Selectable Polarization at X-Band

R. W. Hartop
Radio Frequency and Microwave Subsystems Section

The X-band feeds in the DSN are being upgraded to include selectable polarization in time for the Voyager missions to the outer planets.

I. Introduction

The 64-meter antenna stations of the DSN are equipped with X-band receiving (XRO) cone assemblies (Ref. 1). The X-band feed within the cone operates through the dichroic plate in conjunction with the S-band polarization diverse (SPD) cone assembly. The X-band feed has been required to provide right-hand circularly polarized (RCP) reception only. The entire feed structure is easily removable from the cone assembly as a unit, and provision was made in the original mechanical design to facilitate future upgrades such as the present one.

II. XRO Feed Mod II

Figure 1 shows the Mod II X-band feed which will replace the existing feed. Two complete assemblies have been fabricated and will be implemented at DSS 14 and DSS 43 during the second and third quarters of 1977. One of the original feeds from these stations will be rebuilt with new parts added to provide the third unit at DSS 63 for implementation in the fourth quarter.

Compared to the original feeds, the Mod II feed has the following major items added: two circular waveguide rotary joints, drive motor and gear reducer, gear assembly, two microswitches, and a polarization control junction box. The overall length of the feed remains the same since circular waveguide spacing sections were designed into the original feed to readily permit such modifications. Thus, there is no significant increase in antenna noise temperature compared to the original feed. Figure 2 is a close-up of the drive gear assembly. The circular steel plate is firmly attached to the lower rotary joint flange (identical to the upper rotary joint visible in the center of the picture) and is precisely stopped at its CW and CCW travel limits by the two blocks that contact the worm gear housing. The large gear is spring-loaded to the drive plate so that motor coast after microswitch activation winds up the gear springs and holds the polarizer securely in position despite antenna movement or vibration. Rotating the polarizer 90 degrees changes the polarization from RCP to LCP or vice versa. The measured ellipticity of the Mod II feed assembly is shown in Fig. 3 over a wide bandwidth. It is less than 0.7 dB over the presently required bandwidth of 8.4 to 8.5 GHz.

Since the mechanism requires about seven seconds to complete its travel, holding relays are incorporated in the junction box to insure that a momentary command from the control room panel results in a complete 90-degree movement and microswitch interlock activation.

Electrically the mechanism functions like a standard DSN waveguide transfer switch. This allows the polarizer to be controlled from a spare receptacle on the cone-mounted switch control junction box. Thus, positions may be assigned for RCP and LCP that correspond to positions 1 and 2 of a waveguide switch, and all indicator and interlock circuits are fully compatible.

III. Summary and Future Work

The Mod II XRO feed assembly that will provide remotely selectable RCP/LCP diversity for Voyager has been described. Transfer, shipment, and installation of the first two units is in progress, and the third and last unit is scheduled for implementation before the end of 1977.

Development work is beginning on a prototype orthogonal mode transducer for a Mod III XRO feed that will permit simultaneous RCP and LCP reception (and future transmission). Because of the mechanical design of the XRO cone assembly and feed, additional upgrades of this kind can be made periodically without difficult cone changes that consume valuable station time.

Reference

1. Hartop, R. W., "X-Band Antenna Feed Cone Assembly," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XIX, pp. 173-175, Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1974.

