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<td><strong>FROM:</strong> confidential</td>
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<td><strong>TO:</strong> Approved for public release, distribution unlimited</td>
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<tr>
<td><strong>FROM:</strong> Controlling DoD Organization...U.S. Naval Research Laboratory, Washington, DC.</td>
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**AUTHORITY**
NRL ltr, 19 Jun 2002; NRL ltr, 19 Jun 2002
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FIELD STRENGTHS OF SOME VLF TRANSMISSIONS AND ATMOSPHERIC NOISE MEASURED IN EUROPEAN AND ASIAN AREAS MARCH, APRIL AND MAY, 1962

[UNCLASSIFIED TITLE]

W. E. Garner, F. J. Rhoads, and R. L. Schauer

RADIO DIVISION

29 October 1964

U. S. NAVAL RESEARCH LABORATORY
Washington, D.C.
Qualified requesters may obtain copies of this report from DDC.

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ABSTRACT
(Confidential)

The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. The statistical relationship of the field strength of various VLF transmissions and atmospheric noise and the signal-to-noise ratios with the time of day and season of the year is being investigated. Between December 1958 and approximately March 1964 the subject propagation data has been recorded at the following sites: Hammerfest, Bodø and Varhaug, Norway; Rome, Italy; Haifa, Israel; and Karachi, West Pakistan.

This is the thirteenth in a series of quarterly reports, covering the fourteenth quarter since the program began. During the period covered by this report, March, April and May, 1962, Karachi was in operation the entire time, Haifa ceased operation at the end of March and Hammerfest became productive in April.

PROBLEM STATUS

This is an interim report on one phase of the problem. Work is continuing on this and other phases.

AUTHORIZATION

NRL Problem R01-39
BUSHTS Problem S-1888
SR 008-01-01-7028
INTRODUCTION

The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. For this investigation, the field strengths of various VLF transmissions and atmospheric noise have been and/or are planned to be continuously recorded at several sites on the coasts of Europe and the Near East from December 1958 through approximately March 1964. Extension of the project through the spring of 1964 is primarily intended for obtaining coverage data on the Navy's new VLF transmitting facility at Cutler, Maine which commenced operation in January 1961. Information will continue to be obtained on the other VLF transmissions during that period.

The routine output data is being published in installments covering each quarter of the year, grouped according to the seasons. This series of reports will not contain an analysis of the data. Analysis and correlation of the data with various geophysical phenomena will be the subject of other reports. This report is the thirteenth in the series of these installments and covers the fourteenth quarter, the spring months of March, April and May, 1962. Reference 1 covered two quarters.

TRANSMISSION PATHS

During the period covered in this report, field strengths of VLF transmissions and atmospheric noise were recorded at Hammerfest, Norway, Karachi, Pakistan and Haifa, Israel. The precise locations of these recording sites are given in Table 1. The locations of the U. S. Navy VLF transmitters are given in Table 2.

A VLF recording site was installed in Karachi, West Pakistan in June 1961 and will be operated through March, 1964. However, due to the severe environmental conditions, other local problems, and the use of the unreliable instrumentation discussed above, many equipment outages resulted. As a consequence, consistent, usable data were not available during the spring months of March, April and May, 1962.
CONFIDENTIAL

not obtained for continuous periods of sufficient duration to justify processing until March 1962.
## TABLE 1

Locations of Data Recording Stations and Periods of Operation

<table>
<thead>
<tr>
<th>Station</th>
<th>Location</th>
<th>Period of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Latitude</td>
<td>Longitude</td>
</tr>
<tr>
<td>Varhaug</td>
<td>58° 37.5'N</td>
<td>5° 37.8'E</td>
</tr>
<tr>
<td>Rome</td>
<td>41° 51' N</td>
<td>12° 40' E</td>
</tr>
<tr>
<td>Hammerfest</td>
<td>70° 39' N</td>
<td>23° 37' E</td>
</tr>
<tr>
<td>Haifa</td>
<td>32° 48' N</td>
<td>35° 2' E</td>
</tr>
<tr>
<td>Karachi</td>
<td>24° 54' N</td>
<td>67° 2' E</td>
</tr>
</tbody>
</table>

