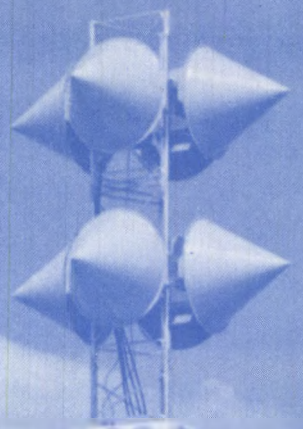
RSMS OPERATIONS REPORT



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MEASUREMENT OF FEDERAL RADIO CHANNEL USAGE IN NORFOLK, VIRGINIA

162-174 MHz Band
March 1978

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

Institute for Telecommunication Sciences
Boulder, Colorado 80303

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162-174 MHz Band
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TABLE OF CONTENTS

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162-174 MHz Band
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1. INTRODUCTION

These data provide the results of measurements made to determine the usage of Federal radio channels in the 162-174 MHz band at Norfolk, Virginia. These measurements were conducted during March 28-30, 1978 as part of the National Telecommunications and Information Administration/ Spectrum Management Support Program (NTIA/SMSP). They were made with the NTIA Radio Spectrum Measurement System (RSMS) which is operated by NTIA personnel of the Institute for Telecommunication Sciences (ITS). Measurements for other bands, which constitute an additional part of this effort, are reported separately. A measurement site was selected at Sewells Point on the Norfolk Naval Air Station, Lat. N36.962°, Long. W76.328°, as shown in figure 1.1, which was about 10 feet above mean sea level.

All measurement activities were carried out in accordance with established Department of Commerce (DOC) policy and administrative procedures as defined in section 1 of the RSMS Operations Manual. A technical description of the system is also provided in the Operations Manual (sec. 2).

Objectives for this portion of the effort were as follows:

(a) collect channel usage data for channels in the 162-174 MHz band; and

(b) analyze the collected data to obtain spectrum usage statistics for each channel and various groups of channels.

Brief discussions of measurement and analysis procedures are provided in sections 3 and 4, respectively. Unprocessed measurements of channel usage and received power levels for each of the 479 channels measured in this band are given in section 5, and an overall usage summary is provided in section 2. Graphs showing usage as a function of time-of-day are given in section 6, and channel usage distributions are provided in section 7.