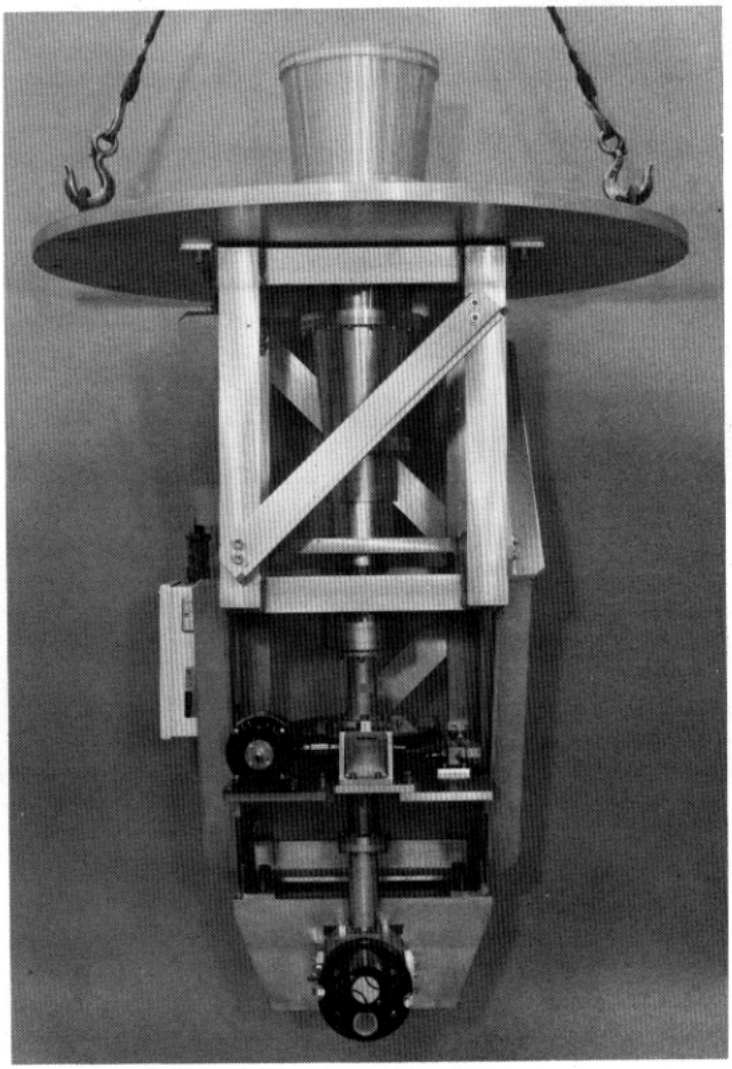

Fig. 1. XRO Mod II Feed Assembly

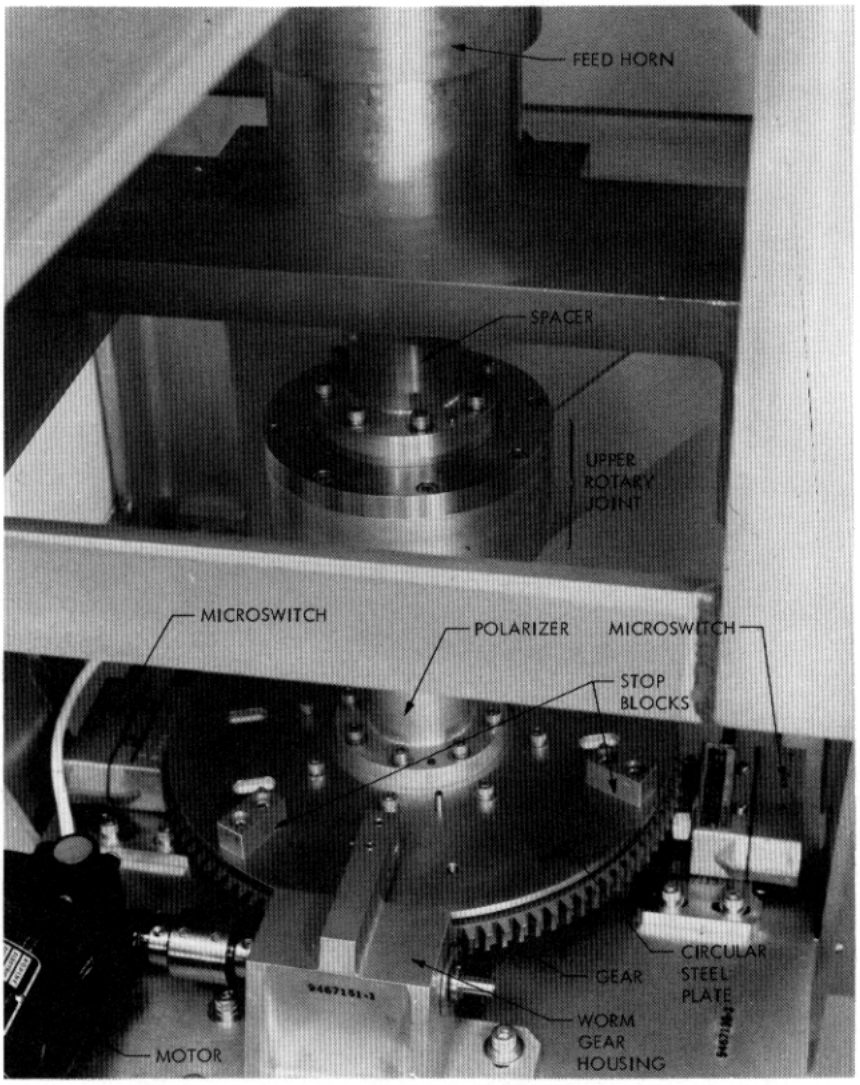

Fig. 2. Polarization drive mechanism

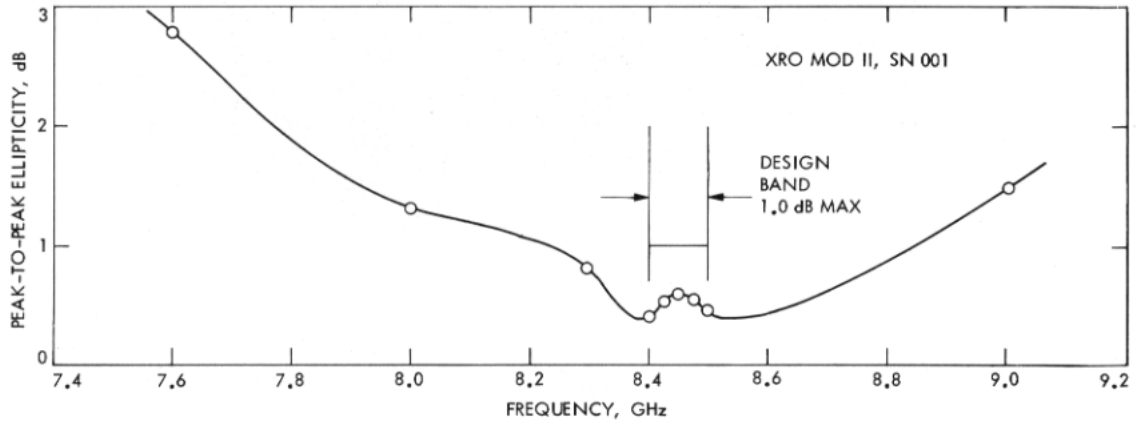

Fig. 3. Feed ellipticity