## TABLE 2

Locations of U.S. Navy VLF Transmitters

<table>
<thead>
<tr>
<th>Station</th>
<th>Call Letters</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Latitude</td>
<td>Longitude</td>
</tr>
<tr>
<td>NSS</td>
<td>38° 59.1'N</td>
<td>76° 27.2'W</td>
</tr>
<tr>
<td>NPG</td>
<td>48° 12' N</td>
<td>121° 55' W</td>
</tr>
<tr>
<td>NPM</td>
<td>21° 25.5'N</td>
<td>158° 9.7'W</td>
</tr>
<tr>
<td>NDT</td>
<td>34° 58.3'N</td>
<td>137° 1.3'E</td>
</tr>
<tr>
<td>NAA</td>
<td>44° 38.9'N</td>
<td>67° 16.9'W</td>
</tr>
<tr>
<td>NBA</td>
<td>9° 3.3'N</td>
<td>79° 38.9'W</td>
</tr>
</tbody>
</table>
DATA RECORDING AND PROCESSING METHODS

All field strength data reported herein were recorded using a 10-foot, vertical, monopole (whip) antenna. One such antenna is installed at each data recording station. A broadband antenna coupler is used to couple the antenna to AN/URM-139 and AN/URM-6 field strength meters which drive Esterline-Angus strip chart recorders. The whip antenna system is calibrated periodically using a loop antenna.

The U.S. Navy transmitters "locked key" for three minutes and, immediately preceding or following, are "off" for three minutes once each hour. It is during these periods that the subject data were recorded.

Atmospheric noise

The atmospheric noise field strengths reported are average values recorded once each hour during the three minute "off" period of the transmitters discussed above. The AN/URM-139 equipments have a nominal noise bandwidth of 41 cps while the noise bandwidth of the AN/URM-6 equipment varies between about 100 and 200 cps depending upon the frequency to which it is tuned. All atmospheric noise field strengths have been normalized to a bandwidth of 100 cps.

Signal Field Strengths

The signal field strengths given in this report are average values over the three minute "locked key" period recorded once each hour, and normalized to a radiated power of one kilowatt. The signal field strengths are calculated from the measurements of the average signal plus noise and the average noise made during the locked-key and off periods of the transmitters. The radiated power during each locked-key period is determined from a measurement of the average transmitting antenna current during each period and the average radiation resistance of the antenna. The radiation resistance values used for each transmitter are given in Table 3. The radiation resistance of each transmitting station is periodically measured and the value appropriately changed if necessary. Although the radiation resistance of NPG appears to have a seasonal dependency, an average value is used throughout
the year since the effect on the radiated power is slight.

### TABLE 3

**AVERAGE RADIATION RESISTANCE FOR VLF TRANSMITTERS**

<table>
<thead>
<tr>
<th>Station</th>
<th>Frequency (kc)</th>
<th>Radiation Resistance (ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAA</td>
<td>14.7</td>
<td>0.078</td>
</tr>
<tr>
<td>NBA</td>
<td>18.0</td>
<td>0.069</td>
</tr>
<tr>
<td>NPG</td>
<td>18.6</td>
<td>0.079</td>
</tr>
<tr>
<td>NPM</td>
<td>19.8</td>
<td>0.072</td>
</tr>
<tr>
<td>NSS</td>
<td>22.3</td>
<td>0.134</td>
</tr>
</tbody>
</table>

**Signal-to-Noise Ratios**

The signal to atmospheric noise ratios for each hourly locked-key and off period reported are the ratios of the locked-key field strengths normalized to a radiated power of one kilowatt, to the average atmospheric noise field strengths normalized to a 100 cps bandwidth.

