MATCHED, DUAL MODE SQUARE WAVEGUIDE CORNER

P. K. PARK, R. L. EISENHART, S. E. BRADSHAW

HUGHES AIRCRAFT COMPANY
CANOGA PARK, CALIFORNIA 91304

ABSTRACT

A design method for matching a square waveguide right angle corner for both E & H-plane (TE_{10} and TE_{01} modes) operation is presented. Results show VSWR <1.05 for 1.0 GHz bandwidth at X-Band with mode-to-mode isolation >30 dB.

INTRODUCTION

Square waveguide is often used for a dual-polarization application because it can support two orthogonal modes (TE_{01} and TE_{10}) with the identical phase velocity. Such an application requires waveguide bends to construct a square waveguide system. A right angle bend or corner is the most severe and represents the most difficult case to design. See Figure 1 for definition of terms. The conventional mitered corner (fixed L, see Figure 1) offers a good match for one mode, however, that identical mitered corner would give poor performance for the other. This paper explains a technique which results in good performance for both modes.

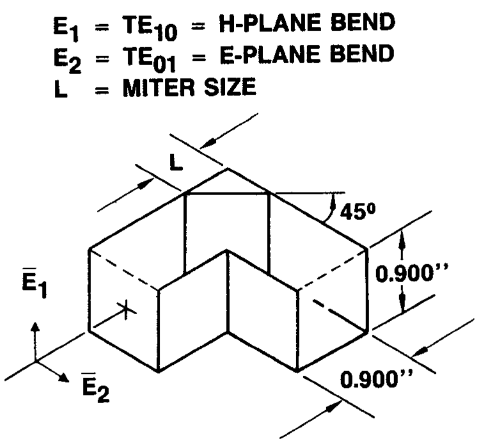

FIGURE 1. Square Corner Description

DESIGN APPROACH

The design philosophy was based upon the conventional mitered corner. That is, for a given frequency, there is a mitered size (L) which is well matched for a given mode (TE_{10} or TE_{01}). See Figure 2.

Figure 2 shows representative match data versus frequency for both E-plane and H-plane operation with the appropriate values of L to match at 7.95 GHz. Also shown are the accompanying results for the non-matched mode in each case.

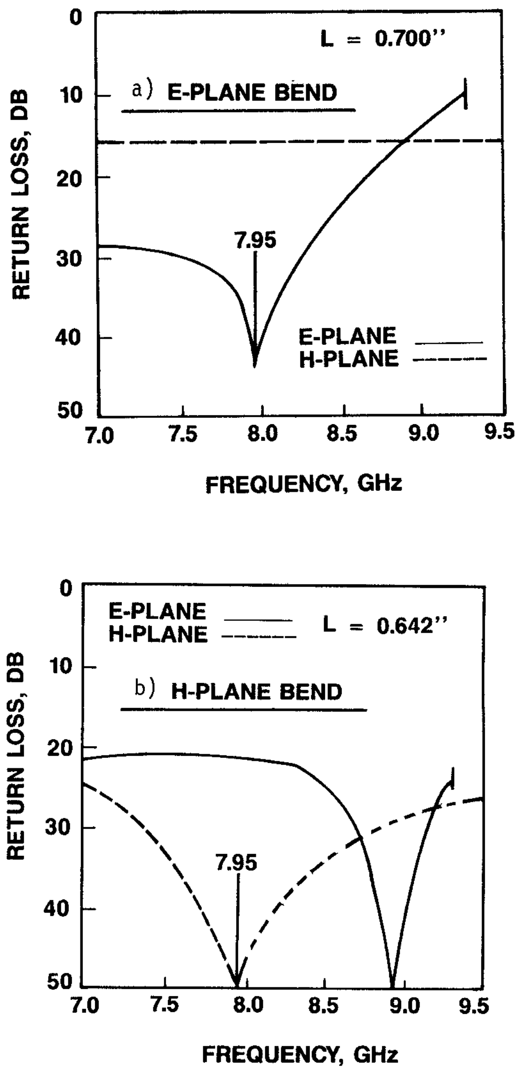

FIGURE 2. Typical Match Characteristics for a Square Waveguide Mitered Corner

0149-645X/86/0000-0155$01.00 © 1986 IEEE

Measurements taken with a range of L values allows the establishment of two empirical design curves, (shown in Figure 3) which represent the optimum L dimension versus frequency for each mode. Note that the L values for the E-plane (TE_{01}) bend are always larger than those for the H-plane (TE_{10}). Consequently, a given value of L cannot provide a match for both modes simultaneously.