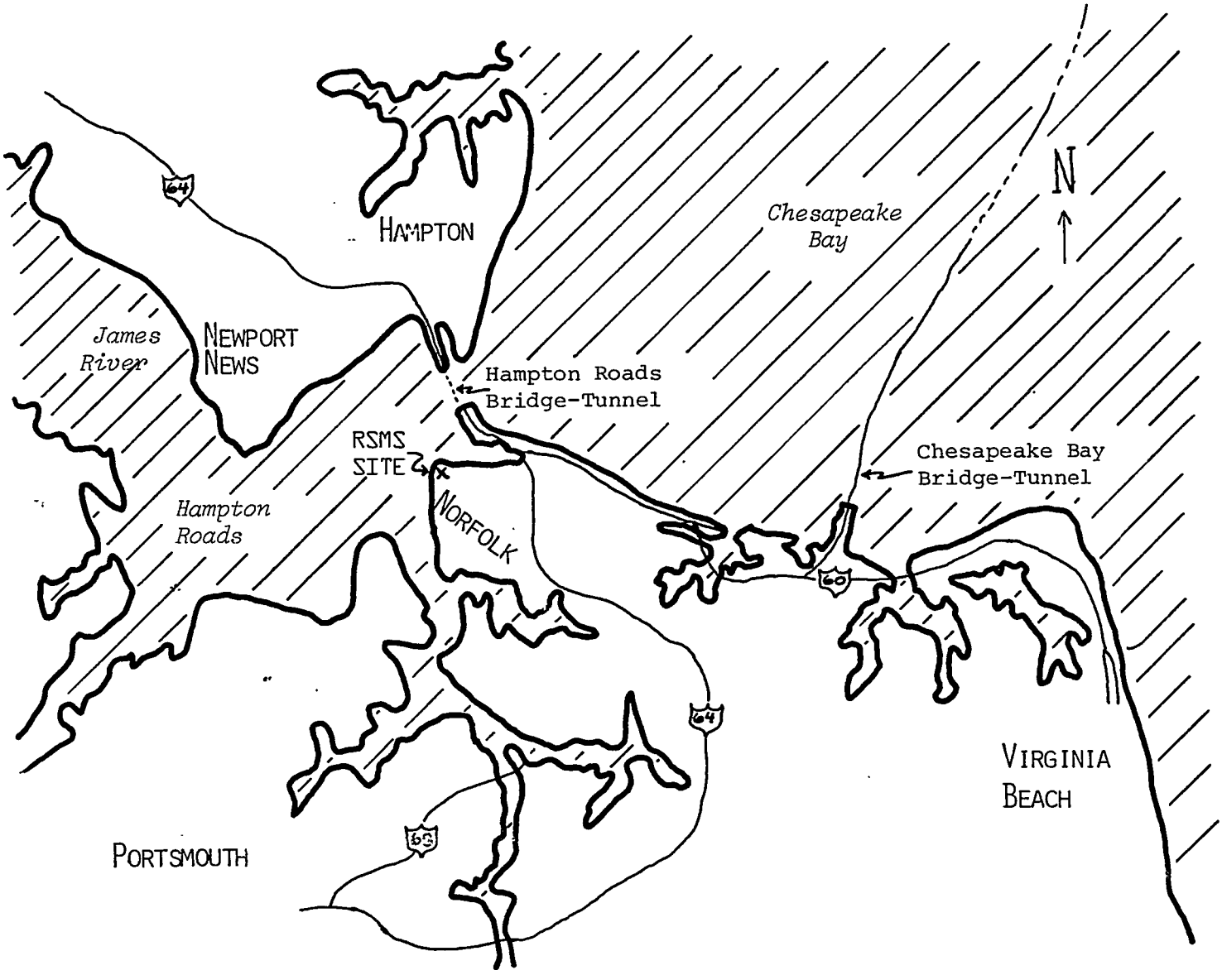

Figure 1.1. Map of Norfolk area, showing RSMS measurement site.

2. SUMMARY

A usage summary for the 162-174 MHz band at Norfolk is provided in table 2.1. It shows that 34 (44%) of the measured channels assigned within 50 miles were used for at least 0.5% of the time. And, 23 measured channels (6%) without assignments within 50 miles on the exact measured channel center frequency also had a usage of at least 0.5%.

Similar measurements were made in Norfolk in June 1974, at a site about one hundred meters away from the recent site. Those measurements (Gierhart, 1974) indicated that, out of the 80 assigned channels, 24 (30%) was in use 0.5% or more, 50 (62%) of the assigned channels showed an observed usage less than 0.5% of the time, and six (8%) showed no usage.

Time-of-day analysis of the 1978 measurements (figure 6.2) shows that the heaviest usage of the 77 fixed government channels assigned within 50 miles occurs between 11 and midnight, and moderate usage between 9 and 10 p.m.

Analysis of the channel usage distribution (figure 7.2) indicates that one percent of the 77 assignments within 50 miles has 100% usage, and four percent have a usage of 14%.

Table 2.1. Usage summary for 162-174 MHz band

Norfolk, Virginia — March 1978 — Cass 174.163
GMF 780101 — Scans 16561 — Threshold (dBm) -112

BAND (MHz)	CHANNELS MEASURED	MEASURED CHANNELS WITH USAGE >=0.5%	0.5-0.1%	<=0.1%
162-174	77 : 402	34 : 23	9 : 17	34 : 362

NOTES:
1) Assigned channels used are given first, and unassigned channels second; i.e., assigned: unassigned.
2) A channel is taken as assigned if it has a center frequency assignment within 50 miles of the measurement site that is made according to the channelization plan of the OTP Manual (P. 4-151).

3. MEASUREMENT PROCEDURES

Data were collected from Tuesday-Thursday, March 23-30, 1978. For 39 hours of this period, statistical summary files were recorded on magnetic tape at the end of each hour. The measurement program is designed to operate continuously in this mode without operator intervention. On March 29 a continuous overnight measurement was made, collecting hourly statistics files on magnetic tape. This 24-hour data was analyzed to give time-of-day information (sec. 6).

