Waveguide Installation Measurements at DSS 14

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The match of the DSS 14 waveguide installation has been affected by several waveguide changes necessitated by the installation of an additional X-band filter. A series of tests has been conducted as part of an effort to reduce transmitter back power.

An X-band filter has been recently added to the transmitter waveguide installation at DSS 14 (see "X-Band Filter," by R. L. Leu, in this issue of the DSN Progress Report). The purpose of the filter is to prevent X-band transmitter harmonics from affecting receiver operation for the Mariner Venus/Mercury 1973 (MVM'73) mission. The installation required several waveguide runs to be modified, changing their electrical length. Following the installation, station personnel began reporting high back power at certain of their operating frequencies. Reflected power data prior to the waveguide modifications is not available. High-power tests with and without the X-band filter show approximately the same reflected back power except with a shift in frequency. An investigation of the nature of the back power problem has been initiated.

As part of the investigation into reducing the back power, a series of swept-frequency waveguide voltage standing wave ratio (VSWR) measurements has been made. The VSWR measurements were made on all portions of the waveguide installation which affect the back power. Both the SMT and SPD cones were included. Figure 1 shows the waveguide runs and components associated with the high-power transmitter. The measurements were made by the installation of an S-band waveguide reflectometer and an S-band precision load, where appropriate, at selected points in the waveguide installation. Figure 2 shows the configuration of the test equipment used in the measurements. The network analyzer was used to measure the return loss of the reflected signal. The X-Y plotter provided a trace of return loss vs sweep generator frequency. The frequency band covered by the measurements was 2110 to 2120 MHz.

The test results of interest are presented in graphical form in Figs. 3 through 7. In these figures, the X-Y plot has been converted to directly show VSWR and theoretical transmitter back power at 400 kW. All measurements are referenced to the 400-kW transmitter output flange. Figures 3 and 4 show the results for the waveguide runs to the inputs of the S-Band Megawatt Transmit (SMT) and S-Band Polarization Diversity (SPD) cones respectively. Figure 5 shows the results for the total waveguide run through the SMT cone. Figures 6 and 7 show the results for the total waveguide runs through the SPD cone for right circular polarization (RCP) and linear feed polarizations respectively.

The data indicates that the SPD configuration in particular should be investigated further to find means to improve the VSWR of the installation to a more acceptable limit. The next effort will be the development of a tuning device usable at the high powers employed in the DSN that can be used to improve the match of the waveguide and cones.