**Transmitter Radiated Power**

As previously stated, the field strengths of all transmissions reported herein have been normalized to a radiated power of one kilowatt. The radiated power during each field strength measurement is calculated by squaring the average transmitting antenna current measured during each locked-key period and multiplying by the average value of radiation resistance (Table 3). To determine the various propagation effects, it is necessary to normalize the data to a constant radiated power. However, for planning communication circuits...
and determining the reliability of the circuits, it is necessary to know the radiated power capability of each transmitting facility.

In Table 4 the average radiated power for each transmitter for each month is given along with the number of hourly periods during which the locked-key test was not transmitted. For approximately six hours each week, NPG operates with only half of its transmitting system for routine maintenance. Although these periods have been referred to as "half-power" transmissions, the reduction in radiated power during such operation is considerably more than 3 db. These "half-system" transmitting periods were not used in determining the average radiated power from NPG because normally the signal is undetectable at all the data recording stations during these periods. The NAA transmitter also operates periodically from half of the system at a reduction in radiated power of approximately 3db. Since these "half power" transmissions can be received at all of the data recording stations, they are not omitted in computing the monthly average radiated power, as is the case with NPG. In Table 4 the monthly average radiated power is computed separately for the full and "half power" transmissions.
TABLE 4
MONTHLY AVERAGE RADIATED POWER

<table>
<thead>
<tr>
<th>STATION</th>
<th>FREQ</th>
<th>MONTH</th>
<th>YEAR</th>
<th>AVERAGE RADIATED POWER</th>
<th># LOCKED-KEY PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DB ABOVE</td>
<td>FULL</td>
</tr>
<tr>
<td>NAA</td>
<td>14.7</td>
<td>Mar</td>
<td>62</td>
<td><em>997.4 (414.4)</em>*</td>
<td>617</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>30.0 (26.2)</em>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Apr</td>
<td>62</td>
<td><em>853.0 (408.0)</em>*</td>
<td>595</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>29.3 (26.1)</em>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>May</td>
<td>62</td>
<td>*1015.9 (412.6)**</td>
<td>623</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td><em>30.0 (26.2)</em>*</td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>Average radiated power for full power periods only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**</td>
<td>Average radiated power for &quot;half power&quot; periods only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPG</td>
<td>18.6</td>
<td>May</td>
<td>62</td>
<td>174.7</td>
<td>589</td>
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<tr>
<td>NPM</td>
<td>19.8</td>
<td>Apr</td>
<td>62</td>
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<td></td>
<td>18.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>62</td>
<td>85.4</td>
<td>19.3</td>
<td>482</td>
</tr>
<tr>
<td>NSS</td>
<td>22.3</td>
<td>Mar</td>
<td>62</td>
<td>145.2</td>
<td>712</td>
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<td></td>
<td></td>
<td></td>
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<td>21.6</td>
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</table>
RESULTS

The data are reported in several forms as follows:

1. The mean plus and minus one standard deviation for the signal and the atmospheric noise field strengths and the signal-to-noise ratios for each hour of one day for a period of one month.

2. The mean for the signal field strengths and the signal-to-noise ratios for each hour of the day over approximately ten day periods of each month.

3. The probability distribution of the signal and the atmospheric noise field strengths and the signal-to-noise ratios for a period of one month.

NOTE: The probability distribution presented for the signal and noise data, separately, are not time correlated. That is, a high signal level did not necessarily occur simultaneously with a high noise level. Therefore, these two sets of data cannot be used for determining the signal-to-noise probability distribution. Graphs showing the true, signal-to-noise probability distribution are presented, however.

In processing the data included in this report, atmospheric noise field strengths are computed only for the hours during which a signal field strength is computed from a recorded locked key transmission. Ideally this occurs once an hour, every hour. Priority traffic and scheduled maintenance at the transmitter and emergency maintenance at the transmitting and receiving sites thwart efforts to attain the ideal situation. The actual number of recorded, locked key transmissions is indicated above each hourly plot on the monthly signal-to-noise ratio curves. These numbers apply to the signal and atmospheric noise field strengths as well as the signal-to-noise ratio calculations.
During the period covered by this report, all three receiving sites, when operating, recorded NAA. Haifa, which was shut down in early April, also recorded NSS. No usable data were recorded at Hammerfest until April at which time NPM and NPC were recorded in addition to NAA. The NPC data at Hammerfest were insufficient until May.

