X-Band Reject Filter

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In support of an effort to isolate any receive band components of transmitter noise being received at the X-band maser, a one-cavity band reject filter has been fabricated and tested. The goal was to develop a series of cavity band reject filters capable of providing a rejection of 100 dB in the passband of the receiver.

I. Introduction

The need for an X-band transmit frequency filter at the DSN tracking stations is to isolate any receive band components of transmitter noise being received at the receiver. This X-band transmit frequency filter, when placed between the transmit arm of the diplexer and the transmitter, will allow signals from the transmitter to go through at 7192 MHz and reject any components of the transmitter noise falling within the passband of the receiver (8400–8450 MHz). As part of an effort to achieve a rejection of 100 dB in the passband of the receiver, a band reject filter with one cavity has been developed.

II. Theory of Operation

The single cavity reject filter is shown in Figure 1. A portion of the main WR125 waveguide signal is coupled to an H-plane WR125 waveguide cavity by means of a rectangular aperture in the side wall of the main waveguide. The power level coupled into the cavity is controlled by the size of this rectangular aperture. The resonant frequency of the cavity is determined by the cavity length. The size of the rectangular aperture used for the single cavity reject filter was calculated to be 0.789 × 1.588 cm (0.350 × 0.625 in.) with a cavity length of 1.905 cm (0.750 in.) (Figure 2). The theoretical attenuation of the waveguide band reject filter derived from the low pass prototype circuit is calculated from Reference 1 and was approximately 24.5 dB.

III. Test Results

Resonance of this single cavity reject filter occurred at a frequency of 9240 MHz (Figure 3). By use of the tuning screw this resonance frequency was tuned to the receive frequency of the receiver (Figure 4). The actual measured attenuation of this filter is 19 dB. The agreement between the theoretical and the measured attenuation is accepta-

ble. The discrepancy was caused by the difficulty in calculating the Q value accurately. Mismatches at the receive frequency in the main waveguide resulting from the aperture were reduced using a matching septum plate 0.546 × 1.588 cm (0.215 × 0.625 in.) with its edges parallel to the electric field (Figure 2). The voltage standing wave ratio (VSWR) was between 1.03 and 1.06 measured at the passband of the receiver (7155–7240 MHz) (Table 1).

IV. Future Plans

From the testing, it was apparent that the tuning screw was very lossy. Thus, to overcome this problem the tuning screw will not be included in the next test sample. The cavity length will be changed to enable resonance to occur at the receive frequency. Also, the number of resonators used will be increased to achieve the desired rejection of 100 dB at the receive frequency.

References

1. Matthaei, G. L., Young, L. and Jones, E. M. T., *Microwave Filters, Impedance-Matching Networks, and Coupling Structures*, McGraw-Hill Book Company, New York, 1964, pp. 156–161, pp. 229–242, pp. 725–771.
2. Marcuvitz, N., *Waveguide Handbook*, Dover Publications, Inc., New York, 1951, pp. 224–227.
3. Buchanan, H. R., "Variable S-Band High Power Tuner," *DSN Progress Report*, Technical Report 32-1526, Vol. XIX, pp. 176–177, Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1974.

Table 1. VSWR at transmit frequency band

Frequency	VSWR
7150	1.060
7155	1.040
7160	1.035
7165	1.035
7170	1.030
7175	1.050
7180	1.060
7185	1.050
7190	1.040
7195	1.030
7200	1.040
7205	1.050
7210	1.060
7215	1.050
7220	1.055
7225	1.040
7230	1.050
7235	1.050
7240	1.060
7245	1.040
7250	1.060

