Improved RF Calibration Techniques: System Operating Noise Temperature Calibrations

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The system operating noise temperatures of the S-band polarization ultra cone at DSS 11 (Pioneer Deep Space Station), the S-band research operational cone at DSS 13 (Venus DSS), and the polarization diversity S-band and multi-frequency X-band/K-band cones at DSS 14 (Mars DSS) are reported for the period October 1, 1970 through January 31, 1971.

The system operating noise temperature performance of the low noise research cones in the Goldstone Deep Space Communications Complex (GDSCC) is reported. The operating noise temperature calibrations were performed with the ambient termination technique (Ref. 1). The cones on which this technique was used during this reporting period are:

(1) S-band research operational (SRO) cone at DSS 13.

(2) S-band polarization ultra (SPU) cone at DSS 11.

(3) Polarization diversity S-band (PDS) cone at DSS 14.

(4) Multi-frequency X-band/K-band (MXK) cone at DSS 14.

The averaged operating noise temperature calibrations for the various cones, and other calibration data, are presented in Table 1. The reporting period for the SRO and SPU cones is October 1, 1970 (day 274) through January 31, 1971 (day 31). The reporting period for the PDS cone is from its initial operation on the 64-m antenna, September 15, 1970 through January 31, 1971. The reporting period for the MXK cone is from its initial installation on the 64-m antenna, March 15, 1970 through February 28, 1971.

The calibration data were reduced with JPL computer program number 5841000, CTS20B. Measurement errors of each data point average are recorded under the appropriate number in Table 1. The indicated errors are the standard deviation of the individual measurements and

Table 1. Averaged operating noise temperature calibrations for the low noise research cones at GDSCC

Station	DSS 11	DSS 13		DSS 14		
Cone	SPU	SRO		PDS	MXK	
Configuration	Receive mode			Diplexed		
Frequency, MHz	2295	2295	2388	2295	7840	8448
Maser serial number	96S5	96S2	96S2	96S3	150X1	150X1
Maser temperature, K	3.7	5.2	5.2	4	10	7
Maser gain, dB	55.8 ± 0.23/0.10 6 measurements	51.0 ± 0.53/0.17 10 measurements	37.1 ± 1.18/0.10 137 measurements	53.4 ± 0.50/0.10 5 measurements	37.0 ± 1.7/0.55 10 measurements	41.3
Follow-up noise temperature contribution, K	0.06 ± 0.003/0.002 6 measurements	0.11 ± 0.06/0.02 9 measurements	0.55 ± 0.09/0.05 137 measurements	0.01 ± 0.07/0.05 4 measurements	1.7 ± 0.60/0.20 10 measurements	0.58 1 measurement
System operating noise temperature, K	18.3 ± 0.10/0.06 4 measurements	16.5 ± 0.37/0.12 9 measurements	16.4 ± 0.76/0.08 137 measurements	24.1 ± 0.55/0.05 4 measurements	27.7 ± 1.3/0.51 13 measurements	23.6 ± 0.25 1 measurement

of the means, respectively. They do not include instrumentation systematic errors. The averages were computed using only data with

(1) Antenna at zenith.

(2) Clear weather.

(3) No RF spur in the receiver passband.

(4) Probable error of computed operating noise temperature due to measurement dispersion less than 0.1 K.

The system operating noise temperatures of the SPU cone at DSS 11 are plotted in Fig. 1 as a function of time in day numbers. Similarly, Figs. 2 and 3 are system operating noise temperatures of the SRO cone at 2295 MHz and 2388 MHz, respectively. Figure 4 shows the PDS cone data and Fig. 5 the MXK cone data.

In all the figures, data that satisfy the four conditions stated above are plotted as asterisks, while data that fail one or more conditions are plotted as circles. The one exception is the single data point at 8448 MHz in Fig. 5 which is plotted as a square; the remainder of the data in the figure is for 7840 MHz. It is expected that the system operating noise temperatures of the MXK cone at 8427 and 8448 MHz will average approximately 3 K lower than the average temperature at 7840 MHz.