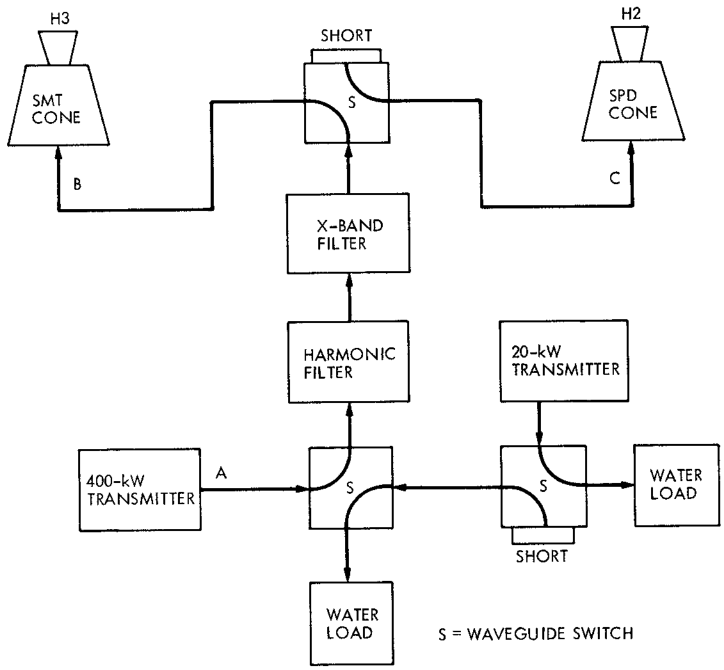

Fig. 1. Transmitter waveguide at DSS 14

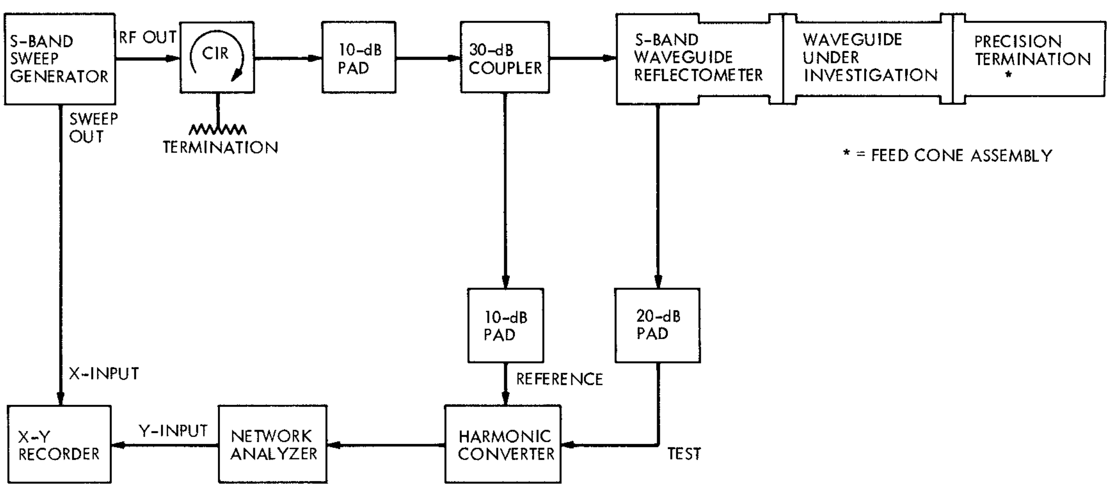

Fig. 2. Test equipment configuration swept-frequency waveguide VSWR measurements, 2110 to 2120 MHz

