Geophysical Data Report

ATMOSPHERIC RADIO NOISE DATA BANGKOK, THAILAND—June-August 1966

By: RANGSIT CHINDAHPORN LT. CHAIKAMOL LUMJIAK
PRAIUAB NIMITYONGSKUL

Prepared for:

U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY

CONTRACT DA-36-039 AMC-00040(E)
ORDER NO. 5384-PM-63-91

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FOR THE
THAI-U.S. MILITARY RESEARCH AND DEVELOPMENT CENTER
SUPREME COMMAND HEADQUARTERS
BANGKOK, THAILAND

STANFORD RESEARCH INSTITUTE

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I INTRODUCTION

Measurements of atmospheric radio noise are being made by the Electronics Laboratory of the Military Research and Development Center (MRDC-EL), a joint Thailand-United States-organization in Bangkok. The noise-measuring equipment (Fig. 1), modeled after the U.S. National Bureau of Standards Radio Noise Recorder, Model ARN-2, is located near the village of Laem Chabang (Fig. 2), about 90 kilometers southeast of Bangkok, in order to minimize interference from man-made noise. A view of the site, showing the standard ARN-2 antenna and ground plane, is presented in Fig. 3.

The cooperation and participation of the staff members of the Thailand Ministry of Defense and the support of the United States Advanced Research Projects Agency and the U.S. Army Electronics Command, have made it possible for the data presented in this report to be accumulated.

Tables I and II, below, present information about the site and the equipment.

For convenience in applying the results in this study, a nomogram for transforming effective antenna noise figure to noise field strength as a function of frequency is presented in Fig. 4.