The statistics files contain data for each channel on:

1) the number of times the amplitude of the received signal was sampled during the previous measurement period and was found to be above the usage threshold. This threshold was chosen to be - 112 dBm and the reception of a signal above this amplitude was assumed to indicate that the channel was being used. This count, along with data on how many times each channel was sampled, is used to determine percent usage for each channel;

2) the peak signal received on each channel; and

3) the sum of signal amplitudes above threshold for each channel. This sum is used to calculate the average amplitude for the periods when a signal above the usage threshold was present.

In addition to the above data arrays for each channel, a 100-element parameter array contains various logistics and identification data on the whole set of measurements. Included in the parameter array are calibration information, time and location, system configuration, and number of samples taken at each frequency.

Each statistics file contains data compiled from about 950 measurements on each of the 479 channels measured in the band. Each channel is measured every four seconds, approximately, with the MSCAN routine, starting at the lowest frequency in the band and continuing until the highest frequency in the band is measured. MSCAN discriminates against impulsive noise by selecting the minimum of 40 measurements made for a specific channel as the current scan measurement value for that channel. It also discriminates against false usage indications associated with receiver overload and intermodulation by rejecting data collected when signals strong enough to cause these problems could be present.

Short summaries of the usage data can be printed out after each hour's measurement during the several minutes while the system is waiting to begin the next hour's measurements. These lists are used to select channels for later subsequent monitoring. Data from monitoring was kept in a card file, with all data pertaining to a given frequency being kept on a single card. Actual monitoring results were then summarized in the RSMS Operations Log.

The special communication measurement receiver (CMR) front-end developed for narrow-band communication channels was used for these measurements along with the MSCAN routine that provides discrimination against impulsive noise. Before starting the measurements, the CMR is calibrated at 168 MHz (band center) with a signal generator. This process generates calibration factors that are used automatically in the measurement process, as well as allowing the operator to check the IF bandpass characteristic. Such a bandpass characteristic is shown in figure 3.1. A frequency error in the CMR local oscillator will show up as a shift in the center frequency of the bandpass characteristic.

The 168 MHz calibration did not account for transmission line loss or frequency response factors. Although these additional factors could not easily be automatically used by the measurement program to correct the measurements, it is important to know what the numbers are--partly to diagnose faulty system operation, and partly to know whether they are small enough to ignore. A second calibration procedure was performed using a noise diode at the antenna terminals, which can be used to calibrate the complete system for frequencies within the 162-174 MHz band. A correction factor, C_{RA}, can be obtained. Power available at the antenna input of the be determined from the indicated received power at the receiver input P_{RR} by using

$$P_A = P_{RR} + C_{RA} + 1.5, \qquad (1)$$

where (1) is dimensionally consistent and decibel-type units are used for all terms.