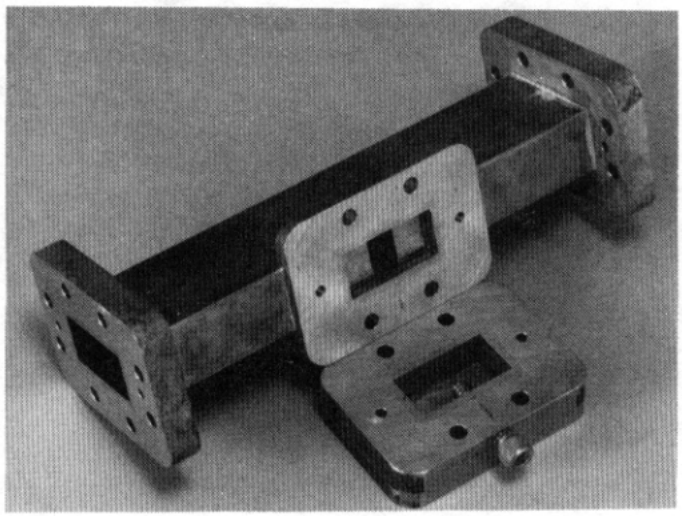

Fig. 1. X-Band reject filter

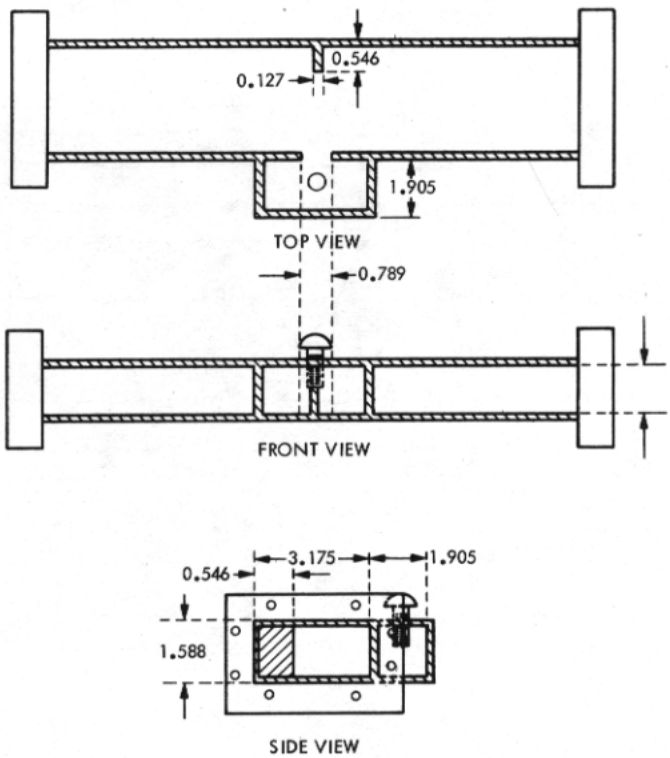

Fig. 2. Mechanical parameters

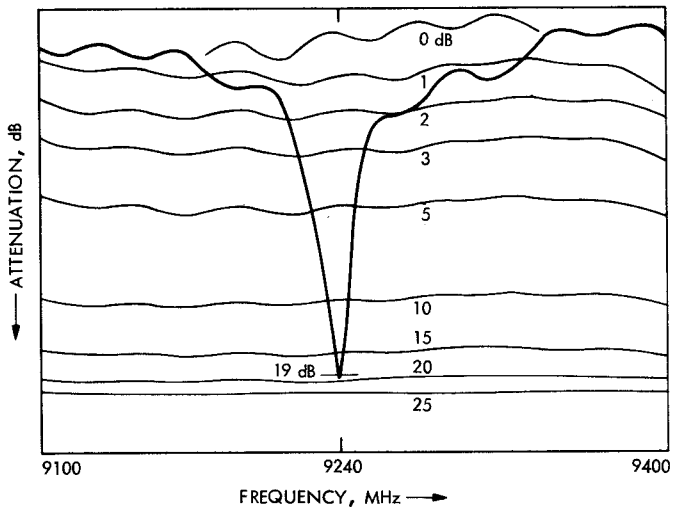

Fig. 3. Filter response without tuning screw

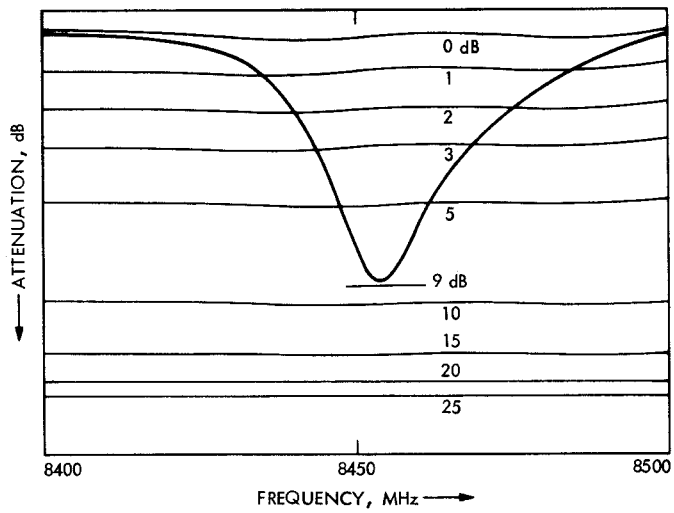

Fig. 4. Filter response tuned to receive frequency band