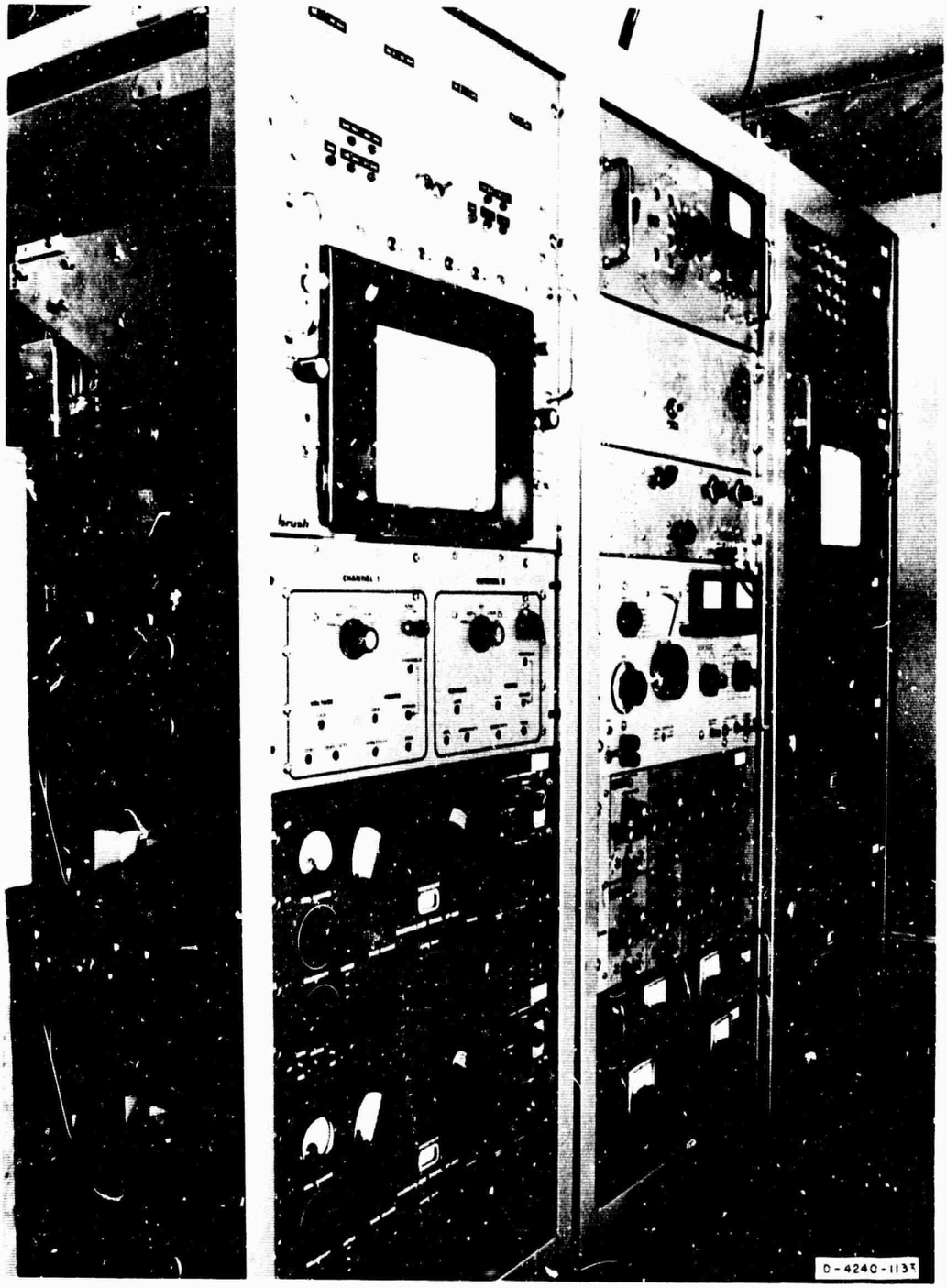


FIG. 1 ARN-3 ATMOSPHERIC RADIO NOISE MEASURING EQUIPMENT

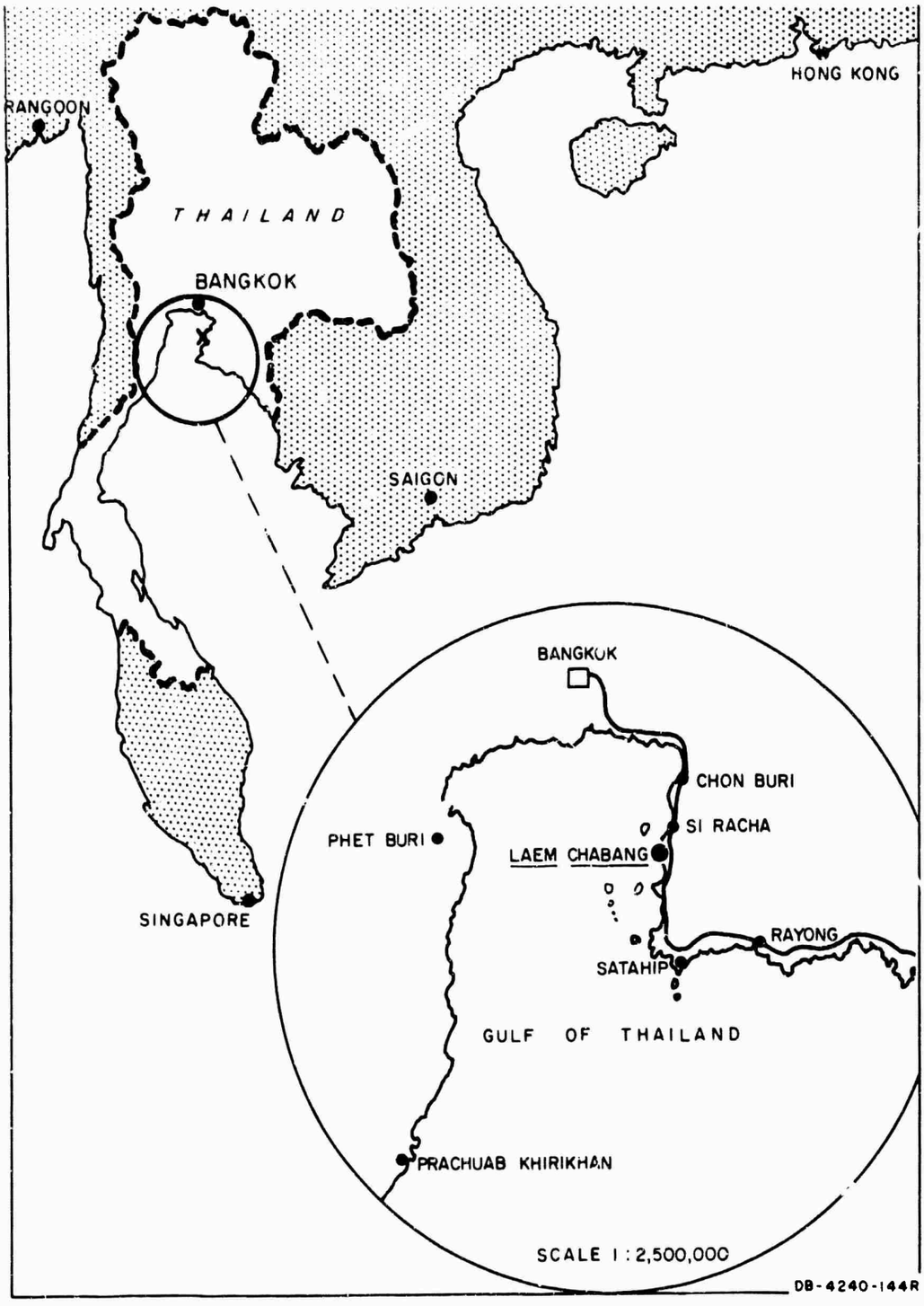


FIG. 2 LOCATION OF THE RADIO NOISE RECORDING STATION AT LAEM CHABANG, THAILAND

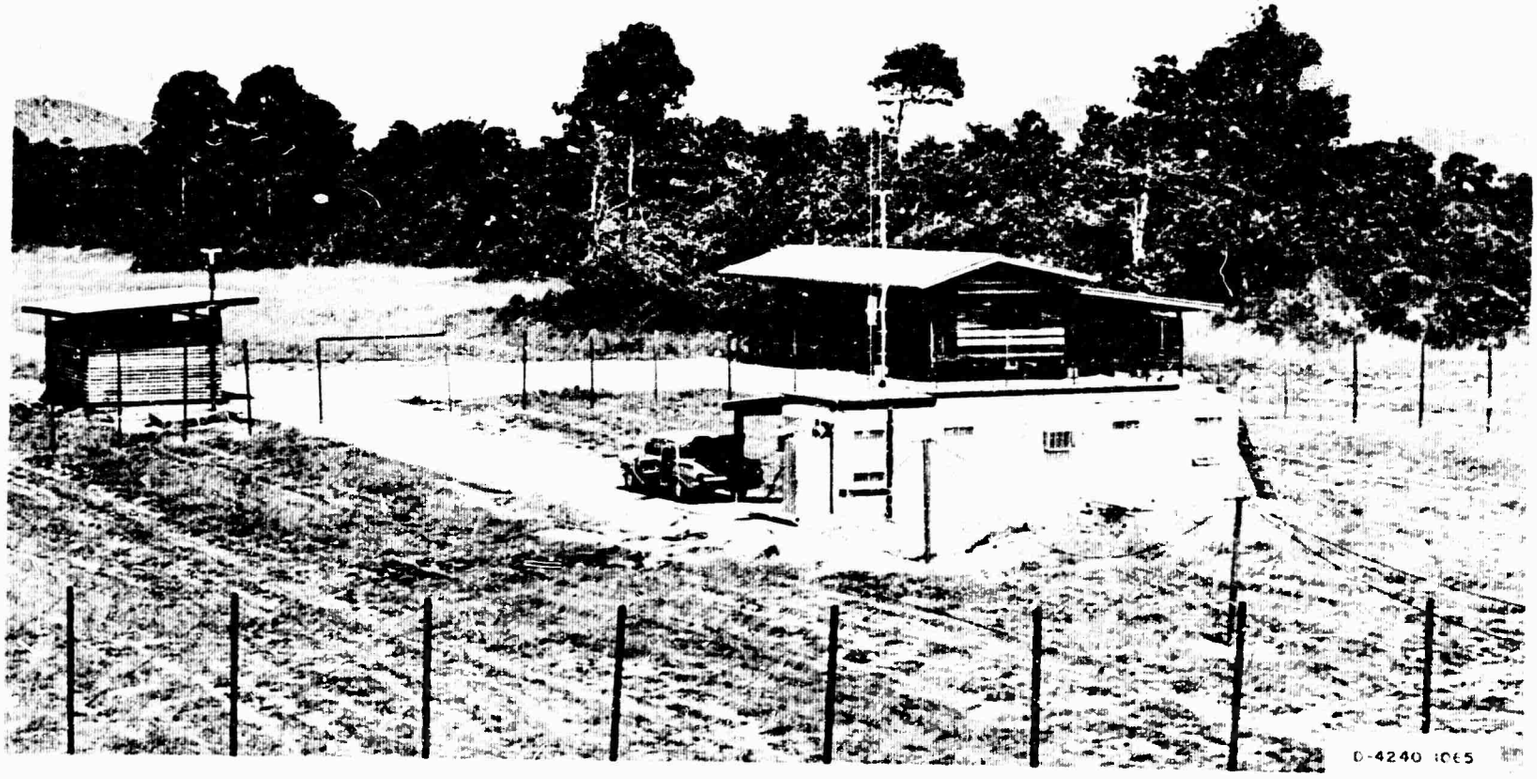


FIG. 3 RADIO NOISE RECORDING STATION

Table I

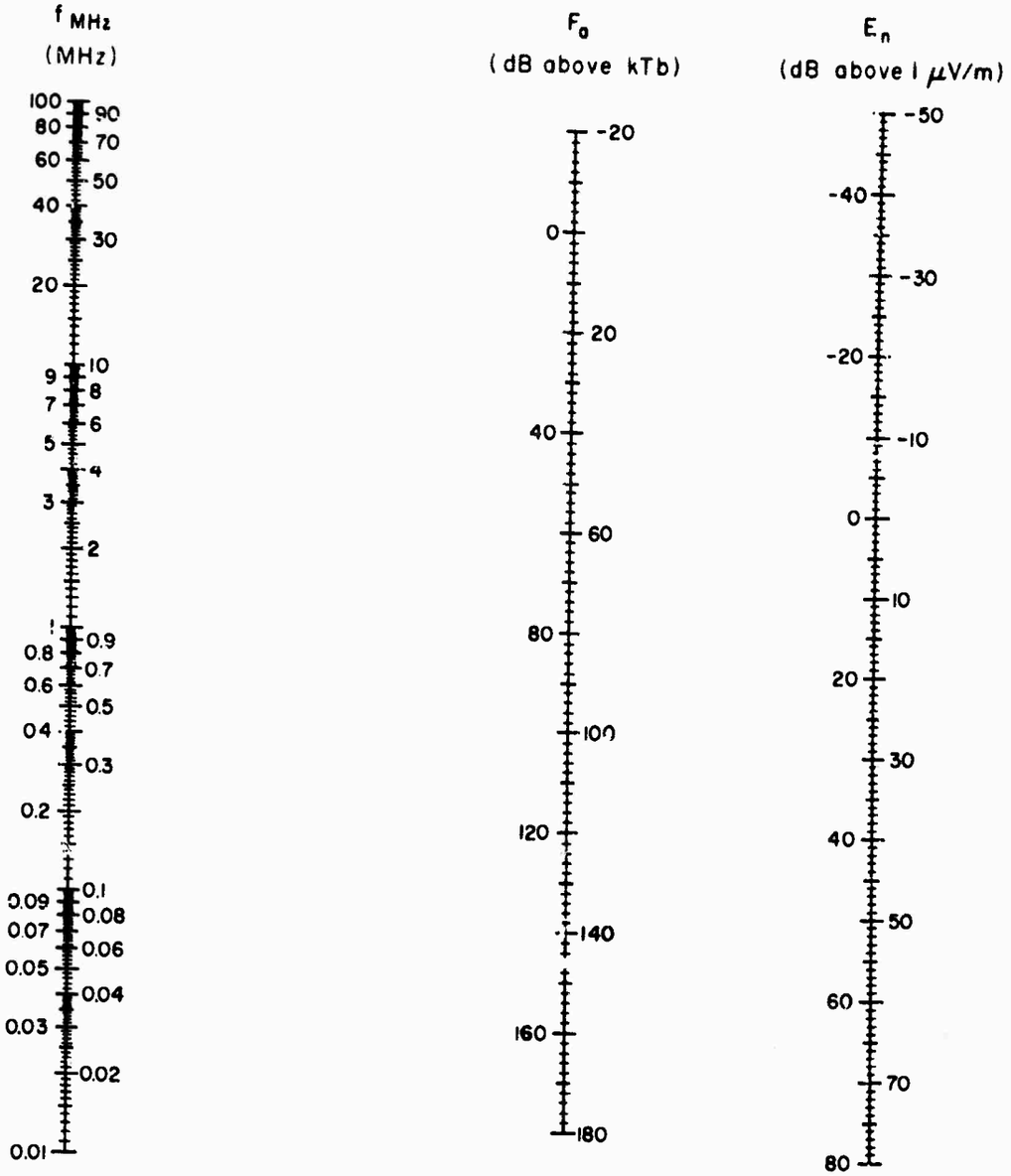
RADIO NOISE MEASURING SITE AT
LAEM CHABANG, THAILAND

GEOGRAPHIC LOCATION		ELEVATION ANGLE OF HORIZON
Latitude	Longitude	
13.55°N	100.90°E	Less than 3 degrees in all directions; zero degrees towards the west (Gulf of Thailand)

Table II

ARN-3 RADIO NOISE RECORDER SPECIFICATIONS

Antenna	Standard 6.6294-meter (21.75 feet) vertical antenna with ground plane consisting of ninety radial wires, each approximately 100 feet long.
Frequencies of Measurement	6, 13, 27, 160, 530, 2,300, 5,000, and 10,000 kHz.
Effective noise bandwidth of receiver	200 Hz
