

Quarterly Radio Noise Data
March, April, May 1965

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Radio noise measurements are being made at eighteen stations in a world-wide network operated in a co-operative program co-ordinated by the Environmental Science Services Administration. The locations of these stations are shown on the map. The results of these measurements for the months of March, April, and May are given in this report. Where the results for these months are not presently available, the data will be published in subsequent reports, and the data for previous months, which are now available but have not been published previously, are included. The tabulated values are based on three basic parameters of the noise; these are the mean power, the mean envelope voltage, and the mean logarithm of the envelope voltage.

The noise power received from sources external to the antenna averaged over a period of several minutes is the basic parameter and can be conveniently expressed in terms of an effective antenna noise factor, f_a , which is defined by:

$$f_a = p_n / kT_o b = T_a / T_o$$

where

p_n = noise power available from an equivalent loss-free antenna (watts)

k = Boltzman's constant = 1.38×10^{-23} joules per degree Kelvin

T_o = reference temperature, taken as 288° K

b = effective receiver noise bandwidth (Hz)

T_a = effective antenna temperature in the presence of external noise.

The antenna noise factors in this report are for a short vertical antenna over a perfectly conducting ground plane and are expressed in decibels, $F_a (= 10 \log_{10} f_a)$. This parameter is simply related to the rms noise field strength along the antenna by:

$$E_n = F_a - 95.5 + 10 \log_{10} b + 20 \log_{10} f_{\text{MHz}}$$

where:

E_n = rms noise field strength for bandwidth b in db above
 $1 \mu\text{V/m}$

b = effective receiver noise bandwidth in Hz

f_{MHz} = frequency in MHz.

The value of E_n for a 1 kHz bandwidth can be found from the attached nomogram. It should be noted that E_n is the vertical component of the field at the antenna. It should also be noted that the rms envelope voltage is 3 db higher than the rms voltage.

The other two noise parameters tabulated are given relative to the mean power. Thus, the mean voltage and mean logarithm expressed as deviations, V_d and L_d , respectively, are in db below the mean power.

Measurements of the three parameters reported were made with the Environmental Science Services Administration's Radio Noise Recorder, Model ARN-2, which has an effective noise bandwidth of about 200 Hz and uses a standard 6.6294 meter (21.75') vertical antenna. A fifteen-minute recording is made on each of eight frequencies two at a time during each hour, and these fifteen-minute samples are taken as representing the noise conditions for the full hour during which they were recorded. The month-hour medians, F_{am} , V_{dm} and L_{dm} are determined from these hourly values for each of the corresponding parameters. Normally from twenty-five to thirty observations of the mean power are obtained monthly for each hour of the day and from ten to fifteen observations of the voltage and logarithm deviations. When there are fewer than fifteen observations of the mean power or seven observations of the voltage and logarithm deviations, the tabulated values are identified by an asterisk.

The upper and lower decile values of F_a are also reported in the following tabulation to give an indication of the extent of the variation of the noise power from day to day at a given time of day. These are expressed in db above and below the month-hour median, F_{am} , and designated by D_u and D_l , respectively.

In addition to these month-hour values, corresponding values are tabulated for the time blocks as defined by CCIR Report 322. All recorded values for the four hours of the day and the three-month period are used to determine the median and decile values. When no data were available for one or two months of the season, it is so indicated and should be noted when considering seasonal trends.

The values presented in the tables reflect the actual measured values of radio noise. The only editing for man-made noise or station contamination of the records has been done by the station operators, and no additional attempt has been made to identify these values by systematic statistical means. These preliminary data values are presented in order to expedite dissemination of the data, and additional analyses, in which an attempt is made to eliminate contaminated data, are presented in other publications. The parameter that will first reflect any such contamination will be the logarithmic parameter, L_d . This contamination generally will cause the value of L_d to be less than it would have been had the recorded value been only atmospheric noise. In determining the amplitude-probability distribution from the three measured moments [Crichlow et al., 1960b] contaminated values of L_d may be found that will not give a solution of the amplitude-probability distribution. When this occurs, it is suggested that the measured value of L_d be ignored and the most probable value of L_d from the curve on the graph of L_d vs. V_d be used. The most probable value has been determined as the best fit for the integrated moments from over sixty measured amplitude-probability distributions of uncontaminated atmospheric radio noise. The second curve on the graph indicates the minimum value of L_d that will give an amplitude-probability distribution with a form factor described in the above reference and can, therefore, be used to determine whether the measured value or the most probable value of L_d for any value of V_d should be used.

