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RF ABSORPTION DUE TO PAINT ON THE 36-FOOT ANTENNA SURFACE

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RF ABSORPTION DUE TO PAINT ON THE 36-FOOT ANTENNA SURFACE

The surface of the NRAO 36-ft parabolic antenna at Kitt Peak is painted with a diffuse reflectance type paint to prevent overheating of the dish when in sunlight. The paint is "Hi-Reflectance Flat White No. 6" manufactured by Triangle Paint Co. 2222 Third Street, Berkeley, California 94710.

This EDIR reports the results of measurements made to determine the decrease of efficiency of the antenna due to absorption by the paint layer of RF energy in the 3-mm wavelength region.

The measurements, made at frequencies of 86 GHz and 116 GHz, indicate maximum absorption losses of .06 dB and .01 dB respectively which translate to efficiency decreases of 1.4% and .3%.

MEASUREMENTS

The absorption measurements were made by alternately clamping an aluminum short circuit and a piece of the painted surface against the end of a 1-inch length of WR-10 waveguide and measuring the VSWR looking into the other end, (Fig. 1). The piece of painted dish surface had the paint removed around a .050" x .100" rectangle which allowed good electrical contact between it and the waveguide (Fig. 2). The high measured VSWR's were most accurately measured by the 3 dB method. In this method the distance along the waveguide between points of the standing wave pattern which are 3 dB above the pattern minimum is measured, (Fig. 3). This distance, ΔX, along with the guide wavelength, λg, is used to calculate the VSWR, S, according to

$$S = \frac{\lambda g}{\pi \Delta X}$$

Once the VSWR is determined, the loss between the slotted line probe and the short circuit is given by

$$\text{Loss (dB)} = 10 \log \frac{S+1}{S-1}$$

The loss due to the paint is then equal to the difference between the loss with the bare short circuit and the loss with the painted short circuit.

ANGLE OF INCIDENCE OF PLANE WAVE

From the geometry of the 36-ft parabola it was calculated that the minimum angle of incidence was 73° (Fig. 4). The angle of incidence of the equivalent plane waves upon the waveguide short circuit (Fig. 5) is given by

$$\theta = \sin^{-1} \frac{\lambda}{2a}$$

where a is the waveguide width.

The incident angles for 86 GHz and 116 GHz thus are 43° and 31° respectively. The effect of these incidence angles being less than 90° is to increase the path length through the paint layer. It can be seen from Figure 6 that the path length through the paint layer on the dish will be less than the path lengths in the present measurements. Therefore the measured losses represent maximums that may be experienced.

RESULTS

	FREQ (GHz)	VSWR	LOSS (dB)	PAINT LOSS (dB)
Short	86	13.84	.629	.056
Paint	86	12.70	.685	
Short	116	16.45	.529	.012
Paint	116	16.06	.541	

