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ELF NONLINEAR NOISE PROCESSING EXPERIMENTAL
MEASUREMENTS, PART 2 - SYNOPTIC SAMPLE OF
DIURNAL AND SEASONAL NOISE VARIATION IN NORWAY

NAVAL RESEARCH LABORATORY, WASHINGTON, D. C.

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**ELF Nonlinear Noise Processing
Experimental Measurements,
Part 2 – Synoptic Sample of Diurnal and
Seasonal Noise Variation in Norway**

JOHN R. DAVIS AND WILLIAM D. MEYERS

*Electromagnetic Propagation Branch
Communications Sciences Division*

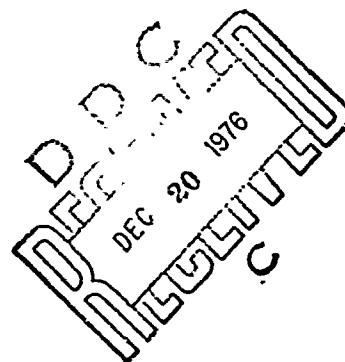
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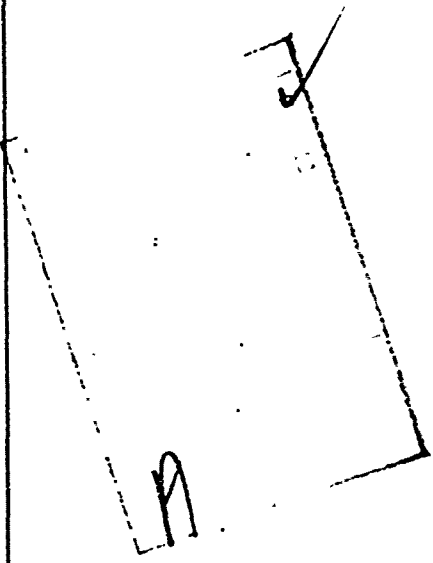
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the improvement in S/N that can be expected from simple clipping under a variety of noise and propagation conditions.

A regular diurnal variation in effective (processed) noise level is observed under quiet conditions. Under both quiet and noisy conditions little performance difference is observed among processing channels with clipping levels as far apart as 6 to 18 dB, in the vicinity of the optimum clipping level.

The nonlinear processing method described in this report provides at least 10 dB of S/N improvement over the performance obtained without suitable processing.



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ELF NONLINEAR NOISE PROCESSING EXPERIMENTAL MEASUREMENTS, PART 2 — SYNOPTIC SAMPLE OF DIURNAL AND SEASONAL NOISE VARIATION IN NORWAY

INTRODUCTION

This report contains the results of a detailed study of the effectiveness of nonlinear noise processing in improving extremely low frequency (ELF) signal-to-noise (S/N) ratio in all seasons and nearly all times of day, for data collected in northern Norway between January 1974 and November 1975. The method used is described by Meyers and Davis [1]. It will be summarized here for the reader's convenience.

Atmospheric noise at ELF is approximately log-normally distributed within the 10% and 90% exceedence limits, but at higher noise levels it depends on local thunderstorm activity [2, 3] and is generally more intense than Gaussian noise of the same rms level. For this reason, it is attractive to place a controlled nonlinearity in the receiver at wide signal-plus-noise bandwidth to improve signal-to-noise ratio by whitening the noise. An earlier investigation has shown that a simple clipper operating between the 10% and 40% exceedence levels in a 140-Hz bandwidth centered on 70 Hz provides near-optimum performance [3].

It is important in estimating communication system performance to characterize the noise environment; we made a synoptic collection of ELF noise data in Norway to permit quantification of the variability of effective (i.e., whitened) ELF noise under a wide range of noise and propagation conditions. Data were recorded on analog magnetic tape in a bandwidth extending from 2 to 130 Hz, together with a low-level calibration signal of high stability, to serve as an indication of S/N improvement. This calibration signal was set below clipping level, at about -140 dB below 1 A/m²·Hz^{-1/2} (henceforth designated dBII) which represents the level below which further clipping was seldom expected to be necessary.

Details of the signal processor are reported by Meyers and Davis [1]. The analog tapes were replayed at increased speed through a bank of six clippers whose clip levels were separately successively by 6 dB. The outputs were recorded on digital tape for computation of effective noise levels, selection of best clipping levels, and calculation of signal statistics. Spectral analysis was used to identify coherent interference bands that occasionally appeared above levels intended to be clipping thresholds, and these bands were removed by notch filtering.

DATA

Data are presented here for four one-month recording periods. All data were recorded in Tromsø, Norway (lat. 20° E, long. 70° N), a location representative of auroral-zone conditions to be expected in a belt extending eastward from Novaya Zemlya, through northern Norway and the Norwegian Sea, to Iceland and the southern tip of Greenland.

Figures 1 and 2 and Tables 1-5 contain data from January 1974, in a form intended to emphasize (1) the bounds of diurnal variation, (2) the day-to-day variability, and (3) the effectiveness of the multiple clipping levels in reducing effective noise for these variable conditions. Similar illustrations will appear below for data acquired during the other three seasons, so that seasonal variation can be assessed.

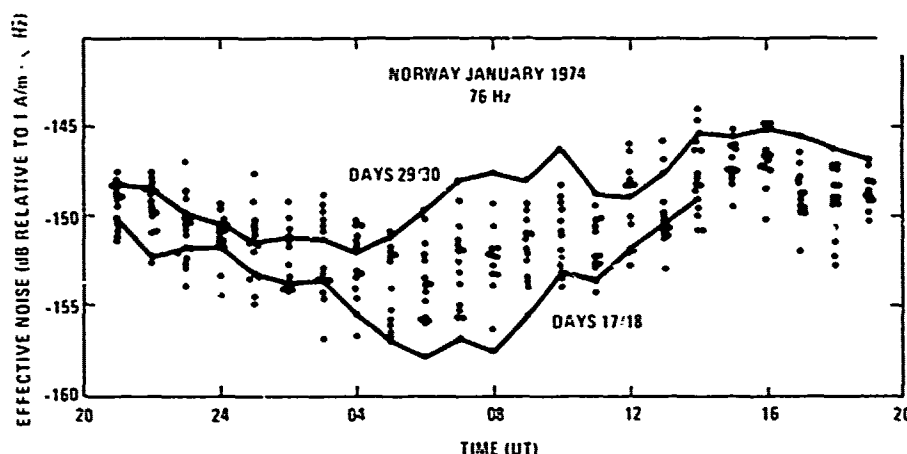


Fig. 1—Hourly samples of minimum effective noise, each averaged over 13 min, for January 1974. The quietest and noisiest days of the month are graphed and designated by Julian day numbers.

Figure 1 is a scatter plot of hourly samples of the minimum effective noise data (each sample of 13-min. duration) taken during this measurement period. By minimum effective noise is meant the noise output of the clipper that provided the greatest improvement in S/N of the six parallel-processed channels. Effective noise is defined as the ratio of the known injected calibration signal level to the measured S/N after clipping. Postclipping S/N was determined by computing the ratio of mean-square signal to signal variance after 13 min of coherent integration. The data in this report represent effective noise at a center frequency of 76 Hz (i.e., the injected calibration signal used for a reference was at 76 Hz). Superimposed on the scatter plot are two lines that represent the noisiest day (days 29/30) and the quietest day (days 17/18) of the month. The Julian day number designation will be used throughout this report—in this case, two day numbers appear in each citation because data tapes extended across midnight Universal Time (UT).

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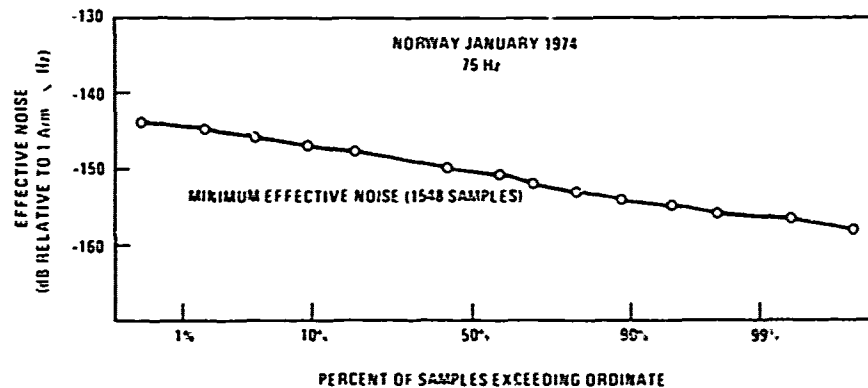


Fig. 2—Cumulative probability distribution of minimum effective noise samples for January 1974

The diurnal variation of about 6 dB in mean noise from a minimum at 04-08 UT to a maximum at 14-18 UT is evident in Fig. 1. It is worthy of note that the disparity between the noisiest and quietest days of the month is greatest in the 06-10 UT interval, when the sunrise terminator passes over the receiving site and regions south, producing instability in ionospheric conditions that affects the propagation of noise northward from more southerly latitudes. This disparity probably is more evident in these winter data than in data from other seasons because the trajectory of the terminator approaches the receiving site more rapidly and from farther south in the winter. Its effect on noise propagating northward is thus more pronounced.

To describe noise conditions indicated by the noisy- and quiet-day extremes in Fig. 1, Tables 1-4 contain information on the individual 13-min noise samples that make up each of these days' data. Table 1 contains 84 samples from the quieter day, tabulated by Julian day number and UT. The six columns represent effective noise in dBH for five of the six signal processor channels in inverse order of clipping vigor, with the minimum of the six effective noise levels in the right-hand column. As a matter of convenience, the sixth clipper output is not shown (not enough columns were available on the computer output printer), but this clipper was never the best one. The clipping levels used in these and other cases to be discussed below were -116 dBH (Column 5) to -140 dBH (Column 1) in 6-dB increments.

The minimum effective noise level for each sample is also boxed in its appropriate clipper's column so that temporal variation of optimum clipping level can readily be observed. Two important points can be inferred from Table 1:

- There is a gradual, systematic, 12-dB variation in best clip level with time, presumably following the diurnal changes in noise conditions.
- The difference in effective noise level among columns 1-3 is seldom more than a few tenths of a decibel.

DAVIS AND MEYERS

Table 1 -- Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 17 and 18, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1A, 0%, 70)					
			1	2	3	4	5	MIN
1	017	20 31 33	151.2	151.3	151.5	151.5	150.4	151.5
2	017	20 34 39	151.0	151.0	151.3	151.0	149.6	151.4
3	017	20 37 43	150.9	151.1	151.2	151.1	150.1	151.2
4	017	21 10 32	150.8	150.7	151.0	150.5	149.2	151.0
5	017	21 21 40	150.7	150.5	150.8	150.6	149.7	150.9
6	017	21 32 05	151.1	151.2	151.5	151.1	149.9	151.3
7	017	21 50 11	152.3	152.1	152.3	152.1	151.0	152.3
8	017	22 03 17	151.7	151.7	152.1	152.0	150.7	152.1
9	017	22 16 23	151.9	152.1	152.1	151.7	150.7	152.1
10	017	22 19 30	151.8	152.1	152.1	151.4	150.5	152.1
11	017	22 42 36	152.2	152.0	152.0	151.9	150.6	152.2
12	017	22 55 42	151.6	151.7	151.8	151.5	150.5	151.8
13	017	23 08 49	152.6	151.6	152.0	151.9	150.3	152.6
14	017	23 21 55	151.4	151.7	151.8	151.5	150.0	151.9
15	017	23 35 01	152.0	151.7	152.1	151.1	150.1	152.1
16	017	23 48 07	151.4	151.6	152.0	151.5	150.1	152.0
17	018	00 01 14	151.8	151.6	151.6	150.7	149.4	151.9
18	018	00 14 20	152.0	152.3	152.4	151.6	150.3	152.6
19	018	00 27 26	152.2	151.9	152.1	151.6	150.0	152.2
20	018	00 40 32	152.5	151.9	152.2	151.5	150.4	152.3
21	018	00 53 39	152.6	152.0	152.3	151.9	150.3	152.4
22	018	01 06 45	152.0	152.0	152.3	152.3	150.9	152.6
23	018	01 19 51	152.9	152.6	152.7	152.3	150.8	152.1
24	018	01 32 57	152.2	152.1	152.5	151.9	150.7	152.3
25	018	01 46 03	152.5	152.7	153.1	151.7	150.4	153.1
26	018	01 59 10	152.8	153.2	153.6	152.5	151.4	153.8
27	018	02 12 16	153.4	153.6	154.1	152.9	151.0	154.3
28	018	02 25 22	153.1	152.8	153.5	152.6	151.3	154.3
29	018	02 38 28	152.3	151.4	152.0	151.5	150.9	152.3
30	018	02 51 35	152.5	152.0	152.5	152.6	151.0	153.5
31	018	03 04 41	152.0	151.2	151.6	152.6	151.1	153.6
32	018	03 17 47	153.0	152.7	153.1	152.0	150.8	153.1
33	018	03 30 53	154.4	153.2	153.7	152.4	151.1	154.4
34	018	03 44 00	154.7	153.9	154.6	153.0	151.6	154.7
35	018	03 57 06	153.5	154.2	154.7	152.3	151.0	155.5
36	018	04 10 12	153.5	153.7	154.2	152.6	151.4	155.3
37	018	04 23 19	153.7	153.6	154.6	152.9	151.4	155.7
38	018	04 36 25	152.7	154.5	155.3	152.7	152.2	156.1
39	018	04 49 31	156.6	154.6	155.6	154.1	152.2	156.6
40	018	05 02 37	156.9	154.4	155.5	153.8	152.5	156.9
41	018	05 15 44	156.7	154.7	156.5	154.5	152.9	156.8
42	018	05 28 50	156.9	154.9	156.3	155.7	152.6	156.6
43	018	05 41 56	156.5	154.1	155.2	153.6	152.2	156.5
44	018	05 55 02	157.0	154.7	155.4	152.7	152.1	157.9
45	018	06 08 09	156.5	154.1	155.2	154.3	152.9	156.5
46	018	06 21 15	156.3	154.3	155.5	154.0	152.6	156.3
47	018	06 34 21	157.8	154.5	155.8	152.9	152.4	157.8
48	018	06 47 27	156.7	154.1	155.2	153.4	152.9	156.7
49	018	07 00 34	156.4	154.0	155.2	153.4	151.7	156.8
50	018	07 13 40	156.5	154.3	155.4	152.9	152.5	156.8
51	018	07 26 46	156.3	154.6	155.4	153.4	152.3	156.7
52	018	07 39 52	155.7	153.9	154.5	152.9	151.5	155.2
53	018	07 52 59	155.9	154.1	154.9	153.1	152.0	155.9
54	018	08 06 05	157.0	154.4	155.7	154.3	153.2	157.4
55	018	08 19 11	153.7	153.5	154.2	153.5	152.4	154.2
56	018	08 32 17	152.9	153.0	154.0	153.7	152.0	154.4
57	018	08 45 24	156.5	154.2	155.2	153.5	152.3	156.5
58	018	08 58 30	155.6	154.1	155.1	154.0	152.5	155.6
59	018	09 11 36	154.0	152.8	153.7	152.5	151.5	154.0
60	018	09 24 42	153.0	152.7	153.3	152.3	151.4	153.4
61	018	09 37 49	155.6	153.8	154.6	153.1	151.4	155.6
62	018	09 50 55	154.7	153.4	154.7	152.5	151.9	154.7
63	018	10 04 01	151.9	152.1	153.1	153.9	150.7	153.1
64	018	10 17 07	153.1	152.3	153.4	152.5	151.3	153.4
65	018	10 30 14	152.7	153.6	154.7	153.4	151.9	154.1
66	018	10 43 20	152.2	152.3	152.5	152.0	150.5	152.5
67	018	10 56 26	152.9	152.3	153.6	152.9	151.2	152.6
68	018	11 09 32	152.5	152.3	152.6	152.3	151.9	152.6
69	018	11 22 38	152.1	152.2	152.5	152.7	151.2	152.5
70	018	11 35 45	151.7	152.0	152.5	152.4	151.2	152.5
71	018	11 48 51	152.3	152.2	152.4	151.3	150.0	152.4
72	000	00 01 14	149.9	149.7	149.8	141.0	140.7	141.3
73	018	12 14 21	151.6	151.0	151.3	150.7	150.0	151.6
74	018	12 27 27	151.6	151.4	151.4	150.4	149.8	151.4
75	018	12 40 33	150.8	150.5	150.6	149.8	148.9	150.8
76	018	12 53 40	150.6	150.2	150.2	149.7	148.7	150.4
77	018	13 06 46	149.7	150.1	150.2	149.6	148.6	149.2
78	018	13 19 52	149.7	150.7	150.0	149.1	148.0	149.2
79	018	13 33 00	149.7	149.6	149.8	149.1	148.1	149.6
80	018	13 46 06	149.1	149.3	149.2	149.0	148.2	149.3
81	018	14 00 12	149.0	149.5	149.5	149.3	147.9	149.0
82	018	14 13 18	149.0	149.9	149.7	149.1	147.4	149.9
83	018	14 26 24	149.6	149.8	149.9	149.3	147.8	149.9
84	018	14 39 30	143.5	142.5	143.8	143.4	144.0	144.0

*REFERENCE ERROR

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Table 2 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian
Days 17 and 18, 1974

