

To: Sandy Weinreb
From: William A. Imbriale

Subject: Wideband feed performance on DSS-28

In response to your request I have computed the performance difference between a Chalmers type wideband feed at the prime focus point and the feed in a dual-shaped Cassegrainian system. This memo details some of the considerations and contains the performance predictions.

In order to compute the gain of the reflector system an estimate of the feed pattern is required. Using the measured patterns of Figure 1 supplied by Sandy Weinreb, a very simplistic estimate of the form $E(\theta) = \cos(\theta)^{**}Q$ with $Q = 2.3$ was used for the pattern at all frequencies. Figure 2 compares the average pattern of Figure 1 with the cosine pattern. Since this pattern does not contain the phase information, cross-pol or backlobe the directivity estimates for performance will be optimistic. However, the performance difference between the two systems (prime focus and Cassegrain) should be valid.

The illumination of the reflector from the prime focus feed is shown in Figure 3. As can be seen from the plot, the wideband feed significantly under illuminates the reflector. Allowing about 1.5 dB for unaccounted for losses in the feed patterns the efficiency is 35% over the entire frequency band.

Using the assumed feed pattern a dual shaped Cassegrainian system with a 3 meter subreflector was designed and shown in Figure 4. At 5 GHz the main and subreflector illumination is shown in Figure 5. Allowing the same 1.5 dB feed loss, the efficiency at 5.0 GHz is 66%. Thus the dual system is 2.8 dB better than the prime focus configuration. It is anticipated that this difference will be pretty much constant over the entire frequency band.