Additional information about atmospheric noise at many locations around the world and for the same period covered by this report may be found in reference 2.

Figures 1 and 2 may be removed from the report and used for interpolation of the appropriate graph scales.

In March, 1962 new antenna couplers were installed at the Hammerfest and Karabhi sites. The method used for determining the antenna factor with the new coupler was different than the method used with the old coupler by a factor of 6db. Unfortunately this change was not incorporated in the computer program. As a consequence, all of the signal and noise field strengths from those stations are in error from that date. The correction factors are noted on the affected curves. THE SIGNAL-TO-NOISE RATIO CURVES ARE, OBVIOUSLY, NOT AFFECTED.
TABLE 5

FIGURE NUMBER INDEX OF THE INCLUDED DATA

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<th></th>
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<th>APRIL</th>
<th></th>
<th>MAY</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>NAA</td>
<td>NSS</td>
<td>NAA</td>
<td>NPM</td>
<td>NAA</td>
<td>NPG</td>
</tr>
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<td>HAIFA</td>
<td>3-9</td>
<td>10-16</td>
<td>HAMMERFEST</td>
<td>17-23</td>
<td>24-30</td>
<td>31-37</td>
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<tr>
<td>KARACHI</td>
<td>52-58</td>
<td>59-65</td>
<td>66-72</td>
<td></td>
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<td></td>
</tr>
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REFERENCES


NORMALIZATIONS

The Field Strengths Of All Transmissions Are Normalized To A Radiated Power \( P_r \) Of One Kilowatt.

Atmospheric Noise Field Strengths Are Normalized To A Bandwidth of 100 Cycles Per Second.
Figure 1
Figure 3

CONFIDENTIAL
HAIFA, ISRAEL
MARCH, 1962
14.7 KC
ATMOSPHERIC NOISE

FIELD STRENGTH (µV/m)

FIELD STRENGTH (DB ABOVE 1µV/m)

TIME (GMT)

Figure 5

CONFIDENTIAL
CONFIDENTIAL

HAIFA, ISRAEL
MARCH, 1962
NAA, 14.7 KC

Figure 6
HAIFA, ISRAEL
MARCH, 1962
NAA, 14.7 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END

TIME (GMT)
00 04 08 12 16 20 24

S/N RATIO
0.01 0.02 0.05 0.1 0.2 0.5 1.0

S/N (DB)
-40 -38 -32 -26 -20 -18 -12 -6 0 6 10

Figure 7
CONFIDENTIAL
Figure 8
Figure 9
HAIFA, ISRAEL
MARCH, 1966
NSS, 22.3 KC
S/N RATIO.

Figure 11
CONFIDENTIAL
HAIFA, ISRAEL
MARCH, 1962
22.3 KC
ATMOSPHERIC NOISE

Figure 12
CONFIDENTIAL
Figure 13

CONFIDENTIAL
HAIFA, ISRAEL -- MARCH, 1962
NSS, 22.3 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END

TIME (GMT)

S/N RATIO

Figure 14
Figure 17 CONFIDENTIAL

HAMMERFEST, NORWAY
APRIL, 1962
NAA, 14.7 KC SIGNAL

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (μV/m)

TIME (GMT)

CONFIDENTIAL
HAMMERFEST, NORWAY
APRIL 1962
NAA, 14.7 KC
S/N RATIO

Figure 18
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
CONFIDENTIAL

HAMMERFEST, NORWAY 38°
APRIL, 1962
NAA, 14.7 KC

DAYS OF THE MONTH
1-10
11-20
21-END

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

Figure 20
CONFIDENTIAL

Figure 22

Field Strength (dB above 1μV/m)

100 50 20 10 5 2 0.1

Hammerfest, Norway, April 1962
NAA and Atmospheric Noise (14.7 KC, 183 samples)

Atmospheric Noise
NAA (Divide by 10 or subtract 20 dB)

Correction to compensate for an error in the antenna factor, multiply the field strength by 2, or add 6 dB.