Recording chart speed	5 cm per hour



$$E_n = F_a + 20 \log_{10} f_{MHz} - 65.5$$

DB-4240-261

F_a = Effective Antenna Noise Figure = External Noise Power Available from an Equivalent Short, Lossless, Vertical Antenna in dB Above kTb.

E_n = Equivalent Vertically Polarized Ground Wave rms. Noise Field Strength in db Above 1 μV/meter for a 1-kHz Bandwidth.

f_{MHz} = Frequency in MHz

Source: ESSA Tech. Report IER 18-ITSA 18-28

FIG. 4 NOMOGRAM FOR TRANSFORMING EFFECTIVE ANTENNA NOISE FIGURE TO NOISE FIELD STRENGTH AS A FUNCTION OF FREQUENCY

II DISCUSSION

The noise data contained in this report are compatible with the data in a series of Technical Notes published by ITSA,* (Series 18) "Quarterly Radio Noise Data." The following two parameters of the atmospheric noise are tabulated in the Appendix:

(1) Mean power

(2) Mean envelope voltage.

The mean power is a basic parameter and is expressed as an effective antenna noise factor, F_a. F_a is defined as the noise power available from an equivalent loss-free antenna in dB above kTb, the thermal noise power available from a passive resistance, where

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

b = Effective receiver noise bandwidth (Hz)

T = Reference temperature taken as 288°Kelvin.

The mean envelope voltage, V_d, is expressed as a deviation in dB below the mean power.

Four frequencies, either in the MF and HF bands or in the VLF and LF bands, may be recorded simultaneously for 30 minutes. Switching between the two sets of four frequencies is accomplished automatically each half hour. The average power and the mean envelope voltage are recorded on an 8-channel strip-chart recorder. The thirty-minute samples are taken as representing the noise condition for the full hour.