	1	2	3	4	5	MIN
DAILY MEAN	-132.1	-132.3	-132.4	-131.9	-130.7	-133.2
STANDARD DEV	2.9	2.3	2.5	2.0	1.8	2.7

PROBABILITY DENSITY						
-154.0	1 1.2	0 0.0	0 0.0	0 0.0	0 0.0	1 1.2
-153.0	3 3.6	0 0.0	0 0.0	0 0.0	0 0.0	2 3.6
-152.0	11 12.1	0 0.0	1 1.2	0 0.0	0 0.0	11 12.1
-151.0	8 9.5	1 1.2	16 19.9	0 0.0	0 0.0	8 9.5
-150.0	5 6.0	17 20.2	12 14.3	5 6.0	0 0.0	6 9.5
-149.0	12 14.3	17 20.2	15 17.9	16 21.4	1 1.2	13 15.5
-148.0	16 19.9	20 22.8	15 17.9	22 26.2	1 1.2	17 20.2
-147.0	24 16.7	15 17.9	12 14.3	22 26.2	23 27.4	19 11.9
-146.0	5 6.0	7 8.3	6 7.1	6 7.1	23 27.4	6 7.1
-145.0	4 4.8	2 2.4	2 2.4	5 6.0	9 10.7	2 2.4
-144.0	3 3.6	3 3.6	3 3.6	4 4.8	6 7.1	3 3.6
-143.0	2 0.0	0 0.0	0 0.0	3 3.6	3 3.6	0 0.0
-142.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.2	1 1.2
-141.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
-140.0	1 1.2	1 1.2	1 1.2	1 1.2	1 1.2	1 1.2

CUMULATIVE PROBABILITY DISTRIBUTION						
-154.0	1 1.2	0 0.0	0 0.0	0 0.0	0 0.0	1 1.2
-153.0	4 4.8	0 0.0	0 0.0	0 0.0	0 0.0	4 4.8
-152.0	15 17.9	0 0.0	1 1.2	0 0.0	0 0.0	15 17.9
-151.0	23 27.4	1 1.2	17 20.2	0 0.0	0 0.0	23 27.4
-150.0	29 33.3	16 19.9	29 33.3	5 6.0	0 0.0	29 33.3
-149.0	49 57.6	33 41.7	44 52.4	23 27.4	1 1.2	44 52.4
-148.0	64 66.7	50 57.6	59 66.7	45 52.4	16 21.4	61 72.4
-147.0	70 83.3	70 83.3	71 84.5	67 79.4	41 49.6	71 84.5
-146.0	75 89.3	77 91.7	77 91.7	73 86.9	64 76.2	77 91.7
-145.0	79 94.9	79 94.9	79 94.9	79 94.9	73 86.9	79 94.9
-144.0	82 97.6	82 97.6	82 97.6	82 97.6	79 94.9	82 97.6
-143.0	82 97.6	82 97.6	82 97.6	82 97.6	81 97.6	82 97.6
-142.0	82 97.6	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4
-141.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-140.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-139.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-138.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-137.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-136.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-135.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-134.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-133.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-132.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-131.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4
-130.0	82 97.6	82 97.6	82 97.6	83 99.4	83 99.4	83 99.4

Table 2 contains a correlation of noise statistics for quieter day's data, showing in the upper block the daily mean and standard deviation of effective noise, both from each of the five columns and from the minimum-noise column. Notice that either column 1 or column 3 alone is within 0.4 dB of providing the minimum mean effective noise. Also shown in Table 2 are a probability density and cumulative probability distribution for all of the samples from the six columns.

Table 3 contains a sample-by-sample tabulation for the noisier day of Fig. 1. Once again there is a general diurnal shift of best clip level, but the tendency is far less uniform for this noisy day than for quiet conditions. Nevertheless, the difference in effective noise level among the columns is very small, and in only a few cases is there more than a few tenths of a decibel difference among columns 1-4. The upper block in Table 4 confirms this circumstance. The lower blocks, as above, contain statistical data for the six columns.

Table 3 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 29 and 30, 1974 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE SPIN LEVEL (% RELATIVE TO LAW-20)					
			1	2	3	4	5	6
12	030	00	167.2	167.2	167.2	167.9	168.2	167.9
13	030	00	167.4	167.4	167.4	168.1	168.5	167.8
14	030	00	169.3	169.4	169.3	169.3	167.2	169.6
15	030	00	167.7	167.7	167.7	167.3	168.5	167.8
16	030	00	168.2	168.3	168.4	167.9	168.2	168.2
17	030	00	168.3	168.4	168.4	167.7	167.9	168.3
18	030	00	168.1	168.2	168.1	167.9	167.2	168.2
19	030	00	167.7	167.8	167.9	167.2	168.5	167.9
20	030	00	168.9	168.9	168.4	168.4	165.9	167.3
21	030	00	168.1	168.7	168.4	168.3	165.9	168.2
22	030	00	165.2	167.6	165.1	165.1	164.4	163.6
23	030	00	165.9	166.2	166.1	166.9	165.3	166.2
24	030	00	165.2	167.6	165.1	165.1	164.4	163.6
25	030	00	165.9	166.2	166.1	166.9	165.3	166.2
26	030	00	166.9	167.2	166.9	166.7	165.4	167.2
27	030	00	167.3	167.3	167.3	167.2	166.4	167.1
28	030	00	167.3	167.3	167.3	167.2	166.4	167.1
29	030	00	167.3	167.3	167.3	167.2	166.4	167.1
30	030	00	167.3	167.3	167.3	167.2	166.4	167.1
31	030	00	167.3	167.3	167.3	167.2	166.4	167.1
32	030	00	167.3	167.3	167.3	167.2	166.4	167.1
33	030	00	167.3	167.3	167.3	167.2	166.4	167.1
34	030	00	167.3	167.3	167.3	167.2	166.4	167.1
35	030	00	167.3	167.3	167.3	167.2	166.4	167.1
36	030	00	167.3	167.3	167.3	167.2	166.4	167.1
37	030	00	167.3	167.3	167.3	167.2	166.4	167.1
38	030	00	167.3	167.3	167.3	167.2	166.4	167.1
39	030	00	167.3	167.3	167.3	167.2	166.4	167.1
40	030	00	167.3	167.3	167.3	167.2	166.4	167.1
41	030	00	167.3	167.3	167.3	167.2	166.4	167.1
42	030	00	167.3	167.3	167.3	167.2	166.4	167.1
43	030	00	167.3	167.3	167.3	167.2	166.4	167.1
44	030	00	167.3	167.3	167.3	167.2	166.4	167.1
45	030	00	167.3	167.3	167.3	167.2	166.4	167.1
46	030	00	167.3	167.3	167.3	167.2	166.4	167.1
47	030	00	167.3	167.3	167.3	167.2	166.4	167.1
48	030	00	167.3	167.3	167.3	167.2	166.4	167.1
49	030	00	167.3	167.3	167.3	167.2	166.4	167.1
50	030	00	167.3	167.3	167.3	167.2	166.4	167.1
51	030	00	167.3	167.3	167.3	167.2	166.4	167.1
52	030	00	167.3	167.3	167.3	167.2	166.4	167.1
53	030	00	167.3	167.3	167.3	167.2	166.4	167.1
54	030	00	167.3	167.3	167.3	167.2	166.4	167.1
55	030	00	167.3	167.3	167.3	167.2	166.4	167.1
56	030	00	167.3	167.3	167.3	167.2	166.4	167.1
57	030	00	167.3	167.3	167.3	167.2	166.4	167.1
58	030	00	167.3	167.3	167.3	167.2	166.4	167.1
59	030	00	167.3	167.3	167.3	167.2	166.4	167.1
60	030	00	167.3	167.3	167.3	167.2	166.4	167.1
61	030	00	167.3	167.3	167.3	167.2	166.4	167.1
62	030	00	167.3	167.3	167.3	167.2	166.4	167.1
63	030	00	167.3	167.3	167.3	167.2	166.4	167.1
64	030	00	167.3	167.3	167.3	167.2	166.4	167.1
65	030	00	167.3	167.3	167.3	167.2	166.4	167.1
66	030	00	167.3	167.3	167.3	167.2	166.4	167.1
67	030	00	167.3	167.3	167.3	167.2	166.4	167.1
68	030	00	167.3	167.3	167.3	167.2	166.4	167.1
69	030	00	167.3	167.3	167.3	167.2	166.4	167.1
70	030	00	167.3	167.3	167.3	167.2	166.4	167.1
71	030	00	167.3	167.3	167.3	167.2	166.4	167.1
72	030	00	167.3	167.3	167.3	167.2	166.4	167.1
73	030	00	167.3	167.3	167.3	167.2	166.4	167.1
74	030	00	167.3	167.3	167.3	167.2	166.4	167.1
75	030	00	167.3	167.3	167.3	167.2	166.4	167.1
76	030	00	167.3	167.3	167.3	167.2	166.4	167.1
77	030	00	167.3	167.3	167.3	167.2	166.4	167.1
78	030	00	167.3	167.3	167.3	167.2	166.4	167.1
79	030	00	167.3	167.3	167.3	167.2	166.4	167.1
80	030	00	167.3	167.3	167.3	167.2	166.4	167.1
81	030	00	167.3	167.3	167.3	167.2	166.4	167.1
82	030	00	167.3	167.3	167.3	167.2	166.4	167.1
83	030	00	167.3	167.3	167.3	167.2	166.4	167.1
84	030	00	167.3	167.3	167.3	167.2	166.4	167.1
85	030	00	167.3	167.3	167.3	167.2	166.4	167.1
86	030	00	167.3	167.3	167.3	167.2	166.4	167.1
87	030	00	167.3	167.3	167.3	167.2	166.4	167.1
88	030	00	167.3	167.3	167.3	167.2	166.4	167.1
89	030	00	167.3	167.3	167.3	167.2	166.4	167.1
90	030	00	167.3	167.3	167.3	167.2	166.4	167.1
91	030	00	167.3	167.3	167.3	167.2	166.4	167.1
92	030	00	167.3	167.3	167.3	167.2	166.4	167.1
93	030	00	167.3	167.3	167.3	167.2	166.4	167.1
94	030	00	167.3	167.3	167.3	167.2	166.4	167.1
95	030	00	167.3	167.3	167.3	167.2	166.4	167.1
96	030	00	167.3	167.3	167.3	167.2	166.4	167.1
97	030	00	167.3	167.3	167.3	167.2	166.4	167.1
98	030	00	167.3	167.3	167.3	167.2	166.4	167.1
99	030	00	167.3	167.3	167.3	167.2	166.4	167.1
100	030	00	167.3	167.3	167.3	167.2	166.4	167.1
101	030	00	167.3	167.3	167.3	167.2	166.4	167.1
102	030	00	167.3	167.3	167.3	167.2	166.4	167.1
103	030	00	167.3	167.3	167.3	167.2	166.4	167.1
104	030	00	167.3	167.3	167.3	167.2	166.4	167.1
105	030	00	167.3	167.3	167.3	167.2	166.4	167.1
106	030	00	167.3	167.3	167.3	167.2	166.4	167.1
107	030	00	167.3	167.3	167.3	167.2	166.4	167.1
108	030	00	167.3	167.3	167.3	167.2	166.4	167.1
109	030	00	167.3	167.3	167.3	167.2	166.4	167.1
110	030	00	167.3	167.3	167.3	167.2	166.4	167.1
111	030	00	167.3	167.3	167.3	167.2	166.4	167.1
112	030	00	167.3	167.3	167.3	167.2	166.4	167.1
113	030	00	167.3	167.3	167.3	167.2	166.4	167.1
114	030	00	167.3	167.3	167.3	167.2	166.4	167.1
115	030	00	167.3	167.3	167.3	167.2	166.4	167.1
116	030	00	167.3	167.3	167.3	167.2	166.4	167.1
117	030	00	167.3	167.3	167.3	167.2	166.4	167.1
118	030	00	167.3	167.3	167.3	167.2	166.4	167.1
119	030	00	167.3	167.3	167.3	167.2	166.4	167.1
120	030	00	167.3	167.3	167.3	167.2	166.4	167.1
121	030	00	167.3	167.3	167.3	167.2	166.4	167.1
122	030	00	167.3	167.3	167.3	167.2	166.4	167.1
123	030	00	167.3	167.3	167.3	167.2	166.4	167.1
124	030	00	167.3	167.3	167.3	167.2	166.4	167.1
125	030	00	167.3	167.3	167.3	167.2	166.4	167.1
126	030	00	167.3	167.3	167.3	167.2	166.4	167.1
127	030	00	167.3	167.3	167.3	167.2	166.4	167.1
128	030	00	167.3	167.3	167.3	167.2	166.4	167.1
129	030	00	167.3	167.3	167.3	167.2	166.4	167.1
130	030	00	167.3	167.3	167.3	167.2	166.4	167.1
131	030	00	167.3	167.3	167.3	167.2	166.4	167.1
132	030	00	167.3	167.3	167.3	167.2	166.4	167.1
133	030	00	167.3	167.3	167.3	167.2	166.4	167.1
134	030	00	167.3	167.3	167.3	167.2	166.4	167.1
135	030	00	167.3	167.3	167.3	167.2	166.4	167.1
136	030	00	167.3	167.3	167.3	167.2	166.4	167.1
137	030	00	167.3	167.3	167.3	167.2	166.4	167.1
138	030	00	167.3	167.3	167.3	167.2	166.4	167.1
139	030	00	167.3	167.3	167.3	167.2	166.4	167.1
140	030	00	167.3	167.3	167.3	167.2	166.4	167.1
141	030	00	167.3	167.3	167.3	167.2	166.4	167.1
142	030	00	167.3	167.3	167.3	167.2	166.4	167.1
143	030	00	167.3	167.3	167.3	167.2	166.4	167.1
144	030	00	167.3	167.3	167.3	167.2	166.4	167.1
145	030	00	167.3	167.3	167.3	167.2	166.4	167.1
146	030	00	167.3	167.3	167.3	167.2	166.4	167.1
147	030	00	167.3	167.3	167.3	167.2	166.4	167.1
148	030	00	167.3	167.3	167.3	167.2	166.4	167.1
149	030	00	167.3	167.3	167.3	167.2	166.4	167.1
150	030	00	167.3	167.3	167.3	167.2	166.4	167.1
151	030	00	167.3	167.3	167.3	167.2	166.4	167.1
152	030	00	167.3	167.3	167.3	167.2	166.4	167.1
153	030	00	167.3	167.3	167.3	167.2	166.4	167.1
154	030							

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**Table 4 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian
Days 29 and 30, 1974**

	1	2	3	4	5	MIN
DAILY MEAN	-148.2	-148.4	-148.3	-148.1	-147.3	-148.5
STANDARD DEV	2.2	2.2	2.3	2.1	1.9	2.2

PROBABILITY DENSITY

-152.0	1	1.0	2	1.9	4	3.9	0	0.0	0	0.0	5	4.9
-151.0	13	12.6	15	14.6	17	16.6	13	12.6	0	0.0	17	16.6
-150.0	16	15.6	13	12.6	10	9.7	14	13.6	11	10.7	9	8.7
-149.0	11	10.7	13	12.6	11	10.7	10	9.7	14	13.6	12	11.7
-148.0	11	10.7	13	12.6	9	8.7	12	11.7	16	15.6	13	12.6
-147.0	16	15.6	15	14.6	19	18.4	16	15.6	16	15.6	17	16.6
-146.0	10	9.7	14	13.6	11	10.7	11	10.7	16	15.6	12	11.7
-145.0	21	20.1	15	14.6	16	15.6	18	17.6	21	20.1	15	14.6
-144.0	2	1.9	3	2.9	5	4.9	6	4.9	8	7.8	2	1.9
-143.0	2	1.9	1	1.0	1	1.0	1	1.0	1	1.0	1	1.0
-142.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-152.0	1	1.0	2	1.9	4	3.9	0	0.0	0	0.0	5	4.9
-151.0	14	13.6	17	16.6	21	20.1	13	12.6	0	0.0	22	21.4
-150.0	30	29.1	30	29.1	31	30.1	27	26.2	11	10.7	31	30.1
-149.0	41	39.8	43	41.7	42	40.8	37	36.0	25	24.3	43	41.7
-148.0	52	50.5	56	54.1	51	49.5	50	48.5	40	38.8	56	54.1
-147.0	68	66.0	71	68.9	70	68.0	68	66.0	56	54.1	73	70.9
-146.0	78	75.7	81	81.6	81	78.6	74	72.7	72	69.9	85	82.5
-145.0	90	88.1	90	88.1	97	94.2	97	94.2	93	90.3	100	97.1
-144.0	101	98.1	102	99.0	102	99.0	102	99.0	101	98.1	102	99.0
-143.0	102	100.0	103	100.0	103	100.0	103	100.0	102	99.0	103	100.0
-142.0	103	100.0	104	100.0	103	100.0	104	100.0	103	100.0	103	100.0

Table 5 contains similar statistical data from all of the 1548 samples taken during January 1974 for the five clip levels and for the sample-by-sample minimum effective noise (sixth) column. Figure 2 is the cumulative probability distribution for the minimum effective noise column of Table 5, showing evident log-normalcy for the entire body of data.

While these data are fresh in the reader's mind, it is appropriate to draw a conclusion that will be seen to be borne out by further examples to be presented below: the difference in performance between processing channels with 6-18 dB separation in clip level is small. Intelligent placement of one or two clippers at levels based on seasonal average noise levels will nearly always provide effective noise within a few tenths of a decibel of the minimum level.

