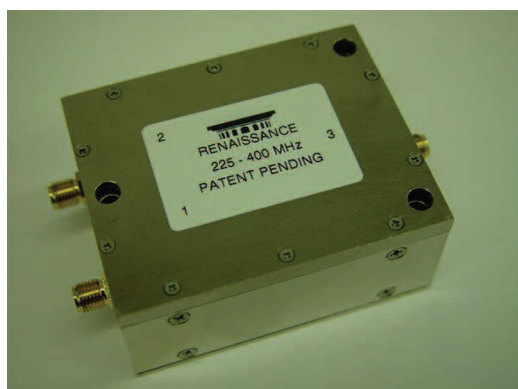


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A BROADBAND CIRCULATOR COVERING 225 TO 400 MHz

One of the crucial components that limits the bandwidth in a communication system tends to be the circulator that duplexes the transmit and receive circuits from the antenna. A new high-power broadband lumped-element circulator has been developed by Renaissance Electronics Corp. (model number 3A2BA) that operates over a nearly full octave bandwidth. The operating frequency of this circulator is from 225 to 400

MHz and exhibits low insertion loss, high return loss and isolation over temperature. It utilizes a patent-pending design that preserves the symmetry between the ports while maintaining very broadband performance. This broad frequency range aids in expanding the number of channels both in the uplink and downlink spectrum.

WIDEBAND PERFORMANCE

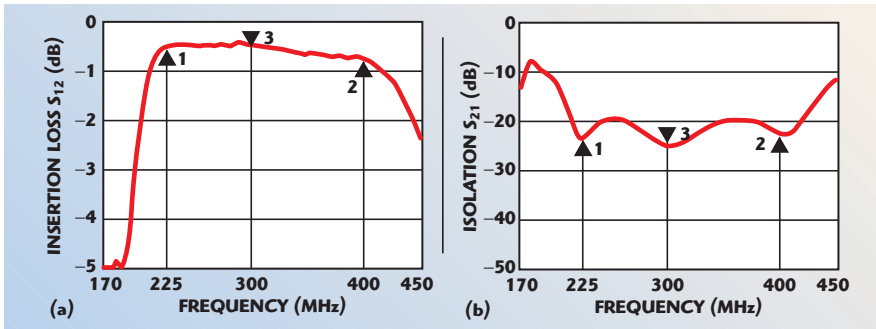
The typical electrical performance of the model 3A2BA circulator is summarized in **Table 1**. The housing of the circulator was designed using aluminum as base material to provide required mechanical integrity while optimizing weight and heat dissipation. This feature makes the design attractive for high-power space and flight applications. The lumped-element circuitry uses a structure that allows the RF power to be spread more evenly over the entire ferrite surface area. Thus, the unit is capable of low insertion loss and improved heat dissipation and can handle up to 60 W of CW power. The stable temperature performance of the 3A2BA circulator over the -40° to $+85^{\circ}\text{C}$ temperature range is a result of

TABLE I

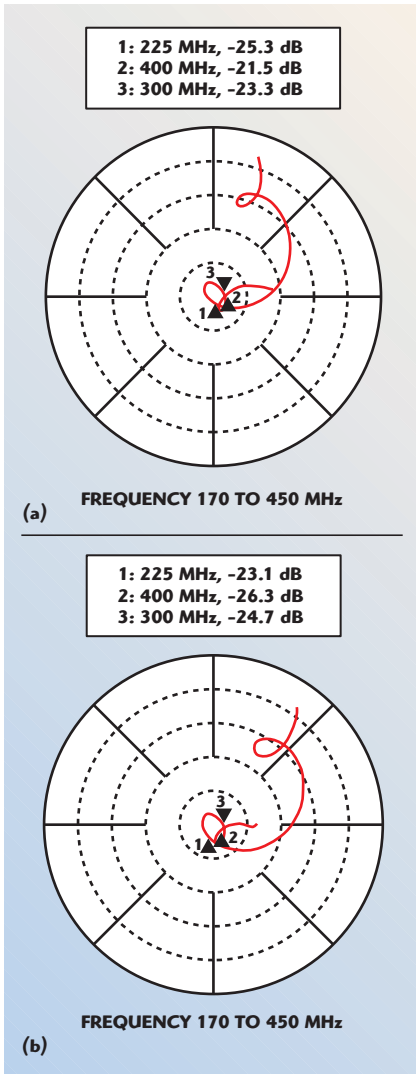
PERFORMANCE CHARACTERISTICS

Temperature ($^{\circ}\text{C}$)	-40	+25	+85
S_{11} , S_{22} , S_{33}	-16	-19	-17
S_{12} , S_{23} , S_{31}	-0.65	-0.75	-1.00
S_{21} , S_{32} , S_{13}	-16	-19	-17

RENAISSANCE ELECTRONICS CORP.
Harvard, MA



▲ Fig. 1 Insertion loss (a) and isolation (b) performance.



▲ Fig. 2 Impedance characteristics; S_{11} (a) and S_{22} (b).

ferrite with temperature. **Figure 1** shows the insertion loss and isolation characteristics of the device over its operating band; **Figure 2** displays the circulator's input and output impedance characteristics.

In addition to the strong mechanical design of the circulators, the connectors and cover are electrically sealed to the body of the housing to reduce the RF radiation leakage to below -100 dBc. Also, the second harmonic level is less than -60 dBc.

The rugged mechanical construction of the housing and its electronic circuitry assures that the circulator can sustain mechanical shock and vibration levels in accordance with current military standards, thus making the part suitable for airborne applications.

CONCLUSION

A new rugged series of high power, broadband circulators has been described that provides low insertion loss and improved heat dissipation over a near octave bandwidth, thereby offering to expand uplink and downlink communication performance and permit the use of a common receive and transmit antenna. The new circulators are designed to operate from 225 to 400 MHz and are capable of handling up to 60 W of CW power with low RF leakage and low harmonic output. Additional information may be obtained from the company's Web site.

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carefully balancing the magnetic flux of a biasing magnet with the variation of the saturation magnetization of the