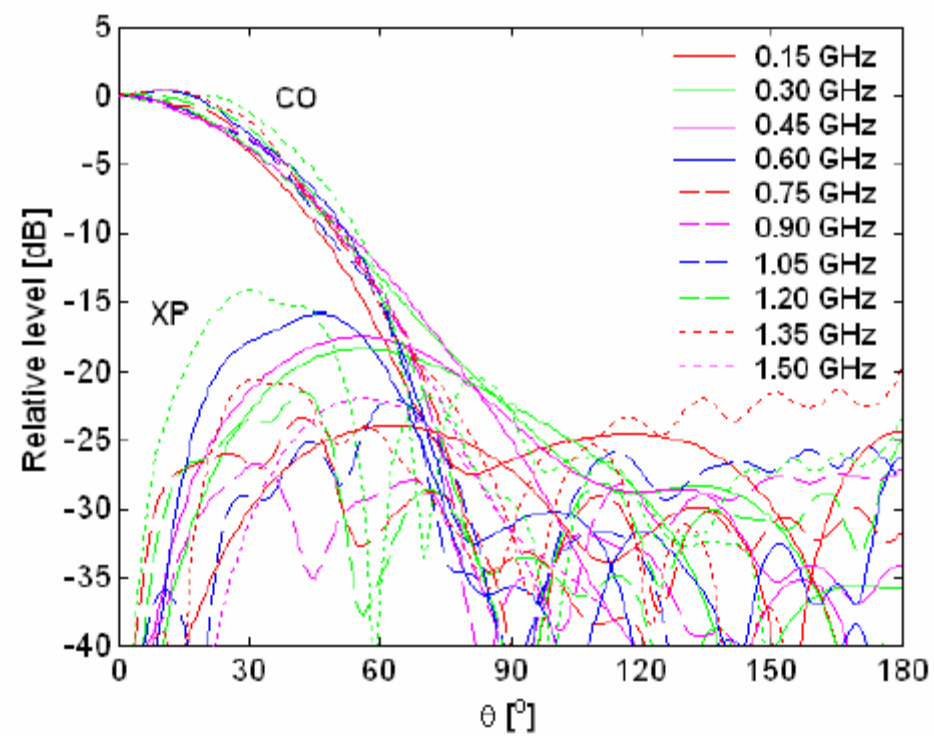


Figure 1. Patterns of Chalmers feed as a function of frequency

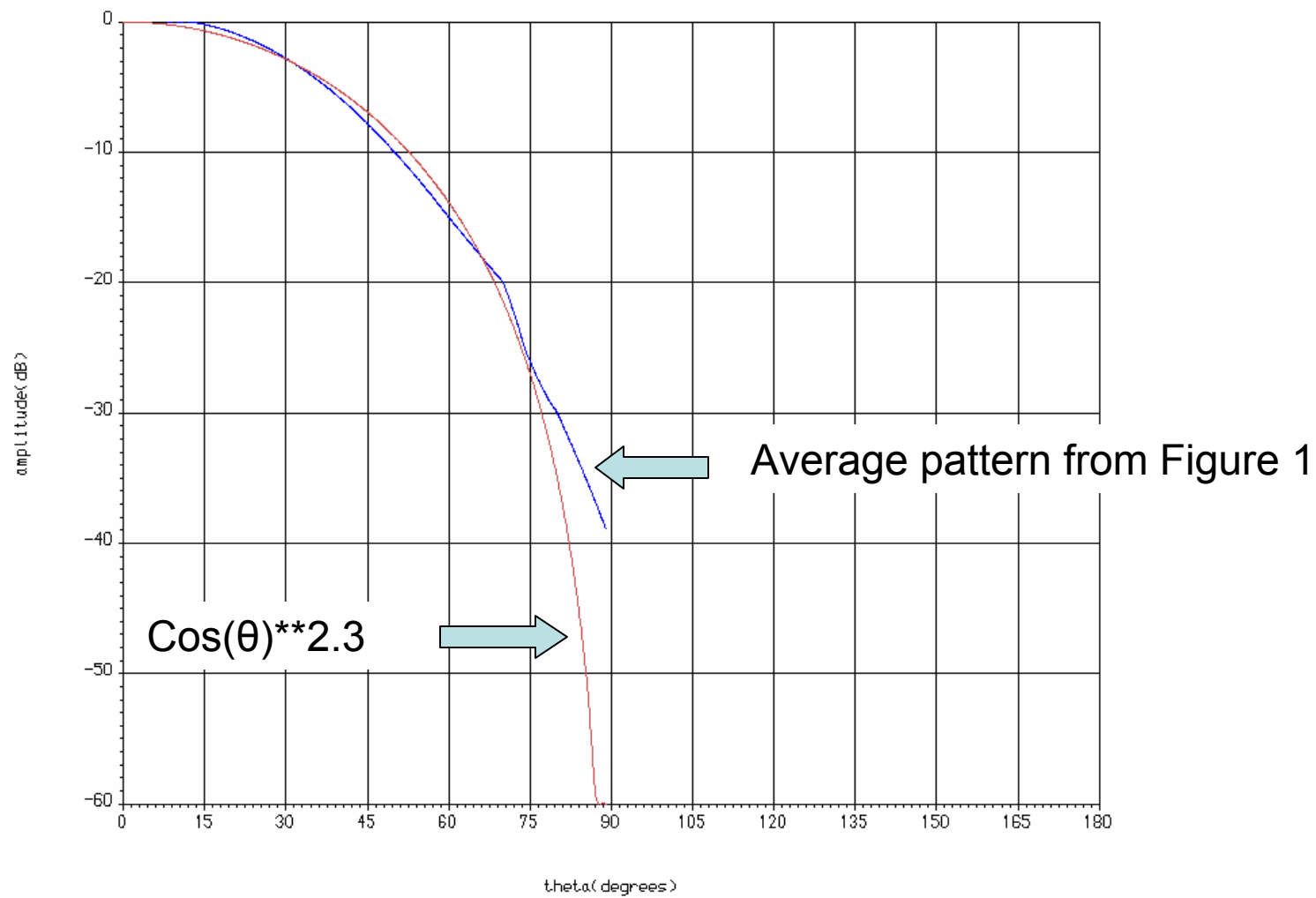


