Circularly Polarized Compact Range Feed with 30 dB Polarization Isolation

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***Abstract*—We have developed a dual polarized compact range feed with a cross-polarization level of -30 dB from 10.7 GHz to 13 GHz.**

I. Introduction

While linear polarized waveguide feeds easily achieve cross-polarization values better than -30 dB [1] over their frequency band of operation, circularly polarized feeds, on the other hand, typically reach axial ratios (AR) of 1 dB, corresponding to a value of -25 dB of cross-polarization [2]-[3]. We are presenting the results of the development of a circularly polarized compact range feed design with a measured axial ratio better than 0.55 dB (-30 dB Cross-pol) from 10.7 GHz to 13 GHz.

In section II we present the description of the compact feed design and polarizer, in section III we present the fabricated feed and expected performance, in section IV we present the antenna measurements results and in section V, the conclusions.

II. Compact Range Circularly Polarized Feed

The circularly polarized feed that was developed has a gain of 10 dBi, and a half power beam width (HPBW) of 67^o designed to illuminate a compact reflector test range. We initially considered a septum polarizer feed approach [4] but the cross-polarization bandwidth is narrower than we required, in addition to a high port-to-port coupling, which makes it a non suitable solution for our application. Our compact range feed design is dual polarized with a waveguide-to-circular transformer with a coaxial probe on the back port (RHCP) and a fin-line launcher section and coaxial probe on the side port (LHCP).

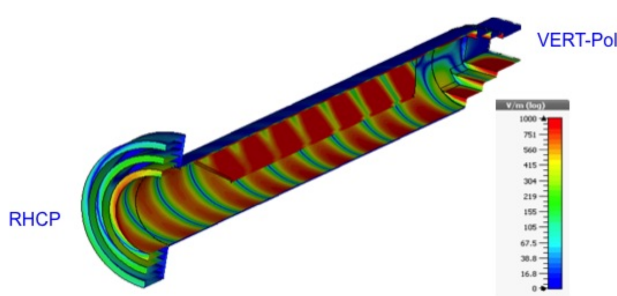

Fig. 1. Conversion from vertical linear polarization to RHCP fields when they pass through the waveguide polarizer section to the aperture of the feed in CST simulation at 12 GHz.

A. Waveguide 90^o Phase Shifter

The conversion from linear to circular polarization is obtained by the use of a Rexolite slab 0.76 mm thick placed at 45^o between the vertical and horizontal polarization directions in the circular waveguide, and a length adjusted to provide a 90^o phase shift at the frequency of interest between 10.7 GHz to 13 GHz, as shown in Figure 1.

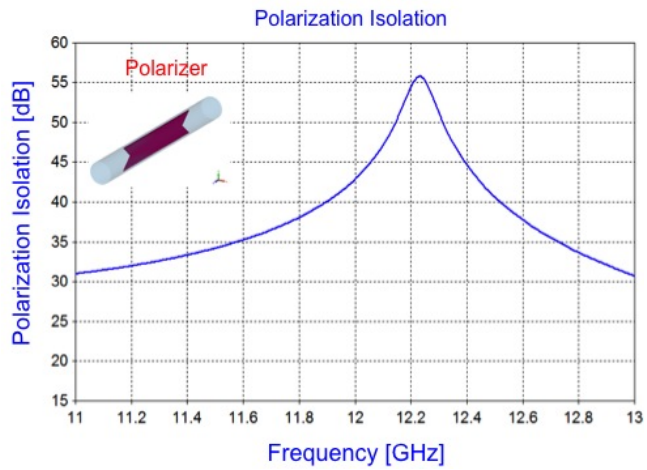

Fig. 2. 90 deg phase shifter design: Calculated polarization isolation of the Rexolite polarizer plated in CST

Figure 2 shows the optimized polarization isolation response of the phase shifter design in CST microwave Studio., indicating an expected polarization isolation better than 30 dB across the frequency band.

III. The Fabricated Feed

We fabricated a dual port circularly polarized compact range feed, with a band of operation from 10 GHz to 15 GHz, (See Figure 3). The feed has a feed-choke to equalized the gain response across the frequency band.

In Figure 4 we show the calculated far field performance in terms of co-polar directivity and on axis cross-polarization level of the compact range feed. The figure also includes a -30 dB cross-polarization sub-band specification within the 10 GHz to 15 GHz band.

IV. Measurements

We measured the feed input match and far field radiation patterns of the feed in an antenna range in our facilities to verify its performance. The measured VSWR is better than

Fig. 3. Fabricated dual port, circularly polarization compact range feed from 10 GHz to 15 GHz.