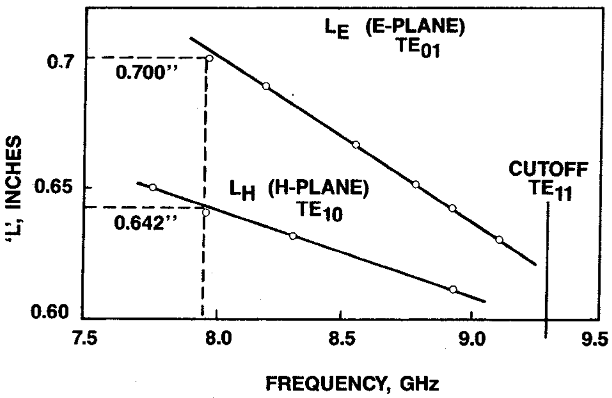

FIGURE 3. Experimental Design Curves

If, however, a reflecting surface were used in the miter which appeared mode dependent in position, then both modes could be matched simultaneously.

At this point, the concept of the polarized mitered corner was introduced. The orthogonality between the two modes allows us to use a polarizer to provide this mode dependence.

By using a flat plate reflector which has added many raised ridges oriented parallel to the E-field of the TE_{01} mode, the effective shorting plane will be coincident with the ridge tops. The other mode, which will have the E-field perpendicular to the ridges, will be little influenced by the ridges and the effective shorting plane will be approximately the original flat plate surface.

This produces the effect of L_E for the TE_{01} mode being larger than L_H for the TE_{10} mode. The experimentally established values for L in Figure 3 can then be used to design the reflecting surface.

Figure 4 shows the match for such a polarized reflecting corner where L_E = 0.695" and L_H = 0.630". The fact that these values do not match those of Figure 3 @ 7.95 GHz implies that there is a slight amount of interaction, requiring minimal design iteration.

A picture of the corner with the top removed is shown in Figure 5.

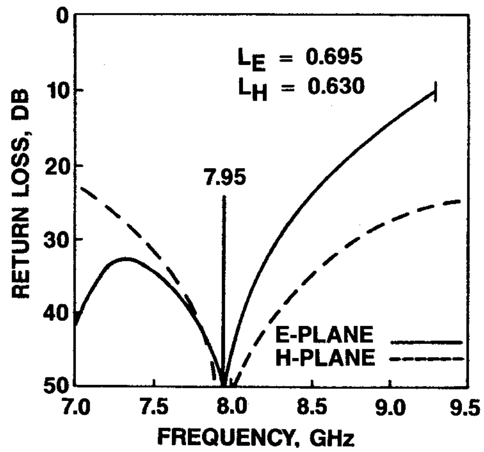

FIGURE 4. Performance of the Matched, Dual Mode Square Waveguide Corner Using a Polarized Miter

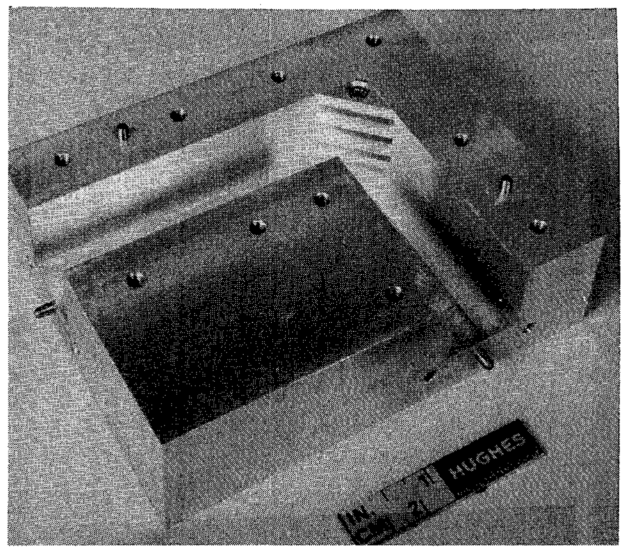

FIGURE 5. Open Test Fixture Showing a Polarized Mitered Corner With a Three Ridge Reflector

EXPERIMENTAL RESULTS

A corner was designed for 7.95 GHz which showed a VSWR <1.05 for both E-plane and H-plane operation over a band of approximately 1.0 GHz. Cross-polarization isolation was typically 30 dB across the 7 to 9.6 GHz band.

CONCLUSIONS

A technique was demonstrated which provides a design for dual-mode operation of a square waveguide through a 90° corner. This approach is applicable to lesser bends as well, allowing the use of square waveguide for dual-mode operation in complex waveguide runs. Other aspects of the design will be included in the presentation.