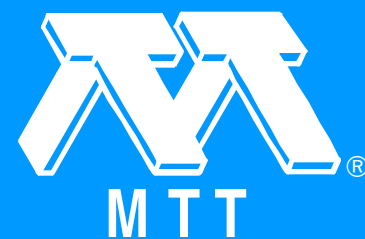
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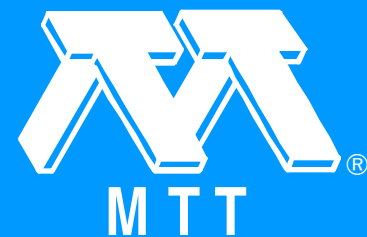
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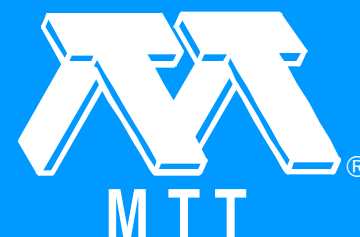
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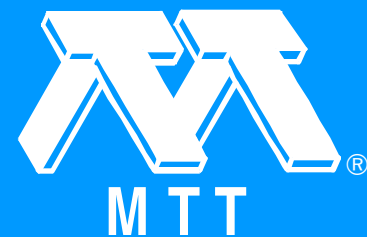
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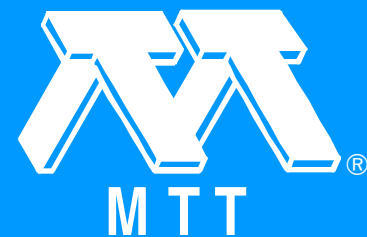
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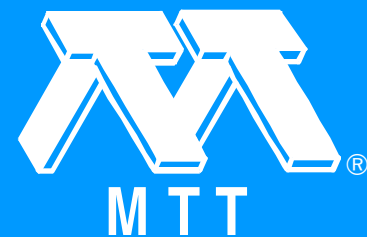
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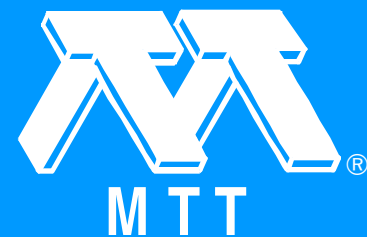
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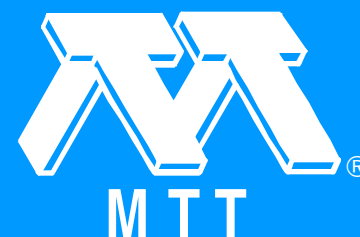
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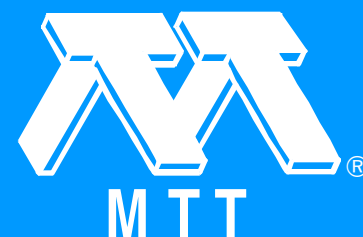
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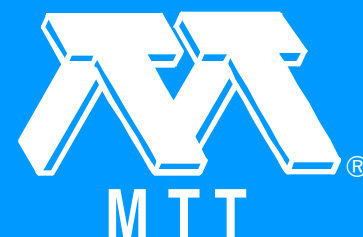
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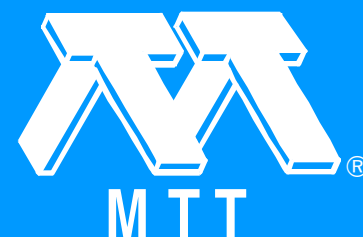
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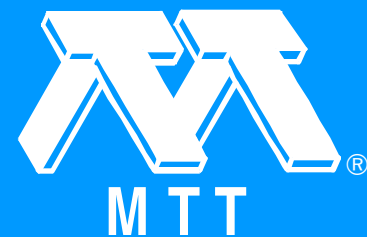
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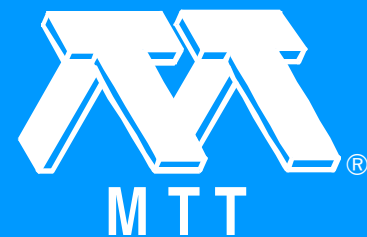
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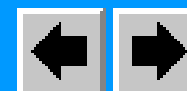


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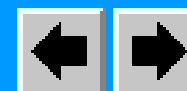


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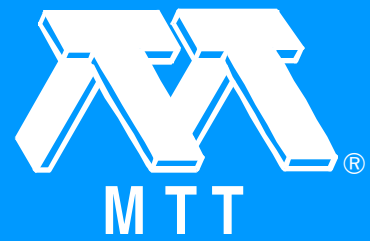
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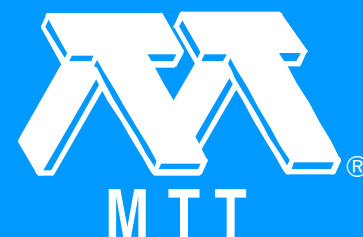
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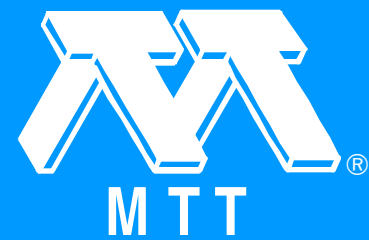
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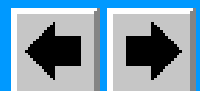
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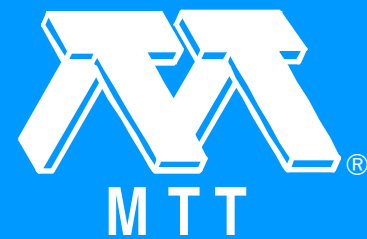
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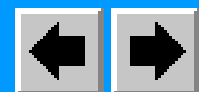
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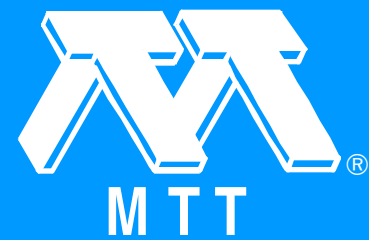
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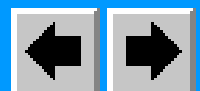
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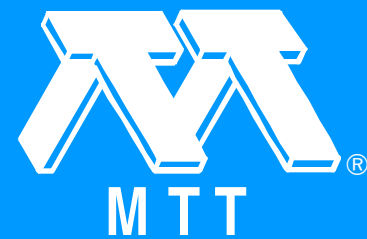
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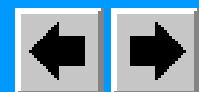
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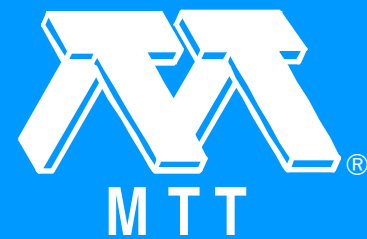
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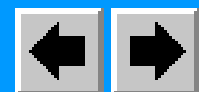
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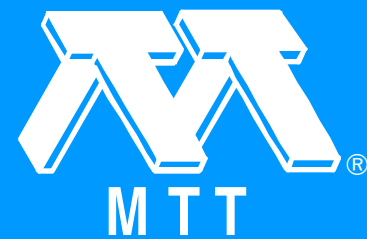
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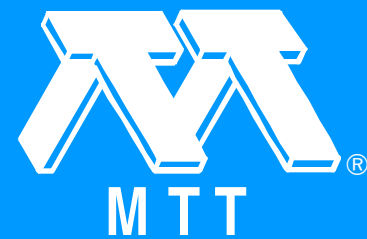
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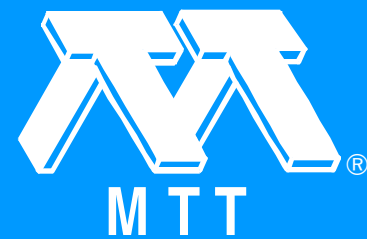
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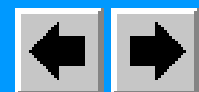
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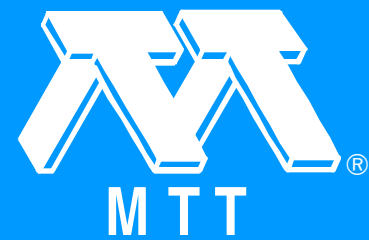
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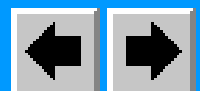
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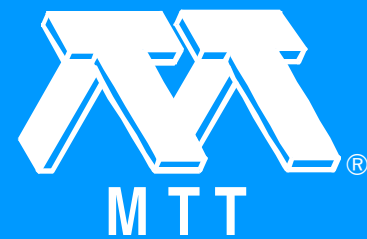
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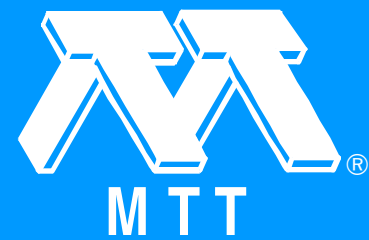
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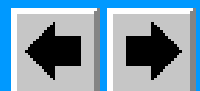
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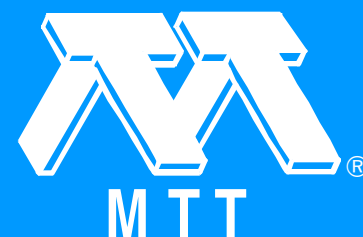
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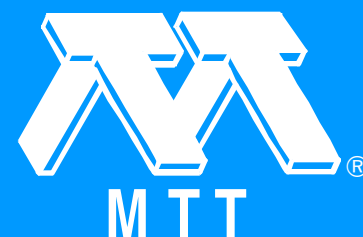
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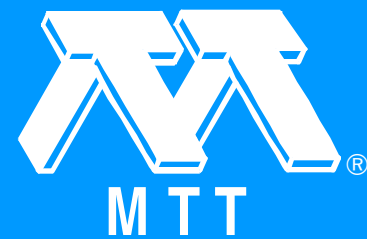
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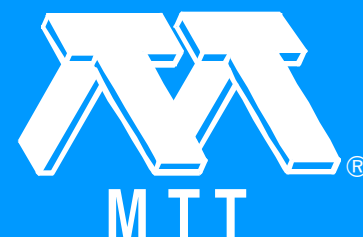
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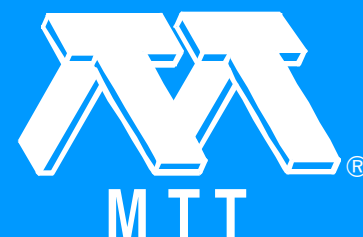
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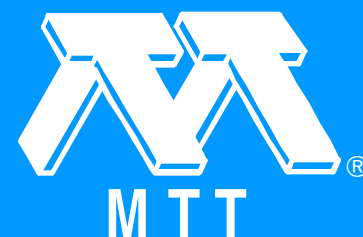
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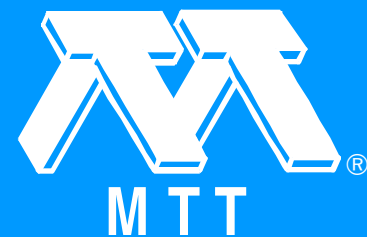