Figures 3 and 4 and Tables 6-9 contain similar data from March 1974. Figure 3 shows somewhat higher effective noise levels and a somewhat less pronounced difference between noisy-day and quiet-day levels in the 06-10 UT interval. Table 6 contains a sample-by-sample tabulation of the quiet-day (days 77/78) data from Fig. 3, with once again an orderly shift of clip level among the channels with time. Toward the end of the day noise began to rise and the orderly progression among processor channels ceased. Under quiet conditions early in the day, columns 3 and 4 were separated by 0.1 to 0.4 dB in effective noise level, and as conditions became noisier toward the end of the day columns 1-4 provided similar performance. This trend of noisy conditions to equalize

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Table 5 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, January 1974

	PROBABILITY DENSITY					
	1	2	3	4	5	MIN
-158.0	2 01	0 00	0 00	0 00	0 00	2 01
-157.0	5 03	0 00	3 02	1 01	0 00	6 04
-156.0	20 13	1 03	13 08	6 04	0 00	30 19
-155.0	19 12	14 09	51 33	71 22	4 03	42 27
-154.0	35 23	54 37	84 54	74 18	22 14	92 59
-153.0	79 51	116 75	132 85	101 67	56 36	126 81
-152.0	176 114	172 112	167 108	170 110	103 67	182 118
-151.0	21 140	218 141	191 123	174 112	165 107	168 109
-150.0	262 163	263 170	229 148	215 139	186 120	242 156
-149.0	247 160	227 147	210 136	214 160	245 158	207 134
-148.0	145 120	187 121	173 116	197 127	255 165	180 116
-147.0	135 87	129 83	128 81	158 103	231 119	124 80
-146.0	79 51	85 55	77 50	85 51	148 98	83 54
-145.0	52 41	45 29	54 35	54 35	84 57	42 27
-144.0	21 14	16 10	20 13	20 13	31 20	16 10
-143.0	7 05	5 03	5 03	2 01	8 05	1 01
-142.0	1 01	2 01	0 00	0 00	1 01	0 00
-141.0	2 01	3 02	3 02	2 01	1 01	3 02
-140.0	3 02	2 01	2 01	2 01	3 02	2 01
-139.0	0 00	0 00	0 00	1 01	0 00	0 00
-138.0	1 01	0 00	0 00	0 00	1 01	0 00
-137.0	0 00	1 01	0 00	0 00	0 00	0 00

	CUMULATIVE PROBABILITY DISTRIBUTION					
	1	2	3	4	5	MIN
158.0	2 01	0 00	0 00	0 00	0 00	2 01
157.0	7 05	0 00	3 02	1 01	0 00	8 05
156.0	27 17	1 03	16 10	7 05	0 00	38 25
155.0	46 30	18 12	67 13	11 26	4 03	80 52
154.0	81 52	76 49	151 98	115 74	26 17	172 11
153.0	160 103	192 124	283 183	219 141	82 53	298 193
152.0	336 217	365 236	450 291	389 251	185 120	480 310
151.0	553 357	543 377	641 414	563 364	350 226	648 419
150.0	815 526	816 547	870 562	778 503	536 346	840 575
149.0	1062 686	1073 693	1040 698	1026 661	781 505	1097 709
148.0	1217 806	1260 814	1259 813	1223 790	1036 668	1277 825
147.0	1382 893	1389 897	1387 896	1382 893	1267 818	1401 965
146.0	1461 914	1474 952	1465 946	1467 948	1415 914	1484 959
145.0	1514 977	1519 981	1518 981	1521 983	1503 971	1526 986
144.0	1534 991	1535 992	1538 994	1541 995	1531 991	1542 996
143.0	1541 995	1540 995	1543 997	1543 997	1542 996	1543 997
142.0	1542 996	1542 996	1543 997	1543 997	1543 997	1543 997
141.0	1544 997	1545 998	1546 999	1545 998	1544 997	1546 999
140.0	1547 999	1547 999	1548 1000	1547 999	1547 999	1548 1000
139.0	1547 999	1547 999	1548 1000	1548 1000	1547 999	1548 1000
138.0	1548 1000	1547 998	1548 1000	1548 1000	1548 1000	1548 1000
137.0	1548 1000	1548 1000	1548 1000	1548 1000	1548 1000	1548 1000

clipper performance was also evident in the January 1974 data. Table 7 contains statistical data for the data in Table 6, indicating very little difference in performance between channels 3 and 4 (although the comparison is muddled in this case, because noise conditions changed during the day).

Table 8 contains a sample-by-sample tabulation of the noisy-day (days 85/86) data from Fig. 3, showing the less orderly shift among clippers coupled with lesser performance distinction between clipper channels, which has been suggested above as characteristic of noisy conditions. A quiet interval between 00 UT and 05 UT can be discerned on Table 8 by the consistency of the best clipper choice, as well as by the low effective noise levels. Table 9 contains statistical information for the noisy-day data, confirming the extremely small variability of clipper performance among four of the five channels.

Figure 4 shows the cumulative probability distribution for the March 1974 minimum effective noise data, compared with noise measured simultaneously on a narrowband (1-Hz) recording channel without wideband nonlinear processing and averaged over a 1-h period. This comparison indicates that nonlinear noise processing provides at least 10 dB of improvement over conditions in which no pre-filtering processing is attempted. However, because the narrowband noise data were recorded on analog tape with no more than 40 dB of linear dynamic range some of the highest amplitude noise pulses were

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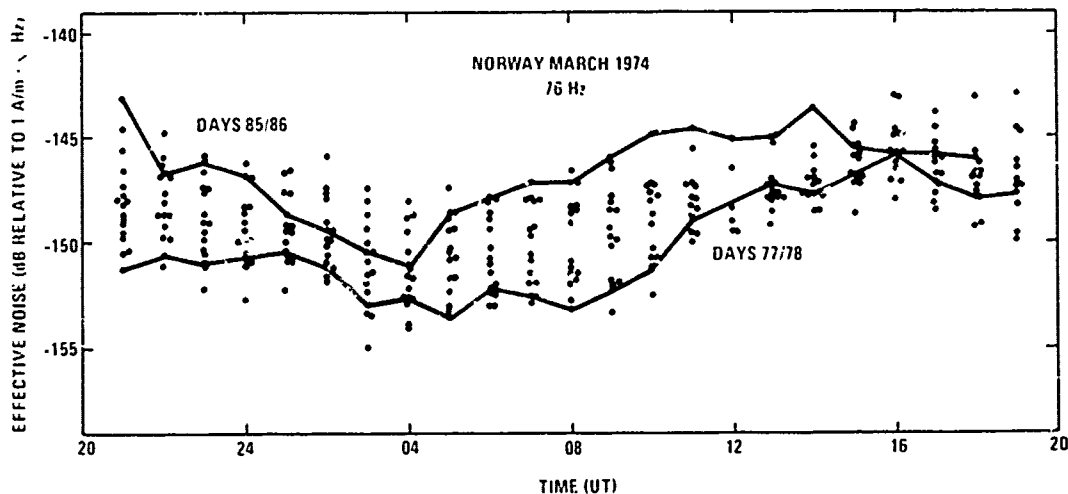


Fig. 3—Hourly samples of minimum effective noise, each averaged over 13 min, for March 1974. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

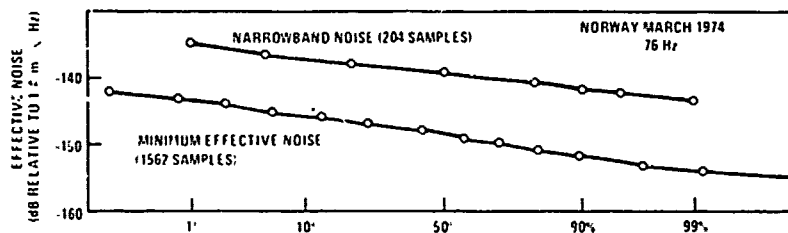


Fig. 4—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for March 1974

inadvertently clipped in the recording system, and the narrowband noise values thus are underestimated by an unknown amount. The frequency of large-amplitude noise pulses is quite low in winter conditions, when thunderstorm centers are far removed from the receiving site, and the March 1974 narrowband noise estimates are probably reliable. However, for summer conditions the opposite is true. Consequently, the tentative view expressed by Meyers and Davis [1] that improvements in S/N due to nonlinear processing are greater under low-noise (winter) conditions than under high-noise (summer) conditions is probably incorrect. It should be understood that the actual effective noise levels reported here and by Meyers and Davis [1] are correct, and only their comparison under high-noise conditions with narrowband noise estimates is of limited validity.

Figures 5-6 and Tables 10-14 contain data from March 1975. The diurnal behavior and the mean effective noise levels are similar to the March 1974 data, but the low-noise data (days 66/67) are extremely low and represent unusually quiet conditions. Table 10

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Table 6 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 77 and 78, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m ² √Hz)					
			1	2	3	4	5	MIN
1	077	20 35 25	-148.3	-148.9	-150.2	-150.6	-149.3	-150.6
2	077	20 48 32	-148.7	-149.3	-150.7	-150.9	-149.4	-150.9
3	077	21 01 39	-149.0	-149.1	-150.7	-151.2	-149.8	-151.2
4	077	21 14 45	-148.3	-148.1	-150.3	-150.7	-149.5	-150.7
5	077	21 27 52	-148.6	-149.2	-150.6	-150.7	-149.1	-150.7
6	077	21 40 59	-148.3	-148.9	-150.3	-150.5	-149.2	-150.5
7	077	21 54 05	-147.8	-148.5	-150.0	-150.6	-149.3	-150.6
8	077	22 07 12	-148.2	-149.3	-150.8	-151.0	-149.7	-151.0
9	077	22 20 18	-148.4	-149.1	-150.8	-151.0	-149.9	-151.0
10	077	22 33 25	-148.1	-148.7	-150.4	-151.0	-149.6	-151.0
11	077	22 46 32	-148.4	-149.1	-150.5	-150.8	-149.8	-150.9
12	077	22 59 38	-148.5	-149.1	-150.6	-150.9	-150.0	-150.9
13	077	23 12 45	-148.7	-149.4	-150.8	-151.7	-150.5	-151.7
14	077	23 25 51	-148.3	-149.1	-150.2	-150.3	-149.0	-150.3
15	077	23 38 58	-149.4	-149.3	-150.5	-150.8	-149.7	-150.8
16	077	23 52 04	-148.8	-149.6	-150.7	-150.8	-149.7	-150.7
17	077	00 05 11	-148.5	-149.2	-150.6	-150.7	-149.4	-150.7
18	078	00 18 17	-148.2	-149.0	-150.7	-151.5	-149.8	-151.5
19	078	00 31 24	-148.4	-149.0	-150.4	-151.2	-149.9	-151.2
20	078	00 44 31	-148.5	-148.9	-150.5	-150.6	-149.3	-150.6
21	078	00 57 37	-147.8	-148.5	-150.0	-150.4	-149.0	-150.4
22	078	01 10 44	-148.7	-149.3	-150.7	-150.7	-149.0	-150.7
23	078	01 23 50	-148.3	-149.0	-150.4	-150.8	-149.7	-150.8
24	078	01 36 57	-148.0	-148.6	-150.2	-150.5	-149.5	-150.5
25	078	01 50 03	-149.0	-149.7	-151.1	-151.7	-150.3	-151.7
26	078	02 03 10	-148.6	-149.4	-150.6	-151.1	-149.8	-151.1
27	078	02 16 16	-149.5	-150.1	-151.3	-151.0	-149.6	-151.5
28	078	02 29 23	-149.0	-149.8	-151.2	-151.3	-150.1	-151.3
29	078	02 42 30	-150.2	-150.9	-152.2	-152.0	-151.1	-152.2
30	078	02 55 36	-150.4	-151.1	-152.9	-152.7	-151.6	-152.9
31	078	03 08 43	-151.4	-152.0	-153.5	-152.7	-151.6	-153.5
32	078	03 21 49	-152.3	-152.8	-154.5	-153.8	-152.6	-154.5
33	078	03 34 56	-151.8	-152.2	-154.1	-153.3	-151.9	-154.1
34	078	03 48 02	-150.6	-151.1	-153.7	-152.9	-152.3	-153.7
35	078	04 01 09	-150.3	-150.7	-153.6	-152.8	-151.8	-153.6
36	078	04 14 16	-150.5	-151.4	-153.2	-152.3	-151.2	-153.2
37	078	04 27 22	-150.3	-150.5	-153.1	-151.3	-150.3	-151.9
38	078	04 40 29	-150.4	-151.2	-152.9	-152.6	-151.2	-152.9
39	078	04 53 35	-151.2	-151.5	-153.0	-152.0	-151.1	-153.0
40	078	05 06 42	-152.0	-152.1	-153.7	-152.6	-151.7	-153.7
41	078	05 19 48	-150.5	-151.1	-152.3	-151.7	-150.5	-152.3
42	078	05 32 55	-150.6	-151.2	-152.1	-151.3	-150.1	-152.1
43	078	05 46 02	-150.6	-151.2	-152.7	-152.0	-150.8	-152.7
44	078	05 59 08	-150.3	-150.8	-152.1	-151.5	-150.4	-152.1
45	078	06 12 15	-150.3	-150.8	-152.1	-151.5	-150.1	-152.1
46	078	06 25 22	-150.4	-151.2	-152.1	-151.6	-150.3	-152.1
47	078	06 38 28	-150.6	-151.2	-152.3	-151.9	-150.8	-152.3
48	078	06 51 34	-150.7	-151.5	-152.3	-151.5	-150.3	-152.3
49	078	07 04 41	-151.0	-151.4	-152.5	-151.8	-150.9	-152.5
50	078	07 17 48	-150.8	-151.4	-152.7	-151.3	-150.1	-152.7
51	078	07 30 54	-150.6	-151.0	-152.7	-151.9	-150.7	-152.7
52	078	07 44 01	-151.1	-151.7	-153.0	-152.1	-150.4	-153.0
53	078	07 57 07	-151.3	-151.5	-153.1	-152.5	-151.0	-153.1

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m ² √Hz)					
			1	2	3	4	5	MIN
54	078	08 10 14	-151.5	-151.7	-152.9	-151.9	-151.0	-152.9
55	078	08 23 20	-150.8	-151.2	-152.3	-151.4	-150.2	-152.3
56	078	08 36 27	-151.5	-152.5	-153.3	-152.3	-151.3	-153.3
57	078	08 49 34	-151.9	-152.1	-153.2	-151.8	-150.5	-153.2
58	078	09 02 40	-150.7	-151.2	-152.3	-151.9	-150.6	-152.3
59	078	09 15 47	-150.7	-151.5	-152.5	-151.2	-150.0	-152.5
60	078	09 28 53	-151.2	-151.5	-152.7	-152.0	-151.2	-152.7
61	078	09 42 00	-151.4	-151.8	-152.6	-151.7	-150.5	-152.6
62	078	09 55 06	-150.0	-150.7	-151.3	-150.7	-149.7	-151.3
63	078	10 08 13	-149.3	-149.6	-150.1	-149.9	-148.9	-150.1
64	078	10 21 19	-149.5	-149.6	-149.8	-149.9	-147.7	-149.8
65	078	10 34 26	-149.2	-149.7	-149.8	-149.3	-148.2	-149.8
66	078	10 47 32	-148.8	-149.0	-149.2	-148.5	-147.7	-149.2
67	078	11 00 39	-148.3	-148.6	-149.0	-148.4	-147.4	-149.0
68	078	11 13 45	-148.5	-148.4	-149.0	-148.7	-147.6	-149.0
69	078	11 26 52	-148.1	-148.1	-148.1	-147.8	-146.8	-148.1
70	078	11 39 58	-148.6	-148.6	-149.1	-148.6	-147.3	-149.1
71	078	11 53 06	-144.7	-144.8	-145.0	-145.0	-144.7	-145.0
72	078	12 06 13	-148.1	-148.4	-148.4	-148.5	-147.2	-148.4
73	078	12 19 20	-147.7	-148.1	-148.1	-147.7	-146.5	-148.1
74	078	12 32 26	-147.5	-147.5	-147.5	-147.3	-146.7	-147.5
75	078	12 45 33	-147.7	-147.7	-147.8	-147.2	-146.4	-147.8
76	078	13 03 10	-147.0	-147.2	-147.3	-147.2	-146.5	-147.3
77	078	13 16 17	-148.1	-148.2	-148.3	-148.0	-147.3	-148.3
78	078	13 29 24	-147.5	-147.1	-147.0	-146.6	-146.1	-147.1
79	078	13 42 31	-147.5	-147.3	-147.4	-147.1	-146.2	-147.4
80	078	13 55 37	-147.3	-147.6	-147.7	-147.3	-146.4	-147.7
81	078	14 08 44	-147.2	-147.3	-147.3	-146.9	-146.0	-147.3
82	078	14 21 51	-147.8	-147.9	-148.1	-147.8	-147.0	-148.1
83	078	14 34 58	-147.7	-147.6	-147.8	-147.5	-146.8	-147.8
84	078	14 48 05	-146.5	-147.3	-147.3	-147.0	-146.0	-147.3
85	078	15 01 11	-146.8	-146.7	-146.7	-146.7	-146.2	-146.8
86	078	15 14 18	-146.4	-146.6	-146.6	-146.5	-145.4	-146.6
87	078	15 27 25	-146.1	-145.7	-145.9	-145.9	-145.3	-146.1
88	078	15 40 32	-145.4	-145.7	-145.6	-145.5	-144.8	-145.7
89	078	15 53 39	-145.5	-145.7	-145.7	-145.3	-144.7	-145.7
90	078	16 06 45	-146.1	-146.0	-145.9	-145.9	-144.9	-146.1
91	078	16 19 52	-146.3	-146.0	-146.1	-145.8	-145.0	-146.3
92	078	16 32 59	-146.6	-146.9	-146.9	-146.7	-145.4	-146.9
93	078	16 46 06	-147.3	-147.6	-147.8	-147.5	-146.2	-147.8
94	078	16 59 12	-147.0	-147.0	-147.0	-146.9	-146.0	-147.0
95	078	17 12 19	-147.1	-147.4	-147.7	-147.4	-145.9	-147.7
96	078	17 25 26	-147.2	-147.6	-147.6	-147.6	-146.5	-147.6
97	078	17 38 33	-147.9	-147.9	-148.3	-148.3	-147.3	-148.3
98	078	17 51 39	-147.1	-147.2	-147.4	-147.4	-146.7	-147.4
99	078	18 04 46	-147.2	-147.6	-147.8	-147.8	-146.9	-147.8
100	078	18 17 53	-146.6	-147.1	-147.3	-147.5	-146.2	-147.6
101	078	18 31 00	-147.3	-147.3	-147.9	-147.8	-146.7	-147.9
102	078	18 44 06	-147.1	-147.0	-147.6	-147.2	-146.3	-147.4
103	078	18 57 13	-147.1	-147.1	-147.4	-147.4	-146.2	-147.4
104	078	19 10 20	-146.8	-147.1	-147.6	-147.8	-146.5	-147.8
105	078	19 23 26	-147.0	-147.3	-147.3	-147.3	-146.3	-147.3

