High-Aperture-Efficiency Horn Antenna

Major design features are a hard (in the electromagnetic sense) boundary and a cosine taper.

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A horn antenna (see Figure 1) has been developed to satisfy requirements specific to its use as an essential component of a high-efficiency Ka-band amplifier: The combination of the horn antenna and an associated microstrip-patch antenna array is required to function as a spatial power divider that feeds 25 monolithic microwave integrated-circuit (MMIC) power amplifiers. The foregoing requirement translates to, among other things, a further requirement that the horn produce a uniform, vertically polarized electromagnetic field in its aperture in order to feed the microstrip patches identically so that the MMICs can operate at maximum efficiency.

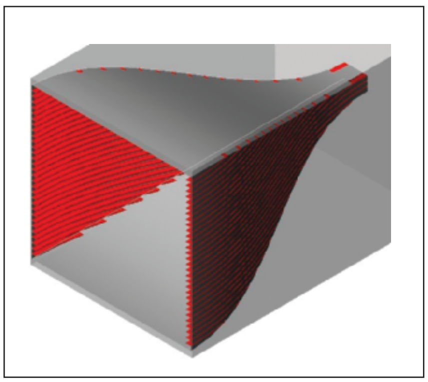

Figure 1. This **Horn Antenna** features cosine-tapered corrugation that imparts desired impedance characteristics.

The horn is fed from a square waveguide of 5.9436-mm-square cross section via a transition piece. The horn features cosine-tapered, dielectric-filled longitudinal corrugations in its vertical walls to create a hard boundary condition: This aspect of the horn design causes the field in the horn aperture to be substantially vertically polarized and to be nearly uniform in amplitude and phase.

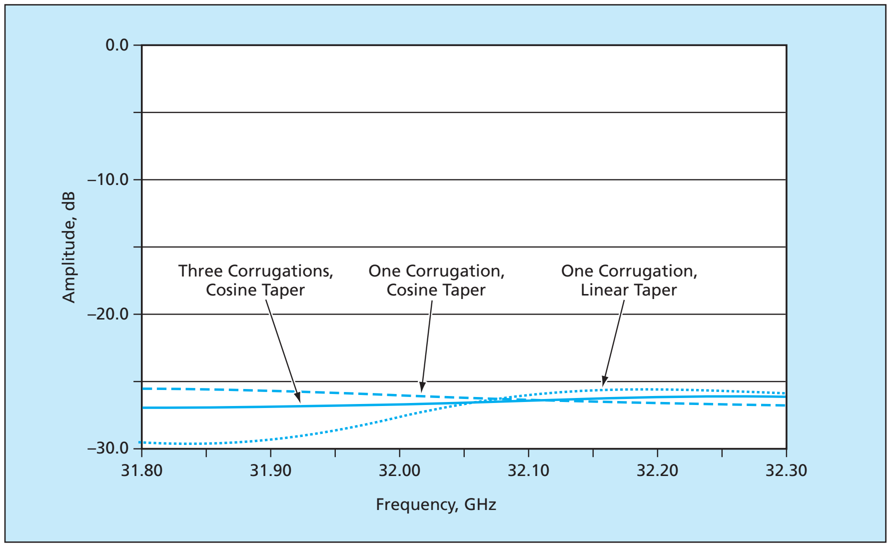

Figure 2. The **Computed Input Reflection Coefficient** in the desired electromagnetic mode was found to be more nearly constant with frequency for the cosine-taper designs than for the linear-taper design. The maximum depth of the taper [73 mils (1.85 mm)] is the same in all three designs.

As used here, "cosine-tapered" signifies that the depth of the corrugations is a cosine function of distance along the horn. Preliminary results of finite-element simulations of performance have shown that by virtue of the cosine taper the impedance response of this horn can be expected to be better than has been achieved previously in a similar horn having linearly tapered dielectric-filled longitudinal corrugations.

It is possible to create a hard boundary condition by use of a single dielectric-filled corrugation in each affected wall, but better results can be obtained with more corrugations. Simulations were performed for a one- and a three-corrugation cosine-taper design. For comparison, a simulation was also performed for a linear-taper design (see Figure 2). The three-corrugation design was chosen to minimize the cost of fabrication while still affording acceptably high performance. Future designs using more corrugations per wavelength are expected to provide better field responses and, hence, greater aperture efficiencies.

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Full-Circle Resolver-to-Linear-Analog Converter

This circuit costs less and is less susceptible to error.

Marshall Space Flight Center, Alabama

A circuit generates sinusoidal excitation signals for a shaft-angle resolver and, like the arctangent circuit described in the preceding article, generates an analog voltage proportional to the shaft angle. The disadvantages of the circuit described in the preceding article arise from the fact that it must be made from precise analog subcircuits, including a functional block capable of implementing some trigonometric identities; this circuitry tends to be expensive, sensitive to noise, and susceptible to errors caused by temperature-induced drifts and imprecise matching of