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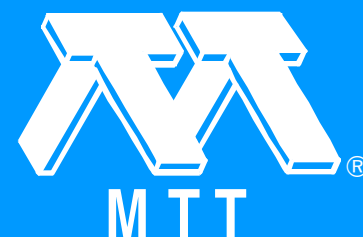
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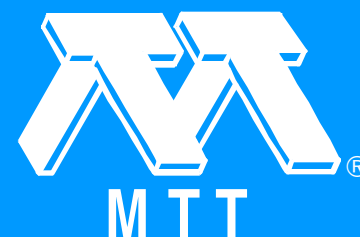
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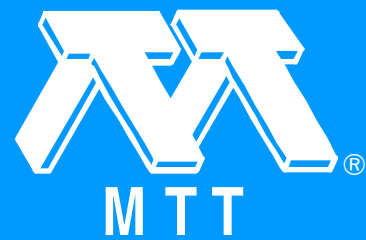


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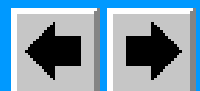


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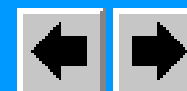


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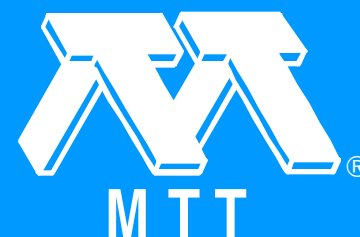
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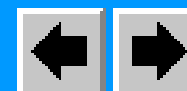
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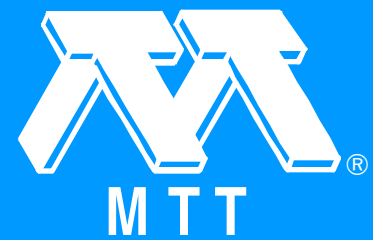
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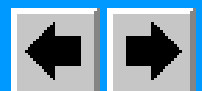
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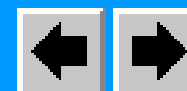


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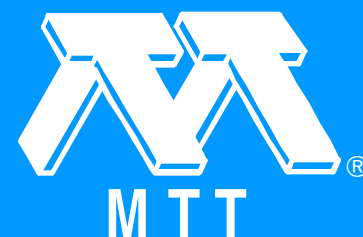
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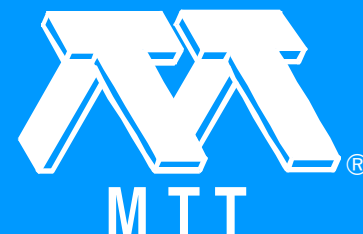
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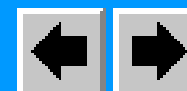
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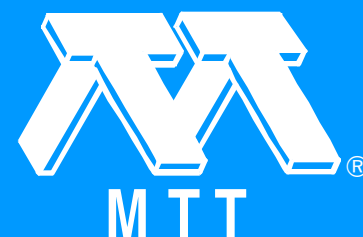
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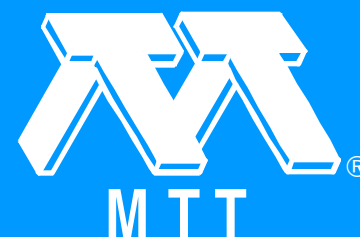
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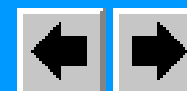
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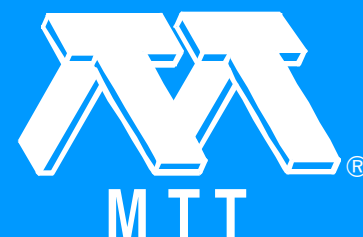
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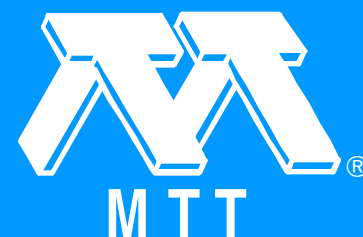
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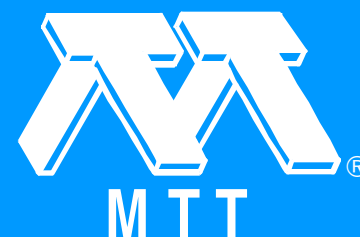
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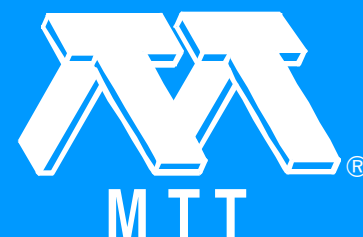
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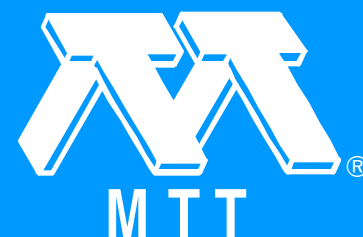
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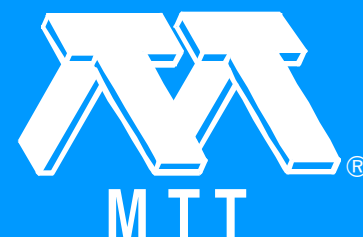
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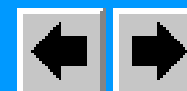
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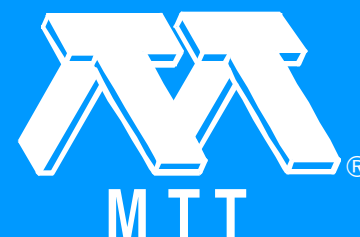
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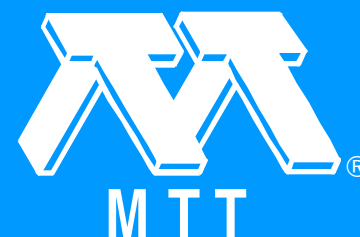
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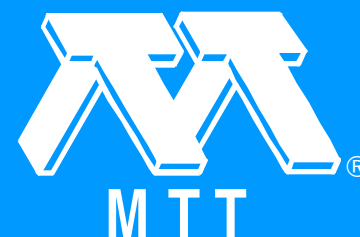
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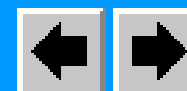