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Table 7 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 77 and 78, 1974

	1	3	4	5	MIN	
DAILY MEAN	116.8	-1.92	150.1	149.8	-145.7	-150.2
STANDARD DEV	17	1.8	2.3	2.2	2.1	2.3

PROBABILITY DENSITY

151.0	0	0.0	0	0.0	2	1.9	0	0.0	0	0.0	2	1.9
152.0	0	0.0	0	0.0	7	6.7	2	1.9	0	0.0	7	6.7
152.6	2	1.9	6	5.7	13	21.9	12	11.4	2	1.9	23	21.9
151.0	11	10.5	21	20.0	5	1.8	27	25.7	13	12.4	11	10.5
150.0	11	20.0	8	7.6	25	23.8	21	20.6	22	21.0	20	19.0
149.0	5	1.8	23	21.9	5	1.8	2	1.9	23	21.9	1	3.8
148.6	20	24.6	15	14.1	8	7.6	7	6.7	1	3.8	8	7.6
147.6	23	21.9	21	20.0	20	19.0	21	20.0	9	8.6	21	20.0
146.0	10	9.5	6	5.7	5	1.8	7	6.7	22	21.9	6	5.7
145.6	2	1.9	1	3.8	1	3.8	6	5.7	1	1.8	3	2.9
144.0	1	1.0	1	1.0	1	1.0	0	0.0	5	4.8	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION

151.0	0	0.0	0	0.0	2	1.9	0	0.0	0	0.0	2	1.9
152.0	0	0.0	0	0.0	9	8.6	2	1.9	0	0.0	9	8.6
152.6	2	1.9	6	5.7	32	30.5	14	13.3	2	1.9	32	30.5
151.0	13	12.4	27	25.7	37	35.2	41	39.0	15	14.3	43	41.0
150.0	34	32.4	35	33.3	62	59.0	62	59.0	37	35.2	63	60.0
149.0	39	37.1	54	55.7	67	63.8	64	61.0	60	57.1	67	63.8
148.0	69	65.7	73	69.5	75	71.1	71	67.6	61	61.0	75	71.1
147.0	92	87.6	91	88.5	95	90.5	92	87.6	73	69.5	96	91.4
146.0	102	95.1	100	95.2	100	95.2	99	94.3	96	95.1	102	97.1
145.0	104	99.0	104	99.0	104	99.0	105	100.0	100	95.2	105	100.0
144.0	105	100.0	105	100.0	105	100.0	105	100.0	105	100.0	105	100.0

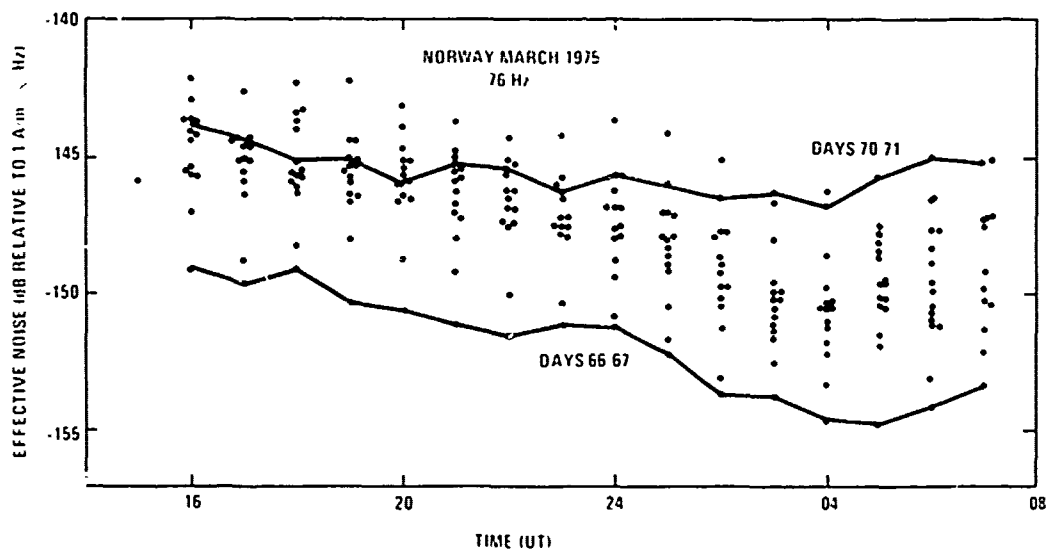


Fig. 5—Hourly samples of minimum effective noise, each averaged over 13 min, for March 1975. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

DAVIS AND MEYERS

Table 8 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 85 and 86, 1974 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m ² /√Hz)					
			1	2	3	4	5	MIN.
1	085	20 17 57	-143.4	-143.4	-142.4	-143.7	-143.1	-143.7
2	085	20 31 04	-143.3	-143.4	-142.5	-142.5	-143.0	-143.5
3	085	20 44 10	-142.7	-143.0	-142.7	-142.7	-142.2	-143.0
4	085	20 57 17	-142.7	-143.0	-142.5	-142.5	-142.2	-143.0
5	085	21 10 23	-142.8	-142.4	-142.3	-142.5	-142.1	-142.5
6	085	21 23 30	-142.9	-142.8	-142.8	-142.0	-142.3	-143.0
7	085	21 36 36	-142.7	-142.0	-142.9	-142.8	-142.3	-144.0
8	085	21 49 43	-143.9	-144.4	-144.5	-144.4	-144.3	-144.5
9	085	22 02 49	-145.4	-146.7	-146.9	-146.7	-144.6	-145.9
10	085	22 15 56	-145.0	-145.1	-145.1	-145.3	-144.4	-145.4
11	085	22 29 02	-145.2	-144.9	-144.8	-144.8	-144.3	-145.2
12	085	22 42 09	-144.8	-145.0	-145.2	-144.9	-144.0	-145.2
13	085	22 55 15	-144.1	-145.1	-145.1	-145.7	-144.8	-146.1
14	085	23 08 22	-144.1	-146.1	-146.3	-146.2	-145.7	-146.3
15	085	23 21 28	-146.2	-146.5	-146.4	-146.0	-145.1	-146.5
16	085	23 34 35	-146.2	-146.1	-146.5	-146.4	-145.6	-146.6
17	085	23 47 41	-146.4	-146.6	-146.7	-146.5	-145.1	-146.7
18	085	00 00 48	-146.6	-146.7	-146.8	-146.5	-145.7	-146.8
19	085	00 13 54	-146.6	-146.9	-147.1	-147.0	-145.9	-147.1
20	085	00 27 01	-147.3	-147.3	-147.0	-147.8	-147.1	-148.0
21	085	00 40 07	-147.7	-148.2	-148.1	-148.2	-146.8	-148.4
22	085	00 53 14	-147.8	-147.8	-148.2	-147.9	-147.1	-148.2
23	085	01 06 20	-148.1	-148.2	-148.7	-148.2	-147.1	-148.7
24	085	01 19 26	-147.5	-147.8	-148.1	-148.2	-147.1	-148.2
25	085	01 32 33	-148.2	-148.2	-148.3	-147.9	-146.9	-148.3
26	085	01 45 39	-148.1	-148.7	-148.2	-148.7	-147.3	-149.2
27	085	01 58 46	-148.6	-148.8	-149.1	-149.1	-147.7	-149.4
28	085	02 11 52	-149.6	-149.6	-150.0	-149.6	-148.8	-150.0
29	085	02 24 59	-149.1	-149.4	-149.7	-149.2	-148.5	-149.7
30	085	02 38 05	-149.7	-150.1	-150.1	-149.6	-148.5	-150.4
31	085	02 51 12	-149.3	-150.1	-150.7	-150.0	-149.2	-150.7
32	085	03 04 18	-149.2	-149.9	-150.1	-150.1	-149.2	-150.1
33	085	03 17 25	-149.5	-149.5	-150.2	-149.6	-148.5	-150.2
34	085	03 30 31	-149.6	-150.0	-150.6	-150.0	-148.6	-150.6
35	085	03 43 37	-150.6	-151.1	-151.1	-150.6	-149.5	-151.1
36	085	03 56 44	-150.3	-150.5	-151.1	-150.3	-149.1	-151.1
37	085	04 09 50	-149.6	-150.2	-150.1	-149.8	-148.6	-150.1
38	085	04 22 57	-148.4	-148.7	-149.1	-148.7	-147.7	-149.1
39	085	04 36 03	-149.3	-149.3	-149.1	-148.7	-148.0	-149.1
40	085	04 49 10	-148.7	-148.9	-149.0	-148.6	-147.8	-149.0
41	085	05 02 16	-148.5	-148.5	-148.8	-148.0	-146.8	-148.6
42	085	05 15 23	-148.6	-149.0	-149.0	-148.5	-147.7	-149.0
43	085	05 28 29	-148.1	-148.6	-148.7	-148.2	-147.5	-148.7
44	085	05 41 36	-148.3	-148.5	-148.5	-148.0	-147.2	-148.5
45	085	05 54 42	-147.5	-147.9	-147.6	-147.1	-146.8	-147.9
46	085	06 07 49	-147.5	-147.9	-147.8	-147.6	-147.0	-147.8
47	085	06 20 55	-147.3	-147.4	-147.1	-147.1	-146.3	-147.1
48	085	06 34 02	-147.6	-147.7	-147.9	-147.8	-147.2	-147.9
49	085	06 47 08	-146.7	-147.1	-147.3	-147.0	-146.2	-147.2
50	085	07 00 15	-147.0	-147.0	-147.1	-146.8	-145.9	-147.1
51	085	07 13 21	-147.0	-146.9	-147.0	-146.6	-145.9	-147.0

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A/m ² /√Hz)					
			1	2	3	4	5	MIN.
52	086	07 26 28	-147.0	-147.0	-146.7	-146.4	-146.0	-147.0
53	086	07 39 34	-146.9	-147.2	-147.1	-146.9	-146.6	-147.2
54	086	07 52 41	-147.0	-146.9	-147.2	-147.2	-146.7	-147.2
55	086	08 05 47	-147.1	-147.1	-147.0	-146.6	-146.1	-147.1
56	086	08 18 53	-147.1	-147.3	-147.4	-146.8	-145.9	-147.4
57	086	08 32 00	-146.9	-146.7	-146.2	-145.6	-145.0	-146.4
58	086	08 45 07	-146.9	-146.2	-146.2	-145.9	-145.1	-146.2
59	086	08 58 13	-146.7	-146.8	-146.8	-145.6	-144.7	-145.8
60	086	09 11 20	-146.0	-146.8	-146.8	-145.7	-144.8	-146.0
61	086	09 24 26	-146.1	-146.1	-146.3	-145.3	-145.2	-146.1
62	086	09 37 33	-146.1	-145.6	-145.5	-145.3	-144.7	-146.6
63	086	09 50 39	-145.3	-145.1	-145.0	-145.1	-144.7	-146.3
64	086	10 03 46	-144.7	-144.5	-144.5	-144.3	-143.8	-144.7
65	086	10 16 52	-144.5	-144.6	-144.4	-144.2	-143.8	-144.6
66	086	10 29 58	-144.6	-144.4	-144.4	-144.3	-143.4	-144.6
67	086	10 42 05	-144.6	-144.5	-144.4	-144.4	-143.7	-144.8
68	086	10 55 11	-144.6	-144.5	-144.5	-144.2	-143.2	-144.5
69	086	11 08 18	-144.3	-144.3	-144.3	-144.1	-143.7	-144.3
70	086	11 21 24	-145.2	-144.8	-144.9	-144.8	-144.1	-145.2
71	086	11 34 31	-144.8	-144.8	-144.8	-144.5	-143.2	-144.8
72	086	11 47 38	-145.1	-145.1	-145.2	-145.2	-144.3	-145.2
73	086	12 00 45	-146.1	-146.1	-146.3	-146.2	-145.4	-146.3
74	086	12 13 52	-146.4	-146.3	-146.2	-146.2	-144.5	-146.4
75	086	12 26 58	-146.5	-146.9	-146.8	-146.4	-144.7	-146.9
76	086	12 39 05	-144.3	-144.2	-144.5	-144.4	-143.8	-144.7
77	086	12 52 12	-144.8	-144.8	-144.8	-144.9	-144.4	-145.0
78	086	13 05 19	-144.1	-144.6	-144.3	-144.3	-143.4	-144.6
79	086	13 18 26	-143.8	-144.1	-144.1	-144.2	-143.3	-144.2
80	086	13 31 33	-143.5	-144.9	-144.9	-144.9	-143.3	-144.9
81	086	13 44 40	-143.5	-143.4	-143.4	-143.7	-143.2	-143.7
82	086	14 00 47	-143.1	-143.5	-143.2	-143.4	-143.1	-143.5
83	086	14 16 54	-142.8	-144.3	-144.1	-143.9	-143.4	-144.3
84	086	14 31 10	-144.8	-144.9	-144.9	-144.6	-143.2	-144.8
85	086	14 44 17	-144.7	-144.7	-144.6	-144.7	-143.0	-144.7
86	086	14 57 24	-144.9	-145.4	-145.5	-145.2	-143.5	-145.5
87	086	15 10 31	-145.3	-145.6	-145.6	-145.9	-145.4	-145.9
88	086	15 23 38	-145.8	-145.9	-145.9	-145.8	-145.8	-145.9
89	086	15 36 45	-146.5	-146.2	-146.3	-146.8	-145.0	-146.5
90	086	15 49 52	-145.0	-145.3	-145.2	-145.1	-144.5	-145.3
91	086	16 02 59	-145.5	-145.7	-145.8	-145.3	-144.3	-145.7
92	086	16 16 05	-145.0	-145.6	-145.5	-145.5	-144.5	-145.5
93	086	16 29 12	-145.0	-145.0	-145.0	-144.9	-144.2	-145.0
94	086	16 42 19	-145.5	-145.4	-145.4	-145.3	-144.1	-145.5
95	086	16 55 26	-145.5	-145.8	-145.7	-145.5	-144.7	-145.8
96	086	17 08 33	-145.1	-145.8	-145.0	-145.9	-145.8	-146.1
97	086	17 21 40	-146.2	-146.0	-145.9	-145.8	-145.1	-146.2
98	086	17 34 46	-146.0	-146.1	-146.2	-146.1	-145.1	-146.2
99	086	17 47 53	-146.3	-146.0	-146.1	-146.0	-145.0	-146.3
100	086	18 01 00	-145.7	-145.5	-145.9	-145.6	-145.0	-146.0
101	086	18 14 07	-146.0	-145.6	-145.7	-145.6	-145.3	-146.7
102	086	18 27 14	-145.8	-145.8	-145.9	-146.0	-145.9	-146.0

*RECORDING ERROR

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Table 9 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian Days
85 and 86, 1974

	1	2	3	4	5	MIN
DAILY MEAN	-146.1	-146.3	-146.3	-146.1	-145.3	-146.1
STANDARD DEV	2.2	2.2	2.3	2.1	2.1	2.2

PROBABILITY DENSITY						
-151.0	0	0.0	1	1.0	2	2.0
-150.0	2	2.0	5	4.9	7	6.9
-149.0	9	8.8	5	4.9	8	7.8
-148.0	10	9.8	11	10.8	10	9.8
-147.0	10	9.8	12	11.8	9	8.8
-146.0	20	19.4	20	19.4	18	17.4
-145.0	22	21.6	22	21.6	24	23.5
-144.0	16	15.7	4	17.4	18	17.4
-143.0	9	8.8	6	5.9	8	7.8
-142.0	3	2.9	7	2.9	3	2.9
-141.0	0	0.0	0	0.0	0	0.0
-140.0	0	0.0	0	0.0	0	0.0
-139.0	0	0.0	0	0.0	0	0.0
-138.0	0	0.0	0	0.0	0	0.0
-137.0	0	0.0	0	0.0	0	0.0
-136.0	0	0.0	0	0.0	1	1.0
-135.0	0	0.0	1	1.0	0	0.0
-134.0	1	1.0	0	0.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION						
-151.0	0	0.0	1	1.0	0	0.0
-150.0	2	2.0	6	5.9	3	2.9
-149.0	11	10.8	11	10.8	11	10.8
-148.0	21	20.6	22	21.6	21	20.6
-147.0	31	30.4	34	33.3	30	29.4
-146.0	51	50.0	54	52.9	48	47.1
-145.0	73	71.6	74	72.5	72	70.6
-144.0	89	87.3	92	90.2	90	88.2
-143.0	98	96.1	98	96.1	98	96.1
-142.0	101	99.0	101	99.0	101	99.0
-141.0	101	99.0	101	99.0	101	99.0
-140.0	101	99.0	101	99.0	101	99.0
-139.0	101	99.0	101	99.0	101	99.0
-138.0	101	99.0	101	99.0	101	99.0
-137.0	101	99.0	101	99.0	101	99.0
-136.0	101	99.0	101	99.0	101	99.0
-135.0	101	99.0	101	99.0	101	99.0
-134.0	102	100.0	102	100.0	102	100.0

