ONE HUNDRED CHANNEL SELECTABLE SURFACE WAVE BANDPASS FILTER

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Abstract

Surface wave multichannel bandpass filters such as the selectable filters, filter trees, or filter banks provide a large number of bandpass filter channels with relatively few transducers. Among major systems applications are frequency-hopped receivers, spread-spectrum equipment, and multichannel multiplex systems. Synthesis of more than 100 bandpass responses of varying center frequency and varying bandwidth with nominally 20 transducers is detailed.*

Summary

The selectable bandpass filter[1,2] is based on a unique concept developed at Texas Instruments which takes advantage of the wide design flexibility available with surface wave filters. By placing multiple taps on a single filter and by switching the phase of the drive on these taps, the bandpass and bandstop characteristics can be altered. That is, the tapped structure of the transducer produces a periodic pass-band/stop-band spectrum which may be shifted by changing the relative phase on adjacent taps. Surface wave bandpass filters have characteristic advantages such as small size, low cost, reproducibility, temperature stability, linear phase, low-loss, wide dynamic range, high Q, excellent design flexibility, and an opportune frequency range. The selectable concept adds to this list variable center frequency, variable bandwidth, and a significant reduction in the number of designs, substrates, and transducers required for a large number of filter channels.

There is a wide range of potential applications for this new development. Some configurations which accrue major benefits from the availability of periodic spectra and tunability in SWD filters are (a) the selectable filter*, which delivers in excess of 100 channels requiring only nine transducer designs; (b) filter banks; and (c) other periodic filters and comb structures. Specific applications include commercial and military aircraft receivers, countermeasures receivers, frequency-hopped communication receivers, and radar receivers. Because of their linear phase characteristics, these filters have potential importance in spread-spectrum equipment and in multichannel multiplex communications systems. The steep skirt and narrow bandwidth capability of these filters make the use of high performance TRF receivers possible for applications where local oscillator radiation problems are serious. Interstage and possibly output filters for transmitters corresponding to the above receiver applications are another class of important uses. One might also inexpensively filter a particular desired frequency out of a comb of frequency spikes generated by a low frequency source. This could be used as an LO in a multichannel receiver or transmitter with fixed channel spacing.

The principles of operation of selectable surface wave filters have been discussed previously.[1] The first experimental confirmation of the basic concepts included the design and test of two-state switchable transducers and related electronic switching. Subsequently, the selection of specific channels from a much larger set of available bandpasses by acoustically coupling successive different periodic responses was demonstrated with prototype devices.[2]

In this presentation, the synthesis of more than 100 bandpass responses of varying center frequency and varying bandwidth with nominally 20 transducers and only nine transducer masks is described. The frequency range covered by this unit is 300 to 400 MHz with output channel widths of 1, 3, 9, and 27 MHz. The results of this development and alternative applications for these techniques and devices are detailed.

References

1. C. S. Hartmann, "Variable Bandwidth - Variable Center Frequency Surface Wave Bandpass Filter," 1972 IEEE Ultrasonics Symposium Proceedings, Cat. #72 CHO 708-8SU (October 1972), pp. 211-214.

2. R. M. Hays, R. C. Rosenfeld, and C. S.Hartmann, "Selectable Bandpass Filters--Multichannel Surface Wave Devices," 1973 IEEE Ultrasonics Symposium Proceedings, Cat. #73 CHO 807-8SU (November 1973), pp. 456-459.

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