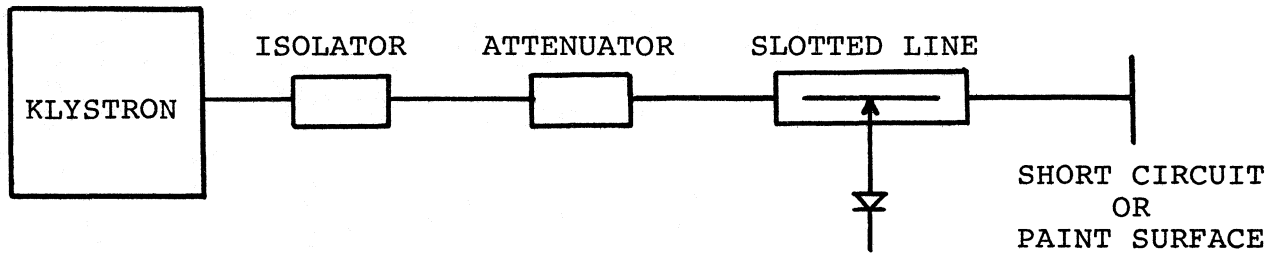

FIGURE 1

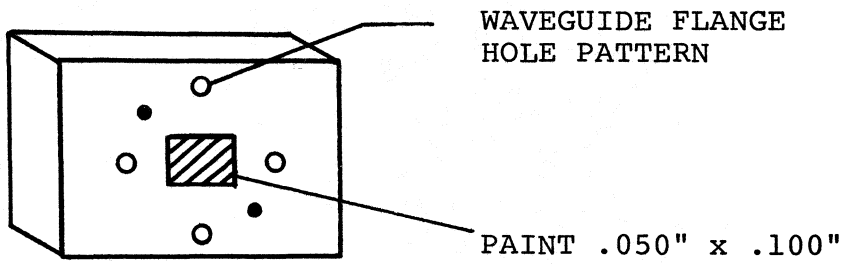

FIGURE 2

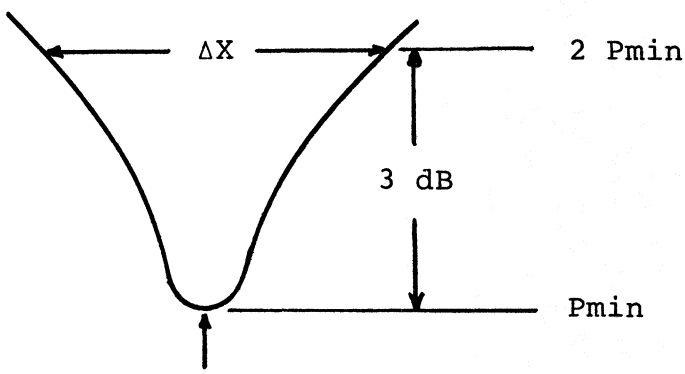

FIGURE 3

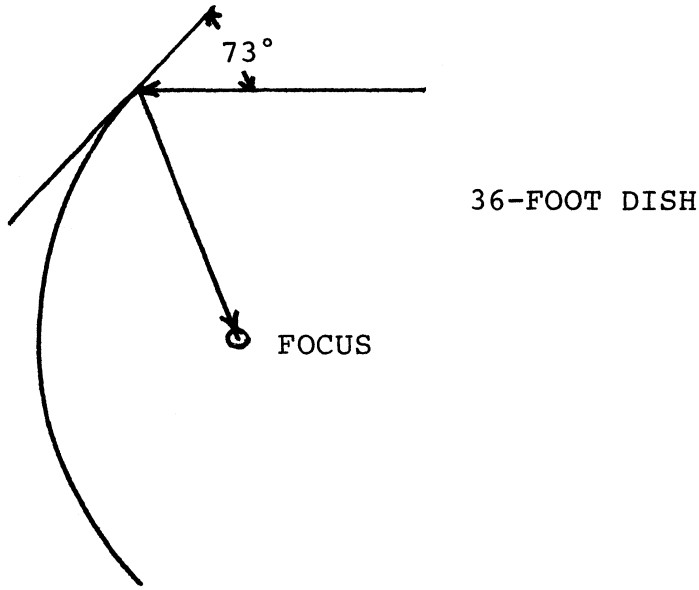

FIGURE 4

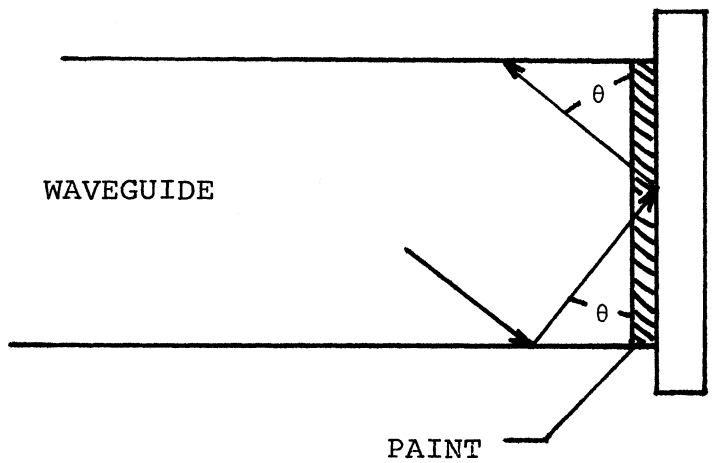

FIGURE 5

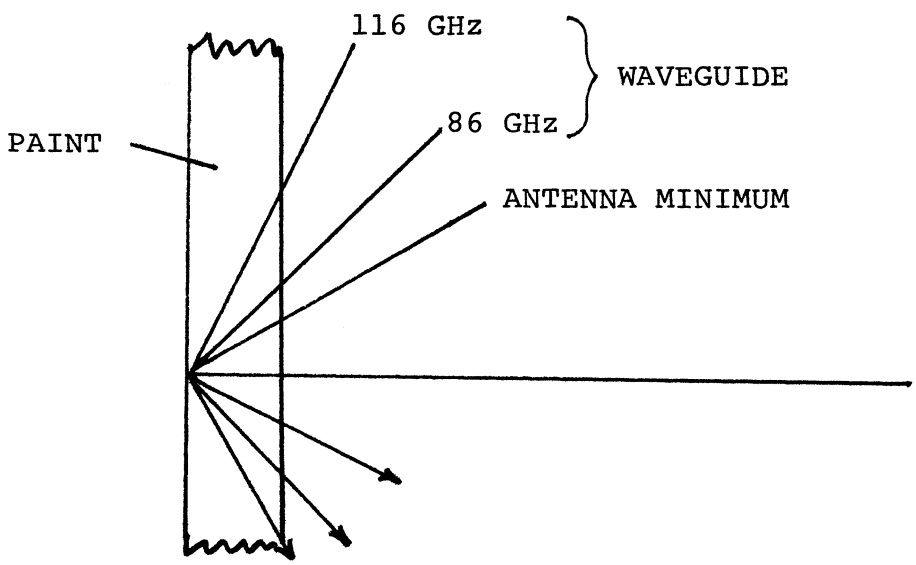

FIGURE 6