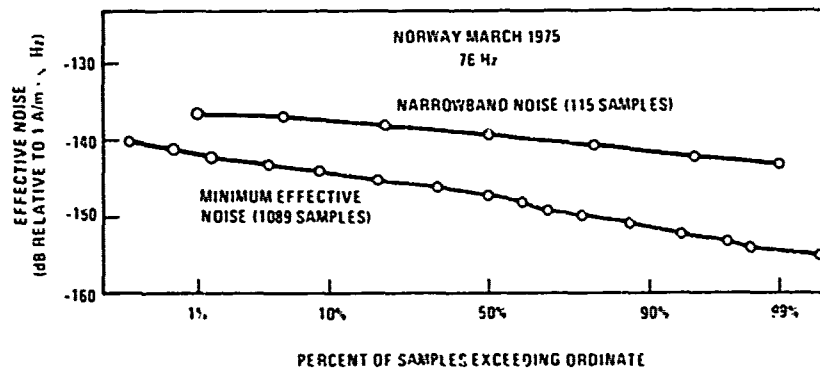


Fig. 6—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for March 1975

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Table 10 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 66 and 67, 1974 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	13-MINUTE NOISE LEVEL					MIN
			DIFFERENTIAL TOTAL (dB)					
			1	2	3	4	5	
1	67	06 50 00	150.4	150.6	152.1	152.2	152.7	152.1
2	67	06 50 00	152.1	152.8	151.2	151.2	152.1	151.2
3	67	06 50 00	151.1	151.5	151.9	151.7	151.9	151.9
4	67	06 50 00	153.5	151.1	151.5	151.2	151.7	151.5
5	67	06 07 00	152.1	152.8	151.2	151.1	152.1	151.2
6	67	06 51 00	148.5	150.9	151.1	151.9	151.3	151.1
7	67	06 51 00	152.8	152.8	151.8	151.3	152.0	151.6
8	67	06 52 00	151.2	151.2	151.3	152.9	151.8	151.3
9	67	06 53 00	151.0	151.7	150.0	152.5	152.2	150.0
10	67	06 54 00	150.7	152.1	151.2	152.9	152.1	151.7
11	67	06 54 00	151.0	151.7	150.1	152.1	151.1	150.1
12	67	06 55 00	152.8	151.7	150.0	152.2	152.3	150.0
13	67	06 55 00	152.8	153.3	150.0	152.6	151.1	152.8
14	67	06 56 00	152.5	151.7	150.2	151.1	152.0	150.2
15	67	06 56 00	149.6	151.7	151.8	151.6	152.3	151.4
16	67	06 57 00	151.0	151.6	150.1	152.1	152.0	150.1
17	67	06 58 00	152.5	151.7	151.0	152.1	151.2	151.0
18	67	06 58 00	152.3	152.9	151.2	152.5	151.7	151.2
19	67	06 59 00	151.1	151.6	150.2	152.5	152.2	152.7
20	67	06 59 00	149.8	151.9	151.8	151.1	152.8	151.9
21	67	06 59 00	152.3	151.2	151.6	152.8	151.8	151.6
22	67	06 59 00	152.0	152.7	151.0	153.0	152.8	151.0
23	67	06 59 00	153.7	152.9	151.1	151.1	152.5	151.1
24	67	01 58 00	149.2	151.1	152.7	151.3	152.5	152.7
25	67	01 42 00	152.8	152.1	151.2	152.8	152.1	152.7
26	67	01 29 00	152.9	151.3	152.5	151.1	151.2	152.5
27	67	01 15 00	152.0	152.2	152.8	151.7	150.8	152.8
28	67	01 02 00	149.0	149.8	152.0	152.2	151.6	152.2
29	67	00 18 00	148.7	150.2	151.6	150.8	149.8	151.6
30	67	00 36 00	151.0	151.5	151.9	150.8	149.8	151.9
31	67	00 23 00	151.5	151.8	152.1	150.9	149.8	152.1
32	67	00 10 00	152.1	152.6	152.8	151.5	150.8	152.8
33	66	23 57 00	148.7	148.1	151.2	150.8	149.8	151.2
34	66	23 58 00	151.6	151.9	150.2	151.0	149.8	152.2
35	66	23 58 00	150.7	150.8	150.2	150.1	149.9	150.9
36	66	23 58 00	150.2	150.7	150.6	149.1	148.1	150.7
37	66	23 58 00	151.0	151.1	151.1	150.1	149.0	151.1
38	66	22 51 00	148.7	147.6	149.8	150.1	149.1	150.1
39	66	22 36 00	151.2	151.1	152.1	151.2	149.3	152.1
40	66	22 25 00	151.3	151.1	151.5	151.1	150.7	151.5
41	66	22 12 00	150.0	150.2	150.4	150.0	149.9	150.7
42	66	21 59 00	148.7	146.2	149.5	151.5	150.7	151.5
43	66	21 46 00	151.0	150.7	151.1	151.1	150.1	151.1
44	66	21 33 00	150.6	149.5	151.0	151.1	150.1	151.1
45	66	21 23 00	149.8	150.1	150.6	150.3	149.2	150.6
46	66	21 07 00	150.6	150.6	150.8	150.7	149.9	150.8
47	66	20 54 00	148.0	146.7	149.8	151.1	150.1	151.1
48	66	20 40 00	150.3	150.8	151.0	150.8	150.0	151.0
49	66	20 27 00	150.9	151.3	151.6	151.5	150.9	151.8
50	66	20 14 00	149.6	149.9	150.1	150.2	149.7	150.3
51	66	20 01 00	148.4	146.2	149.2	150.6	150.0	150.6
52	66	19 48 00	150.0	150.0	150.1	150.1	149.8	150.1
53	66	19 35 00	149.7	149.7	150.1	150.2	149.5	150.2
54	66	19 22 00	149.8	149.8	150.1	149.9	149.0	150.1
55	66	19 09 00	149.7	149.8	150.1	150.0	149.2	150.1
56	66	18 56 00	148.0	145.7	148.8	150.3	149.8	150.3
57	66	18 43 00	148.2	145.2	148.1	148.6	148.3	148.6
58	66	18 29 00	149.5	149.2	149.5	148.2	148.1	149.5
59	66	18 16 00	148.0	148.9	149.1	149.1	148.8	149.1
60	66	18 03 00	148.8	147.6	148.0	148.1	148.4	149.1
61	66	17 50 00	148.5	148.9	147.9	148.9	148.7	149.5
62	66	17 37 00	148.1	148.3	148.1	148.1	147.1	148.1
63	66	17 24 00	148.2	148.6	148.7	148.6	147.6	148.8
64	66	17 11 00	148.1	148.3	148.3	148.0	148.1	148.2
65	66	16 58 00	148.0	148.1	147.5	147.7	148.1	148.2
66	66	16 45 00	148.2	148.1	148.5	148.1	147.6	148.8
67	66	16 32 00	148.8	148.6	148.7	148.1	147.9	148.2
68	66	16 19 00	148.8	148.9	149.1	148.1	147.3	148.1
69	66	16 06 00	148.6	148.9	148.7	148.6	147.1	148.1
70	66	15 52 00	148.7	148.5	148.1	148.1	148.7	148.1
71	66	15 39 00	148.1	148.2	148.1	148.0	148.2	148.1
72	66	15 26 00	148.0	148.1	148.1	148.9	147.8	148.1

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Table 11 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian Days
66 and 67, 1975

	1	2	3	4	5	MIN
DAILY MEAN	150.0	150.8	151.7	151.2	150.3	151.9
STANDARD DEV	1.1	2.7	2.3	1.7	1.6	2.1

PROBABILITY DENSITY												
155.0	0	0.0	0	0.0	1	5.6	0	0.0	0	3.0	1	5.6
154.0	1	5.6	9	12.5	16	22.2	1	1.1	0	0.0	16	22.2
153.0	12	16.7	11	15.3	6	8.3	17	23.6	1	1.1	6	8.3
152.0	6	8.3	3	4.2	6	8.3	9	12.5	11	15.3	6	8.3
151.0	7	9.7	10	14.9	8	11.1	9	12.5	12	16.7	11	15.3
150.0	8	12.5	12	16.7	11	15.3	10	13.9	10	13.9	13	18.1
149.0	12	16.7	11	15.3	12	16.7	8	11.1	16	22.2	11	15.3
148.0	11	15.3	7	9.7	7	9.7	10	13.9	12	16.7	5	6.9
147.0	1	1.1	2	2.8	2	2.8	0	0.0	7	9.7	0	0.0
146.0	0	0.0	3	4.2	0	0.0	0	0.0	0	0.0	7	9.7
145.0	3	4.2	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0
144.0	0	0.0	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0
143.0	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
142.0	2	2.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
141.0	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION												
155.0	0	0.0	0	0.0	1	5.6	0	0.0	0	0.0	1	5.6
154.0	1	5.6	9	12.5	20	27.9	1	1.1	0	0.0	20	27.9
153.0	16	22.2	20	27.9	26	36.1	16	22.2	1	1.1	26	36.1
152.0	22	30.6	23	31.9	22	31.1	27	37.5	15	20.8	32	44.1
151.0	29	40.3	13	18.8	30	41.6	36	50.0	27	37.5	39	53.7
150.0	36	50.0	15	20.8	41	56.7	51	70.0	37	51.1	56	77.9
149.0	50	67.1	56	77.9	63	87.5	62	86.1	53	72.4	67	93.1
148.0	61	83.7	63	87.5	70	97.2	72	100.0	65	89.3	72	100.0
147.0	62	86.1	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0
146.0	62	86.1	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0
145.0	62	86.1	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0
144.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
143.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
142.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
141.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
140.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
139.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
138.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
137.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
136.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
135.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
134.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
133.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
132.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
131.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
130.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
129.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
128.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
127.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
126.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
125.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
124.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
123.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
122.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
121.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
120.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
119.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
118.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
117.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
116.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
115.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
114.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
113.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
112.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
111.0	62	86.1	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

shows the relative consistency of clipper 3 as the most effective of the processor channels throughout the day with, however, some diversity of performance among the clippers near the bottom of the table. For example, samples 42, 47, 51, 56, 65 and 70 show 1.3 to 2.2 dB of difference in performance between clipper 3 and 4 but only tenths of a decibel difference between clippers 4 and 5, implying that rather large short-term changes in noise conditions took place during this period. Julian days 66 and 67 of 1975 (March 7 and 8) were the beginning of a period of major geophysical disturbance that showed the greatest effect on ELF propagation paths from the Navy test transmitter in Wisconsin to receivers in the northeastern United States, Greenland, and Norway of all of the ELF propagation measurements that have been made to date. The unusually low effective noise indicated in Fig. 5 for this period thus probably resulted from this propagation disturbance affecting atmospheric noise propagation northward from more southerly latitudes. Table 11 contains statistical data for this day indicating that, averaged over the entire day, clippers 3 and 4 both provided good performance.

Table 12 contains sample-by-sample data for the noisy-day case in Fig. 5. The choice among clipper channels varies, as has been shown above to be true in general for relatively noisy conditions. For all samples, however, at least two clipper channels provide nearly equivalent performance, in distinction from the quiet-day case. Thus, even under vigorously disturbed propagation conditions, the choice among clipping levels is less critical for

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Table 12 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 70 and 71, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (dB RELATIVE TO 1 μV/m, Hz)					MIN
			1	2	3	4	5	
1	71	07	144.2	144.5	144.3	143.7	142.9	144.1
2	71	08 35 00	140.5	142.6	145.2	144.8	143.8	145.2
3	71	08 42 00	144.6	143.9	144.8	143.9	143.0	144.9
4	71	08 52 00	144.9	145.0	144.9	143.9	142.3	145.0
5	71	08 55 00	145.4	145.6	145.6	145.1	144.3	145.6
6	71	09 02 00	140.2	142.7	143.7	143.0	141.0	145.0
7	71	09 09 00	141.5	143.6	143.6	141.2	141.1	144.6
8	71	09 26 00	145.1	145.2	145.0	144.5	143.7	145.1
9	71	09 23 00	145.9	146.2	146.0	145.5	144.3	146.2
10	71	09 30 00	144.9	145.2	144.8	143.5	143.6	145.0
11	71	09 37 00	149.6	143.3	143.2	145.5	144.4	145.7
12	71	09 44 00	145.4	145.8	145.6	145.2	143.5	145.8
13	71	09 51 00	146.2	145.8	145.7	145.2	144.9	146.2
14	71	09 58 00	146.6	146.6	146.4	145.7	144.5	146.6
15	71	10 05 00	146.6	146.9	146.1	145.6	144.5	146.9
16	71	10 12 00	146.9	146.2	146.3	145.5	146.9	146.5
17	71	10 19 00	146.5	146.7	146.3	145.1	143.7	146.7
18	71	10 26 00	146.7	147.3	147.2	146.2	145.0	147.2
19	71	10 33 00	146.4	146.2	146.3	145.5	144.1	146.7
20	71	10 40 00	149.9	143.1	145.9	146.3	144.9	146.3
21	71	10 47 00	146.7	146.5	146.1	145.1	144.5	146.7
22	71	10 54 00	146.0	146.5	146.1	145.4	144.1	146.5
23	71	11 01 00	145.9	146.5	146.2	145.5	144.5	146.5
24	71	11 08 00	146.1	146.2	146.2	145.3	144.1	146.1
25	71	11 15 00	149.4	143.3	145.8	146.0	144.9	146.0
26	71	11 22 00	145.8	145.8	145.4	144.8	144.0	145.8
27	71	11 29 00	145.8	145.7	145.7	145.2	144.2	145.8
28	71	11 36 00	146.5	146.5	146.6	145.9	144.8	146.6
29	71	11 43 00	141.3	143.9	146.0	145.5	144.7	146.0
30	71	11 50 00	146.2	146.2	146.1	145.1	144.1	146.7
31	71	11 57 00	146.1	146.1	146.1	145.2	144.2	146.1
32	71	12 04 00	146.1	145.9	145.4	144.9	143.1	146.1
33	71	12 11 00	145.2	145.8	145.3	144.2	143.1	145.8
34	71	12 18 00	149.5	143.1	145.8	145.5	144.1	145.6
35	71	12 25 00	146.0	145.9	145.4	144.7	143.6	146.0
36	71	12 32 00	145.9	145.7	145.5	144.4	143.5	145.1
37	71	12 39 00	146.3	146.2	146.0	145.2	144.1	146.3
38	71	12 46 00	142.8	144.8	146.2	146.0	145.0	146.2
39	71	12 53 00	142.7	144.7	146.2	146.0	144.7	146.5
40	71	13 00 00	146.1	146.1	146.1	145.2	144.2	146.1
41	71	13 07 00	146.2	146.1	146.1	145.2	144.2	146.1
42	71	13 14 00	145.4	145.9	146.0	145.4	144.1	146.0
43	71	13 21 00	149.8	142.2	145.5	145.1	144.5	145.1
44	71	13 28 00	145.7	145.8	145.8	145.1	143.8	145.8
45	71	13 35 00	146.4	146.2	146.2	145.2	144.7	146.2
46	71	13 42 00	146.1	146.1	146.2	145.5	144.8	146.5
47	71	13 49 00	145.2	145.3	145.1	144.5	143.0	145.1
48	71	13 56 00	149.1	143.5	146.3	146.1	144.8	146.3
49	71	14 03 00	145.7	145.5	145.1	145.1	144.1	145.7
50	71	14 10 00	145.3	145.2	145.0	144.4	143.1	145.1
51	71	14 17 00	145.5	145.5	145.2	144.2	143.5	145.5
52	71	14 24 00	146.0	146.0	145.4	145.0	143.0	145.0
53	71	14 31 00	146.3	145.8	146.0	145.7	144.1	146.0
54	71	14 38 00	145.1	145.0	144.9	144.1	142.0	145.1
55	71	14 45 00	144.4	144.9	144.8	144.2	143.2	144.9
56	71	14 52 00	144.7	145.1	144.9	144.5	143.5	145.1
57	71	14 59 00	149.8	142.1	145.0	145.0	143.9	145.0
58	71	15 06 00	145.3	145.2	145.0	144.2	143.1	145.3
59	71	15 13 00	145.4	145.5	145.3	144.4	143.5	145.5
60	71	15 20 00	145.7	145.8	145.6	144.8	143.7	145.8
61	71	15 27 00	149.5	142.3	144.9	145.1	144.0	145.1
62	71	15 34 00	144.1	144.5	144.0	143.5	142.5	144.5
63	71	15 41 00	144.5	145.2	145.0	144.7	143.9	145.2
64	71	15 48 00	147.2	144.4	144.1	143.7	142.1	144.7
65	71	15 55 00	149.4	142.4	144.2	144.3	143.2	144.3
66	71	16 02 00	142.9	144.1	144.1	143.4	141.0	144.1
67	71	16 09 00	143.5	143.5	143.5	142.9	141.7	143.7
68	71	16 16 00	143.3	143.3	143.2	142.9	142.1	143.3
69	71	16 23 00	143.1	143.4	143.5	142.8	141.9	143.4
70	71	16 30 00	149.2	142.8	143.5	143.4	142.1	143.4
71	71	16 37 00	144.8	144.8	144.7	144.2	143.1	144.8

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Table 13 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian Days
70 and 71, 1975

	1	2	3	4	5	MIN
DAILY MEAN	100.1	100.0	105.2	100.7	103.4	105.5
STANDARD DEV	2.5	1.5	1.6	1.6	1.5	1.3

PROBABILITY DENSITY										
107.0	0	0.0	1	1.4	1	1.4	0	0.0	0	0.0
106.0	19	26.1	17	23.6	22	30.6	1	5.6	0	0.0
105.0	19	26.1	22	31.9	25	34.7	33	45.6	0	0.0
104.0	11	15.3	11	15.3	17	23.6	23	31.9	33	45.6
103.0	1	5.6	11	15.3	5	6.9	7	9.7	29	39.9
102.0	1	1.4	6	8.3	0	0.0	1	1.2	4	5.7
101.0	3	4.2	1	1.4	0	0.0	0	0.0	3	4.2
100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
99.0	5	6.9	0	0.0	1	1.4	1	1.4	0	0.0
98.0	1	1.4	1	1.4	0	0.0	0	0.0	1	1.4
97.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
96.0	1	1.4	1	1.4	0	0.0	0	0.0	0	0.0
95.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
94.0	0	0.0	0	0.0	1	1.4	0	0.0	1	1.4
93.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0
92.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
91.0	0	0.0	0	0.0	1	1.4	0	0.0	1	1.4
90.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION										
107.0	0	0.0	1	1.4	1	1.4	0	0.0	1	1.4
106.0	19	26.1	10	25.9	23	31.9	1	5.6	0	0.0
105.0	38	52.1	31	46.9	45	66.7	17	31.1	0	0.0
104.0	57	68.1	52	72.2	65	90.3	49	63.1	33	45.6
103.0	68	73.6	63	87.5	79	97.2	67	93.1	61	84.7
102.0	69	75.0	69	95.6	80	97.2	70	97.2	67	93.1
101.0	70	76.2	70	97.2	70	97.2	70	97.2	70	97.2
100.0	70	76.2	70	97.2	70	97.2	70	97.2	70	97.2
99.0	70	76.2	70	97.2	71	98.6	71	98.6	70	97.2
98.0	71	78.6	71	98.6	71	98.6	71	98.6	71	98.6
97.0	71	78.6	71	98.6	71	98.6	71	98.6	71	98.6
96.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
95.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
94.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0
93.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

relatively noisy conditions than for quiet conditions. Table 13 bears out this indication. Table 14 contains the statistics of all 1089 samples acquired during March 1975. Figure 6 contains the comparison of cumulative probability distributions between minimum effective noise and the narrowband noise data that were recorded simultaneously. Both graphs are virtually indistinguishable from those of Fig. 4, indicating seasonal consistency of the noise from year to year.