The month-hour medians for power and voltage, F_{am} and V_{dm}, respectively, are determined from the hourly values scaled from the chart recordings for each of the corresponding frequencies. Normally, from twenty-five to thirty observations of the mean power are obtained monthly

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*Institute for Telecommunication Sciences and Aeronomy, of the Institutes for Environmental Research, Environmental Science Services Administration, U.S. Department of Commerce.

for each hour of the day and from ten to fifteen observations of the voltage deviations. When there are fewer than fifteen observations of the mean power or seven observations of the voltage deviations, the tabulated values in the Appendix are identified by an asterisk.

The extent of the variation of the noise power from day to day at a particular hour of the day can be determined from the upper and lower decile values of F_a. These are expressed in dB above and below the month-hour median, F_{am}, and designated by D_u and D_l, respectively, in Table A-1.

Time-block median values of noise are tabulated on a seasonal basis and are obtained by averaging all month-hour medians for the four hours of the day within the three-month period (see Table A-2 and Fig. A-1). The time-block values conform to the seasonal time-block values used in CCIR Report No. 322.

The results of the noise measurements at MF and HF for the months June, July, and August 1966 are given in this report. No data for LF and VLF for these months are available, but it is expected that data for these frequency bands will be published in subsequent reports.

APPENDIX

RADIO NOISE VALUES

Table A-1

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM CHABANG Lat. 13.55°N Long. 100.9°E Month June 1966

HR. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				10.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	103	12	13	4.0	*73	--	--	4.0	66	6	15	2.0	53	15	13	3 0
01	102	12	9	4.0	*70	--	--	4.0	67	6	14	2.0	53	13	17	3.0
02	102	12	16	5.0	*69	--	--	4.0	63	9	12	2.0	52	16	22	3.5
03	99	13	13	5.0	*73	--	--	4.0	64	8	15	2.0	*49	--	--	3.0
04	9[illegible]	13	11	5.0	*71	--	--	4.0	*61	--	--	2.0	*47	--	--	4.5
05	96	13	12	5.0	*74	--	--	4.0	*64	--	--	2.0	*52	--	--	4.0
06	*86	--	--	3.0	*70	--	--	4.0	64	11	13	2.0	53	9	9	3.5
07	83	22	10	4.0	*70	--	--	2.0	*58	--	--	2.0	49	11	9	4.0
08	82	20	10	4.0	*56	--	--	2.0	51	17	4	3.0	46	13	9	6.0
09	80	19	11	4.0	*55	--	--	3.0	*47	--	--	2.0	47	8	13	4.0
10	84	14	14	4.0	*51	--	--	3.0	*47	--	--	3.0	45	6	10	4.0
11	84	18	15	6.0	*48	--	--	3.0	*43	--	--	3.0	*45	--	--	4.5
12	88	12	17	7.0	49	16	11	4.0	45	7	13	2.0	43	8	13	4.5
13	88	14	14	7.0	49	9	12	4.0	44	6	10	3.0	44	8	14	5.0
14	93	12	19	7.0	*52	--	--	5.0	47	10	12	4.0	47	6	15	5.0
15	99	12	22	9.0	57	19	17	4.0	53	11	9	3.0	50	3	17	4.5
16	95	15	13	6.5	*66	--	--	3.0	58	13	13	2.0	52	3	16	4.0
17	98	14	5	6.0	*70	--	--	2.0	59	14	12	2.0	55	12	13	3.0
18	100	13	5	4.0	*73	--	--	2.0	66	14	12	2.0	55	12	13	3.0
19	101	13	11	4.0	*78	--	--	2.0	75	--	--	2.0	57	11	13	3.0
20	102	13	13	4.0	*78	--	--	2.0	74	7	8	2.5	56	8	10	2.0
21	103	12	16	4.0	*78	--	--	2.0	*68	--	--	2.0	55	12	16	3.0
22	100	14	10	4.0	*77	--	--	2.0	68	8	14	2.0	57	14	19	3.5
23	103	11	12	4.5	*76	--	--	2.0	*66	--	--	2.0	55	11	15	3.0

* Fewer observations than 15 days of mean power measurements or 7 days obaervations of voltage measurements.

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median F_{am} in dB

D_l = Ratio of median F_{am} to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-1 (Continued)

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM CHABANG Lat. 13.55°N Long. 100.9°E Month July 1966

