Microwave Component Time Delays for the 70-Meter Antennas

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The X-band feed assemblies in the 64-meter antennas have been redesigned to accommodate the upgrading to 70 meters and the associated surface reshaping. To maintain time delay data logs, new calculations have been made of the microwave component delays for the XRO Mod IV X-band (8.4 to 8.45 GHz) feed assembly that has been installed at DSS–63, and will soon be implemented at DSS–43 and DSS–14.

I. Introduction

Since the microwave time delays were last calculated for the DSN 64-meter antennas [1], the feed configurations at S- and X-band have remained the same, despite some other changes to the antennas (such as the addition of L-band). But the extension of the antennas from 64 meters to 70 meters and the reshaping of the surfaces to further increase the gain has required that the XRO Mod III X-band feed be replaced.

The Mod III feed [2] was designed to provide more efficient illumination of the 64-meter antennas in time for the Voyager 1 encounter with Jupiter. With the current reshaping of the antenna main reflector and subreflector, the dual hybrid mode feed pattern produced by the Mod III feed is no longer advantageous. Thus, the Mod IV feed assembly returns to the DSN standard 22.4 dB gain gaussian beam design. The feed assembly incorporates a Bethe hole coupler for precision phase calibration and a new feedhorn extension that obviates the need to relocate the traveling wave masers within the feedcone. The coupler and feedhorn extension will be reported on later.

II. MOD IV XRO Feed Assembly

The new feed assembly is shown in Fig. 1. A schematic of its layout is shown in Fig. 2. Like the Mod III feed, the new feed incorporates an orthogonal mode transducer to provide simultaneous right- and left-hand circular polarization. Thus, there are two paths to consider for time delays. The quarter-wave plate polarizer is rotatable by 90 degrees to reverse the polarization senses at each output port in the event that the primary traveling wave maser (normally RCP) should fail.

The microwave component time delays, τ_g, (see Table 1) were computed at 8420 MHz using the methods described in [1], with the exception of the new feedhorn. In this case, a new computer program developed at JPL was used. The program calculates the modes propagating (and reflecting) from each discontinuity to find the total delay from the feedhorn throat to the radiating aperture of the extension. This value was then adjusted for the distance to the phase center, which lies in front of the aperture for this feed assembly. As before, the centerline of the TWM coupler (at the Type N coaxial connector) is chosen as the interface to the calibration signal equipment.

Acknowledgment

D. Hoppe performed the computer analysis to determine the feedhorn time delay.

References

[1] R. Hartop, "Microwave Time Delays in the DSN 34- and 64-Meter Antennas," *DSN Progress Report 42-51,* vol. March-April, pp. 183-185, Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1979.

[2] R. Hartop, "New X-Band Antenna Feeds for the DSN 64-Meter Stations," *DSN Progress Report 42-52,* vol. May-June, pp. 71-74, Jet Propulsion Laboratory, Pasadena, Calif., August 15, 1979.

Table. 1. Microwave component time delays for XRO Mod IV feed assembly at 8420 MHz

Item	τ_g, ns	
Feedhorn	3.479	
Phase calibration coupler	0.477	
Rotary joints, 2, total	0.424	
Polarizer	0.444	
	Straight Path to TWM No. 2	Side Path to TWM No. 1
Orthogonal mode junction	0.707	0.709
Waveguide twist	---	0.511
Waveguide switch	0.342	0.342
Waveguide	---	0.153
TWM coupler (to center)	0.153	0.153
TOTAL delay	6.026	6.690