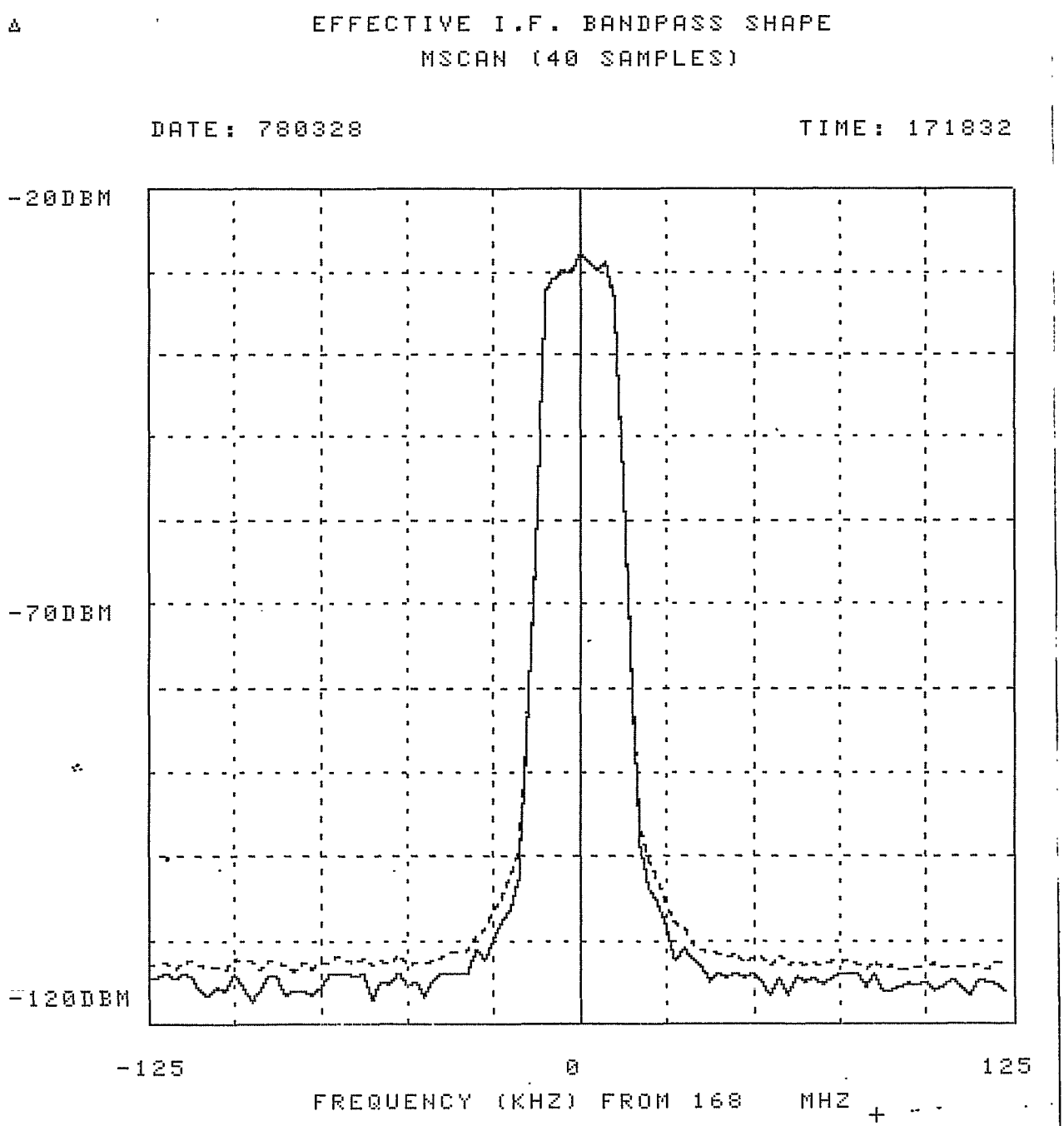

Figure 3.1. Effective IF bandpass shape. The dashed line is based on a single measurement per channel. The solid line is based on the minimum of 40 measurements per channel as per the MSCAN measurement routine, and is appropriate for the 162-174 MHz band measurements made at Norfolk.

4. ANALYSIS PROCEDURES

Tapes supplied by the Frequency Management Support Division (FMSD) of NTIA with the January 1978 GMF and May 1975 non-government assignment data for the Norfolk area were processed at ITS to obtain a Mini-GMF file (MGF). The Mini-GMF code is a six digit word that is generated from assignment files and paired with channel center frequencies measured by the RSMS to provide a concise summary of the assignment situation. Each digit of the code word indicates that number (up to 9) of assignments within a specific category. A value of 9 indicates nine or more such assignments. The first four digits are concerned with Government Master File (GMF) assignments and the last two are concerned with non-government (NG) and International Telecommunications Union File (ITUF) assignments. Details on the Mini-GMF code can be found in Table 4.1.

