An Analysis of Noise Bursts on the 64-m-Diameter Antenna at Goldstone

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To provide more information for the noise-burst study, a comparison of noise bursts with the polarization diversity S-band (PDS) and S-band megawatt transmit (SMT) cones was made. For a period of approximately one month, DSS 14 conducted its regular tracking missions alternately with the PDS and SMT cones. The S-band total power system temperature strip chart recordings were analyzed for noise bursts. The conclusion is that with respect to noise-burst performance, the PDS and SMT cones are similar.

To provide more information for the noise-burst study, a comparison of noise bursts with the polarization diversity S-band (PDS) and S-band megawatt transmit (SMT) cones was made. S-band system temperature (T_{op}) strip chart recordings were used for this comparison. The data recorded on these strip charts were total power at S-band during regular station tracking missions. The results are presented in tabular and graphical form. The method of analysis is described below. The conclusion is that with respect to noise-burst performance, the PDS and SMT cones are similar.

To compare the PDS and SMT noise bursts, a comparison period was set up. This was October 1, 1972 through November 3, 1972. In this period DSS 14 tracked alternate days through the PDS and SMT cones. An agreed schedule of PDS and SMT tracking was set up, and the S-band T_{op} strip chart recordings were analyzed for noise bursts.

At the end of this comparison period, it was found that several charts were not usable or missing. Most of these were SMT recordings. To gain a firmer PDS analysis, several charts made prior to October 1, 1972 were analyzed. These were all PDS charts. In all, 41 tracks were analyzed for the PDS cone and 9 for the SMT cone.

The normal strip chart speed was 5.1 cm (2 in.)/h, which is equivalent to 3 min per 0.25 cm (0.1 in.) of chart. In each 0.25 cm (0.1 in.) (or 3 min of tracking time) a data point was found such that the peak T_{op} of the noise burst in Kelvins was recorded. This data point was called T_{NB}. Thus for each 3 min of tracking time one data point, T_{NB} was recorded, where T_{NB} was given by

T_{NB} = peak recorded T_{op} minus normal system temperature for the given antenna elevation angle averaged over 3 min.

Only tracking time with the transmitter on was analyzed. The following information was recorded for each day's track:

(1) Transmitter power.

(2) Number of data points in the track equals tracking time with the transmitter on, in min/3.

(3) Number of unreadable spikes (i.e., noise-burst spike ambiguous because it was confused with the automatic gain control (AGC) recording).

(4) Number of spikes whose maximum value is unknown (i.e., number of spikes that hit the chart maximum limit, i.e., 10 in. of chart or (usually) 500 K T_{op}).

(5) The value of the maximum spike in the track (in Kelvins).

(6) The value of the minimum spike in the track (usually zero Kelvins if there was a 3-min period of tracking when no noise bursts were recorded, which was not always the case).

For each day's tracking an average noise burst, $\overline{T}$, was computed thus:

$$\overline{T} = \frac{\Sigma\, T_{NB}}{\text{No. of 3-min periods in the track}}$$

For each cone and for each transmitter power (TX) an average noise burst $\overline{\overline{T}}$ for all the data analyzed was found thus:

$$\overline{\overline{T}} = \frac{\Sigma\, \overline{T}}{\text{No. of days}}$$

The results are presented in Table 1.

From the above table it may be seen that the PDS and SMT cones are remarkably similar, when compared by their average noise burst, $\overline{\overline{T}}$. This might be an indication that the major noise burst sources are outside the cones. It may also be seen from the table that the average noise burst, $\overline{\overline{T}}$, increases with increasing transmitter power. This may be seen in Fig. 1, which is a graph of average noise burst $\overline{\overline{T}}$ (K) against transmitter power (kW). The data lie approximately on a straight line on the log-log scales used in the figure. The following equation describes this line:

$$\overline{\overline{T}} = 1.6\,(TX)^{0.6}$$

where $\overline{\overline{T}}$ is the average noise burst in Kelvins and TX is the transmitter power in kW.

It must be noted that although the averaged data approximate to a straight line that implies repeatability, the character of the noise-burst phenomenon is random. This may be seen from the standard deviations of each set of $\overline{\overline{T}}$ as shown in Table 1. These standard deviations are large, which indicates that many hours of data need to be averaged before any repeatability becomes apparent.

Table 1. Summary of noise-burst analysis

Cone	TX power, kW	No. of days averaged	$\overline{T}_{MIN}$, K	$\overline{T}_{MAX}$, K	$\overline{\overline{T}}$, K	Standard deviation of $\overline{T}$, K
PDS	10	4	0.63	120.4	7.02	4.5
PDS	20	15	0	134.2	10.4	12.2
SMT	20	4	1.5	88.9	10.7	8.4
PDS	200	4	3.1	176.0	44.2	30.5
SMT	200	1	3.0	418.0	46.7	–
PDS	400	18	2.1	330.6	68.2	52.4
SMT	400	4	2.8	397.0	68.8	41.3

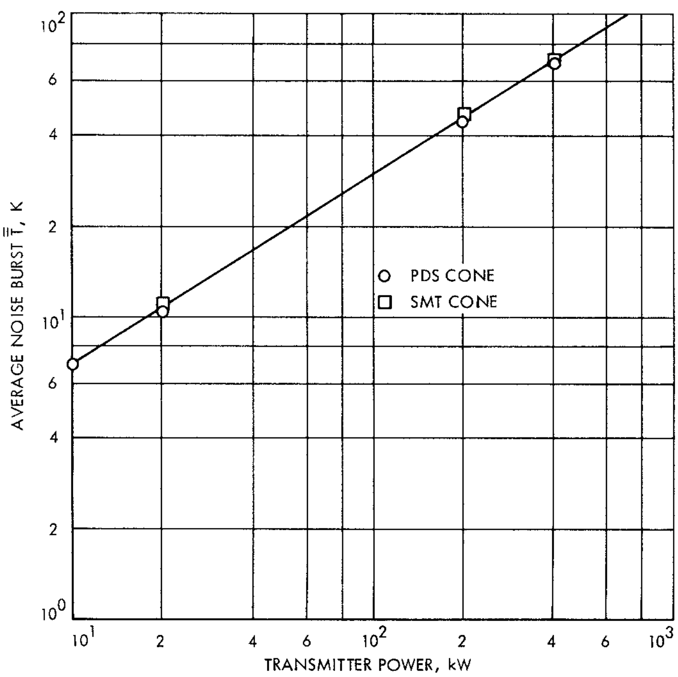

Fig. 1. PDS and SMT noise-burst analysis from T_{op} strip chart recordings, Aug.–Nov. 1972, DSS 14