A NEW SELF-CALIBRATING TRANSISTOR TEST FIXTURE

Richard Q. Lane, Gary L. McCollum
California Eastern Laboratories, Inc.
3005 Democracy Way, Santa Clara, California 95050

Abstract

The design of a test fixture for strip line microwave transistors, accommodating precision coaxial calibration standards, is described. A wide variety of package styles may be measured without disturbing the initial calibration. Test data to 16 GHz is shown.

Introduction

The recent marriage of the desk top calculator and network analyzer [1] makes accurate device S-parameter characterization potentially available to all circuit designers. Such characterization is potentially but not actually available because this system and its predecessors [2,3] remove only the systematic measurement errors up to the reference plane of a pair of precision coaxial connectors. Unfortunately, however, microwave transistors are rarely packaged with mating precision coaxial connectors. Precision shorts, open and sliding loads are not available with strip line leads to fit transistor fixtures.

The new fixture is able to accommodate both a wide range of strip line transistor styles and the precision coaxial standards used for overall system reflexion calibration as well as forming its own thru standard.

Fixture Description

The fixture is unique in its system of partitioning at the transistor-coaxial line interface. Fig. 1 exploded view shows the fixture with its lid removed. The grounding bars 1U and 1L, hereafter referred to as the insert, clamp the test device accurately in relation to the slotted coaxial inner conductors. 40 mil diameter Rexolite rods press the device leads into contact with the very ends of these inner conductors. Similar rods support these conductors from below.

Lid part 2u and body part 21 are used alone for system reflexion calibration.

Two removable dowel pins align a sliding load APC-7 connector or shielded open with the half fixture, see Fig. 2a. A clamp holds these standards in place. A short circuit is formed by shim stock pressed to the fixture's open end by means of a rubber pad, as in Fig. 2b. Thru calibration is achieved by placing parts 2 and 3 directly in contact with each other.

Different transistor package styles are accommodated by changing the inserts 1U and 1L of Fig. 1. The system calibration is undisturbed by these insert changes, at least to a first order.

The mechanical length (connector to connector), of course, changes, but this is accommodated by a high quality, flexible cable forming the analyzer return port.

Fig. 3 depicts the uncorrected frequency response of the new fixture thru 16 GHz.

Coaxial Line to Package Correction

The coaxial inner conductors clear the transistor inserts by 0.02", in order to ensure reasonable repeatability of center line to insert end capacitance. The short unenclosed length of transistor lead may be modeled as the low pass pi network of Fig. 4a.

A special "skinny" insert of Fig. 4b is used to measure the S-parameters of the double network. This insert simulates the stray capacitance of each line to an insert but with the insert thickness shrunk to 5 mils. Different packages require different diaphragm cutouts. The thru is a strip of gold plated metal appropriate to the package style.

The network values are derived by means of "COMPACT" computer optimization to best fit the measure "skinny" insert S-parameters. Fig. 5 is a plot of the measured and modeled S-parameters from 2-16 GHz of a NEC type 83 package insert.

Calibration and Measurement Sequence

The fixture, bias tees and network analyzer is calibrated over the desired frequencies with a sliding load, short, open and thru using an extended version of the full error model software [1].

This removes the fixture errors depicted in Fig. 3 and those of the bias tees and the N.A. The measurement part of the software, on a separate tape file, selects from the calibrate tape just those frequencies and the sets of error vectors at which measurement of the particular device is desired.

Therefore, recalibration is not needed to handle different measurement jobs during each day. The measurement program, for NEC devices, selects appropriate values for the three elements of the lead network from a "look up" table based on the transistor type number, e.g., NE388<u>83</u>, the last two digits representing the package style.

The error corrected data is transformed in the sequence of Fig. 6, yielding the required device data. This de-embedding and additional freedoms in measurement frequency choice, of course, adds to the memory requirements, necessitating splitting the calibration, measurement and output parts of the program into three overlayed files.

Acknowledgement

Shigeru Sando of NEC kindly provided the uncorrected fixture frequency response data of Fig. 3.

REFERENCES

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3. Hackborn, R. A., "An Automatic Network Analyzer System," Microwave Journal, vol. 11, pp45-52, May 1968.

