Duplexer Delivers Low Loss at PCS E-block Frequencies

The Technical Requirements For Duplexers Are More Stringent Now Than Ever.

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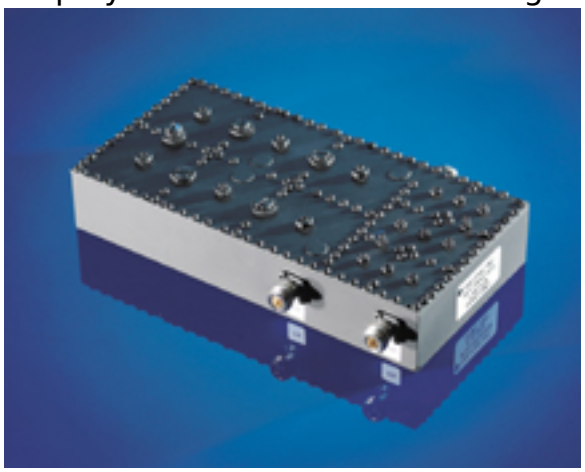
A new series of dielectric resonator/combline duplexers from Trilithic, exceed the minimum performance criteria required to serve the North American PCS E-block frequencies they serve, while remaining competitive in price. The combination of a dielectric resonator filter for the transmit line and coaxial combline filter with a classic Chebyshev response for the receive line provides unique benefits that neither type could alone achieve.
The E-88 Series of duplexers have been a fundamental component for communications systems for nearly as long as they have existed. However, their use has become more and more widespread in direct proportion to the need for spectral purity dictated by increasing spectrum congestion. The lowest possible insertion loss and highest out-of-band rejection are essential ingredients for service in these networks. The technical requirements for duplexers are more stringent now than ever, especially in the PCS bands, where the digital modulation schemes employed demand filters with high near-band rejection.



In the new filters, a narrowband dielectric resonator filter is used on the transmit side because it provides both very low passband insertion loss and very high near-band rejection. A combline filter is used because the receive filter specification is very wideband.

A Competitive Environment

The duplexers compete with other bandpass filters designed in the three most viable technologies:
&#149Combline filters
&#149High-temperature superconducting (HTS) filters

&#149Dielectric resonator filters

All three types have positive and negative attributes that define their performance. Combline cavity filters are the most popular because they are comparatively inexpensive to manufacture and can develop unloaded quality factors (Qu) of 2000 to 9000. This produces highly selective resonances with low passband insertion loss and high rejection. Typical combline filter performance at PCS frequencies includes fractional bandwidths of typically 0.5 to 5.0 %, insertion loss of 1.5 dB or less, and out-of-band rejection of at least 60 dB, and the best spurious suppression of the three filter types. They can usually handle input power up to 1 kW depending upon customer requirements.

HTS filters have generated considerable publicity because of their &quotgee-whiz&quot technology and their potential to deliver Qu's well in excess of that deliverable by any other technology. However, Trilithic has matched most of these performance benchmarks, including Qu of greater than 50,000, without the use of superconductivity (see sidebar).

Trilithic E-88 duplexer performance: Actual vs specification

	Customer specification (dB)	Measured (dB)
Receive passband		
(1885 to 1890 MHz)		
Return loss		
Input	18	23
Output	18	23
Insertion loss	1.5	0.67
Rejection	60	104
(1964 to 1971 MHz)		
Tx/RX isolation		
1885 to 1890 MHz	90	102
1964 to 1971 MHz	90	106
Transmit passband		
(1960.5 to 1969.5 MHz)		
Return loss		
Input	18	25
Output	18	24
Insertion loss	1.5	0.81
Rejection		
100 to 1890 MHz	60	96
1892 to 1964 MHz	15	21
1971 to 2100 MHz	15	21

The E-88 duplexers combine the desirable characteristics of both dielectric resonator filters (for transmit) and combline cavity filters (for receive) to deliver performance that is equal to or better than the specifications it was designed to meet (Figure 1). The filters have an unloaded Q up to 25,000, and fractional bandwidth between 0.1 and 2.0 %. The duplexers operate over temperatures of &#150 55 to 80 &#176 C with average power levels exceeding 1 kW. The measured receive-side insertion loss in the receive passband of 1885 to 1890 MHz is less than 0.67 dB, with rejection of at least 102 dB. Transmit-side insertion loss is 0.81 dB, and rejection from 100 to 1892 MHz is 96 dB.

These duplexers are competitive in size and weight with designs using other techniques, and are considerably smaller than HTS filters, while delivering low insertion loss and high near-band rejection required for E-block PCS service.

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