Percentage of values that exceeded the ordinate

CONFIDENTIAL
Figure 23
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
HAMMERFEST, NORWAY
APRIL, 1962
NPM, 19.8 KC
S/N RATIO

Figure 25

CONFIDENTIAL
HAMMERFEST, NORWAY
APRIL, 1962
19.8 KC
ATMOSPHERIC NOISE

FIELD STRENGTH (µV/m)

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (DB ABOVE 1µV/m)

TIME (GMT)

Figure 26
To compensate for an error in the antenna factor, multiply the field strength by 2, or add 6 db.
Figur 29 COFINIA

**Correlation**

To compensate for an error in the antenna factor, multiply the field strength by 2, or add 5 dB.
CORRECTION

TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.
Figure 32

Confidential.
HAMMERFEST, NORWAY
MAY, 1962
14.7 KC
ATMOSPHERIC NOISE

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

Figure 33

CONFIDENTIAL
CORRECTION

TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

Figure 34
Figure 35

HAMMERFEST, NORWAY 18 MAY, 1962
NAA, 14.7 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END

TIME (GMT)

S/N RATIO

S/N (DB)
Figure 36

HAMMERFEST, NORWAY
MAY, 1962
NAA AND ATMOSPHERIC
NOISE, 14.7 KC
279 SAMPLES

FIELD STRENGTH (μV/m)

PERCENTAGE OF VALUES THAT EXCEEDED THE ORDIATE

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULPLY THE FIELD
STRENGTH BY 2, OR ADD 8 DB.
HAMMERFEST, NORWAY
MAY, 1962
NPG, 18.6 KC
SIGNAL

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (μV/m)

FIELD STRENGTH (dB ABOVE 1μV/m)

TIME (GMT)

Figure 38
HAMMERFEST, NORWAY
MAY, 1962
18.6 KC
ATMOSPHERIC NOISE

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (μV/m)

FIELD STRENGTH (DB ABOVE 1μV/m)

TIME (GMT)

Figure 40

CONFIDENTIAL
CORRECTION

TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
HAMMERFEST, NORWAY 18 MAY, 1962
NPG, 18.6 KC

S/N RATIO

DAYS OF THE MONTH
1 - 10
11 - 20
21 - END

TIME (GMT)

S/N RATIO

S/N (DB)

0.01 0.02 0.05 0.1 0.2 0.5 1.0

-40 -38 -32 -26 -20 -18 -12 0

-40 24 20 16 12 8 4 0

00 04 08 12 16 20 24

Figure 42
Figure 43
Figure 44

HAMMERFEST, NORWAY
MAY, 1962
NPG, 18.6 KC
S/N RATIO
191 SAMPLES

S/N RATIO

PERCENTAGE OF VALUES THAT EXCEEDED THE ORDIATE
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 45

CONFIDENTIAL
HAMMERFEST, NORWAY
MAY, 1962
NPM, 19.8 KC
S/N RATIO

TIME (GMT)

Figure 46
HAMMERFEST, NORWAY
MAY, 1962
19.8 KC
ATMOSPHERIC NOISE

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

Figure 47
HAMMERFEST, NORWAY
MAY, 1962
NPM, 19.8 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END

FIELD STRENGTH (μV/m)
00 04 08 12 16 20 24

FIELD STRENGTH (DB ABOVE μV/m)
0 6 12 18 24

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

TIME (GMT)
00 04 08 12 16 20 24

Figure 48
Figure 49
Figure 50

CONFIDENTIAL
KARACHI, WEST PAKISTAN
MARCH, 1962
NAA, 14.7 KC
SIGNAL

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (µV/m)

FIELD STRENGTH (dB ABOVE 1µV/m)

TIME (GMT)

Figure 52

CONFIDENTIAL
KARACHI, WEST PAKISTAN
MARCH, 1962
NAA, 14.7 KC
S/N RATIO

CONFIDENTIAL

Figure 53

CONFIDENTIAL
KARACHI, WEST PAKISTAN
MARCH, 1962
14.7 KC
ATMOSPHERIC NOISE

FIELD STRENGTH (μV/m)