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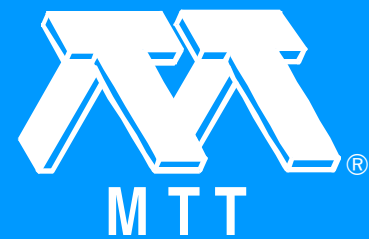
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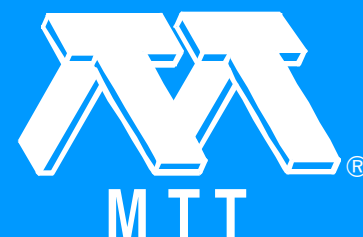
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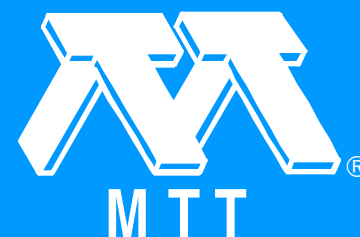
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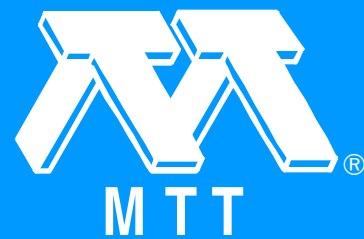
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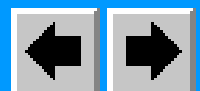
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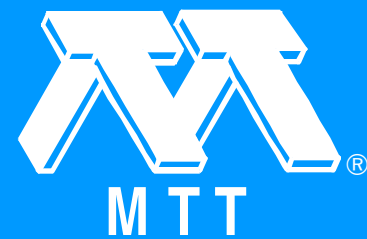
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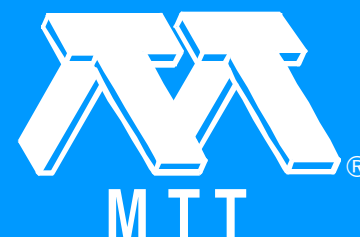
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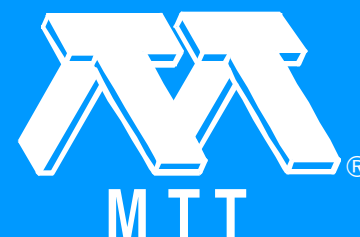


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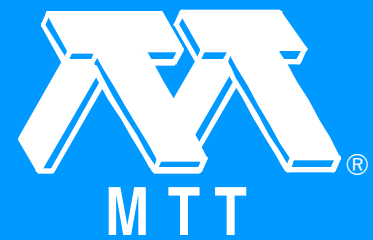
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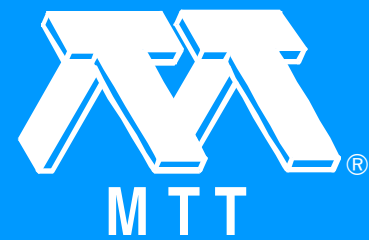
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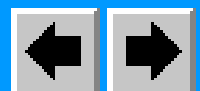
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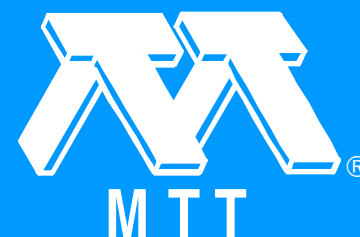
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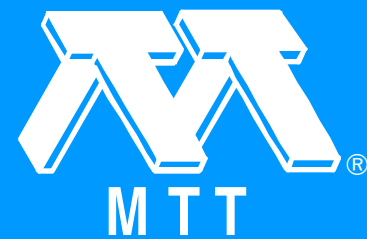
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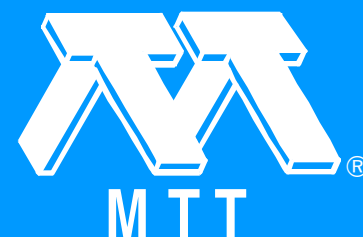
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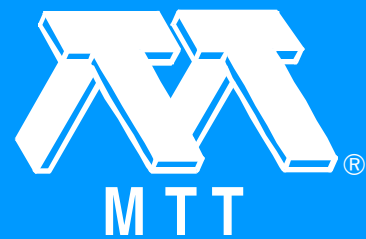
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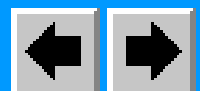


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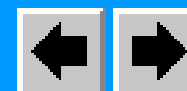


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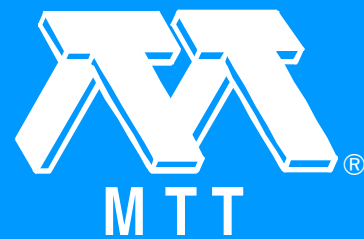
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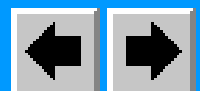
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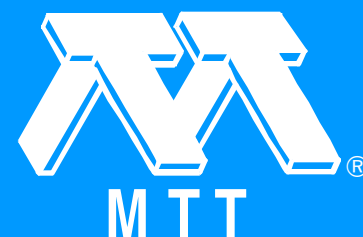
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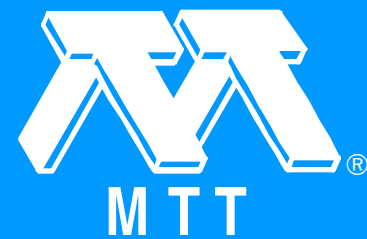
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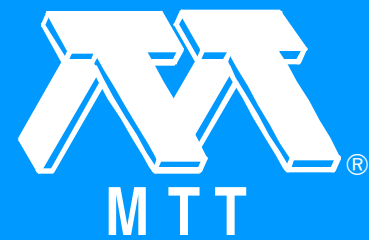
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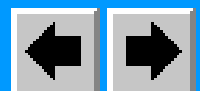
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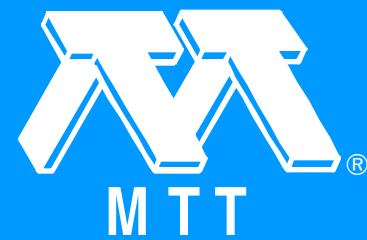
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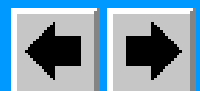
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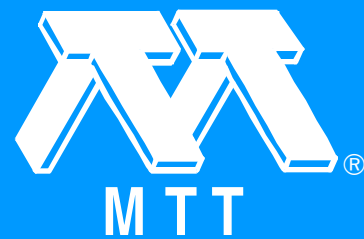
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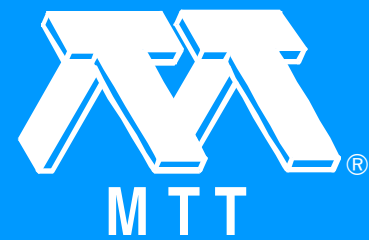
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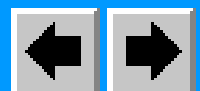
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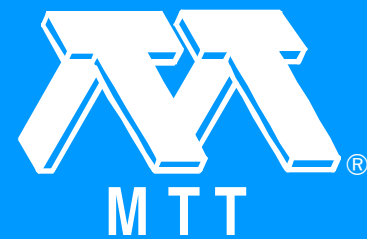


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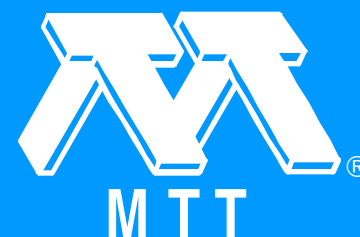