Station clocks are set to local standard time (LST) which is taken from the time zone in which the station is located and is always an integral number of hours different than universal or Greenwich time (see table on page 5). The data from the Floating Antarctic Research Vessel, USNS Eltanin, are grouped so that a block 10° in latitude by 15° in longitude is treated as a separate station. The station clock in this case is

corrected to the LST at the center of the block. Because of this grouping, very few readings may be used to obtain the median values tabulated in some cases. If, during the month, fewer than ten readings are obtained for any one block, the decile values are not given. If data for less than three months are used in the time block summaries, this fact is noted on the summary sheet. Because of the small sample size, some caution should be exercised when using these values.

The assistance of the station operators and other personnel of the operating agencies in obtaining the data contained in this report is gratefully acknowledged. Stations in the recording network were operated by the following agencies:

ESSA - Bill, Wyoming; Boulder, Colorado; Byrd Station;
Front Royal, Virginia; Kekaha, Hawaii;
Warrensburg, Missouri; USNS Eltanin

U.S. Army Strategic Communications Command - Balboa, C.Z.;
Thule, Greenland

Postmaster General's Department (Australia) - Cook

Board of Telecommunications (Sweden) - Enköping

DSIR (Great Britain) and Ahmadu Bello University, Electrical
Engineering Department, Zaria, Northern Nigeria

Ministry of Communications, Wireless Planning and Co-ordination
Organization - New Delhi

Radio Research Laboratories (Japan) - Ohira

Telecommunications Research Laboratory (South Africa) - Pretoria

Institut Scientifique Cherifien (Morocco) - Rabat

Comissão Nacional das Atividades Espaciais (Brazil) - São José
dos Campos

Department of Scientific and Industrial Research (Great Britain) -
Singapore

The following publications contain additional information on radio noise:

- Clark, C., "Atmospheric Radio-Noise Studies Based on Amplitude-Probability Measurements at Slough, England, during the International Geophysical Year," Proc. Inst. Elec. Eng., Pt. B, 109, 47, 393 (September, 1962).
- Crichlow, W. Q., A. D. Spaulding, C. J. Roubique, and R. T. Disney, "Amplitude-Probability Distributions for Atmospheric Radio Noise," NBS Monograph 23 (November, 1960b).
- Crichlow, W. Q., C. J. Roubique, A. D. Spaulding, and W. M. Beery, (January-February, 1960) "Determination of the Amplitude-Probability Distribution of Atmospheric Radio Noise from Statistical Moments," J. Res. NBS 64D (Radio Propagation) No. 1, 49-56.
- Crichlow, W. Q., "Noise Investigation at VLF by the National Bureau of Standards," Proc. IRE, 45, 6 778 (1957).
- Crichlow, W. Q., D. F. Smith, R. N. Morton, and W. R. Corliss, "Worldwide Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 Megacycles," NBS Circular 557, August 25, 1955.
- "Report on Revision of Atmospheric Radio Noise Data," C.C.I.R. Report No. 65, VIIIth Plenary Assembly, Warsaw, 1956, (International Radio Consultative Committee, Secretariat, Geneva, Switzerland).
- "World Distribution and Characteristics of Atmospheric Radio Noise," C.C.I.R. Report No. 322, Xth Plenary Assembly, Geneva, 1963, (International Radio Consultative Committee, Secretariat, Geneva, Switzerland).
- Fulton, F. F. (Jr.) (May-June, 1961), "Effect of Receiver Bandwidth on the Amplitude Distribution of VLF Atmospheric Noise," J. Res. NBS 65D (Radio Propagation) No. 3, 299-304.
- Horner, F., "An Investigation of Atmospheric Radio Noise at Very Low Frequencies," Proc. Inst. Elec. Eng., Pt. B, 103, 743 (1956).