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (DB ABOVE 1μV/m)

TIME (GMT)

Figure 54
KARACHI, WEST PAKISTAN  
MARCH, 1962  
NAA, 14.7 KC SIGNAL  

DAYS OF THE MONTH  
1 - 10  
11 - 20  
21 - END  

CORRECTION  
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 55  
CONFIDENTIAL
KARACHI, WEST PAKISTAN  
MARCH, 1962  
NAA, 14.7 KC  
S/N RATIO  
DAYS OF THE MONTH  
1 - 10  
11 - 20  
21 - END  

Figure 56  
CONFIDENTIAL
Figure 57

To compensate for an error in the antenna factor, multiply the field strength by 2, or add 6 db.

Percentage of values that exceeded the ordinate.

Field strength (dB above $10^6$ V/m)

Karachi, West Pakistan
March 1962
NAA and Atmospheric Noise
14.7 kc
520 samples

Correction

Confidential
**CORRECTION**

To compensate for an error in the antenna factor, multiply the field strength by 2, or add 6 dB.

**Figure 59**

Karachi, West Pakistan
April, 1962
NAA, 14.7 KC
Signal

Field Strength (μV/m)

Field Strength (dB Above 1μV/m)

Time (GMT)
KARACHI, WEST PAKISTAN
APRIL, 1962
NAA, 14.7 KC
S/N RATIO

S/N RATIO

S/N (DB)

TIME (GMT)

Figure 60

CONFIDENTIAL
KARACHI, WEST PAKISTAN
APRIL, 1962
14.7 KC
ATMOSPHERIC NOISE

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.

FIELD STRENGTH (µV/m)

FIELD STRENGTH (DB ABOVE 1µV/m)

TIME (GMT)

Figure 61
KARACHI, WEST PAKISTAN
APRIL 13, 1962
NAA147 KC SIGNAL
50DAYS OF THE MONTH
1-10-20-7-21-END
200 46
200
E
10040
loo38
231x294
235x231
20x11-1602
359x192
TIME (GMT)
F%e6 ONIETA
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
Figure 64

KARACHI, WEST PAKISTAN
APRIL, 1962
NAA AND ATMOSPHERIC NOISE, 14.7 KC
320 SAMPLES

FIELD STRENGTH (DB ABOVE 10 V/M)

ATMOSPHERIC NOISE
(MULTIPLY BY 10
OR ADD 20 DB)

NAA

CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2 OR ADD 6 DB.

PERCENTAGE OF VALUES THAT EXCEEDED THE ORDEinate

FIELD STRENGTH

Figure 64

CONFIDENTIAL
KARACHI, WEST PAKISTAN
APRIL, 1962
NAA AND ATMOSPHERIC NOISE, 14.7 KC
S/N RATIO
320 SAMPLES

Figure 65

S/N RATIO

PERCENTAGE OF VALUES THAT EXCEEDED THE ORDNATE

CONFIDENTIAL
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 66

CONFIDENTIAL
CORRECTION

TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 68
KARACHI, WEST PAKISTAN
MAY, 1962
NAA, 14.7 KC
SIGNAL
DAYS OF THE MONTH

1 - 10
11 - 20
21 - END

FIELD STRENGTH (μV/m)

1000
500
200
100
50
20
10
5
2
1
0

FIELD STRENGTH (dB above 1 μV/m)

60
58
52
46
40
38
32
26
20
18
12
6
0

TIME (GMT)

00 04 08 12 16 20 24

Figure 69

CORRECTION

TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

CONFIDENTIAL
KARACHI, WEST PAKISTAN
MAY, 1962
NAA, 14.7 KC, S/N RATIO
DAYS OF THE MONTH
1 - 10
11 - 20
21 - END

Figure 70
Figure 71
KARACHI, WEST PAKISTAN
MAY, 1962
NAA, 14.7 KC
S/N RATIO
464 SAMPLES

Figure 72
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