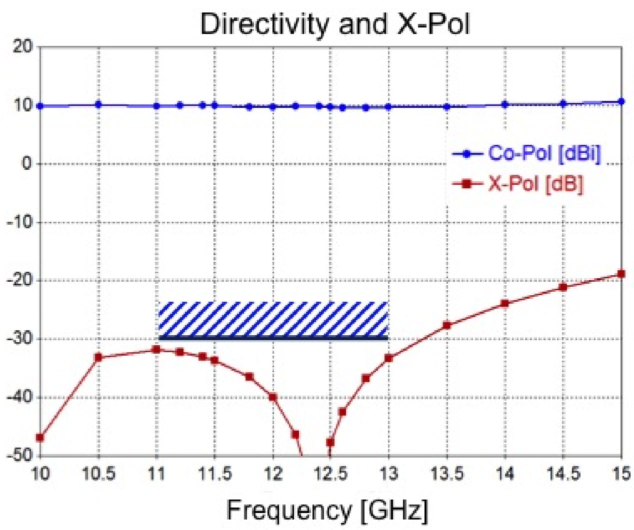

Fig. 4. Calculated directivity (blue circles) and cross-polarization (red squares) of the circularly polarized compact range feed design, indicating the frequency band of interest for the cross-polarization response.

1.5:1 for the back port and better than 1.65:1 for the side port respectively across the frequency band as shown in Figure 5.

The measured cross-polarization response of the compact range feed as a function of frequency is shown in Figure 6. The cross-polarization < -30 dB extends down to 10.7 GHz and up to 13 GHz. At 13 GHz the RHCP port cross-pol is better than -30 dB while the LHCP port cross-pol response is -29 dB.

V. Conclusions

We have developed a dual port circularly polarized compact range feed from 10 GHz to 15 GHz with a gain of 10 dBi and a on axis cross-polarization better than -30 dB across the band of interest from 11 GHz to 13 GHz, and an input VSWR better than 1.65:1 across the band.

ACKNOWLEDGEMENT

I would like to thank Fernando Nelson for the antenna range measurements and in particular for his help while I was fine tuning the polarizer length in the antenna range.

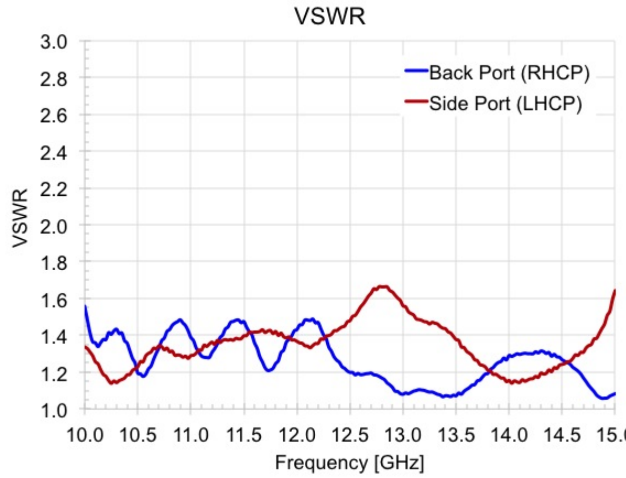

Fig. 5. Measured compact range feed input VSWR.

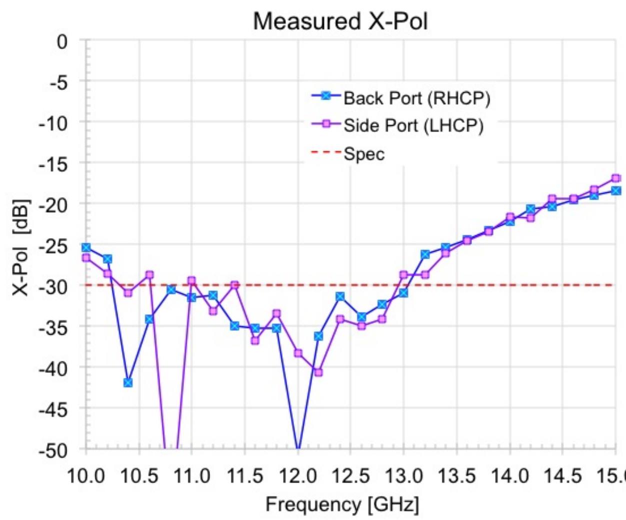

Fig. 6. Measured circularly polarized compact range feed cross-polarization response.

References

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