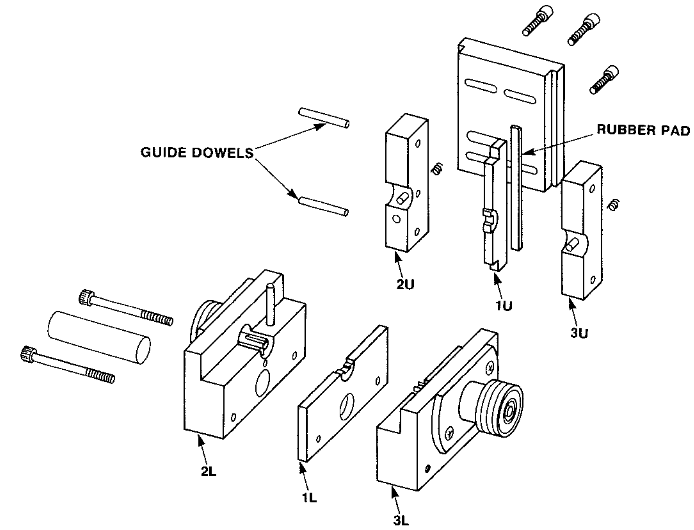

FIGURE 1. Exploded View

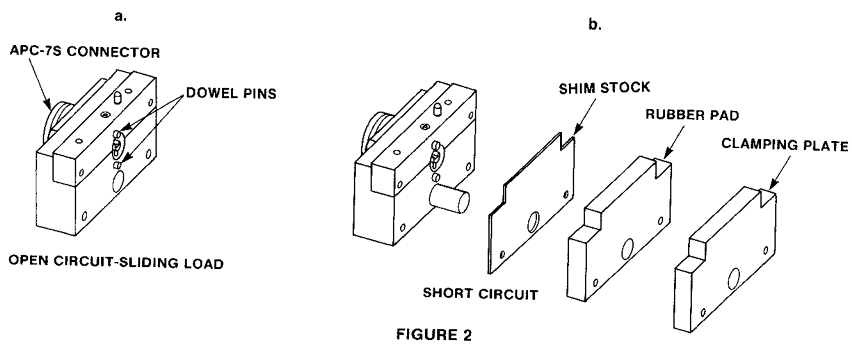

FIGURE 2

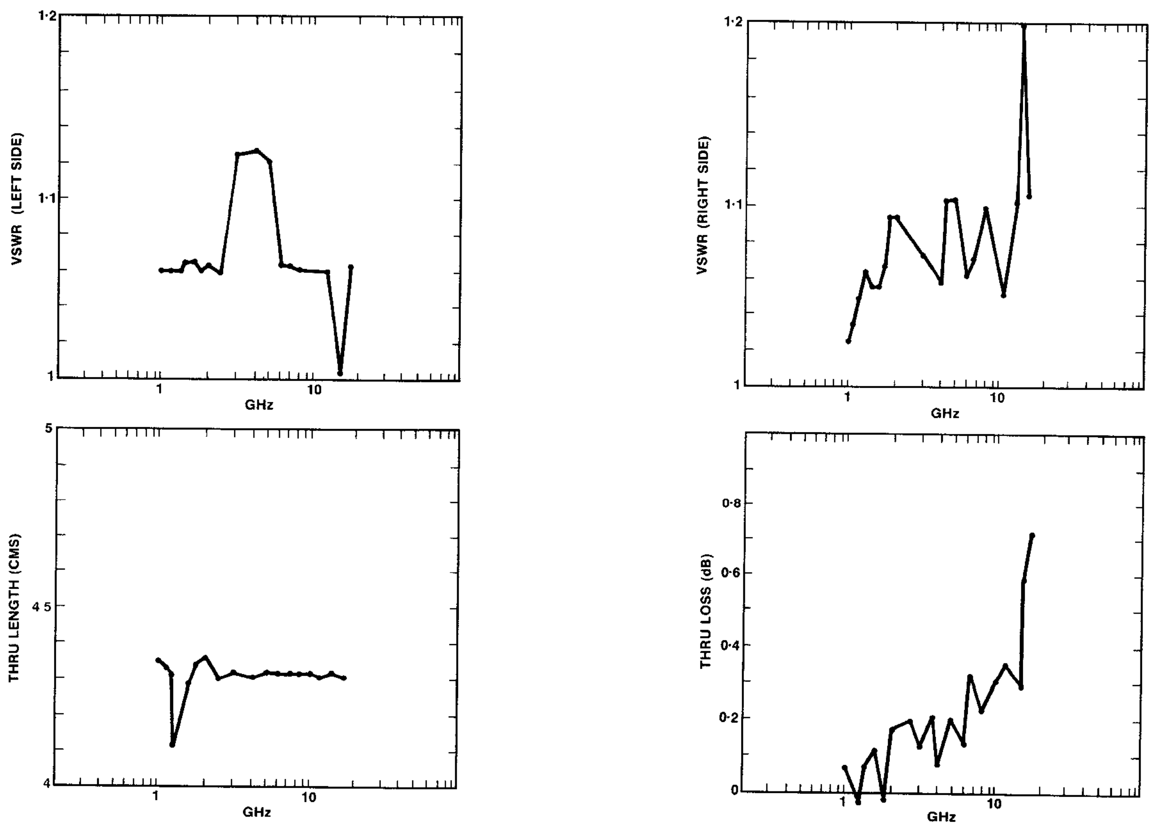

FIGURE 3. Fixture Frequency Response