Figures 7-8 and Tables 15-19 contain summer data from July and August 1975. The indication of diurnal variation is less distinct than for the winter data, as might be expected both from the circumstance that the overhead ionosphere is continuously sunlit in summer at Tromsø and because thunderstorms in the area become important noise sources. Figure 7 shows what may indicate a diurnal trend of minimum noise in the early morning and maximum noise in late afternoon and evening. There seems to be an intra-day minimum near 17 UT.

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Table 14 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, March 1975

	PROBABILITY DENSITY					
	1	2	3	4	5	MIN
155.0	0	0.0	0	0.0	0	0.0
154.0	1	0.1	0	0.0	0	0.0
153.0	16	1.5	11	1.0	17	1.6
152.0	29	2.6	23	2.1	34	3.1
151.0	44	4.0	32	2.9	51	4.7
150.0	67	6.0	50	4.1	70	6.6
149.0	98	9.0	75	6.7	100	9.2
148.0	92	8.1	87	6.0	79	7.3
147.0	82	7.6	106	9.9	96	8.6
146.0	111	13.2	123	13.1	107	13.7
145.0	139	12.8	127	12.6	136	12.5
144.0	106	9.7	111	10.5	191	17.5
143.0	79	7.3	80	7.3	154	14.1
142.0	57	5.2	55	5.1	79	6.4
141.0	30	2.4	36	3.4	63	5.7
140.0	13	1.3	17	1.6	10	0.9
139.0	30	2.4	17	1.6	10	0.9
138.0	6	0.6	3	0.3	0	0.0
137.0	1	0.1	1	0.1	0	0.0
136.0	1	0.1	1	0.1	0	0.0
135.0	0	0.0	0	0.0	0	0.0
134.0	0	0.0	0	0.0	0	0.0
133.0	0	0.0	0	0.0	0	0.0

	TIME LATENT PROBABILITY DISTRIBUTION					
	1	2	3	4	5	MIN
155.0	0	0.0	0	0.0	0	0.0
154.0	1	0.1	0	0.0	0	0.0
153.0	20	1.4	23	1.4	19	1.7
152.0	44	4.1	52	3.9	45	4.0
151.0	92	8.1	95	8.7	134	12.3
150.0	179	16.4	171	15.7	233	21.1
149.0	277	25.1	266	24.4	333	30.4
148.0	369	33.9	353	32.1	412	37.4
147.0	432	41.5	401	37.3	508	46.4
146.0	596	54.7	491	45.5	683	61.3
145.0	725	67.5	711	64.0	809	73.6
144.0	611	57.2	635	58.5	934	86.1
143.0	720	64.5	725	65.9	1017	93.1
142.0	977	90.7	989	90.9	1060	97.3
141.0	1007	92.5	1076	95.1	1077	96.9
140.0	1016	94.4	1064	97.7	1085	99.4
139.0	1000	93.2	1081	98.9	1084	99.9
138.0	1000	93.9	1083	99.4	1084	99.9
137.0	1000	93.9	1084	99.9	1084	99.9
136.0	1000	100.0	1089	100.0	1084	99.9
135.0	1000	100.0	1089	100.0	1084	99.9
134.0	1000	100.0	1089	100.0	1084	99.9
133.0	1000	100.0	1089	100.0	1084	99.9

The large disparity between the noisiest and quietest days in Fig. 7 may be attributable to the fact that the two-week period in which they fell was a period of substantial geophysical disturbance, with several magnetic storms and considerable variability in ELF propagation conditions. Conceivably, the apparent diurnal noise minimum near 17 UT in Fig. 7 could be an artifact of the geophysical disturbance that affected the ionosphere during most of the data collection period.

Table 15 shows sample-by-sample data from the quiet-day case (day 226), with one clipper channel as the consistent best or near-best choice for the entire day, as expected. Table 16 confirms this circumstance and indicates once more that for relatively quiet conditions, there can be substantial differences in performance among clipper channels. Table 17 shows the noisy-day sample-by-sample data, with far more variance in channel choice than on the quiet day, but also much less of a performance differential among channels. Table 18 reflects this relative uniformity of performance, showing only 0.4 dB of difference in daily mean effective noise level among four clipper channels. Table 19

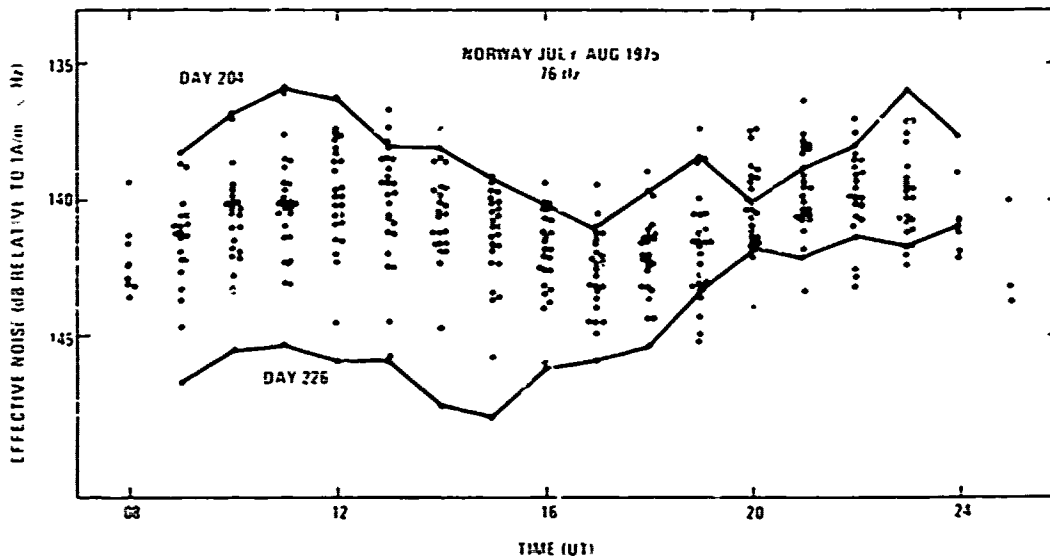


Fig. 7—Hourly samples of minimum effective noise, each averaged over 13 min, for July and August 1975. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

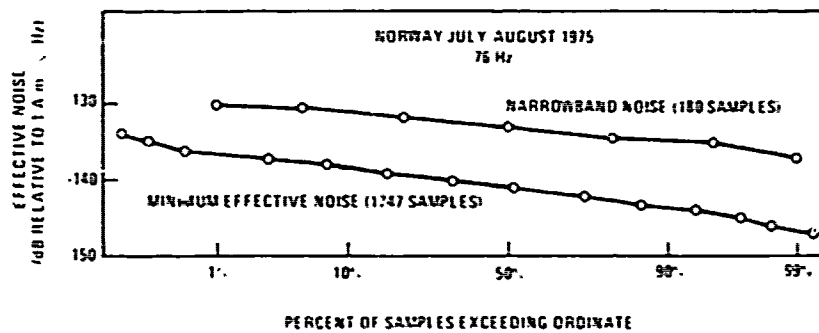


Fig. 8—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for July and August 1975

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Table 15 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 226, 1975 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 μV, Hz)				
			1	2	3	4	5
1	1	0000	125.9	126.3	125.4	124.4	122.9
2	1	0013	125.6	126.7	125.4	124.7	122.7
3	1	0026	125.5	126.7	125.4	124.3	122.9
4	1	0039	125.6	125.3	124.7	123.1	122.3
5	1	0052	125.3	125.9	125.5	124.5	123.1
6	1	0105	125.1	125.3	124.9	124.4	122.6
7	1	0118	125.2	125.3	125.0	124.7	122.7
8	1	0131	125.6	125.9	125.1	124.6	122.9
9	1	0144	125.9	126.2	125.3	124.7	123.1
10	1	0157	125.1	126.3	125.4	124.9	123.1
11	1	0210	125.1	126.3	125.4	124.2	122.7
12	1	0223	125.3	125.3	124.4	123.6	122.4
13	1	0236	124.9	125.6	124.4	123.3	122.1
14	1	0249	125.4	126.0	125.2	123.9	122.7
15	1	0302	125.1	126.3	125.3	124.6	122.7
16	1	0315	125.6	125.9	124.9	123.5	122.7
17	1	0328	124.9	126.2	125.3	124.0	123.4
18	1	0341	125.9	127.1	126.4	124.7	123.3
19	1	0354	125.9	127.0	125.6	124.0	122.9
20	1	0407	125.2	125.4	124.9	123.5	122.4
21	1	0420	125.2	125.9	125.1	123.9	122.9
22	1	0433	125.1	125.7	124.9	123.6	122.5
23	1	0446	125.7	126.6	125.9	124.1	123.1
24	1	0459	126.4	127.2	126.5	124.7	123.7
25	1	0512	126.5	127.5	126.9	124.9	123.5
26	1	0525	126.6	127.9	126.9	125.2	123.9
27	1	0538	126.7	127.9	126.7	125.2	123.9
28	1	0551	126.2	126.6	125.4	124.1	123.2
29	1	0604	126.4	127.2	126.6	124.7	123.7
30	1	0617	126.6	126.9	126.1	124.7	123.9
31	1	0630	126.9	126.2	126.4	125.7	124.9
32	1	0643	126.4	126.9	126.4	124.9	123.4
33	1	0656	126.2	127.1	126.4	125.2	124.7
34	1	0709	125.3	126.7	125.7	124.4	123.9
35	1	0722	125.6	125.9	125.1	123.9	122.9
36	1	0735	125.2	126.1	125.2	123.9	122.9
37	1	0748	125.4	126.2	125.4	124.9	123.4
38	1	0801	125.4	126.2	125.4	124.9	123.4
39	1	0814	125.4	125.9	125.9	124.9	123.9
40	1	0827	125.7	125.9	124.7	123.2	122.9
41	1	0840	125.7	125.9	124.7	123.2	122.9
42	1	0853	125.7	125.9	124.7	123.2	122.9
43	1	0906	125.7	125.9	124.7	123.2	122.9
44	1	0919	125.7	125.9	124.7	123.2	122.9
45	1	0932	125.7	125.9	124.7	123.2	122.9
46	1	0945	125.7	125.9	124.7	123.2	122.9
47	1	0958	125.7	125.9	124.7	123.2	122.9
48	1	1011	125.7	125.9	124.7	123.2	122.9
49	1	1024	125.7	125.9	124.7	123.2	122.9
50	1	1037	125.7	125.9	124.7	123.2	122.9
51	1	1050	125.7	125.9	124.7	123.2	122.9
52	1	1103	125.7	125.9	124.7	123.2	122.9
53	1	1116	125.7	125.9	124.7	123.2	122.9
54	1	1129	125.7	125.9	124.7	123.2	122.9
55	1	1142	125.7	125.9	124.7	123.2	122.9
56	1	1155	125.7	125.9	124.7	123.2	122.9
57	1	1208	125.7	125.9	124.7	123.2	122.9
58	1	1221	125.7	125.9	124.7	123.2	122.9
59	1	1234	125.7	125.9	124.7	123.2	122.9
60	1	1247	125.7	125.9	124.7	123.2	122.9
61	1	1300	125.7	125.9	124.7	123.2	122.9
62	1	1313	125.7	125.9	124.7	123.2	122.9
63	1	1326	125.7	125.9	124.7	123.2	122.9
64	1	1339	125.7	125.9	124.7	123.2	122.9
65	1	1352	125.7	125.9	124.7	123.2	122.9
66	1	1405	125.7	125.9	124.7	123.2	122.9
67	1	1418	125.7	125.9	124.7	123.2	122.9
68	1	1431	125.7	125.9	124.7	123.2	122.9
69	1	1444	125.7	125.9	124.7	123.2	122.9
70	1	1457	125.7	125.9	124.7	123.2	122.9
71	1	1510	125.7	125.9	124.7	123.2	122.9
72	1	1523	125.7	125.9	124.7	123.2	122.9
73	1	1536	125.7	125.9	124.7	123.2	122.9
74	1	1549	125.7	125.9	124.7	123.2	122.9
75	1	1602	125.7	125.9	124.7	123.2	122.9
76	1	1615	125.7	125.9	124.7	123.2	122.9
77	1	1628	125.7	125.9	124.7	123.2	122.9
78	1	1641	125.7	125.9	124.7	123.2	122.9
79	1	1654	125.7	125.9	124.7	123.2	122.9
80	1	1707	125.7	125.9	124.7	123.2	122.9
81	1	1720	125.7	125.9	124.7	123.2	122.9
82	1	1733	125.7	125.9	124.7	123.2	122.9
83	1	1746	125.7	125.9	124.7	123.2	122.9
84	1	1759	125.7	125.9	124.7	123.2	122.9
85	1	1812	125.7	125.9	124.7	123.2	122.9
86	1	1825	125.7	125.9	124.7	123.2	122.9
87	1	1838	125.7	125.9	124.7	123.2	122.9
88	1	1851	125.7	125.9	124.7	123.2	122.9
89	1	1904	125.7	125.9	124.7	123.2	122.9
90	1	1917	125.7	125.9	124.7	123.2	122.9
91	1	1930	125.7	125.9	124.7	123.2	122.9
92	1	1943	125.7	125.9	124.7	123.2	122.9
93	1	1956	125.7	125.9	124.7	123.2	122.9
94	1	2009	125.7	125.9	124.7	123.2	122.9
95	1	2022	125.7	125.9	124.7	123.2	122.9
96	1	2035	125.7	125.9	124.7	123.2	122.9
97	1	2048	125.7	125.9	124.7	123.2	122.9
98	1	2101	125.7	125.9	124.7	123.2	122.9
99	1	2114	125.7	125.9	124.7	123.2	122.9
100	1	2127	125.7	125.9	124.7	123.2	122.9

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**Table 16 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian Day
226, 1975**

	1	2	3	4	5	MIN
DAILY MEAN	-1012	-1110	-1111	-1110	-1121	-1108
STANDARD DEV	10	23	10	18	16	24

PROBABILITY DENSITY													
-118.0	0	0.0	3	1.3	0	0.0	0	0.0	0	0.0	3	1.3	4.3
-117.0	0	0.0	0	12.9	0	0.0	0	0.0	0	0.0	0	12.9	4.3
-116.0	10	14.3	15	21.1	11	15.7	0	0.0	0	0.0	15	21.1	4.3
-115.0	27	38.6	18	22.9	22	31.4	4	5.7	0	0.0	18	22.9	4.3
-114.0	27	12.9	2	2.9	11	15.7	19	27.1	6	8.6	2	2.9	4.3
-113.0	3	1.3	4	5.7	3	4.3	19	27.1	15	21.1	4	5.7	4.3
-112.0	6	7.1	6	7.1	6	8.6	6	7.1	23	32.9	6	7.1	4.3
-111.0	12	18.6	11	15.7	13	18.6	10	14.3	6	7.1	11	20.0	4.3
-110.0	3	4.3	6	7.1	4	5.7	11	15.7	13	18.6	1	1.1	4.3
-109.0	0	0.0	0	0.0	0	0.0	2	2.9	7	10.0	0	0.0	4.3
-108.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.1	0	0.0	4.3

CUMULATIVE PROBABILITY DISTRIBUTION													
-118.0	0	0.0	3	4.3	0	0.0	0	0.0	0	0.0	3	4.3	4.3
-117.0	0	0.0	12	17.1	0	0.0	0	0.0	0	0.0	12	17.1	4.3
-116.0	10	14.3	27	38.6	11	15.7	0	0.0	0	0.0	27	38.6	4.3
-115.0	27	38.6	43	61.4	32	47.1	4	5.7	0	0.0	43	61.4	4.3
-114.0	46	65.7	45	64.3	41	62.9	23	32.9	6	8.6	46	65.7	4.3
-113.0	49	70.0	49	70.0	47	67.1	12	60.0	21	30.0	49	71.1	4.3
-112.0	54	77.1	54	77.1	53	75.7	47	67.1	44	62.9	54	78.6	4.3
-111.0	67	88.7	66	92.9	66	91.3	67	81.1	49	70.0	69	98.6	4.3
-110.0	70	100.0	70	100.0	70	100.0	68	97.1	62	88.6	70	100.0	4.3
-109.0	70	100.0	70	100.0	70	100.0	70	100.0	69	98.6	70	100.0	4.3
-108.0	70	100.0	70	100.0	70	100.0	70	100.0	70	100.0	70	100.0	4.3

contains the monthly statistical data for the five clipper channels and for the minimum effective noise channel for each sample. Figure 8 illustrates the nearly log-normal characteristic of summer nonlinear processed data, with a hint of a tail at amplitudes above the 1% exceedence level, indicating some residual spikiness in the data.