Figure 2. Cosine pattern comparison with average pattern

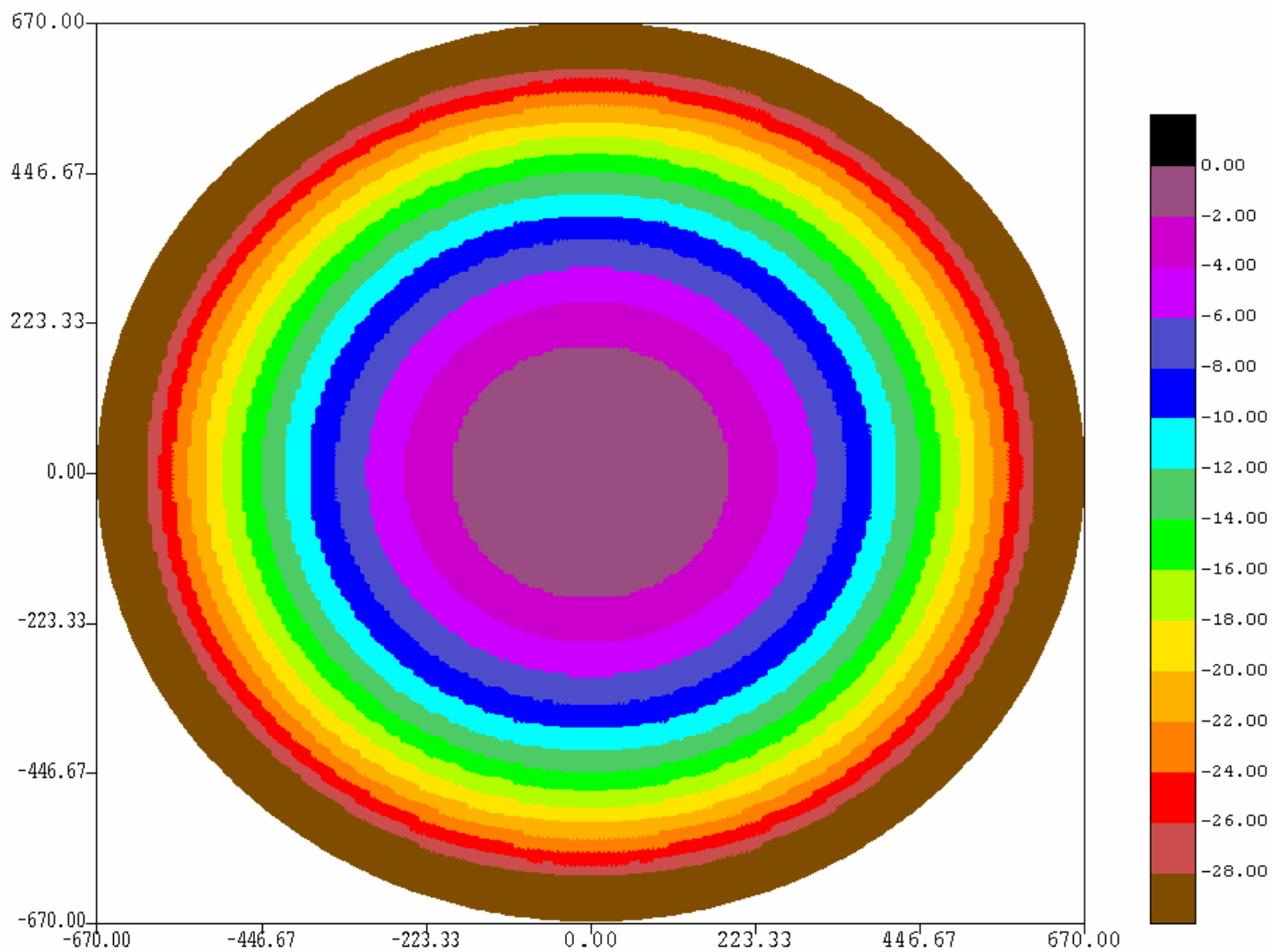


Figure 3. Prime focus