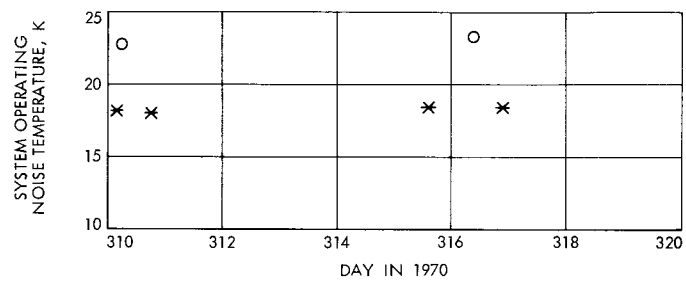

Fig. 1. System operating noise temperature of SPU cone at DSS 11

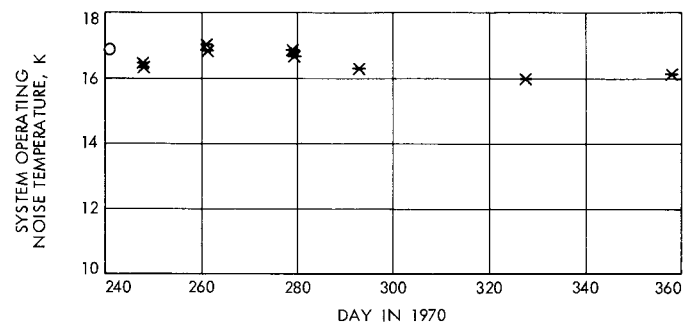

Fig. 2. System operating noise temperature of SRO cone at 2295 MHz at DSS 13

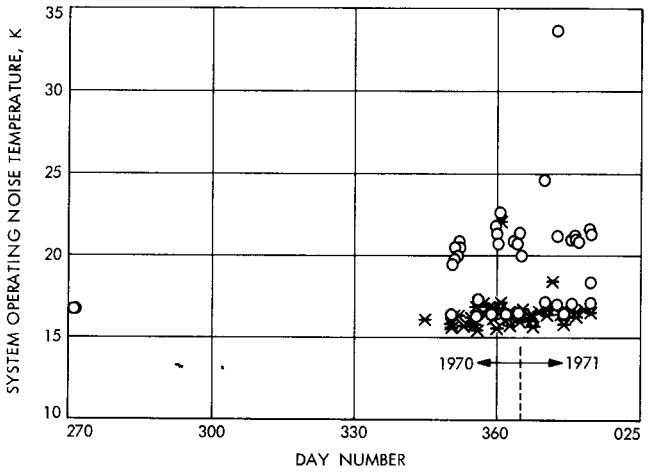

Fig. 3. System operating noise temperature of SRO cone at 2388 MHz at DSS 13

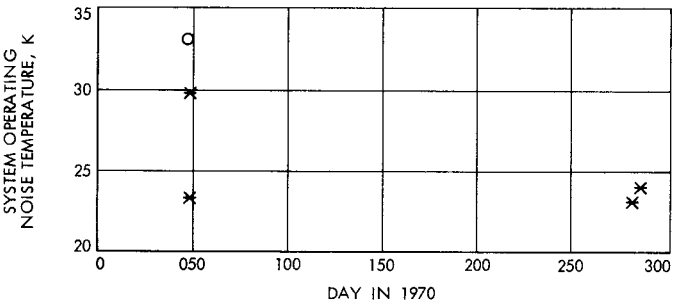

Fig. 4. System operating noise temperature of PDS cone at DSS 14

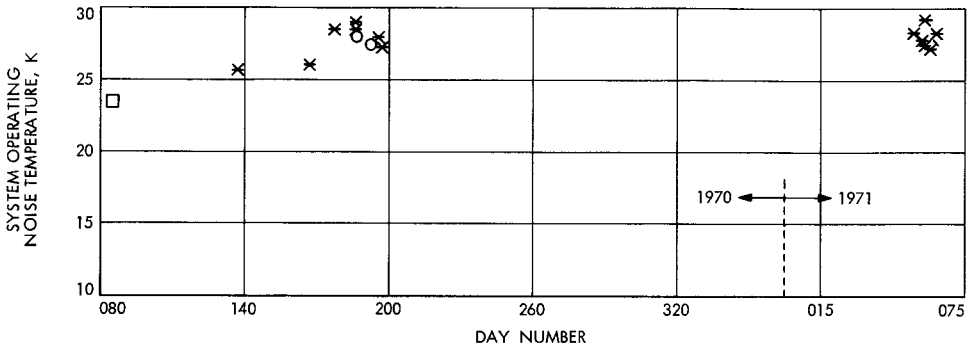

Fig. 5. System operating noise temperature of MXK cone at DSS 14

Reference

1. Stelzried, C. T., "Improved RF Calibration Techniques: Daily System Noise Temperature Measurements," in *The Deep Space Network*, Space Programs Summary 37-42, Vol. III, pp. 25–32. Jet Propulsion Laboratory, Pasadena, Calif., Nov. 30, 1966.