HR. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				.0.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	101	13	15	2.0	68	12	8	2.5	64	11	16	1.0	54	15	17	5.0
01	100	12	12	2.0	66	11	5	2.5	64	11	15	1.0	*58	--	--	4.0
02	100	11	12	3.0	66	7	5	3.0	62	10	13	2.0	*62	--	--	4.0
03	101	9	13	3.0	65	9	4	4.0	62	12	13	2.0	*51	--	--	5.0
04	99	11	13	3.0	65	9	5	4.0	61	15	12	2.0	*55	--	--	5.0
05	98	11	14	4.0	64	13	5	4.0	60	12	11	2.0	*56	--	--	5.0
06	92	16	9	3.0	68	13	7	2.0	60	11	11	1.0	53	8	11	5.0
07	86	17	6	4.0	68	4	12	2.0	54	18	8	1.5	50	12	13	6.0
08	83	19	12	3.0	61	8	15	2.0	47	10	8	2.0	47	8	12	5.0
09	88	6	12	5.0	59	14	14	2.0	49	14	15	2.0	40	7	9	4.0
10	84	8	13	4.0	56	13	15	2.0	48	6	16	1.0	41	9	9	4.0
11	83	13	15	4.0	57	8	15	2.0	44	13	13	2.0	36	13	3	4.0
12	84	7	12	3.0	58	6	19	3.0	45	14	13	2.0	40	8	9	6.0
13	86	6	9	3.0	59	14	15	3.0	44	11	12	2.0	40	12	9	4.0
14	87	9	6	3.0	58	13	12	4.0	46	16	10	2.0	45	8	15	4.0
15	88	10	14	3.0	60	6	10	3.0	52	9	11	2.0	47	17	7	5.0
16	92	6	19	3.0	66	9	17	2.0	57	12	13	2.0	51	12	12	4.0
17	96	12	19	3.0	75	7	25	2.0	65	9	26	2.0	55	13	14	3.0
18	100	10	16	3.0	75	14	16	2.0	70	7	22	2.0	62	7	19	4.0
19	102	14	17	2.5	77	12	14	1.0	74	8	26	2.0	61	10	18	4.0
20	104	10	13	3.0	78	15	19	1.0	73	11	24	2.0	63	9	21	4.0
21	103	10	17	4.0	77	11	11	2.0	71	11	22	1.0	53	17	9	5.0
22	102	11	14	3.5	74	15	11	2.0	70	9	22	2.0	54	23	11	4.0
23	102	11	15	2.5	70	11	5	2.0	64	14	16	2.0	57	22	16	4.0

* Fewer observations than 15 days of mean power measurements or 7 days observations of voltage measurements.

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median F_{am} in dB

D_l = Ratio of median F_{am} to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-1 (Concluded)

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM CHABANG Lat. 13.55°N Long. 100.9°E Month August 1966

HR. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				10.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	97	7	10	10.0	71	10	10	3.0	61	19	9	2.0	49	13	20	5.0
01	96	8	14	9.0	72	7	8	3.5	60	22	9	2.0	47	21	11	5.0
02	96	5	13	7.0	72	5	10	4.0	62	19	9	2.0	45	23	9	5.0
03	96	6	15	8.0	70	7	10	5.0	64	14	12	2.0	48	7	13	7.5
04	95	5	15	8.0	69	7	11	6.0	61	10	12	2.0	42	9	16	6.0
05	90	8	9	8.5	70	6	12	5.0	59	11	9	2.0	45	5	10	6.0
06	89	8	20	8.0	71	14	17	2.0	60	8	12	2.0	46	19	6	4.0
07	83	9	6	10.0	70	10	20	2.0	56	9	16	2.0	41	11	7	6.5
08	82	15	8	4.0	65	13	17	2.0	50	17	13	2.0	38	11	5	6.0
09	80	14	17	4.0	57	22	10	2.0	49	8	17	2.0	34	14	5	6.5
10	79	17	10	4.0	54	19	6	2.0	46	13	18	2.0	34	16	5	6.0
11	82	17	11	10.0	58	19	11	2.0	49	9	14	2.0	33	17	7	6.0
12	84	16	11	11.0	64	15	18	2.0	46	12	12	2.0	38	9	16	6.5
13	87	13	11	6.0	66	13	18	2.5	48	9	10	4.0	39	7	17	8.0
14	91	10	13	8.0	70	9	19	4.0	51	8	8	4.0	43	5	10	8.0
15	93	8	15	11.0	68	10	13	3.5	52	8	7	2.0	44	5	8	8.0
16	92	13	11	8.0	73	7	15	2.0	60	9	8	2.0	47	9	8	6.0
17	95	9	9	6.0	77	8	16	2.0	65	7	11	1.5	55	9	18	4.0
18	96	6	7	7.0	80	7	13	2.0	69	5	9	1.5	54	11	16	4.5
19	100	3	11	5.5	82	5	16	2.0	68	11	11	2.0	51	9	30	6.0
20	97	7	9	4.5	81	9	11	2.0	69	14	9	1.5	51	8	25	5.0
21	97	5	8	6.0	82	5	19	2.0	68	15	8	2.0	51	14	18	4.5
22	97	5	10	6.0	78	7	8	2.0	67	11	8	2.0	54	7	17	4.0
23	96	8	9	6.5	73	9	10	2.5	63	9	8	2.0	48	8	13	4.0

* Fewer observations than 15 days of mean power measurements or 7 days observations of voltage measurements.

