Operating Noise Temperature Calibrations of the S-Band Systems at DSS 14 for Calendar Year 1974

M. S. Reid and D. W. Veelik
Communications Elements Research Section

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The S-band megawatt transmit (SMT) cone was in operation on the 64-m antenna at DSS 14 throughout 1974. Figure 1 shows a summary of the data for the whole year. System operating noise temperature in kelvins is plotted against time in day number and date. The configuration for the upper data set is the SMT cone, with the maser in the Module 3 area, operating in the diplexed mode. The low-noise receive-only path, operating with the maser in the SMT cone, is shown in the lower data set. All measurements were made at 2295 MHz with the antenna at zenith. Measurements made in clear weather are plotted as solid circles, and measurements made in overcast weather or rain are plotted as open circles. There are 402 data points in the upper set excluding the unclear weather data. The average of these 402 clear weather measurements is 22.8 K and the standard deviation is 0.55 K. There are 60 clear weather measurements of the SMT cone low-noise path. The average of these data is 13.2 K and the standard deviation is 0.45 K. Most of the measurements, but not all, were made with the reflex feed system retracted. No distinction has been made in Fig. 1 between dichroic feed extended and retracted because the dichroic feed system does not degrade the SMT cone performance at high elevation angles (above 30 deg) (Ref. 1). The SMT cone was removed from the antenna on January 27, 1975.

Figure 2 is a plot of the system operating noise temperature of the polarization diversity S-band (PDS) and the S-band polarization diversity (SPD) cones. On September 28/29, 1974, the PDS cone was replaced by the SPD cone, which is the standard DSN S-band cone at all three 64-m antenna stations. This change is shown in Fig. 2. In this figure also, measurements made in overcast or rain conditions have been clearly separated and excluded from the averages. All measurements were made at 2295 MHz with the antenna at zenith.

The noise temperature of the diplexed PDS cone shows a significant improvement in the second half of the year, and the PDS low-noise path shows an even greater improvement. Several changes were made in the PDS system, which could account for these lower noise temperatures in the latter part of the year. A bad rotary joint was replaced, and this improved both the low-noise path and the diplexed-noise temperatures. Furthermore, during September the PDS cone underwent a major configuration change. The following equipment was removed from the cone: two rotary joints, a quarter-wave plate, the cosine taper, orthomode transducer, an H-plane bend, the waveguide band-reject filter, a waveguide switch, and associated waveguide runs. A crossguide coupler was removed and replaced with a loop coupler, which reduced the waveguide path by approximately 13 cm. These changes were reflected by a marked improvement in operating noise temperature as shown in the figure. Additional changes in the PDS cone prior to the Mariner 10 Mercury II encounter were the removal of the diplexer and the transmit filter. Insufficient measurements were recorded during these changes to yield a good average.

Two sets of SPD cone data are included in Fig. 2. The lower set shows the SPD cone diplexed measurements. The average of these 131 data points is 21.2 K and the standard deviation is 0.68 K. Measurements made with the SPD cone, diplexed, and the maser in the Module 3 area, are shown in the upper set. The average of these 22 measurements is 25.3 K and the standard deviation is 1.1 K.

All measurements in this report (most of which were made by station personnel at DSS 14) were made with the Y-factor technique of switching between an ambient termination and the horn. Most of the data points are based on a single Y-factor measurement, and the remainder were made with a precision technique of multiple Y-factors which has been discussed elsewhere (Refs. 2, 3, and 4). Table 1 is a summary of the averages of all the measurements.

References

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Table 1. System operating noise temperature and other data for the SMT, SPD, and PDS cones for calendar year 1974

Cone and maser	System operating noise temperature			Maser gain, dB	Follow-up noise temperature, K	Number of measurements	Nominal maser noise temperature, K
	Average, K	Standard deviation	Number of measurements				
SMT cone MOD 3 maser Diplexed	22.8	0.55	402	45.0	0.19	6	
SMT cone SMT maser Low-noise path	13.2	0.45	60	48.6	0.09	6	2.1
SPD cone SPD maser Diplexed	21.2	0.68	131				
SPD cone MOD 3 maser Diplexed	25.3	1.07	22				
PDS cone PDS maser Diplexed Before mod.	24.1	0.79	52				
PDS cone PDS maser Diplexed After Mod.	22.2	1.1	4				
PDS cone PDS maser Low-noise path Before mod.	20.4	0.56	18				4.3
PDS cone PDS maser Stripped cone	14.6	1.1	2				