Comparison of narrowband with wideband noise data, if taken at face value in Fig. 8, suggests that nonlinear processing is less advantageous for high-noise data than for the winter and spring (low-noise) data. However, as explained above, under summer conditions the narrowband recording system imposes an unspecified degree of preclipping on the data and causes an under-estimate of the noise level. Nonlinear processing thus achieves at least the 8 dB of advantage in S/N indicated by Fig. 8 and probably exceeds that advantage considerably.

Figures 9-10 and Tables 20-24 contain data from October and November 1975. Diurnal variation and mean effective noise levels similar to those of the winter data are evident in Fig. 9. (Relative to the winter solstice, these fall data would correspond to a period between the January and March data.) The extent of the diurnal variation is 5 to 7 dB, in agreement with the January 1974 examples. The quiet-day and noisy-day extremes in Fig. 9 are significantly separated, particularly in the morning hours that were shown in the midwinter data of January 1974 to be substantially separated as

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Table 17 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Day 204, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 μm √Hz)					
			1	2	3	4	5	MIN
1	204	08 38 21	-138.2	-138.5	-138.6	-137.9	-137.6	-138.6
2	204	08 51 31	-138.1	-138.4	-138.5	-138.0	-137.4	-138.5
3	204	09 00 38	-137.8	-138.3	-138.2	-137.7	-136.9	-138.3
4	204	09 17 45	-137.4	-137.3	-137.6	-137.1	-136.7	-137.6
5	204	09 30 52	-138.0	-138.3	-138.5	-137.9	-137.4	-138.5
6	204	09 43 59	-137.7	-137.5	-137.3	-137.2	-137.0	-137.7
7	204	09 57 07	-136.6	-136.6	-136.8	-136.4	-136.2	-136.8
8	204	10 10 14	-137.6	-137.5	-137.5	-137.4	-137.4	-137.6
9	204	10 23 21	-136.4	-136.4	-136.0	-135.6	-135.5	-136.4
10	204	10 36 28	-136.3	-136.4	-136.3	-136.1	-135.6	-136.4
11	204	10 49 35	-136.1	-136.7	-136.5	-136.1	-135.9	-136.7
12	204	11 02 42	-135.9	-135.4	-135.5	-135.2	-135.3	-135.9
13	204	11 15 49	-137.4	-136.7	-137.1	-136.6	-136.7	-137.4
14	204	11 28 56	-136.0	-136.0	-136.3	-136.1	-135.6	-136.3
15	204	11 42 03	-135.7	-135.6	-135.4	-135.1	-135.0	-135.7
16	204	11 55 11	-138.0	-136.2	-136.3	-136.0	-135.6	-136.3
17	204	12 08 18	-136.4	-136.3	-136.4	-136.1	-135.8	-136.4
18	204	12 21 25	-136.0	-136.2	-136.0	-135.8	-135.9	-136.2
19	204	12 34 32	-136.5	-136.8	-136.7	-136.7	-135.7	-136.8
20	204	12 47 39	-137.6	-137.5	-137.0	-136.8	-137.1	-137.6
21	204	13 00 46	-138.0	-137.1	-137.1	-136.8	-136.5	-138.0
22	204	13 13 53	-136.8	-137.1	-137.2	-136.9	-136.4	-137.4
23	204	13 27 00	-137.3	-137.6	-137.7	-137.2	-136.9	-137.7
24	204	13 40 07	-137.6	-138.1	-137.7	-137.4	-136.8	-138.1
25	204	13 53 11	-138.4	-138.9	-138.7	-138.4	-137.5	-138.9
26	204	14 06 21	-138.0	-138.1	-138.0	-137.1	-137.1	-138.1
27	204	14 19 28	-138.2	-138.2	-138.0	-137.6	-137.0	-138.2
28	204	14 32 35	-138.9	-138.9	-138.7	-138.4	-138.1	-138.9
29	204	14 45 42	-139.0	-138.8	-139.3	-138.6	-137.6	-139.3
30	204	14 58 49	-139.0	-139.0	-139.2	-138.5	-137.7	-139.2
31	204	15 11 57	-139.4	-139.9	-139.9	-138.9	-138.5	-139.9
32	204	15 25 04	-138.7	-138.6	-139.0	-138.5	-137.8	-139.0
33	204	15 38 11	-138.6	-139.5	-139.8	-138.7	-137.9	-139.8
34	204	15 51 18	-140.2	-140.1	-139.5	-139.2	-139.0	-140.2
35	204	16 04 25	-139.9	-140.1	-140.1	-139.5	-139.1	-140.1
36	204	16 17 32	-139.5	-139.1	-139.0	-138.0	-137.3	-139.5
37	204	16 30 39	-140.5	-140.1	-140.4	-139.7	-138.6	-140.5
38	204	16 43 46	-139.7	-139.8	-139.8	-139.2	-138.3	-139.8
39	204	16 56 53	-141.3	-141.0	-141.0	-140.2	-139.8	-141.3
40	204	17 10 00	-141.2	-141.0	-140.8	-139.7	-139.3	-141.2
41	204	17 23 07	-140.5	-140.6	-140.6	-139.8	-138.8	-140.6
42	204	17 36 14	-140.6	-140.9	-140.4	-140.1	-139.4	-140.9
43	204	17 49 21	-140.5	-140.6	-140.3	-139.9	-139.4	-140.6
44	204	18 02 28	-139.9	-139.3	-139.1	-139.0	-138.5	-139.9
45	204	18 15 35	-140.2	-140.0	-139.8	-139.5	-139.0	-140.2
46	204	18 28 42	-139.3	-139.2	-139.3	-138.8	-138.1	-139.3
47	204	18 41 49	-139.1	-139.3	-139.1	-138.8	-138.5	-139.4
48	204	18 54 56	-138.2	-138.5	-138.5	-138.1	-138.0	-138.5
49	204	19 08 03	-138.8	-138.8	-138.6	-137.6	-137.3	-138.8
50	204	19 21 10	-139.2	-139.6	-139.9	-139.5	-139.1	-139.9
51	204	19 34 17	-139.5	-139.4	-139.1	-138.5	-138.1	-139.5
52	204	19 47 24	-138.7	-138.8	-139.0	-138.5	-138.0	-139.0
53	204	20 00 31	-138.9	-139.2	-138.9	-138.5	-138.0	-139.2
54	204	20 13 38	-138.5	-138.4	-138.9	-138.3	-137.7	-138.9
55	204	20 26 45	-139.0	-138.2	-139.0	-138.7	-138.1	-139.2
56	204	20 39 52	-138.3	-138.2	-138.3	-138.1	-137.8	-138.3
57	204	20 52 59	-138.9	-138.4	-138.4	-138.1	-138.3	-138.9
58	204	21 06 06	-138.4	-138.9	-138.7	-138.5	-138.1	-138.9
59	204	21 19 12	-137.1	-137.8	-137.5	-137.1	-136.9	-137.8
60	204	21 32 19	-138.5	-137.9	-138.2	-138.1	-137.6	-138.3
61	204	21 45 26	-137.0	-137.3	-137.3	-136.9	-137.0	-137.3
62	204	21 58 33	-137.1	-137.7	-138.1	-137.5	-137.1	-138.1
63	204	22 11 40	-137.4	-137.2	-137.6	-137.2	-137.6	-137.7
64	204	22 24 47	-136.2	-136.9	-136.6	-136.3	-136.7	-136.9
65	204	22 37 54	-136.6	-136.2	-136.7	-136.7	-136.4	-136.7
66	204	22 51 01	-136.9	-136.7	-136.9	-137.0	-136.7	-137.0
67	204	23 04 08	-135.7	-135.9	-136.0	-135.4	-135.3	-136.0
68	204	23 17 15	-136.1	-135.9	-136.0	-136.2	-135.8	-136.2
69	204	23 30 22	-136.3	-136.1	-136.3	-136.2	-136.2	-136.4
70	204	23 43 29	-136.3	-136.6	-136.9	-136.5	-136.3	-136.9
71	204	23 56 36	-137.7	-137.7	-137.6	-137.2	-137.0	-137.7

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Table 18 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, Julian Day
204, 1975

	1	2	3	4	5	MIN
DAILY MEAN	-134.1	-134.1	-137.1	-137.7	-137.4	-134.3
STANDARD DEVIATION	1.1	1.1	1.4	1.3	1.1	1.4

PROBABILITY DENSITY										
-141.0	2	28	1	14	0	00	0	00	2	28
-140.0	6	85	8	113	7	99	2	28	7	99
-139.0	10	141	12	165	13	183	9	127	7	99
-138.0	18	254	18	254	19	268	21	296	13	183
-137.0	16	225	13	183	14	197	16	225	23	324
-136.0	15	211	14	197	15	211	17	239	16	225
-135.0	4	56	5	70	3	42	6	84	11	155
-134.0	0	00	0	00	0	00	0	00	1	14

CUMULATIVE PROBABILITY DISTRIBUTION										
-141.0	2	28	1	14	0	00	0	00	2	28
-140.0	8	113	9	127	7	99	2	28	0	00
-139.0	18	254	21	296	20	282	11	155	7	99
-138.0	36	507	39	519	39	519	32	451	20	282
-137.0	52	732	52	732	53	746	18	676	43	606
-136.0	67	944	66	930	68	958	65	915	59	831
-135.0	71	1000	71	1000	71	1000	71	1000	70	986
-134.0	71	1000	71	1000	71	1000	71	1000	71	1000

well. Table 20 contains the quiet-day sample-by-sample data, with little variation in best clipper choice during the later, quieter period of the data and several examples of substantial performance differences among channels. Table 21 contains statistical information for the quiet-day data.

Table 22 lists the noisy-day samples, shows their wider diversity of best clipping levels, and confirms the uniformity of clipper performance under these conditions. The statistical listings in Table 23 confirm these findings.

Table 24 contains the statistical accounting for the full month's data (a probability density is unavailable due to a computer error), and Fig. 10 compares minimum effective noise and narrowband noise cumulative probability distributions. Both graphs fall almost precisely between those for the January and March data, respectively.

CONCLUSIONS

Data presented in this report are from one-month collections of auroral zone ELF noise during each of the seasons of the year. They represent a reasonably comprehensive sampling of noise and propagation conditions, from stable to highly disturbed, and extend over nearly all hours of the day in each season. Lowest-noise fractions of the day have been left out of the summer and fall data, however.

Several important conclusions can be drawn:

**Table 19 — Noise Statistics for Five Clipper Settings
and Minimum Effective Noise Level, July and August
1975**

10/11/2011 10:05:34 AM 10/11/2011 10:05:34 AM

- Under relatively quiet conditions, there is a gradual, regular, diurnal change of best clip level over a span of approximately 12 dB, but there is seldom more than a few tenths of a decibel difference in performance between clipper channels in this interval. Occasionally clipper channels separated by 6 dB yield as much as 2 dB of difference in performance, but these occasions are infrequent and of short duration.

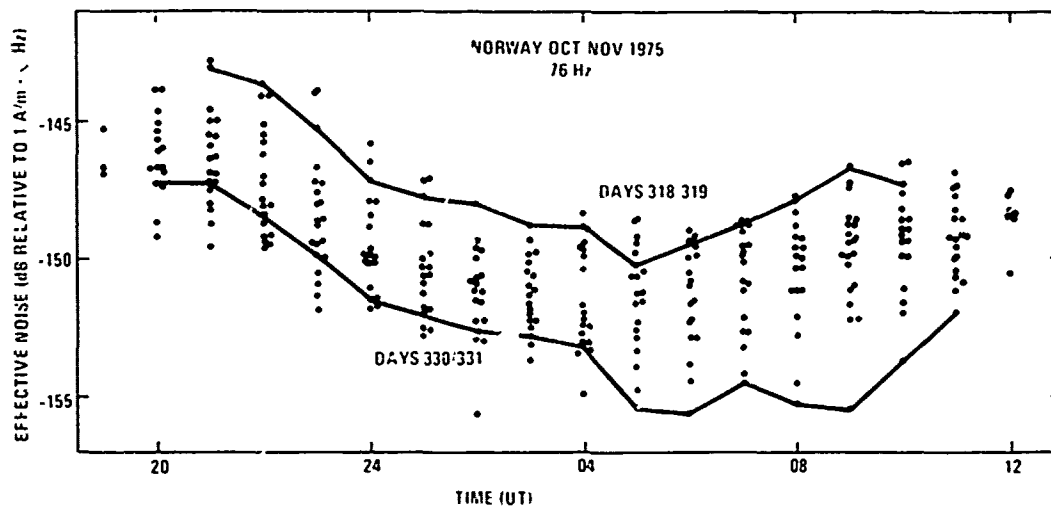


Fig. 9—Hourly samples of minimum effective noise, each averaged over 13 min, for October and November 1975. The quietest and noisiest days of the month are graphed and designated by Julian day numbers

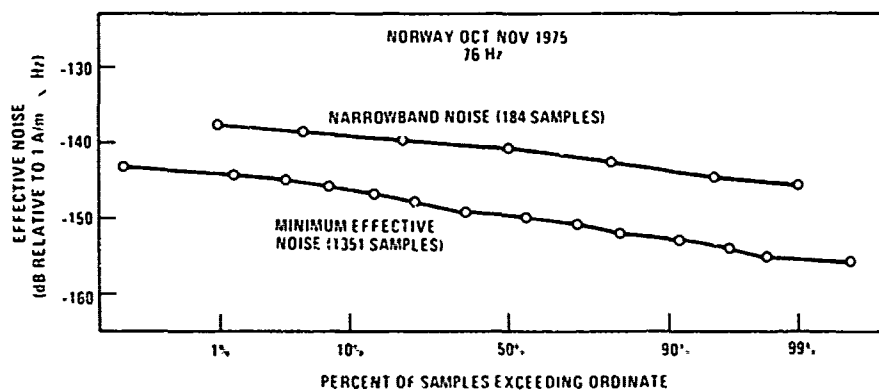


Fig. 10—Cumulative probability distribution of minimum effective noise samples compared with narrowband noise for October and November 1975

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Table 20 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 330 and 31, 1975 (Quiet Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1A m ₀ , TG)					
			1	2	3	4	5	MIN
1	330		-146.7	-146.9	-146.9	-146.2	-144.8	-146.9
2	330		-146.7	-146.7	-146.5	-146.1	-144.9	-146.7
3	330		-147.2	-146.9	-146.9	-146.2	-144.8	-147.2
4	330		-147.4	-147.6	-147.5	-146.8	-145.5	-147.6
5	330		-147.7	-147.7	-147.7	-147.2	-146.1	-147.8
6	330		-148.2	-148.2	-148.3	-147.7	-146.0	-148.3
7	330		-147.8	-148.0	-148.0	-147.2	-146.2	-148.0
8	330		-147.2	-147.2	-147.0	-146.2	-145.1	-147.2
9	330		-147.1	-147.1	-146.8	-146.1	-145.1	-147.1
10	330		-147.6	-147.5	-147.6	-146.6	-145.3	-147.7
11	330		-147.2	-147.2	-147.7	-146.8	-145.5	-147.8
12	330		-148.1	-148.3	-148.3	-147.3	-146.4	-148.1
13	330		-148.2	-148.3	-148.5	-147.6	-146.6	-148.5
14	330		-148.8	-148.3	-148.2	-147.3	-146.1	-148.8
15	330		-149.3	-149.2	-149.6	-148.3	-146.9	-149.8
16	330		-149.3	-149.7	-149.5	-148.0	-146.9	-149.7
17	330		-149.9	-149.9	-149.9	-148.6	-147.7	-149.9
18	330		-149.6	-149.5	-149.5	-148.5	-147.2	-149.6
19	330		-149.3	-149.1	-149.1	-148.0	-147.0	-149.1
20	330		-149.2	-150.1	-150.2	-149.2	-147.6	-150.2
21	331		-150.8	-151.3	-151.1	-150.2	-148.9	-151.1
22	331		-151.1	-151.5	-151.6	-150.2	-148.8	-151.6
23	331		-151.7	-152.3	-152.5	-150.8	-149.1	-152.5
24	331		-151.1	-151.6	-152.0	-150.6	-148.3	-152.0
25	331		-152.3	-152.5	-152.5	-150.7	-149.2	-152.5
26	331		-150.6	-151.1	-152.0	-150.1	-149.1	-152.0
27	331		-149.9	-150.6	-151.6	-150.1	-149.3	-151.6
28	331		-151.6	-151.7	-151.9	-150.6	-149.1	-151.9
29	331		-151.2	-151.3	-151.3	-149.8	-148.7	-151.3
30	331		-151.7	-152.5	-152.8	-150.9	-149.6	-152.6
31	331		-152.1	-153.1	-153.3	-151.9	-150.5	-153.3
32	331		-153.2	-153.4	-153.9	-152.5	-151.2	-153.9
33	331		-153.5	-153.6	-153.9	-152.2	-151.0	-153.9
34	331		-152.8	-153.2	-153.1	-151.7	-150.6	-153.1
35	331		-152.1	-152.6	-152.2	-151.6	-150.1	-152.8
36	331		-152.2	-152.5	-152.7	-151.5	-150.2	-152.8
37	331		-152.6	-153.2	-153.5	-151.7	-150.6	-152.5
38	331		-153.0	-153.7	-154.1	-152.6	-151.5	-154.1
39	331		-152.6	-153.2	-153.1	-151.9	-150.1	-153.1
40	331		-152.2	-153.0	-153.2	-152.5	-150.6	-153.3
41	331		-153.0	-153.3	-153.6	-152.1	-151.1	-153.6
42	331		-152.5	-152.9	-153.1	-151.3	-149.7	-153.1
43	331		-151.9	-151.7	-153.5	-151.4	-151.1	-153.3
44	331		-151.6	-153.3	-155.1	-153.3	-152.0	-155.1
45	331		-155.2	-155.8	-155.9	-154.1	-152.7	-155.9
46	331		-154.8	-155.5	-156.0	-154.7	-153.5	-156.0
47	331		-154.3	-155.7	-155.8	-153.8	-152.3	-155.8
48	331		-154.3	-155.2	-155.6	-153.6	-152.4	-155.6
49	331		-154.6	-154.8	-155.5	-153.6	-152.1	-155.5
50	331		-153.3	-153.9	-154.6	-153.5	-152.1	-154.6
51	331		-151.1	-154.7	-154.7	-153.0	-151.7	-154.7
52	331		-154.1	-153.9	-154.1	-152.8	-151.6	-154.1
53	331		-153.9	-154.9	-155.5	-152.9	-151.6	-154.5
54	331		-154.2	-154.9	-155.8	-152.8	-151.4	-154.8
55	331		-154.2	-155.1	-155.3	-153.1	-151.9	-155.3
56	331		-152.2	-154.8	-155.1	-153.8	-152.1	-155.1
57	331		-152.1	-153.8	-155.3	-152.7	-152.0	-155.3
58	331		-154.7	-155.6	-155.5	-153.6	-152.1	-155.6
59	331		-154.2	-154.5	-155.0	-153.7	-152.3	-155.0
60	331		-153.1	-154.5	-155.0	-153.6	-152.1	-155.0
61	331		-154.1	-155.1	-155.3	-153.7	-152.6	-155.3
62	331		-154.8	-155.2	-155.5	-153.8	-152.5	-155.5
63	331		-154.9	-155.1	-155.1	-153.0	-152.2	-155.1
64	331		-152.8	-154.4	-154.6	-152.9	-151.7	-154.6
65	331		-153.0	-153.7	-154.1	-152.9	-151.9	-154.1
66	331		-152.7	-153.5	-154.7	-152.1	-150.9	-153.7
67	331		-152.7	-153.6	-154.8	-152.1	-150.9	-153.8
68	331		-152.2	-152.9	-154.0	-151.8	-150.5	-154.0
69	331		-151.5	-151.6	-151.6	-150.9	-149.7	-151.7
70	331		-152.1	-152.5	-152.1	-150.9	-149.7	-152.5
71	331		-151.1	-151.9	-151.8	-150.2	-149.1	-151.9
72	331		-151.0	-151.0	-151.0	-149.9	-149.0	-151.0

