

Improved RF Calibration Techniques: System Operating Noise Temperature Calibrations

M. S. Reid

Communications Elements Research Section

The system operating noise temperatures of the S-band research operational cone at DSS 13 (Venus Deep Space Station) and the polarization diversity S-band cone at DSS 14 (Mars DSS) are reported for the period February 1 through May 31, 1971.

The system operating noise temperature performance of the low noise research cones at the Goldstone Deep Space Communications Complex (GDSCC) is reported for the period February 1 through May 31, 1971. The operating noise temperature calibrations were performed with the ambient termination technique (Ref. 1). The cones on which this technique¹ was used during this reporting period are:

- (1) S-band research operational (SRO) cone at DSS 13.
- (2) Polarization diversity S-band (PDS) cone at DSS 14.

The averaged operating noise temperature calibrations for the various cones, and other calibration data, are presented in Table 1. The calibration data were reduced with JPL computer program number 5841000, CTS20B.

¹Most of the measurements were taken by JPL DSS 13 (Venus) and DSS 14 (Mars) personnel.

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

Table 1 shows that the SRO cone was operated on the ground at zenith. Eleven measurement sets were taken within 24 hours (May 18 and 19, 1971). The average system operating noise temperature was 13.9 K, whereas

the average for the reporting period with the cone on the antenna at zenith, at the same frequency, was 17.0 K. Eight measurement sets were made at the ALSEP frequency (2278.5 MHz); the average system operating noise temperature at this frequency was 18.8 K. Furthermore, one data set was made at the ALSEP frequency with the maser connected to a standard-gain horn looking through a section of the antenna surface opened for this purpose. The antenna was at zenith and the system operating noise temperature in this configuration was 25.9 K.

Figures 1, 2, and 3 are plots of the system operating noise temperatures of the SRO cone as a function of time in day numbers, at 2388, 2295, and 2278.5 MHz, respectively. Figure 4 is a plot of the system operating noise temperature of the SRO cone on the ground at 2388 MHz. Similarly, Fig. 5 shows the data for the PDS cone at 2298 MHz, low noise path.

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.

Reference

1. Stelzried, C. T., "Operating Noise-Temperature Calibrations of Low-Noise Receiving Systems," *Microwave J.*, Vol. 14, No. 6, pp. 41-48, June 1971.

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

Station	DSS 13					DSS 14	
Cone	SRO					PDS	
Configuration	Cone on ground	Cone on antenna	Cone on antenna	Cone on antenna	Standard gain horn	Low noise path	Diplexed
Frequency, MHz	2388	2388	2295	2278.5	2278.5	2298	2292
Maser serial number	96S2	96S2	96S2	96S2	96S2	96S3	96S3
Maser temperature, K	5.2	5.2	5.2	5.2	5.2	4	4
Maser gain, dB	38.0 ±0.16/0.05 11 measurements	37.3 ±0.21/0.03 48 measurements	50.1 ±0.46/0.12 15 measurements	44.0 ±0.82/0.29 8 measurements	45.4 1 measurement	53.9 ±0.37/0.11 7 measurements	53.6 ±0.56/0.32 3 measurements
Follow-up noise temperature contribution, K	0.43 ±0.12/0.006 11 measurements	0.50 ±0.02/0.003 35 measurements	0.15 ±0.07/0.02 11 measurements	0.53 ±0.42/0.15 8 measurements	0.28 1 measurement	0.02 ±0.004/0.001 8 measurements	0.02 ±0.004/0.002 3 measurements
System operating noise temperature, K	13.9 ±0.39/0.11 11 measurements	17.0 ±0.27/0.05 35 measurements	16.0 ±0.50/0.14 11 measurements	18.8 ±0.31/0.15 8 measurements	25.9 ±0.27 1 measurement	19.6 ±0.67/0.24 8 measurements	23.8 ±0.40/0.22 3 measurements