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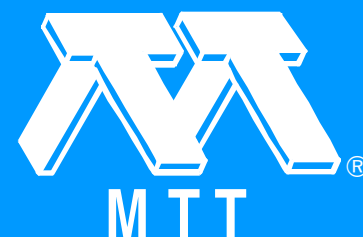
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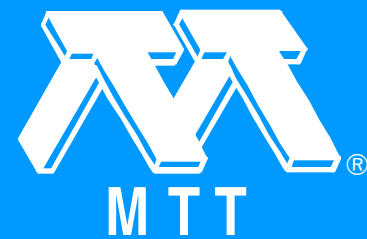
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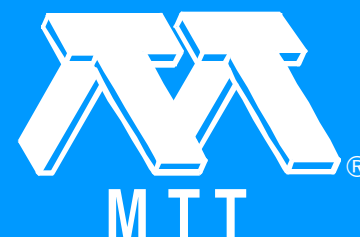
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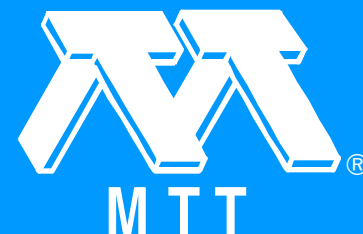
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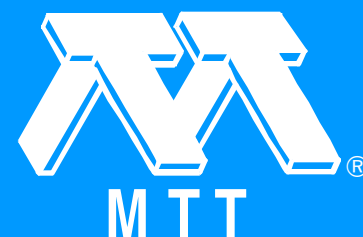
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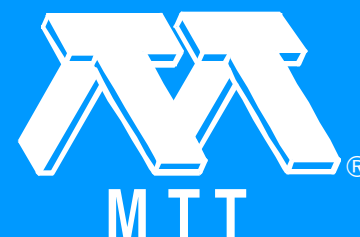
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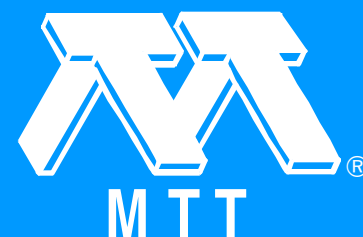
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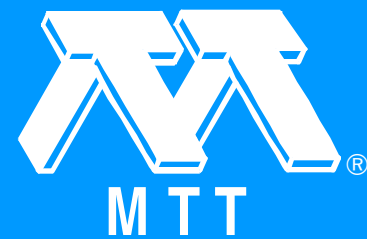
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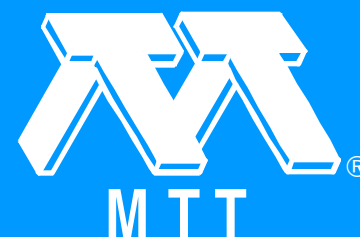
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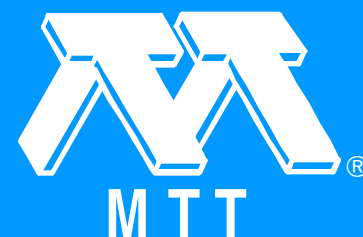
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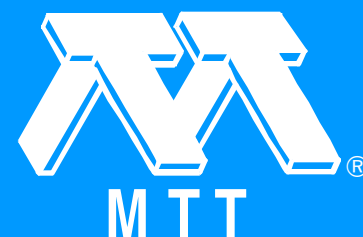
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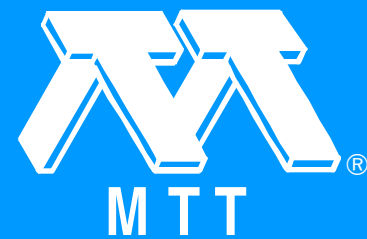


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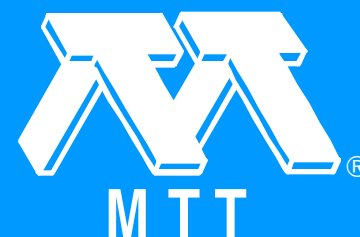
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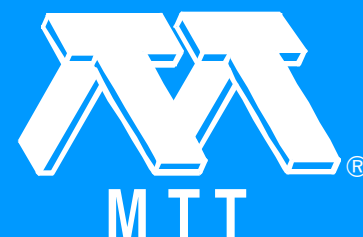
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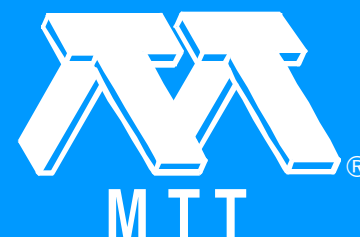
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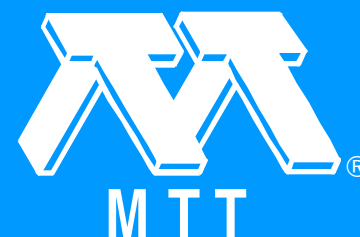
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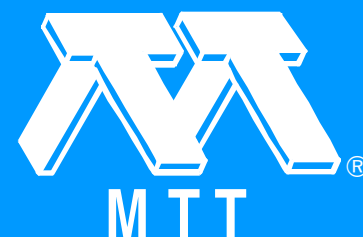
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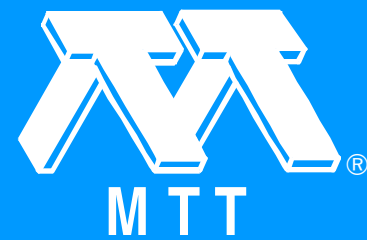
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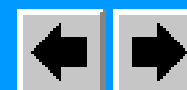


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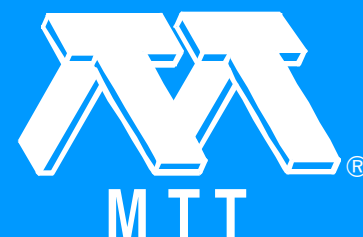
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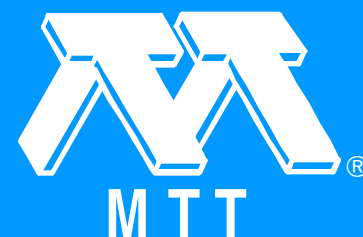
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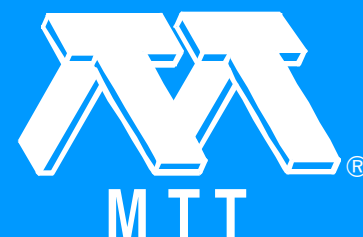
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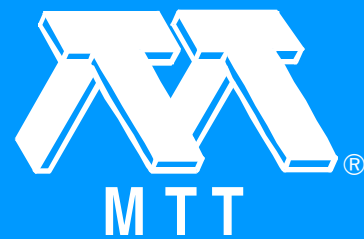


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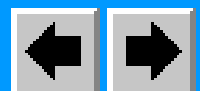
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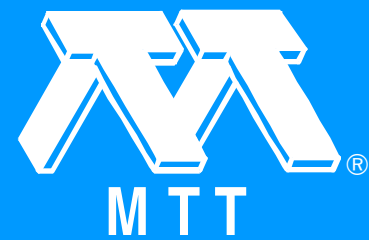
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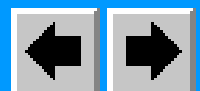
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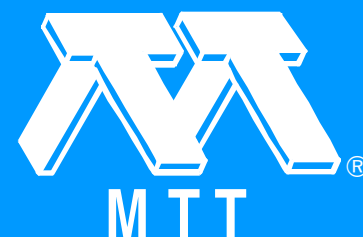
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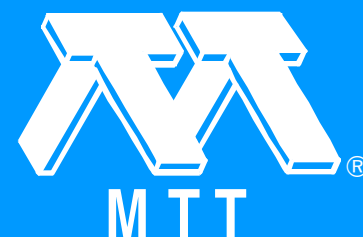
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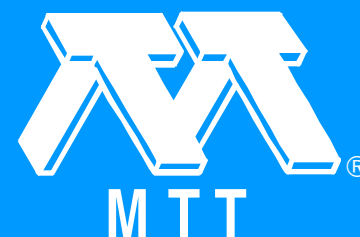
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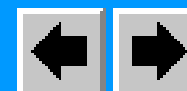
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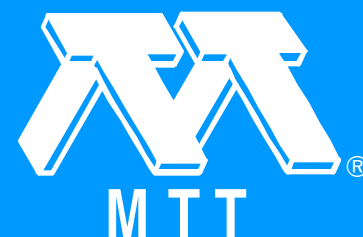
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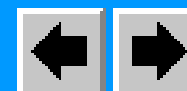
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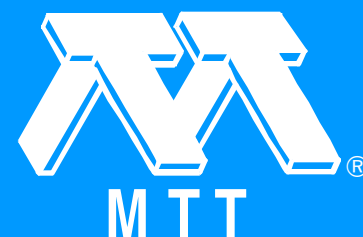
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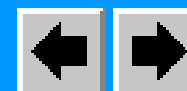
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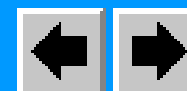