TIME DATA NOT INTERPRETED CORRECTLY BY COMPUTER

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Table 21 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 330 and 331, 1975

	1	2	3	4	5	MIN
DAILY MEAN	151.6	152.1	152.3	150.8	149.6	152.3
STANDARD DEV	2.1	2.7	2.9	2.5	2.5	2.8

PROBABILITY DENSITY												
150.0	0	0.0	0	0.0	1	1.1	0	0.0	0	0.0	1	1.1
150.5	1	1.1	10	12.9	11	12.9	0	0.0	0	0.0	11	12.9
151.0	15	20.8	9	12.5	10	12.9	3	4.2	0	0.0	10	12.9
151.5	9	12.5	15	20.8	11	15.3	11	14.1	2	2.8	11	15.3
152.0	15	20.8	8	11.1	7	9.7	11	14.1	11	14.1	7	9.7
151.0	8	11.1	8	12.5	9	12.5	8	11.1	11	14.1	9	12.5
150.5	1	1.2	7	7.8	1	1.1	1	1.67	10	12.9	1	1.1
149.0	7	9.7	5	6.9	5	6.9	3	4.2	12	16.7	5	6.9
148.5	1	1.6	5	6.9	1	1.6	1	1.6	3	4.2	5	6.9
147.5	8	11.1	6	8.3	6	8.3	2	2.7	2	2.7	2	2.7
146.0	2	2.8	3	4.2	4	5.6	8	11.1	8	11.1	2	2.8
145.0	0	0.0	0	0.0	0	0.0	0	0.0	6	8.3	0	0.0
144.0	0	0.0	0	0.0	0	0.0	0	0.0	3	4.2	0	0.0

CUMULATIVE PROBABILITY DISTRIBUTION												
150.0	0	0.0	0	0.0	1	1.1	0	0.0	0	0.0	1	1.1
150.5	1	1.1	10	12.9	15	20.8	0	0.0	0	0.0	15	20.8
151.0	16	22.2	19	26.1	25	31.7	3	4.2	0	0.0	25	31.7
151.5	25	31.7	31	42.2	36	50.0	17	23.6	2	2.8	36	50.0
152.0	40	55.6	42	58.3	43	59.7	30	41.7	16	22.2	43	59.7
151.0	47	66.7	51	70.8	52	72.2	38	52.8	27	37.5	52	72.2
150.0	51	70.8	53	73.6	53	73.6	50	69.1	47	64.1	53	73.6
149.0	58	80.8	58	80.8	58	80.8	53	73.6	49	66.1	58	80.8
148.0	62	86.1	63	87.5	62	86.1	52	72.2	52	72.2	63	87.5
147.0	70	97.2	69	95.8	68	94.1	61	85.9	55	76.1	70	97.2
146.0	72	100.0	72	100.0	72	100.0	72	100.0	62	87.5	72	100.0
145.0	72	100.0	72	100.0	72	100.0	72	100.0	69	95.8	72	100.0
144.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0	72	100.0

• Under relatively noisy conditions, there is no regular diurnal variation of best clipping channel, but performance differences among channels separated by 6-18 dB in clipping level are negligible.

• Nonlinear noise processing provides at least 10 dB of improvement over no-prefiltering processing under virtually all noise conditions. An earlier, tentative conclusion by Meyers and Davis (1976) that the improvement may be greater under low-noise conditions than under high-noise conditions is in error.

• Under conditions of vigorously disturbed propagation due to ionospheric instability, clipper performance maintains its improvement in effective noise level. The behavior of the nonlinear noise processor with a disturbed propagation environment is similar to its behavior with a stable propagation environment for low-noise, and high-noise conditions, respectively. This statement should not be construed to indicate, however, that received S/N will be unaffected by propagation disturbance. Considerable evidence indicates that disturbance effects on point-to-point signal propagation and on noise propagation are dissimilar and, perhaps, substantially independent. Examples exist in which signal levels decreased and noise levels increased during ionospheric disturbance, as well as the converse.

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Table 22 — Individual 13-Minute Noise Samples for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 318 and 319, 1975 (Noisy Day)

SAMPLE NUMBER	DAY NUMBER	UNIVERSAL TIME	EFFECTIVE NOISE LEVEL (DB RELATIVE TO 1 μm/sec ² Hz)					
			1	2	3	4	5	MIN
1	318		141.5	141.3	141.1	141.2	143.1	141.6
2	318		141.0	141.3	141.2	141.2	143.3	141.3
3	318		142.4	141.5	143.3	143.3	142.6	143.5
4	318		143.1	143.7	143.6	143.5	143.2	143.7
5	318		143.7	143.6	143.5	143.6	142.9	143.7
6	318		143.3	143.3	143.3	143.7	142.6	143.4
7	318		143.2	143.3	143.5	143.2	142.5	143.3
8	318		143.9	143.3	144.1	143.9	143.5	144.3
9	318		143.9	143.7	143.6	143.5	143.0	143.9
10	318		142.9	143.0	143.1	143.0	141.9	143.1
11	318		143.1	143.3	143.0	142.9	142.5	143.2
12	318		143.1	143.4	143.2	143.1	142.7	143.1
13	318		143.0	143.9	143.4	143.1	142.5	142.9
14	318		143.0	144.5	144.3	144.2	143.7	144.5
15	318		143.7	143.7	143.3	143.2	142.7	143.7
16	318		143.2	143.9	143.6	143.6	142.5	143.7
17	318		143.9	143.3	145.1	144.7	143.7	145.3
18	318		144.1	144.1	144.6	144.4	143.2	144.7
19	318		145.3	145.1	144.4	144.2	143.5	145.4
20	318		145.2	145.2	147.9	144.5	143.6	145.2
21	318		145.3	145.7	145.6	145.3	144.5	145.7
22	318		145.8	145.9	145.7	145.3	144.5	145.9
23	318		147.0	147.0	147.1	146.7	145.5	147.1
24	319		147.2	147.2	147.2	147.0	145.9	147.2
25	319		149.5	148.1	148.2	147.7	146.2	148.5
26	319		147.5	147.5	147.5	147.2	146.2	147.5
27	319		148.3	148.4	148.2	147.5	146.6	148.1
28	319		147.1	147.8	147.4	147.0	146.1	147.9
29	319		146.0	146.8	146.5	146.3	145.0	146.4
30	319		146.7	146.7	146.8	146.4	145.2	146.4
31	319		146.7	146.7	146.7	146.3	145.2	146.7
32	319		147.3	147.8	147.1	146.9	146.2	147.6
33	319		147.6	148.0	147.7	147.3	146.2	148.0
34	319		147.5	147.5	147.5	147.2	146.1	147.7
35	319		147.2	148.1	147.9	147.4	146.4	148.1
36	319		148.7	148.1	147.2	147.6	147.0	148.4
37	319		148.8	148.4	148.4	147.9	146.8	148.8
38	319		148.5	148.6	148.6	147.9	146.7	148.6
39	319		148.3	148.3	148.3	147.8	146.6	148.5
40	319		148.2	148.4	148.4	147.6	146.6	148.4
41	319		148.4	148.5	148.5	147.7	146.4	148.7
42	319		148.5	148.5	148.6	148.5	147.4	148.6
43	319		149.3	149.5	149.3	148.4	147.1	149.3
44	319		150.1	149.4	148.8	149.2	148.1	150.1
45	319		149.5	149.7	149.7	149.4	148.9	149.7
46	319		150.0	149.9	150.2	149.3	148.5	150.3
47	319		149.5	149.6	149.6	148.7	147.4	149.6
48	319		149.0	149.6	149.9	148.9	147.4	149.9
49	319		149.1	149.4	149.2	148.8	147.3	149.7
50	319		149.5	149.5	149.2	149.1	147.3	149.8
51	319		149.3	149.4	149.3	148.3	147.3	149.5
52	319		149.0	148.9	148.8	147.8	146.9	149.0
53	319		148.6	148.9	148.8	147.9	146.3	148.9
54	319		148.6	148.6	148.5	147.7	146.3	148.6
55	319		148.8	148.8	148.9	148.1	146.8	148.9
56	319		148.5	148.5	148.6	147.6	146.3	148.8
57	319		149.0	149.5	149.1	148.2	146.7	149.5
58	319		148.8	148.8	149.0	147.9	146.1	149.0
59	319		148.2	148.5	148.3	147.5	146.1	148.5
60	319		147.7	147.9	147.8	146.8	145.8	147.9
61	319		147.4	148.0	148.0	147.2	145.9	148.0
62	319		147.3	147.6	147.7	147.2	146.2	147.7
63	319		147.2	147.5	147.3	147.0	145.6	147.4
64	319		146.4	146.7	146.6	146.4	145.0	146.7
65	319		146.5	146.7	146.3	145.9	145.0	146.5
66	319		146.5	146.6	146.6	146.0	144.9	146.6
67	319		146.4	146.9	146.7	146.2	145.2	146.9
68	319		146.1	146.6	146.9	146.2	144.4	146.8
69	319		147.2	147.3	147.2	146.7	145.5	147.3
70	319		147.0	147.5	147.5	146.7	145.4	147.5
71	319		146.1	147.8	147.9	146.9	145.5	148.1

TIME DATA NOT INTERPRETED CORRECTLY BY COMPUTER

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Table 23 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, Julian Days 318 and 319, 1975

	1	2	3	4	5	MIN
DAILY MEAN	-146.8	-146.8	-146.9	-146.4	-146.3	-147.0
STANDARD DEV.	2.1	2.1	2.2	1.8	1.7	2.1

PROBABILITY DENSITY

-160.0	1 1.4	0 0.0	1 1.4	0 0.0	0 0.0	2 2.8
-159.0	8 11.2	10 14.1	9 12.7	3 4.2	0 0.0	9 12.7
-158.0	18 25.4	18 25.4	16 22.0	9 12.7	1 1.4	18 25.4
-157.0	14 19.7	13 18.3	19 21.1	21 29.6	8 11.2	12 16.9
-156.0	8 11.2	8 11.2	8 11.2	19 21.1	24 32.8	8 11.2
-155.0	4 5.6	5 7.0	3 4.2	3 4.2	12 16.9	5 7.0
-154.0	5 7.0	5 7.0	7 9.9	8 11.2	5 7.0	6 8.5
-153.0	11 15.5	12 16.9	12 16.9	10 14.1	10 14.1	11 15.5
-152.0	2 2.8	0 0.0	0 0.0	2 2.8	9 12.7	0 0.0
-151.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.4	0 0.0

CUMULATIVE PROBABILITY DISTRIBUTION

-160.0	1 1.4	0 0.0	1 1.4	0 0.0	0 0.0	2 2.8
-159.0	9 12.7	10 14.1	10 14.1	3 4.2	0 0.0	11 15.5
-158.0	27 38.0	28 39.4	26 36.6	12 16.9	1 1.4	29 40.8
-157.0	41 57.7	41 57.7	41 57.7	33 46.5	9 12.7	41 57.7
-156.0	49 69.0	49 69.0	49 69.0	48 67.6	34 46.5	49 69.0
-155.0	53 74.6	54 76.1	52 72.2	51 71.8	46 64.8	54 76.1
-154.0	68 81.7	69 83.1	69 83.1	69 83.1	51 71.8	69 83.1
-153.0	69 87.2	71 100.0	71 100.0	69 87.2	61 86.9	71 100.0
-152.0	71 100.0	71 100.0	71 100.0	71 100.0	70 98.6	71 100.0
-151.0	71 100.0	71 100.0	71 100.0	71 100.0	71 100.0	71 100.0

Table 24 — Noise Statistics for Five Clipper Settings and Minimum Effective Noise Level, October and November 1975

CUMULATIVE PROBABILITY DISTRIBUTION

	1	2	3	4	5	MIN
-167.0	1 0.07	1 0.07	0 0.0	0 0.0	0 0.0	0 0.0
-166.0	1 0.07	2 0.2	1 0.07	0 0.0	0 0.0	1 0.2
-165.0	7 0.5	18 1.2	17 1.2	0 0.0	0 0.0	26 1.9
-164.0	30 2.2	43 3.2	26 2.7	1 0.3	0 0.0	61 3.8
-163.0	69 5.1	100 7.1	76 5.6	21 1.6	2 1.5	114 8.1
-162.0	187 12.3	222 16.1	193 14.3	48 3.6	18 1.3	217 16.2
-161.0	318 23.6	369 27.3	318 25.8	119 8.8	36 2.8	395 29.2
-160.0	629 46.2	677 52.7	614 46.1	217 16.4	80 6.0	696 51.1
-159.0	801 59.3	845 61.9	777 58.7	351 26.1	198 14.7	853 63.1
-158.0	1024 76.2	1037 78.8	941 72.6	692 51.7	361 27.0	1080 77.7
-157.0	1149 86.1	1160 85.9	1141 83.8	930 69.9	568 42.1	1195 86.2
-156.0	1241 92.2	1248 92.1	1231 91.4	1127 83.5	628 46.3	1249 92.5
-155.0	1294 95.6	1298 96.2	1285 95.7	1231 91.2	1070 79.3	1302 96.1
-154.0	1322 97.9	1330 98.5	1321 97.9	1300 96.3	1201 89.2	1322 98.6
-153.0	1345 99.6	1348 99.8	1337 99.8	1327 99.9	1293 95.8	1349 99.9
-152.0	1348 99.8	1350 100.0	1349 99.9	1317 99.8	1331 98.8	1350 100.0
-151.0	1349 99.9	1350 100.0	1349 99.9	1350 100.0	1346 99.7	1350 100.0
-150.0	1349 99.9	1350 100.0	1349 99.9	1350 100.0	1348 99.9	1350 100.0
-149.0	1349 99.9	1350 100.0	1349 99.9	1350 100.0	1349 99.9	1350 100.0
-148.0	1350 100.0	1350 100.0	1350 100.0	1350 100.0	1350 100.0	1350 100.0

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- The data generally tends to confirm that both the diurnal variation and the seasonal dependence of mean effective noise levels, as well as the cumulative probability distribution of data averaged over several weeks, are predictable functions of the solar season.

Finally, it can be concluded that these findings suggest that good nonlinear noise processor performance, under the high-noise conditions that represent the system performance limit, can be provided by a manually adjusted, one- or two-channel signal processor whose clipping levels can be set according to seasonal mean noise level predictions.

In an operational environment, of course, frequency-domain excision may be necessary to deal with cultural noise sources, which are not addressed in this report. Such sources probably vary from receiving platform to receiving platform and, somewhat less probably, from operating theater to operating theater. Frequency-domain excision parameters would thus have to be tailored at least to each platform and would have to be adapted to expected changes in cultural emissions from that platform. Simple, manually operated devices might not suffice for this task. However, in dealing with impulse noise of atmospheric origin, the subject of this report, the data indicate strongly that simple measures can achieve near-optimum performance.

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