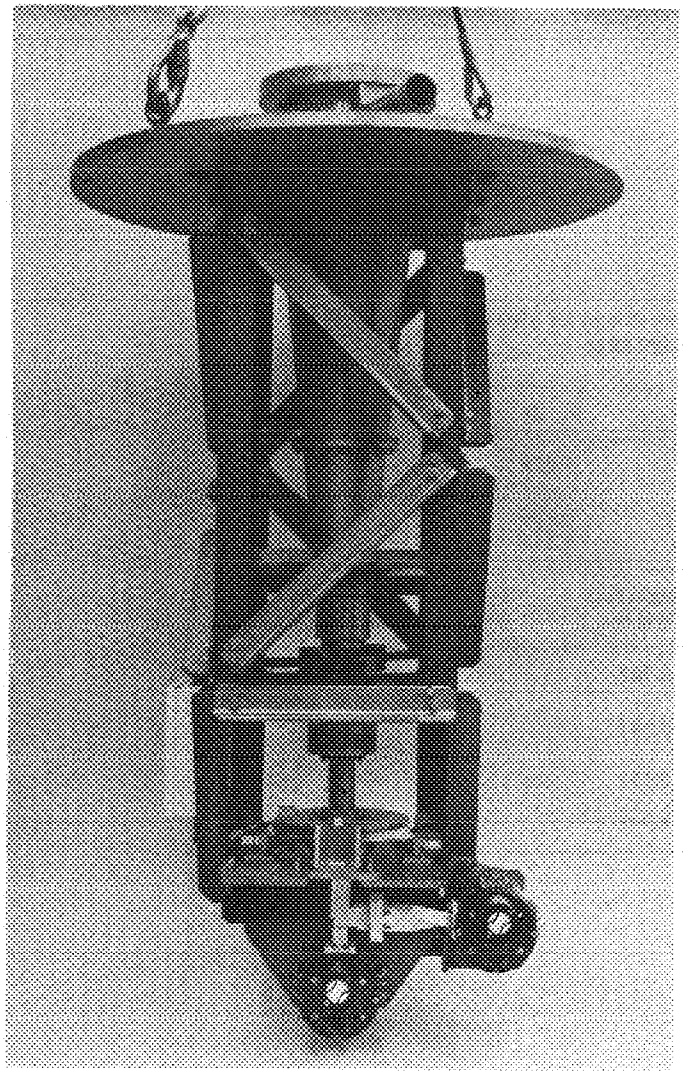

Fig. 1. XRO Mod IV feed assembly

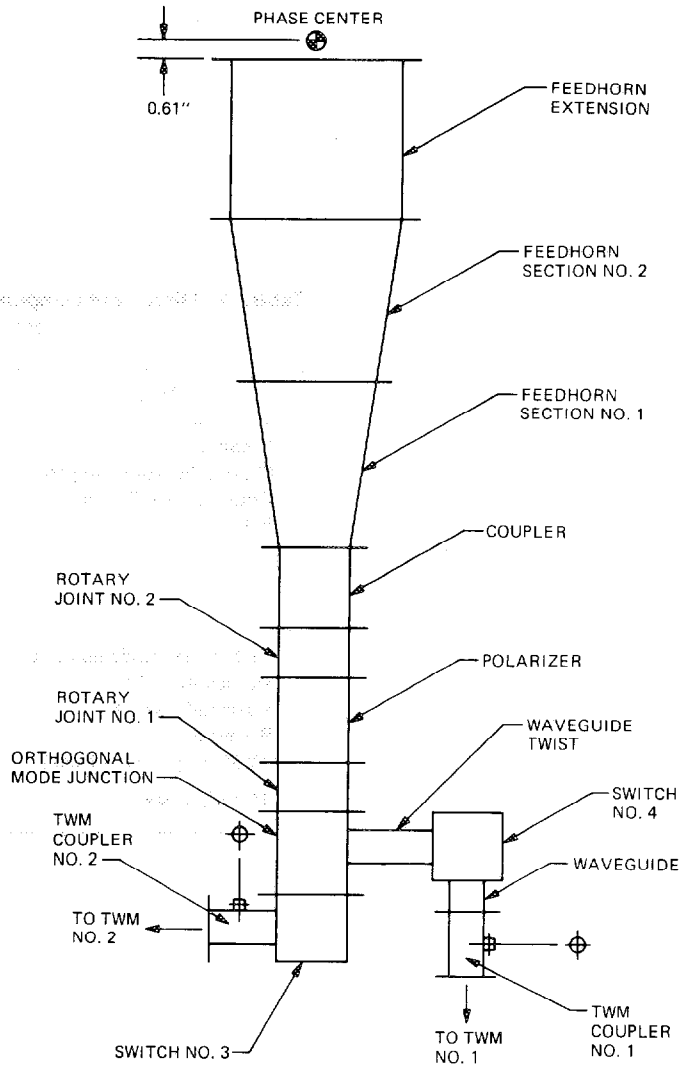

Fig. 2. XRO Mod IV feed layout