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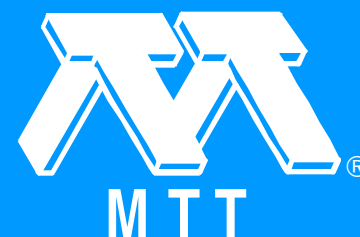
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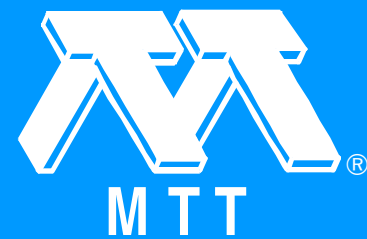
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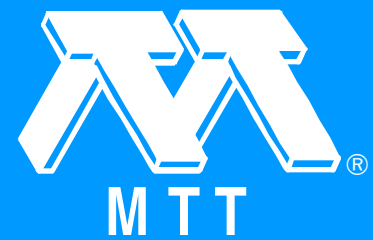
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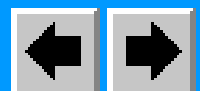
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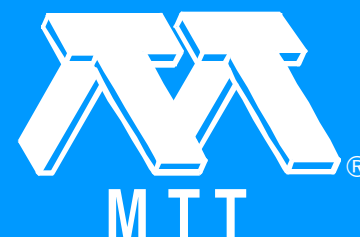
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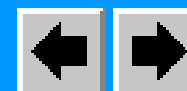
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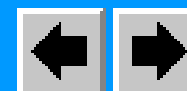
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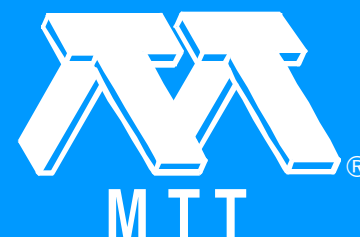
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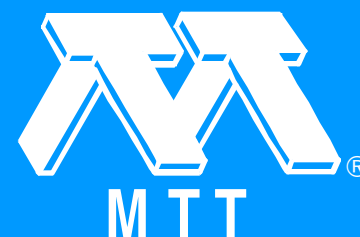
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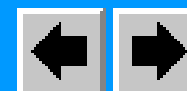
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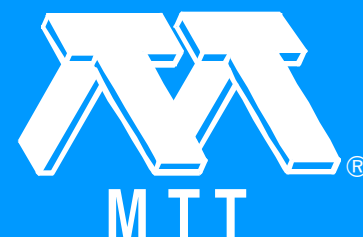
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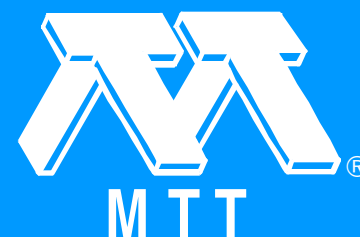
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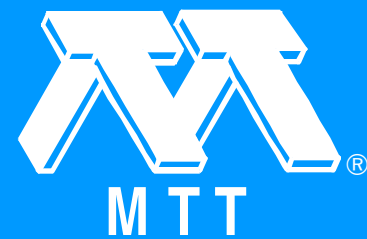
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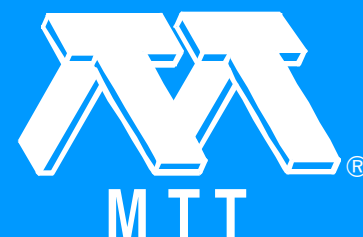
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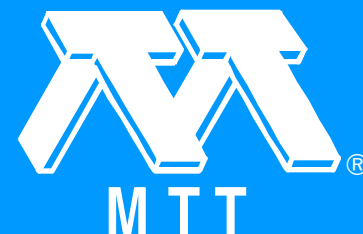
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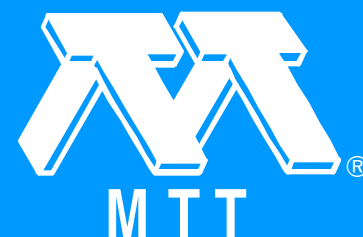
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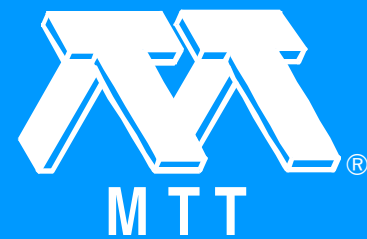
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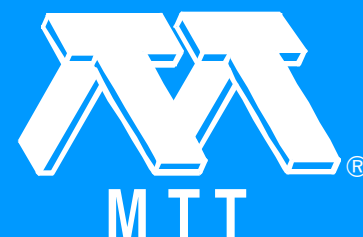
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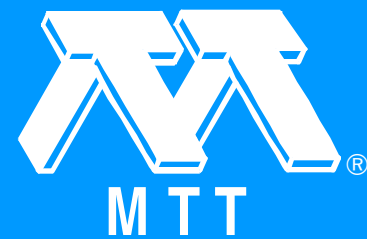
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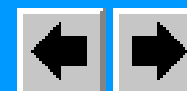
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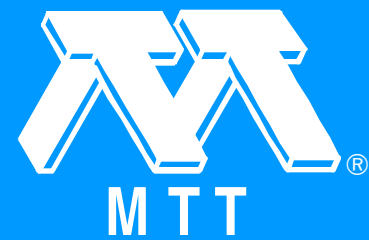
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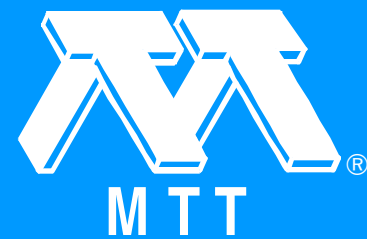
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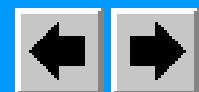


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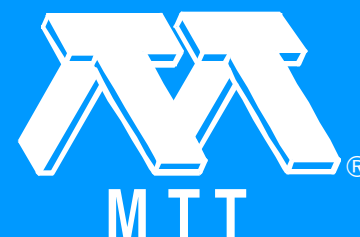
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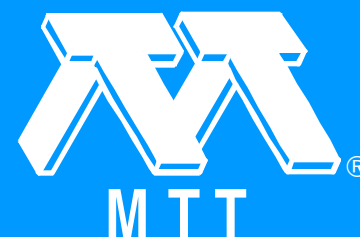
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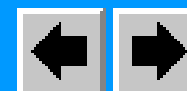