illumination of main reflector

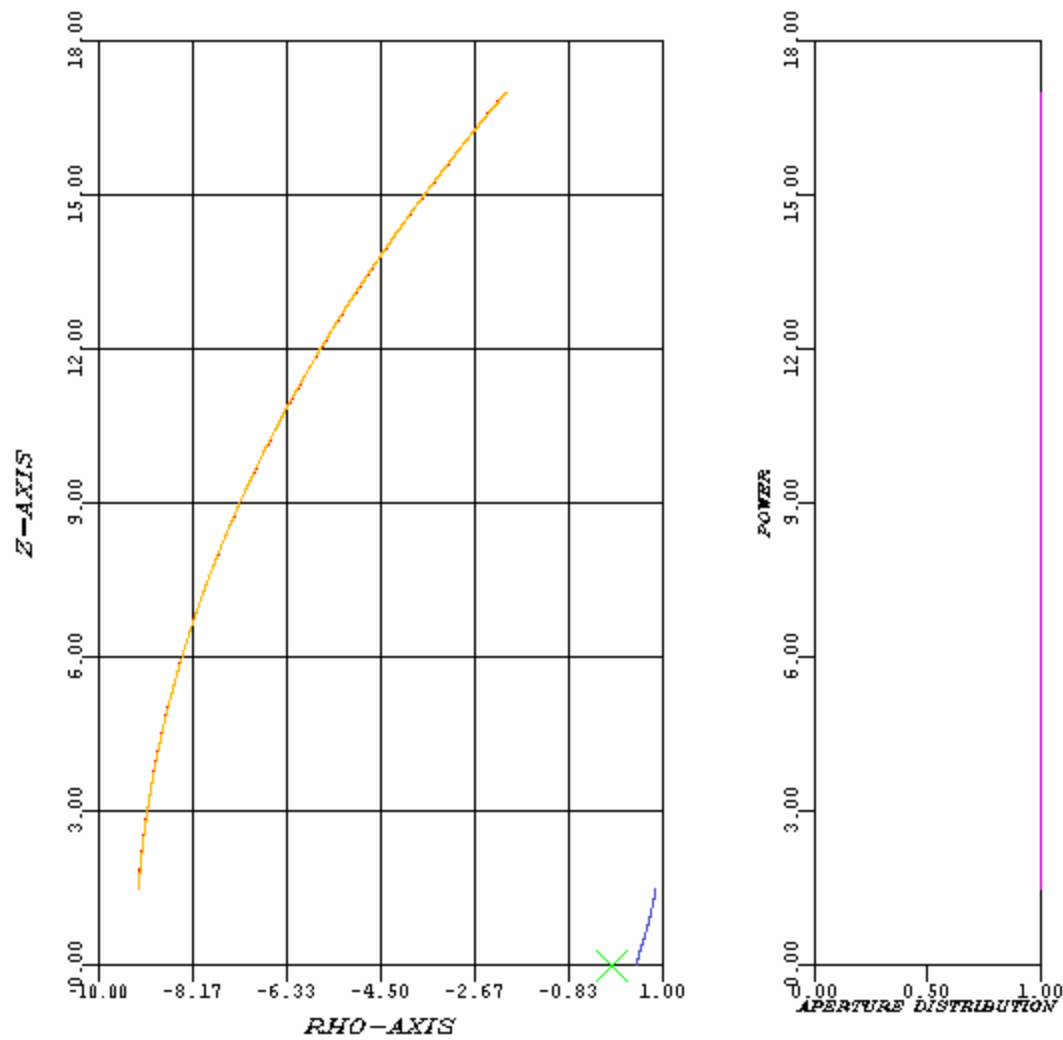


Figure 4.0 Dual reflector configuration (dimensions in meters)