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median F_{am} in dB

D_l = Ratio of median F_{am} to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-2

THREE-MONTH TIME-BLOCK VALUES OF RADIO NOISE

Station: LAEM CHABANG, THAILAND Lat. 13.55°N Long. 100.9°E Period June-July-August 1980

FREQUENCY (MHz)	TIME BLOCKS (LST)																							
	0000-0400				0400-0800				0800-1200				1200-1600				1600-2000				2000-2400			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
0.53	99	10	13	5.0	91	12	11	5.5	83	15	12	5.0	89	12	14	9 0	97	11	12	5.0	100	10	12	5.0
2.3	70	9	8	4.0	69	10	11	3.0	57	15	13	2.0	59	12	15	3.5	74	9	17	2.0	77	10	11	2.0
5	63	12	13	2.0	60	12	12	1.9	48	12	13	2.0	48	10	11	3.0	66	10	15	2.0	68	11	14	2.0
10	52	15	15	4.0	49	11	10	5.0	41	11	8	7.5	43	8	13	6.0	55	10	16	4.0	55	13	16	4.0

F_{am} = Median value of effective antenna noise in dB in kTb

D_u = Ratio of upper decile to median F_{am} in dB

D_l = Ratio of median F_{am} to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

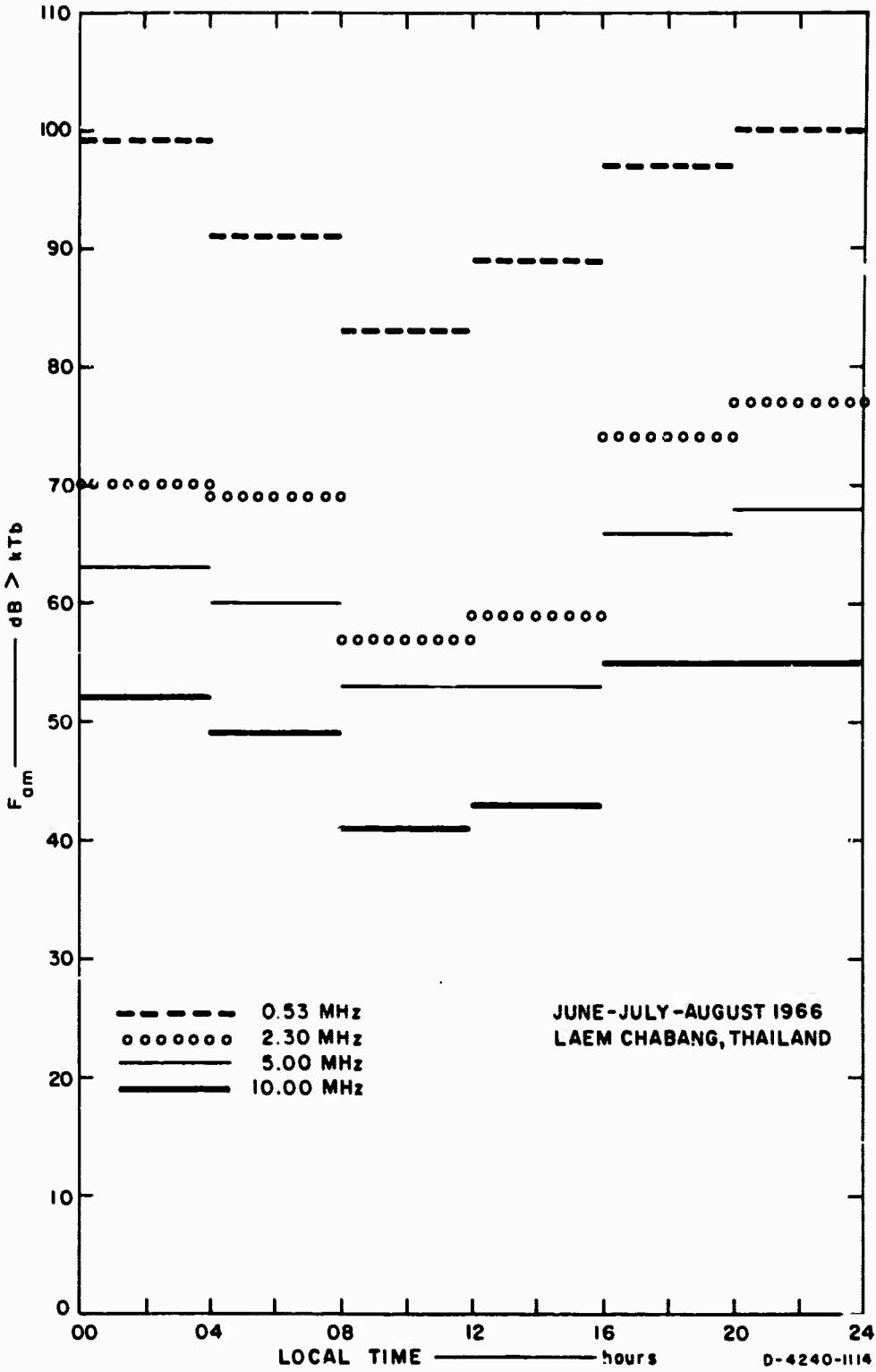

FIG. A-1 THREE-MONTH MEDIAN TIME-BLOCK VALUES OF RADIO NOISE POWER

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Security Classification

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

None: Data Report

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Atmospheric radio noise						
VLF, LF, MF, HF						
Mean power, F_a						
Mean envelope voltage, V_d						
Four-hour time blocks						
Monthly Summary						
Quarterly Summary						
AWN-2						
AWN-3						
June, July, August 1966						
Laem Chabang (near Sirracha), Thailand						

