PERFORMANCE RESULTS OF EM COMPONENTS

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Feed:

In order to build an array with small beam spacing, the KFPA receiver will use compact corrugated horns. The horn has a continuously changing inside taper, usually a cosine profile that makes the aperture smaller by about 30% compared to that of a linear taper horn. The outside diameter of the KFPA horn is 3.4". Close packing of these horns results in a beam spacing of 2.7 HPBWs between adjacent elements at 22 GHz. Measured far-field patterns are in excellent agreement with theory and an example is shown in Figure 1.

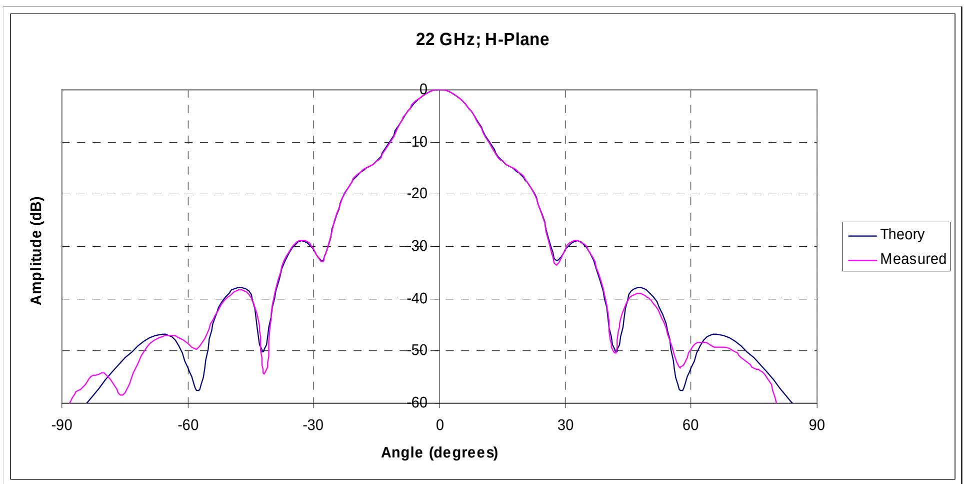
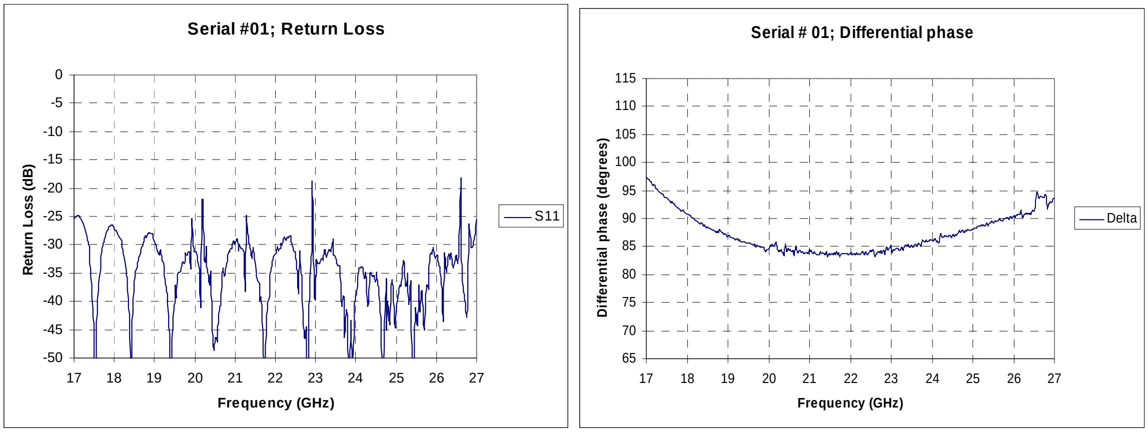


Figure 1. Measured pattern and theory at 22 GHz; H-plane

Using the measured feed patterns of the KFPA feed and that of the narrow band linear taper feeds of the first generation K-band receiver, aperture efficiencies were calculated. The KFPA feed has efficiencies of 0.6560 and 0.6050 at 20 GHz and 24 GHz, respectively. At 20 GHz, the 18-22 GHz feed has an aperture efficiency of 0.7283. The 22-26.5 GHz feed has an efficiency of 0.6669. At these frequencies, the efficiency of the compact horn is about 9% lower compared to that of the linear taper horns.

Phase Shifter:

The phase shifter used on this receiver was developed for the EVLA K-band system. The phase shifter has corrugations on all the four walls of the nearly square waveguide. Aluminum mandrel, a copy of the inside, is first machined and then copper is grown on the mandrel by electroform process. After machining the outside, flanges are soldered and then the aluminum is etched away. A batch of 10 phase shifters is in the production pipeline after the initial three. Measurement done on Serial #01 is shown in Figure 2.



(a) Return loss **(b) Differential phase shift**

Figure 2. Measured results on Serial #01

Ortho Mode Junction:

The ortho mode junction (OMJ), which is based on the Boifot junction, was also developed for the EVLA. The OMJ has two machined sections that are bolted together after the beryllium copper septum and the pins are set in place. The OMJs for the EVLA receivers were machined out of leaded brass. Considering the number of elements on the KFPA receiver, it was decided to manufacture the OMJs out of aluminum which would result in substantial weight reduction. Figure 3 shows the OMJ machined out of aluminum. The measured insertion loss and input return loss of the side arm are shown in Figure 4. The performance of the aluminum OMJ is no different from that of OMJs machined out of brass.