- Horner, F., "Radio Noise of Terrestrial Origin," Proc. of Commission IV on Radio Noise of Terrestrial Origin during the XIIIth General Assembly of URSI, " London, September, 1960.
- Spaulding, A. D., C. J. Roubique, and W. Q. Crichlow (November-December, 1962) "Conversion of the Amplitude-Probability Distribution Function for Atmospheric Radio Noise from One Bandwidth to Another," J. Res. NBS 66D (Radio Propagation) No. 6, 713-720.
- Obayashi, T. (January-February, 1960), "Measured Frequency Spectra of Very-Low-Frequency Atmospheric," J. Res. NBS 64D (Radio Propagation) No. 1, 41-48.
- Taylor, W. L. (September-October, 1963), "Radiation Field Characteristics of Lightning Discharges in the Band 1 kc/s to 100 kc/s," J. Res. NBS 67D (Radio Propagation) No. 5, 539-550.
- Taylor, W. L. and A. G. Jean (September-October, 1959), "Very-Low-Frequency Radiation Spectra of Lightning Discharges," J. Res. NBS 63D (Radio Propagation) No. 2, 199-204.
- URSI Special Report No. 7, "The Measurement of Characteristics of Terrestrial Radio Noise," Elsevier Publishing Co. (1962).
- Watt, A. D. and E. L. Maxwell, "Characteristics of Atmospheric Noise from 1 to 100 kc," Proc. IRE, 45, 6, 787 (1957).
- Watt, A. D. (September-October, 1960), "ELF Electric Fields from Thunderstorms," J. Res. NBS 64D (Radio Propagation) No. 5, 425-433.
- Watt, A. D. and E. L. Maxwell, "Measured Statistical Characteristics of VLF Atmospheric Radio Noise," Proc. IRE, 45, 1, 55 (1957).
- Watt, A. D., R. M. Coon, E. L. Maxwell, and R. W. Plush, "Performance of some Radio Systems in the Presence of Thermal and Atmospheric Noise," Proc. IRE, 46, 12, 1914 (1958).

Data included in this report and the standard time for each station are as follows:

Station	Data			To Convert LST to GMT (hours)
Balboa	March, April, May	1965	75W	+05
Bill	March, April, May	1965	105W	+07
Boulder	March	1965	105W	+07
Cook	March, April, May	1965	135E	-09
USNS Eltanin	April	1965		
Enköping	March, April, May	1965	15E	-01
Front Royal	March, April, May	1965	75W	+05
Kekaha	March, April, May	1965	150W	+10
New Delhi	March, April, May	1965	75E	-05
Ohira	March, April, May	1965	135E	-09
Pretoria	March, April, May	1965	30E	-02
Rabat	March, April, May	1965	GMT	0
São Jose	March, April, May	1965	45W	+03
Singapore	March, April, May	1965	105E	-07
Warrensburg	March, April, May	1965	90W	+06

Previous data from the World-Wide Network have been published in the following Technical Note 18 series:

- 18-1 July 1, 1957-December 31, 1958
- 18-2 March, April, May 1959
- 18-3 June, July, August 1959
- 18-4 September, October, November 1959
- 18-5 December, January, February 1959-60
- 18-6 March, April, May 1960
- 18-7 June, July, August 1960
- 18-8 September, October, November 1960
- 18-9 December, January, February 1960-61
- 18-10 March, April, May 1961
- 18-11 June, July, August 1961
- 18-12 September, October, November 1961
- 18-13 December, January, February 1961-62
- 18-14 March, April, May 1962
- 18-15 June, July, August 1962
- 18-16 September, October, November 1962
- 18-17 December, January, February 1962-63
- 18-18 March, April, May 1963

18-19 June, July, August 1963
18-20 September, October, November 1963
18-21 December, January, February 1963-64
18-22 March, April, May 1964
18-23 June, July, August 1964
18-24 September, October, November 1964
18-25 December, January, February 1964-65