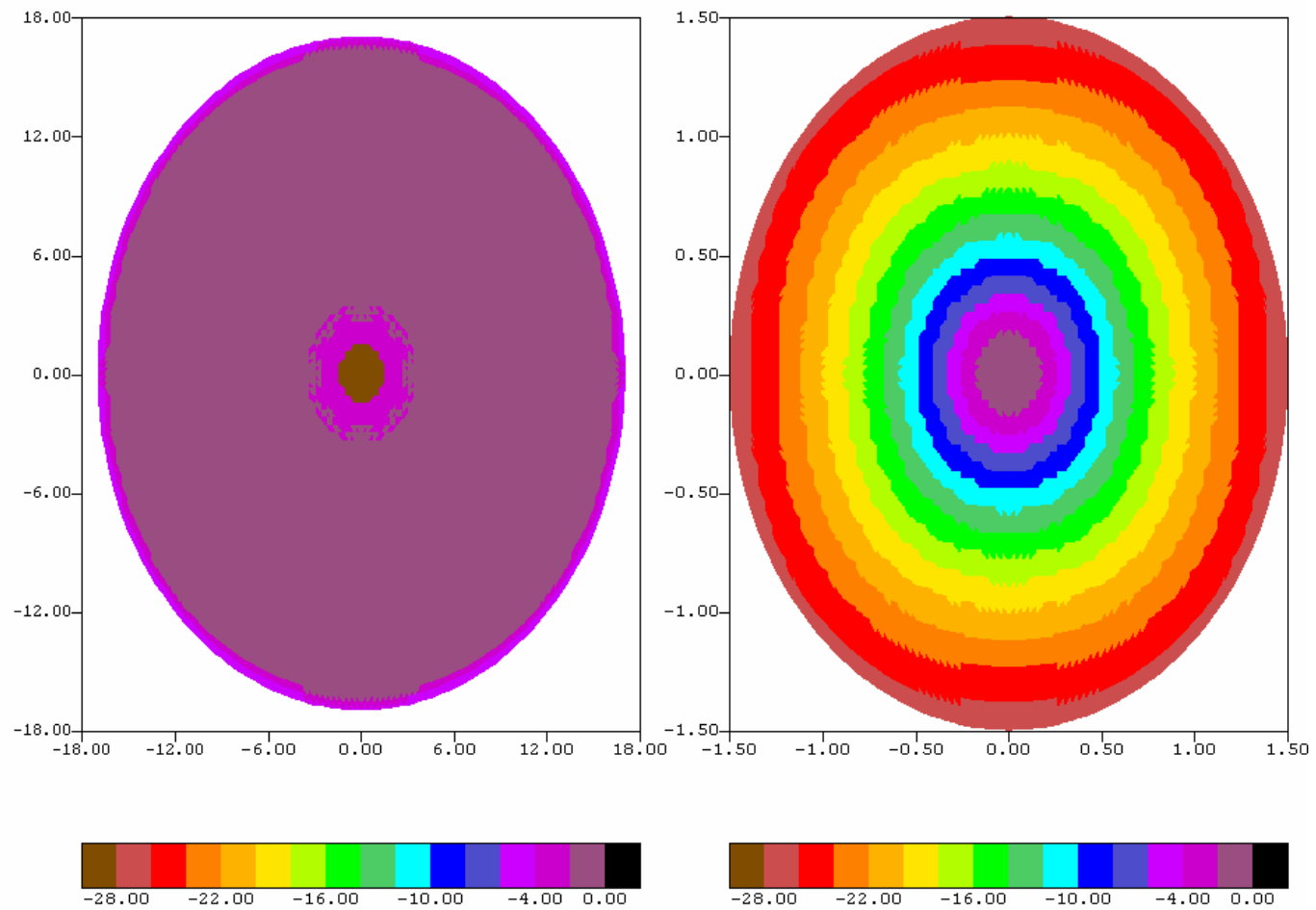


Figure 5.0 Aperture illumination for main and subreflector at 5 GHz.