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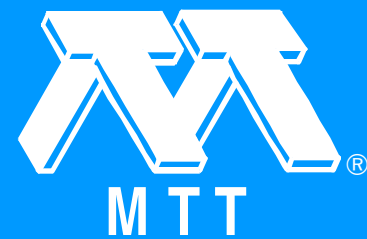
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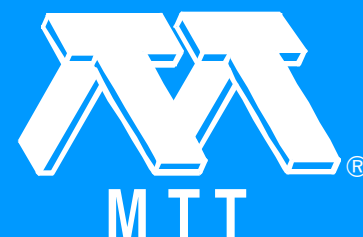
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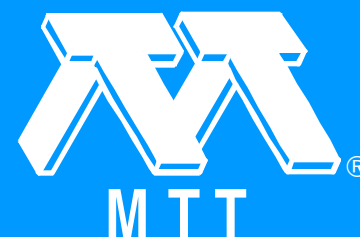
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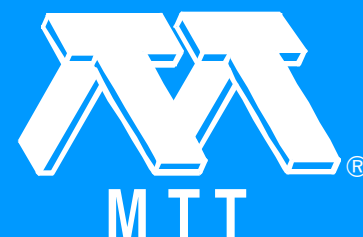
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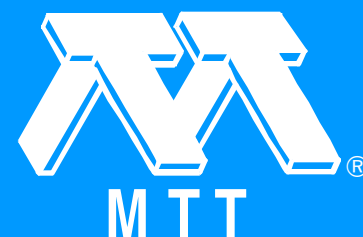
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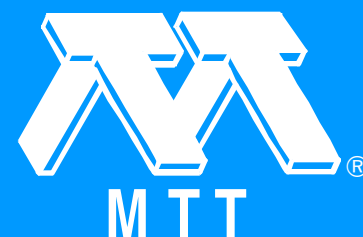
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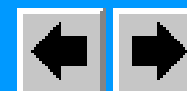
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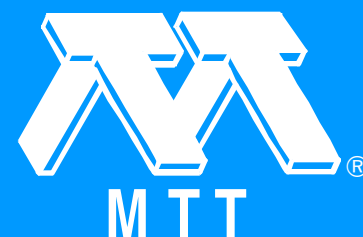
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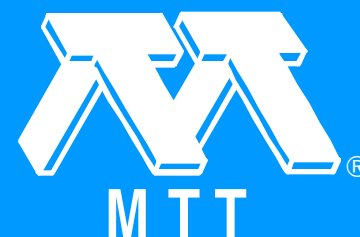
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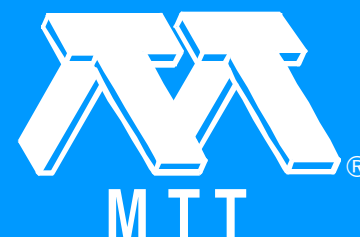
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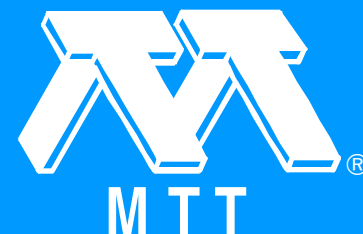
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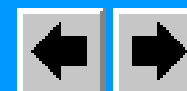


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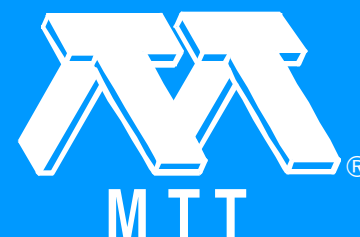
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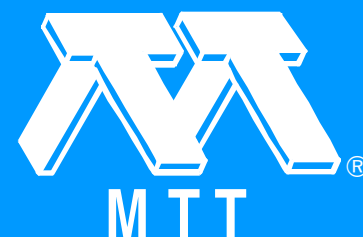
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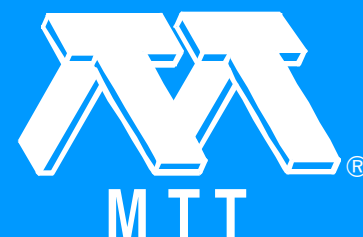
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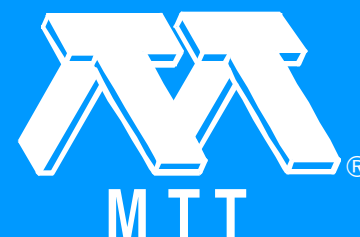
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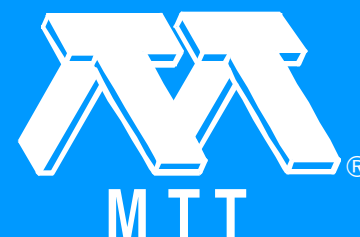
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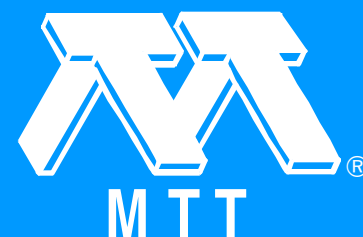
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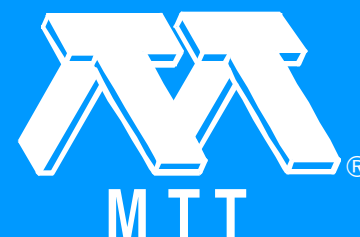
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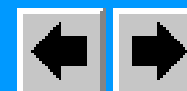
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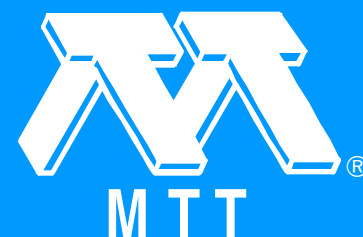


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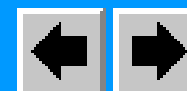


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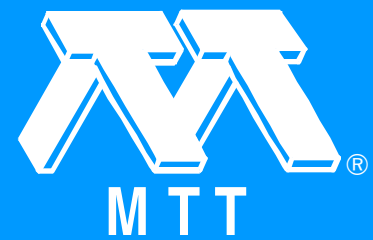
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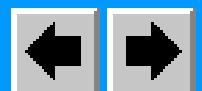
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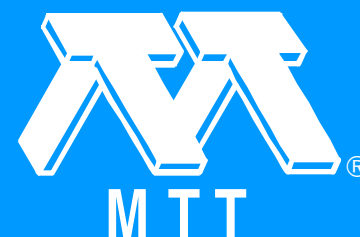
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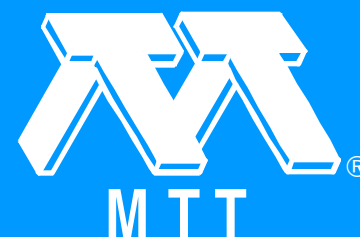
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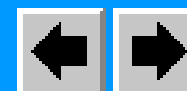


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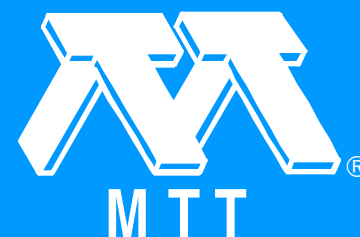
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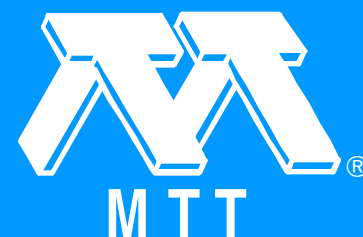
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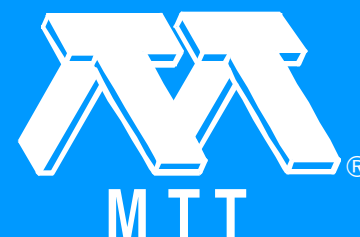
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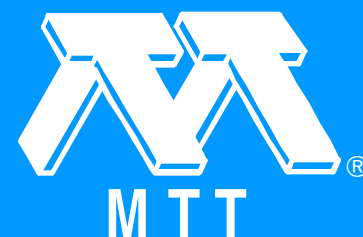
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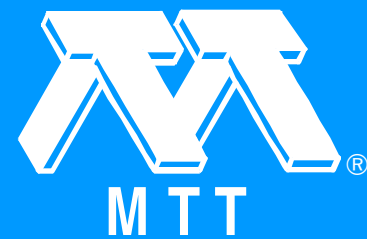
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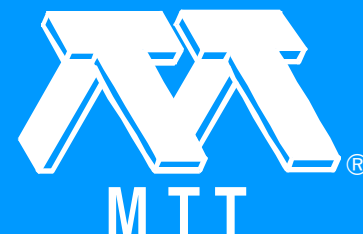
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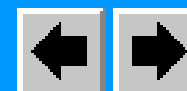


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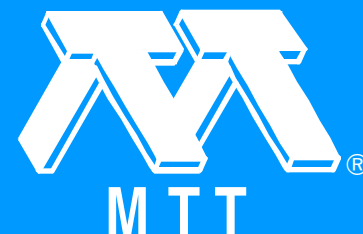
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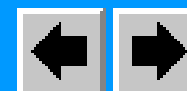