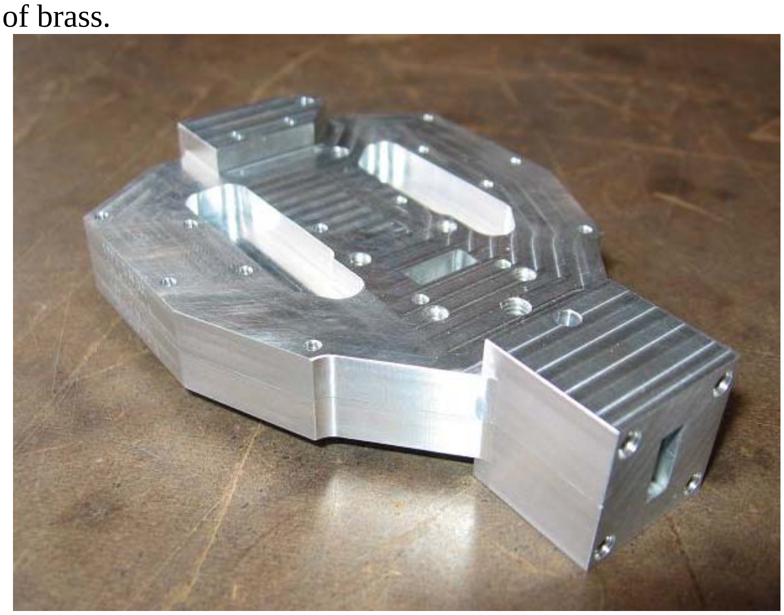
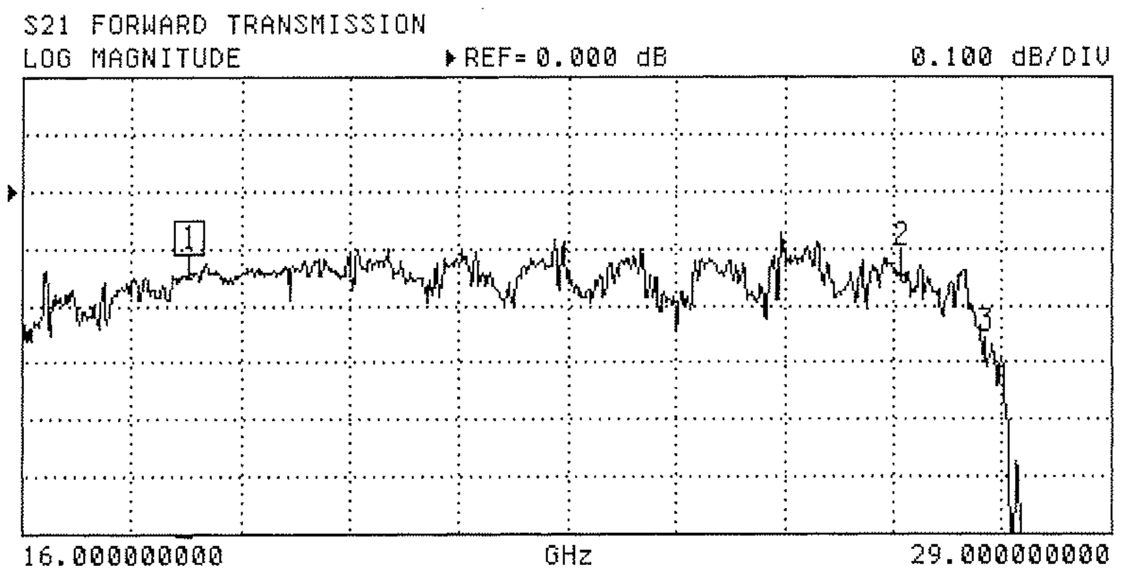
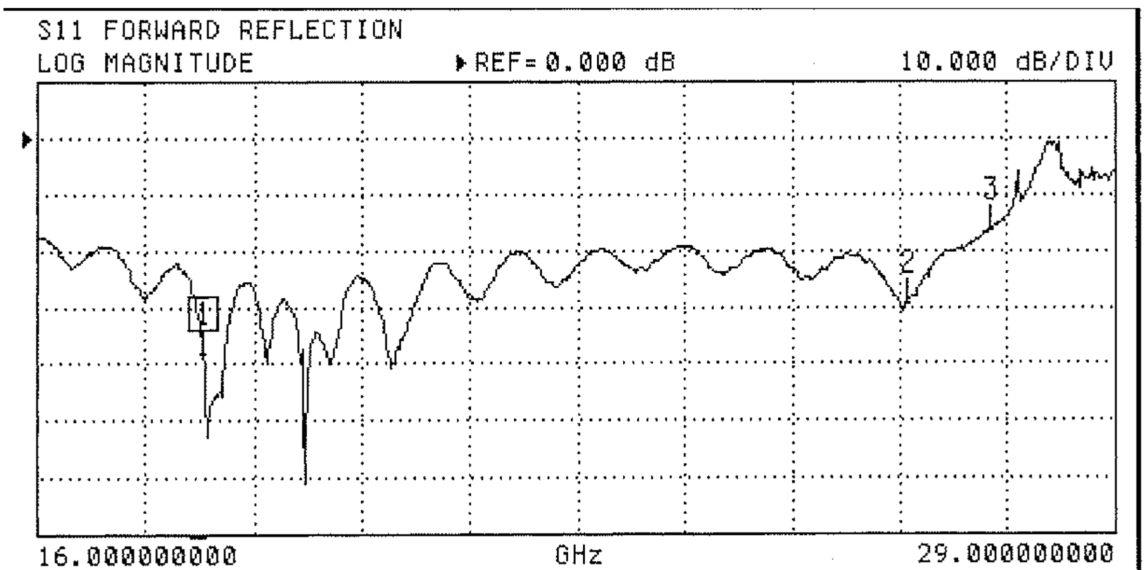


Figure3. Aluminum OMJ



(a) Insertion loss through side arm



(b) Input return loss measured at the side port

Figure4. Measured S-parameters of the aluminum OMJ