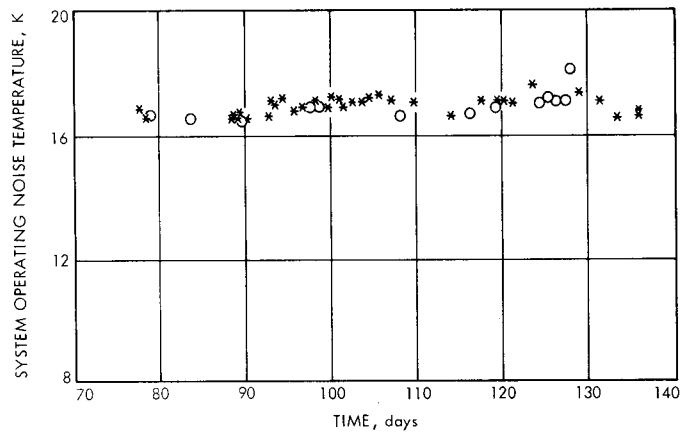


Fig. 1. System operating noise temperature of SRO cone at 2388 MHz at DSS 13

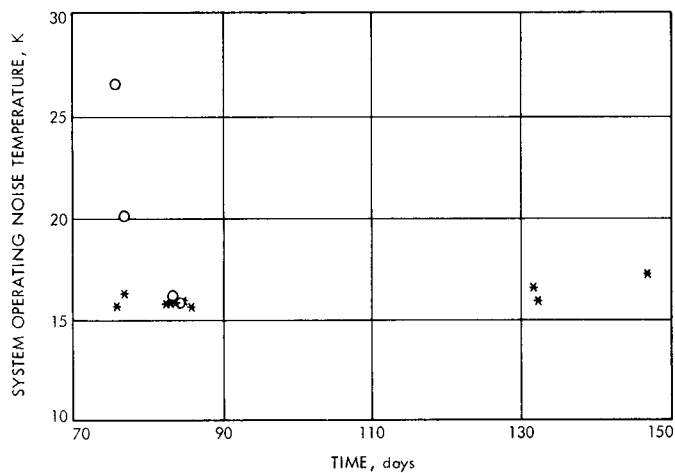


Fig. 2. System operating noise temperature of SRO cone at 2295 MHz at DSS 13

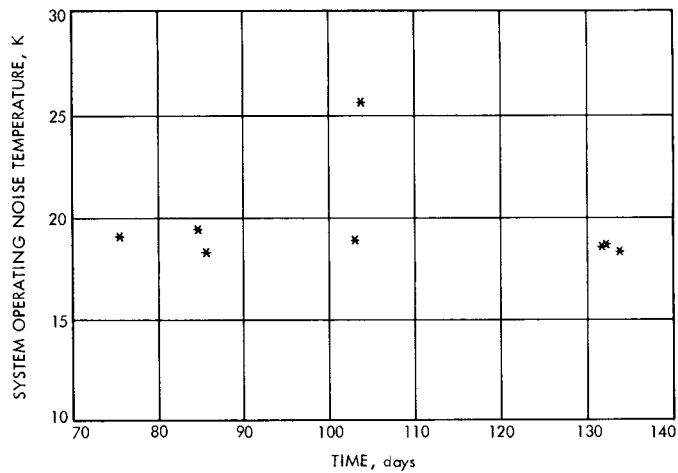


Fig. 3. System operating noise temperature of SRO cone at 2278.5 MHz at DSS 13

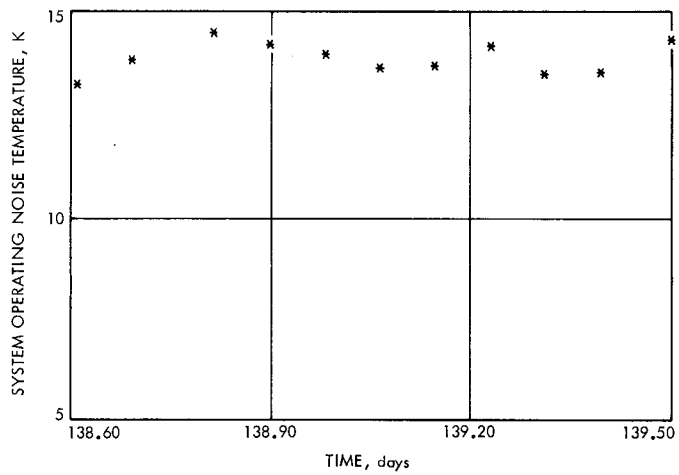


Fig. 4. System operating noise temperature of SRO cone at 2388 MHz on the ground at DSS 13

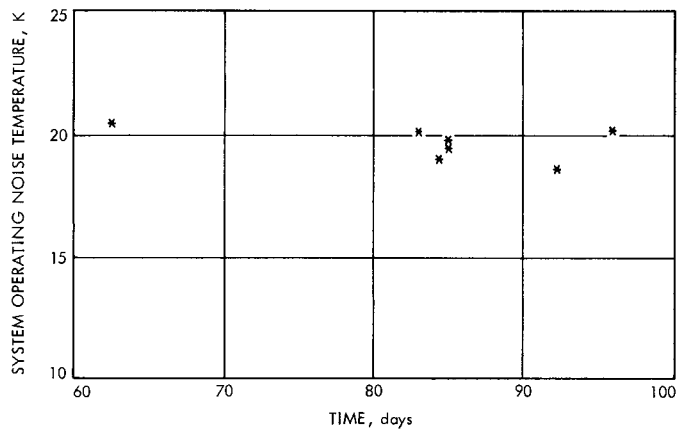


Fig. 5. System operating noise temperature of PDS cone at 2298 MHz at DSS 14