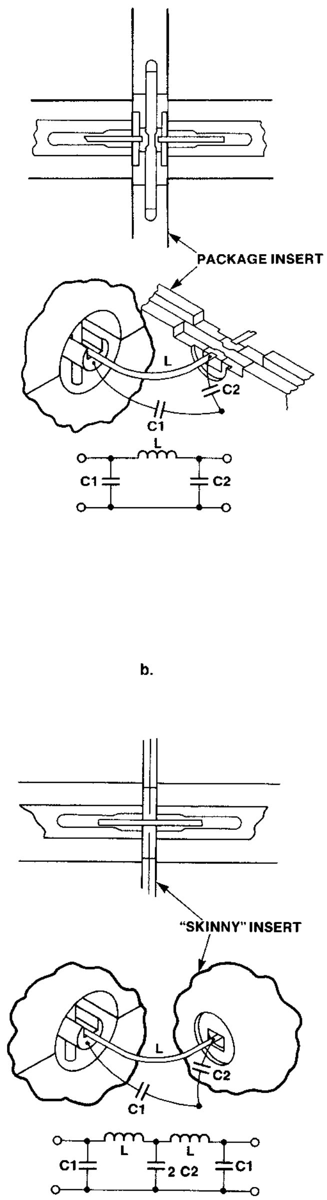

FIGURE 4

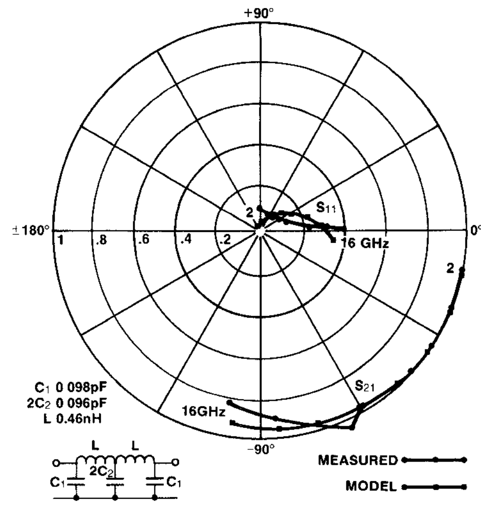

FIGURE 5. 50Ω Line to Package Transition (double network)

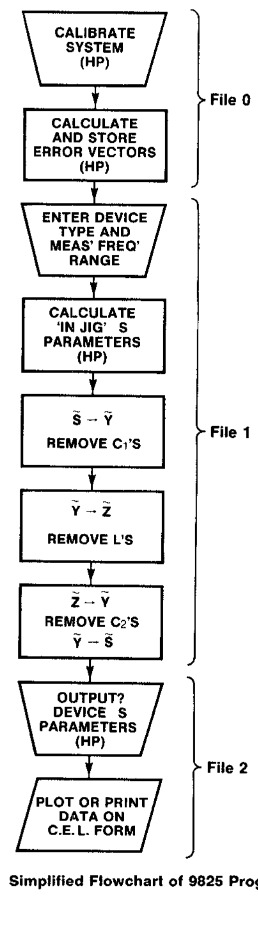

FIGURE 6. Simplified Flowchart of 9825 Program