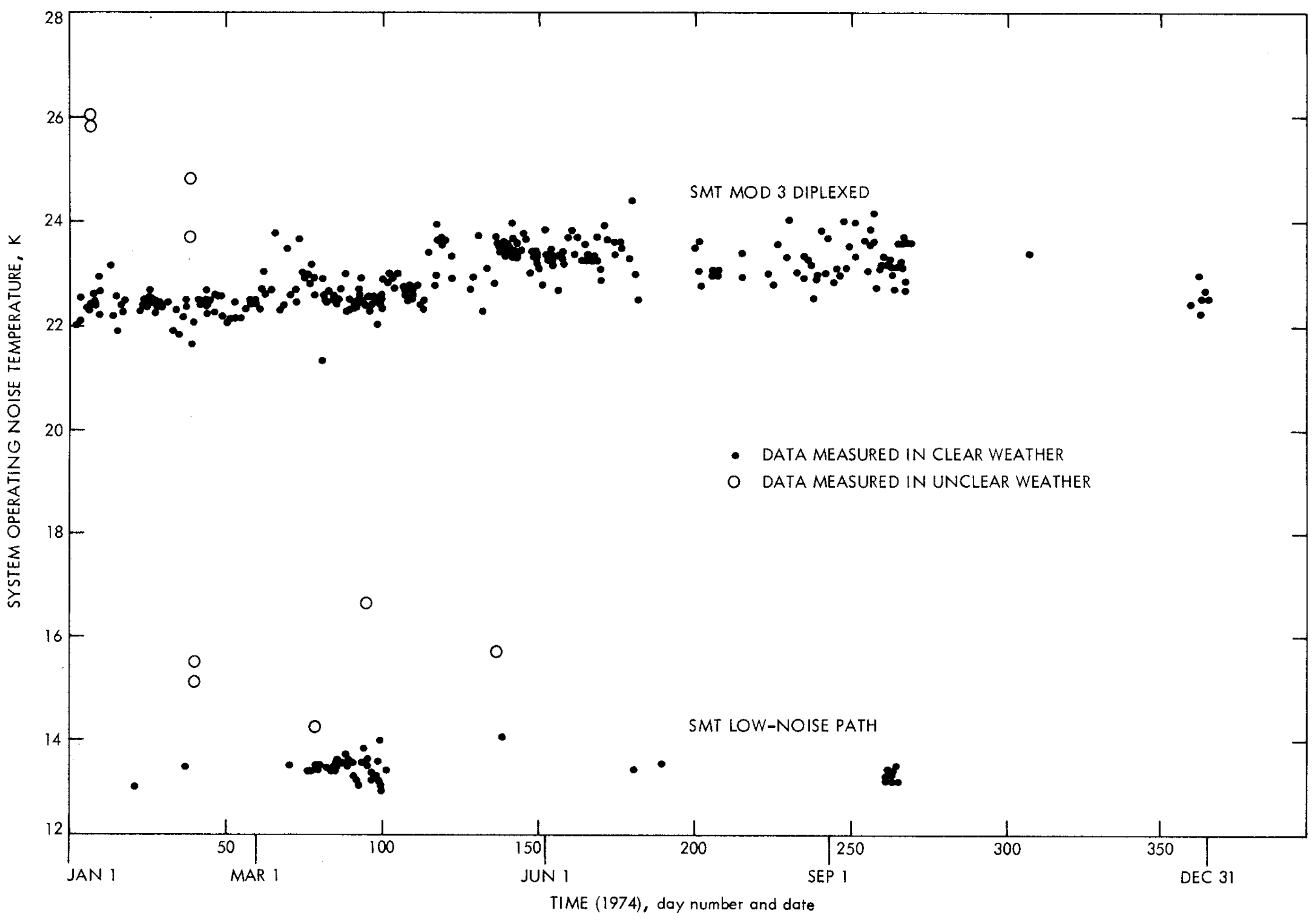

Fig. 1. System operating noise temperature of the SMT cone as a function of time for calendar year 1974