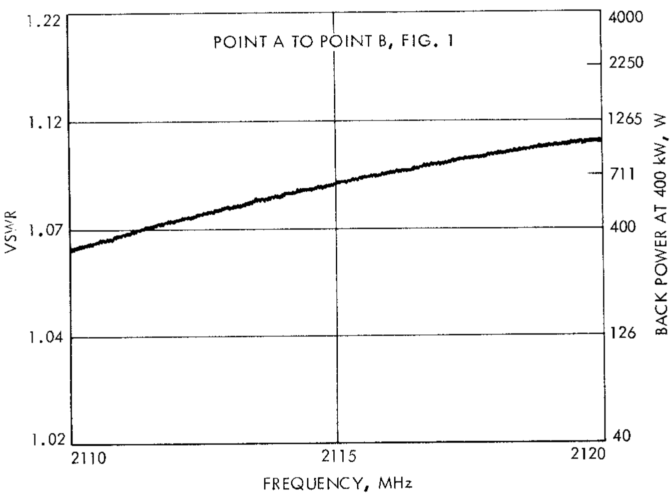

Fig. 3. VSWR, 400-kW transmitter to SMT cone input

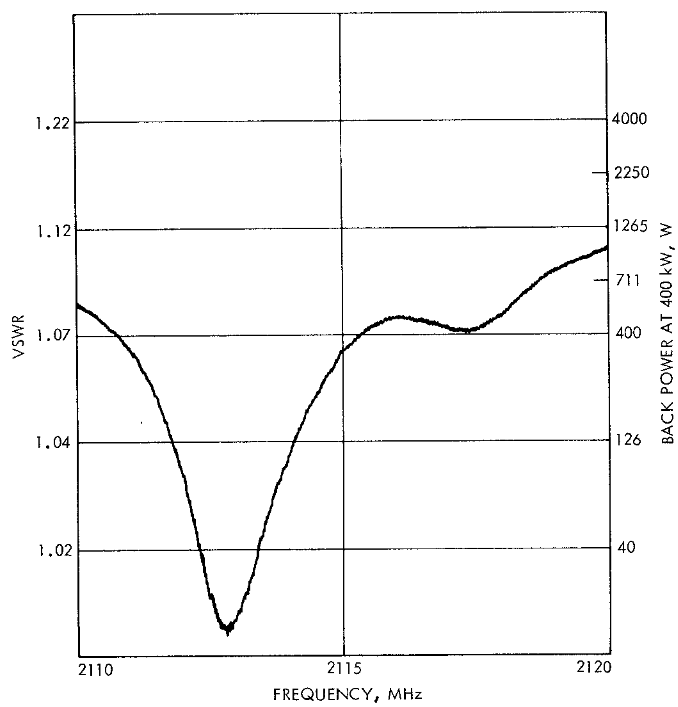

Fig. 5. VSWR, 400-kW transmitter through SMT cone

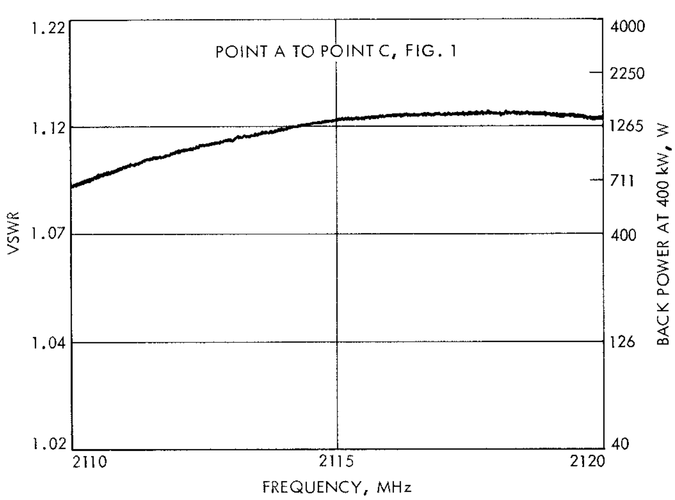

Fig. 4. VSWR, 400-kW transmitter to SPD cone input

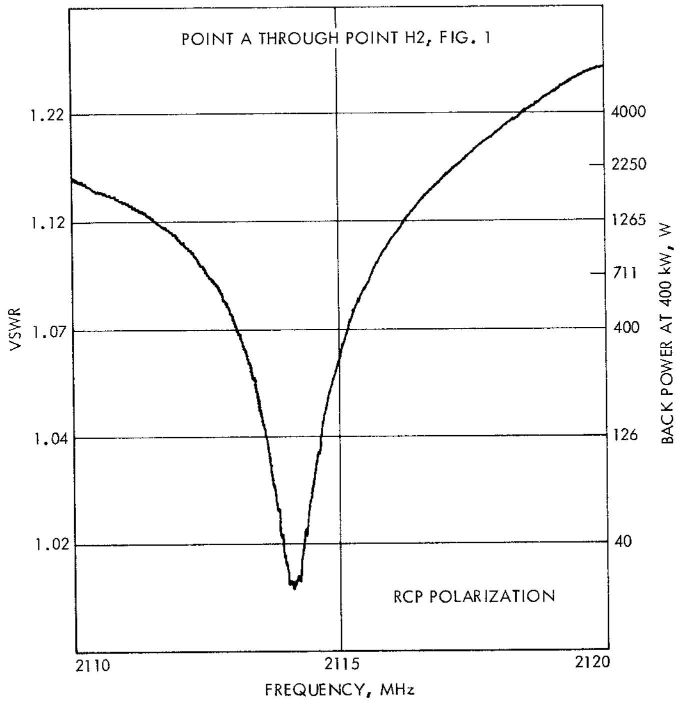

Fig. 6. VSWR, 400-kW transmitter through SPD cone

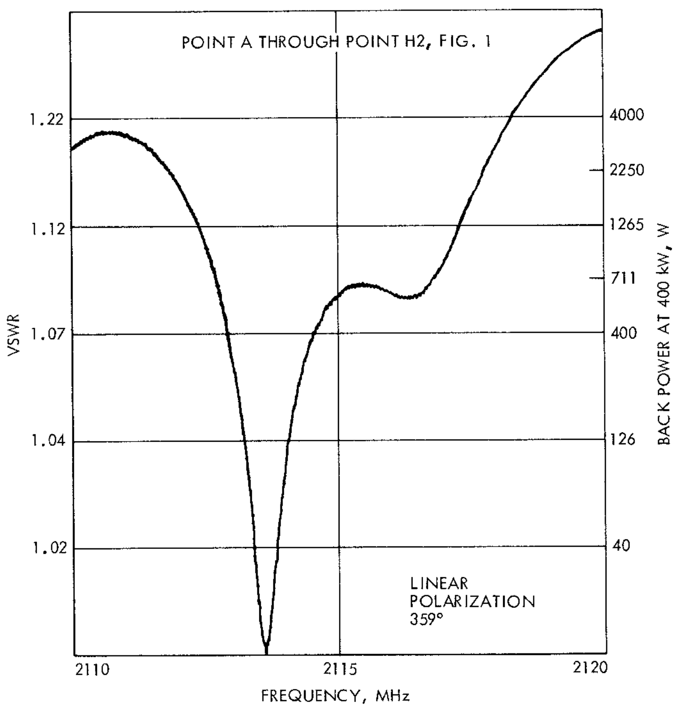

Fig. 7. VSWR, 400-kW transmitter through SPD cone