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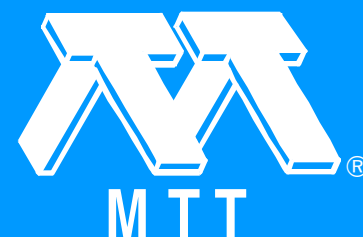
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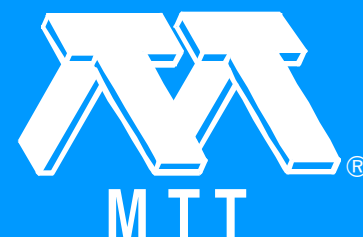
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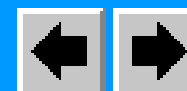
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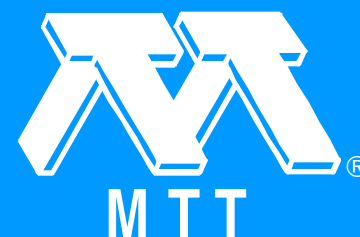


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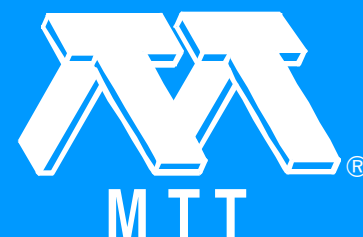
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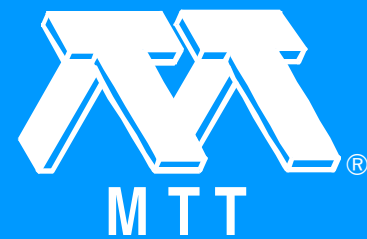
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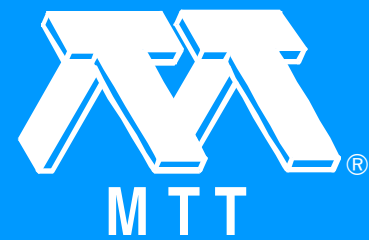
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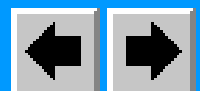
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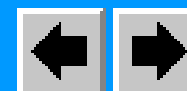


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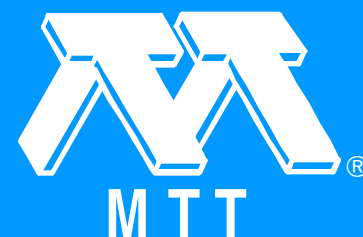
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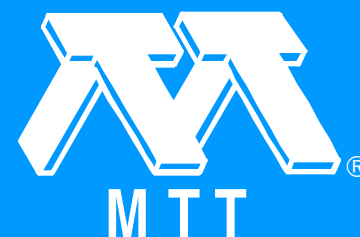
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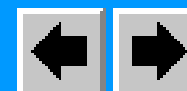
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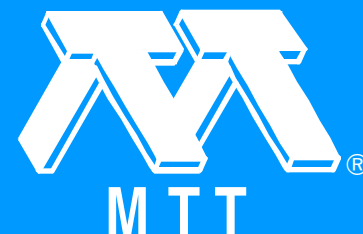
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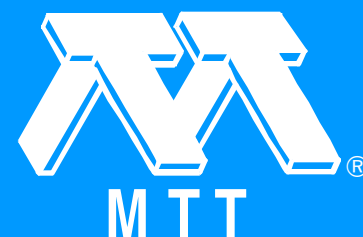
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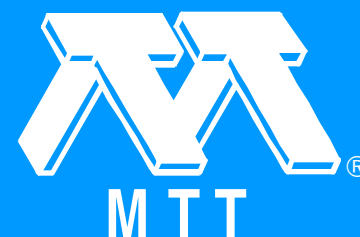


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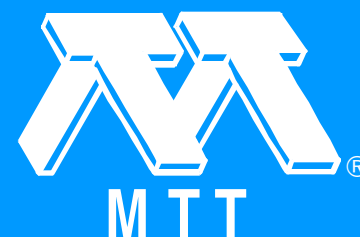


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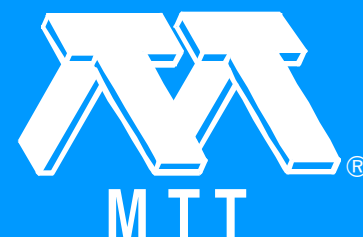
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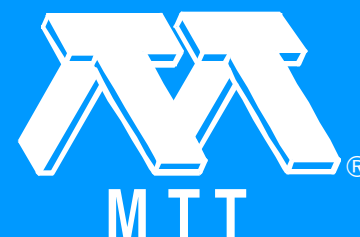
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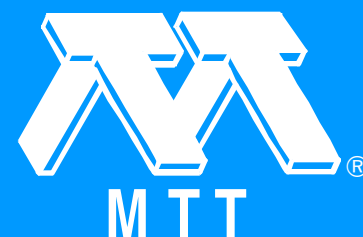
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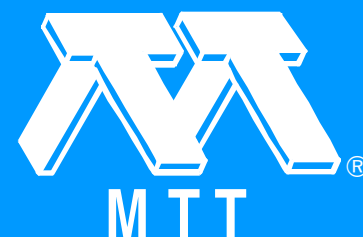
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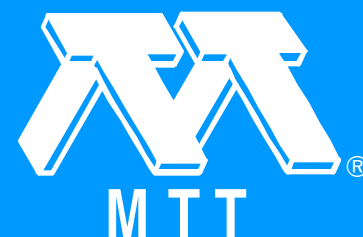
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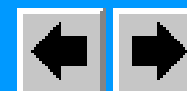
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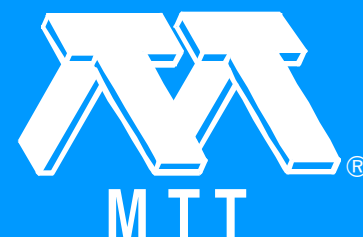
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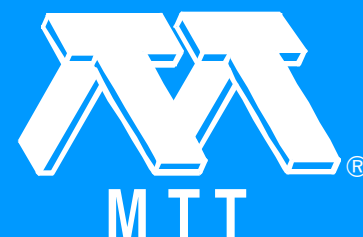
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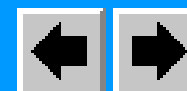


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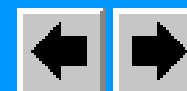
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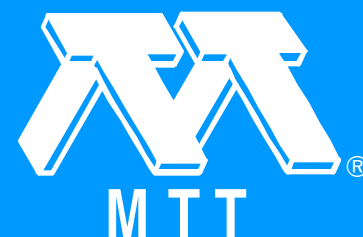
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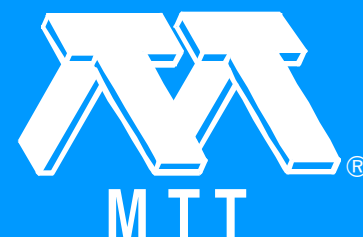
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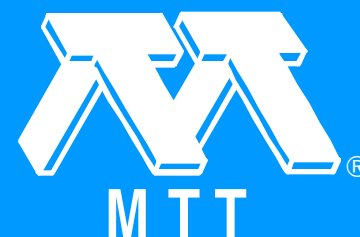
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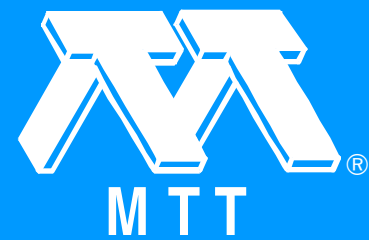
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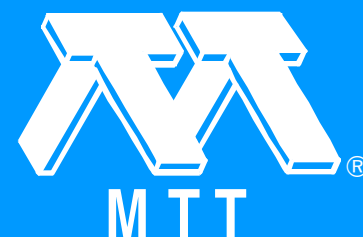
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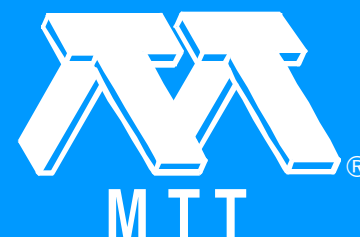
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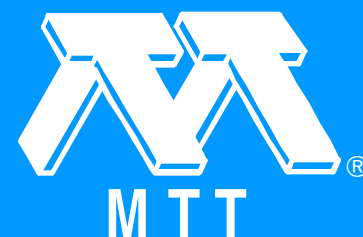
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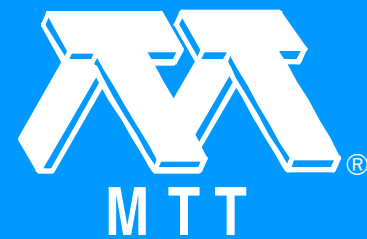
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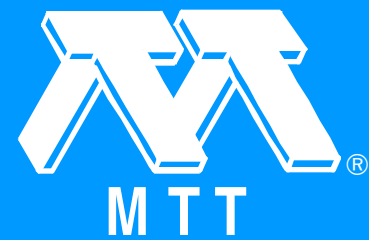
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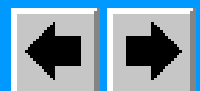
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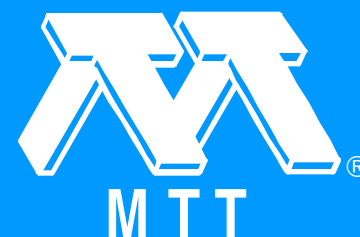