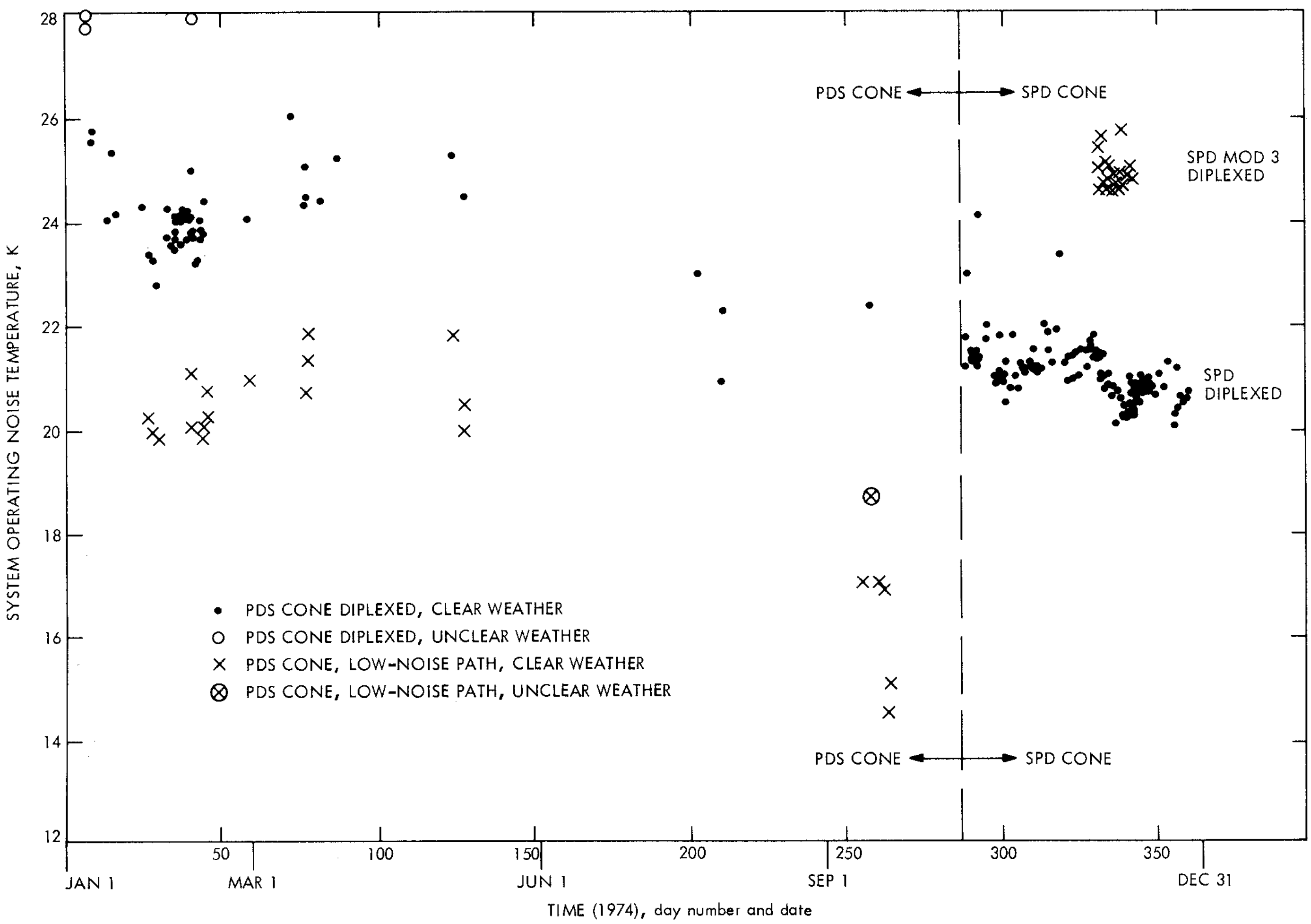

Fig. 2. System operating noise temperature of the PDS and SPD cones as a function of time for calendar year 1974