ERRATUM

Ref: "Atmospheric Radio Noise Data, Bangkok, Thailand--June-August 1966," Geophysical Data Report, by Rangsit Chindahporn, Lt. Chaikamol Lumjiak, and Prajuab Nimityongskul, Contract DA 36-039 AMC-00040(E), SRI Project 4200, Stanford Research Institute, Menlo Park, California (January 1967).

An error has been found in Fig. A-1 of the report as printed. The illustration has been corrected and is attached. Please correct the copy(ies) of this report as submitted to you.

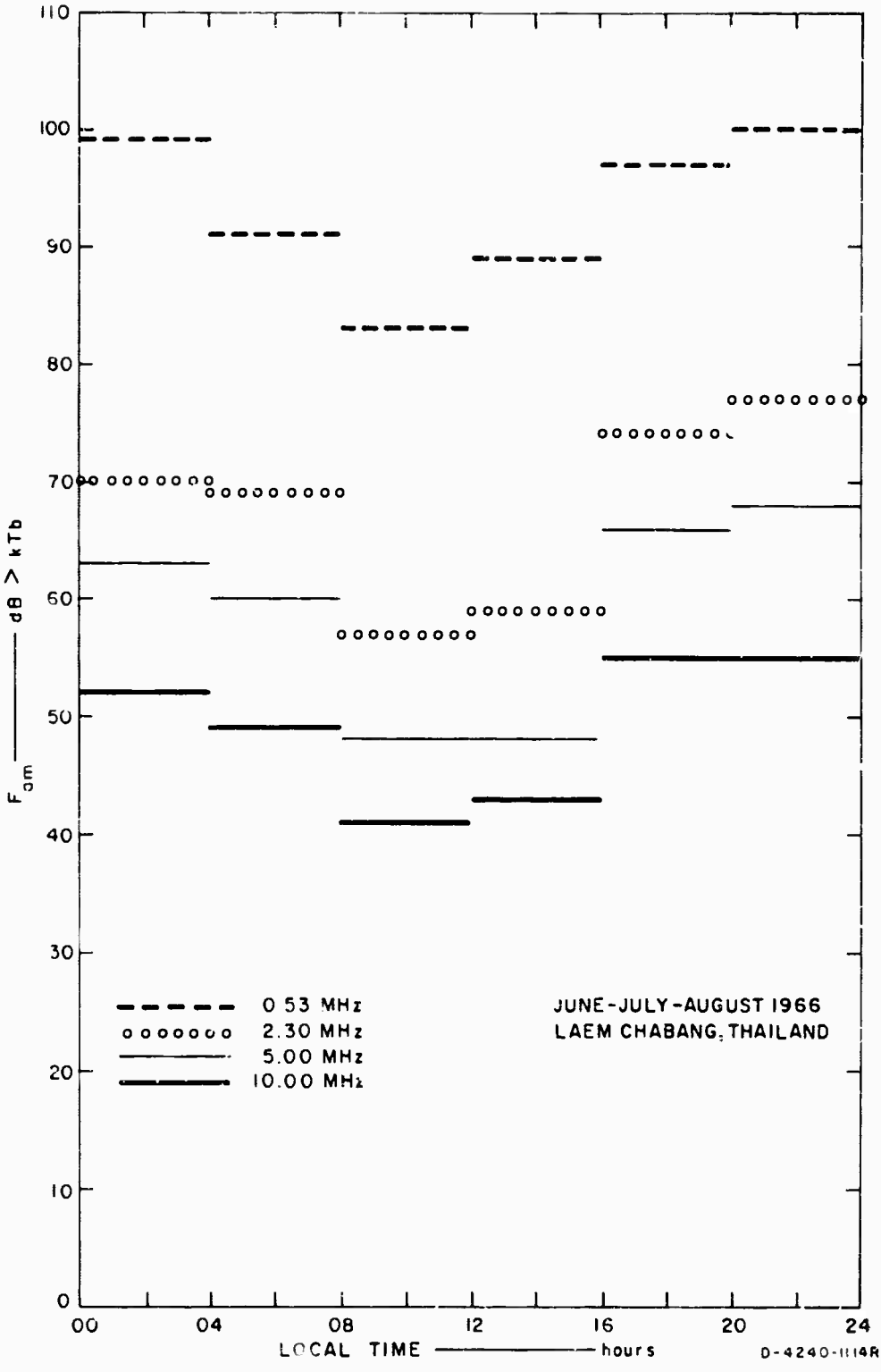

FIG. A-1 THREE-MONTH MEDIAN TIME-BLOCK VALUES OF RADIO NOISE POWER