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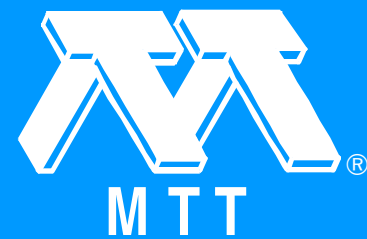
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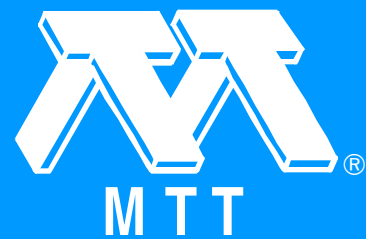
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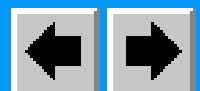
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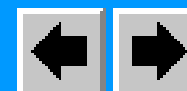
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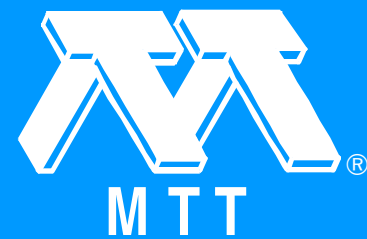
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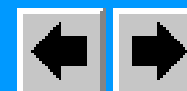
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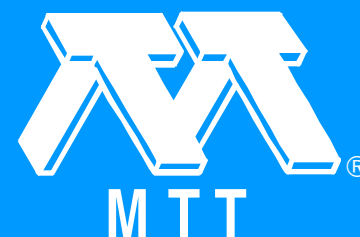
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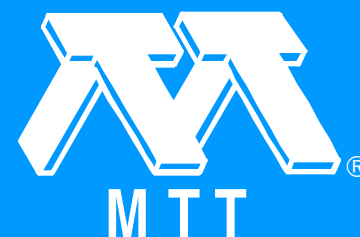
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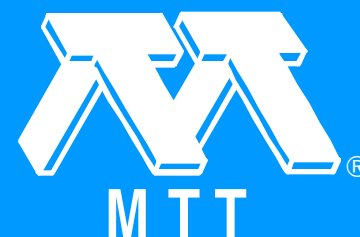
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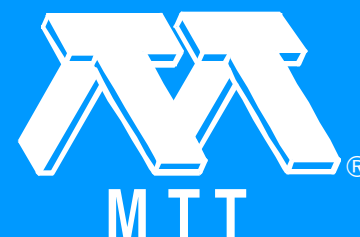
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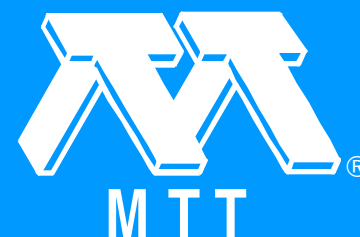
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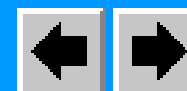
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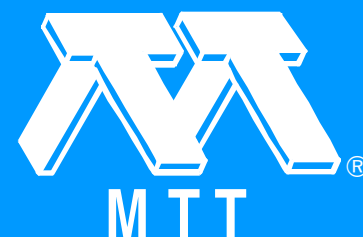
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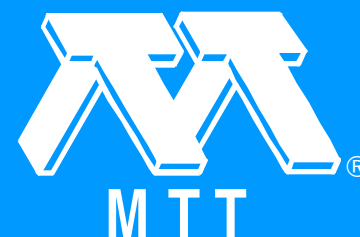
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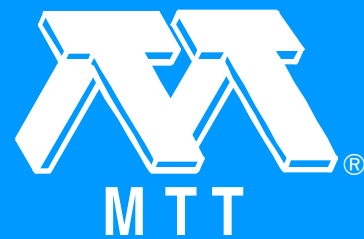


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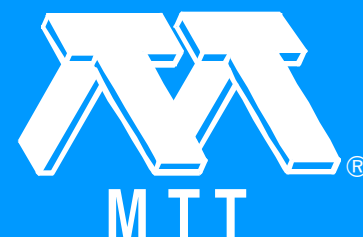
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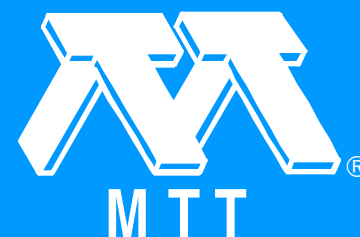
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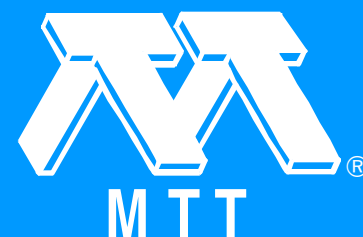
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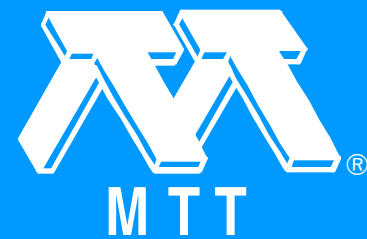
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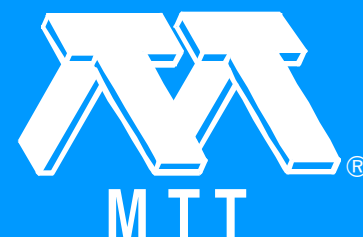
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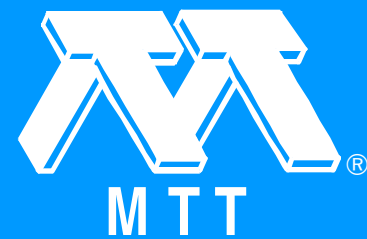
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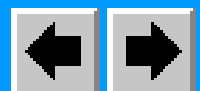
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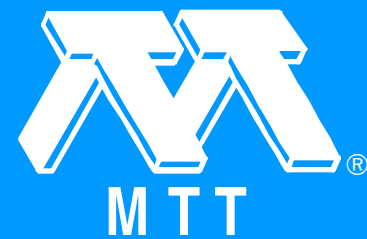
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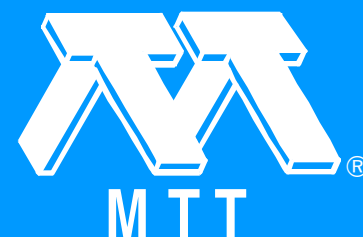
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- ❑ A 15 watt PFP GaAs PHEMT MMIC power amplifier for 3G wireless transmitter applications
- ❑ A 6 watt LDMOS broadband high efficiency distributed power amplifier fabricated using LTCC technology
- ❑ A broadband monolithic S-band class-E power amplifier
- ❑ A broadband, push-pull power MMIC operating at K/Ka-band frequencies

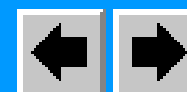


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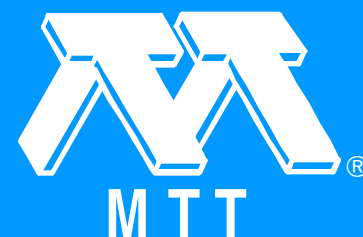
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- ❑ A filter synthesis technique applied to the design of multistage broadband microwave amplifiers (2002 Vol. III [MWSYM])
- ❑ A filter synthesis technique applied to the design of multistage broad-band microwave amplifiers (Dec. 2002 [T-MTT])
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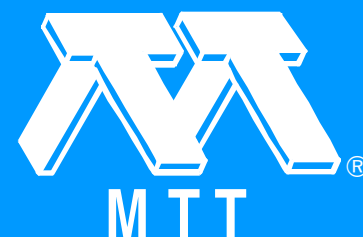
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