Table 4.1. Mini-GMF code word description.*

Digit	Category
sign	Negative (-) if aural monitoring is *not* permitted (i.e., if digit 5 is non-zero). Positive (blank) if aural monitoring is permitted (i.e., digit 5 is zero). Positive (+) if digit 5 is non-zero, but a manual check of the assignment records show that the NG assignment(s) involved could not be demodulated into intelligible messages by the RSMS.
1	Fixed GMF assignments within range of expected signal reception (50 mi) and on exact frequency.
2	Fixed GMF assignments within possible signal reception range (150 mi) and on exact frequency.
3	Fixed GMF assignments within extended range that are not on the exact frequency, but have bandwidth overlap.
4	Area GMF assignments with bandwidth overlap.
5	Fixed and area NG assignments in extended range with bandwidth overlap.
6	Fixed and area non-USA ITUF assignments in extended range with bandwidth overlap.

Individual one-hour statistics files collected on weekdays between 8 a.m. and 5 p.m. are combined into a single master statistics file (MSF) for the entire 162-174 band measurement period using program EDIT 162. Then the MSF and MGF are processed with program PLOT 162 to produce a band usage summary (table 2.1) along with channel-by-channel usage summary tables (tables 5.1 to 5.12), and plots (figs. 5.1 to 5.12).

Program EDIT 162 is used to obtain a set of 24 consecutive hourly statistics files that are ordered by time-of-day starting with the hour after midnight. This data and the MGF are processed with program TOD-162 (time-of-day) to produce graphs showing band usage as a function of time-of-day for all channels in the band (fig. 6.1) and channels with GMF assignments within 50 mi of the RSMS (fig. 6.2).

Processing of the MSF and the MGF by program DIST-162 produces channel usage distributions. This program uses the MGF to select appropriate channels. Distributions for all channels in the band (fig. 7.1) and channels with GMF assignments within 50 mi of the RSMS (fig. 7.2) are developed.

5. CHANNEL OCCUPANCY AND AMPLITUDE STATISTICS

This section contains the results of measurements on the 162-174 MHz band in the Norfolk area. Measurements included in this analysis were collected during three weekdays between 8 a.m. and 5 p.m. This included 18 hours of data which contained 16,561 measurements on each channel. At the end of this section the data are listed and plotted according to frequency in 1 MHz blocks. The same data are used in section 7.

The measurement index number used in tables 5.1 to 5.12 is not to be construed as any sort of OFFICIAL designation, but is used in data analysis as a convenient means of identifying each of the 479 channels measured in this band. The percent usage is rounded off to the nearest 0.1% (corresponding to 10 measurements out of 16,561). The maximum and average received power is rounded to the nearest decibel. All amplitude measurements were made with the MSCAN routine, which may not accurately measure average power values, depending on modulation characteristics. When signals larger than - 30 dBm are present, general statistics are not collected, but the peak signal amplitude is recorded.

The plots of usage in figures 5.1 to 5.12 are plotted between 0.5% and 100% on a logarithmic scale with grid lines drawn on a 1-2-5-10 basis. The amplitude statistics are plotted over the range between - 120 dBm and - 20 dBm, with the bottom of the vertical line representing the average signal level during the time the signal was above - 112 dBm threshold. The top of the line is the maximum signal amplitude measured at that frequency. In both graphs, the graphed data have been offset very slightly to the right of their proper positions so that data are not hidden when they fall directly on the scale lines or edges of the graphs.

Table 5.1. Usage summary list for 162-163 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
1	162.025	.4	-80	-106	010100
2	162.05	.3	-85	-107	020200
3	162.075	.3	-89	-108	0
4	162.1	.1	-93	-108	010100
5	162.125	.1	-95	-107	110100
6	162.15	.1	-98	-107	0
7	162.175	.1	-101	-108	0
9	162.225	1.5	-54	-83	122400
10	162.25	.1	-103	-108	110100
11	162.275	.1	-105	-110	021300
12	162.3	.1	-105	-109	0
14	162.35	.1	-105	-109	0
16	162.4	1.6	-104	-110	020200
19	162.475	.1	-98	-108	010100
22	162.55	100	-57	-64	140400
25	162.612	.1	-96	-107	0
28	162.687	.1	-91	-105	160600
30	162.737	.1	-96	-105	010100
31	162.762	.1	-95	-105	010100
32	162.787	.1	-95	-107	0
37	162.9	.1	-93	-105	030300

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

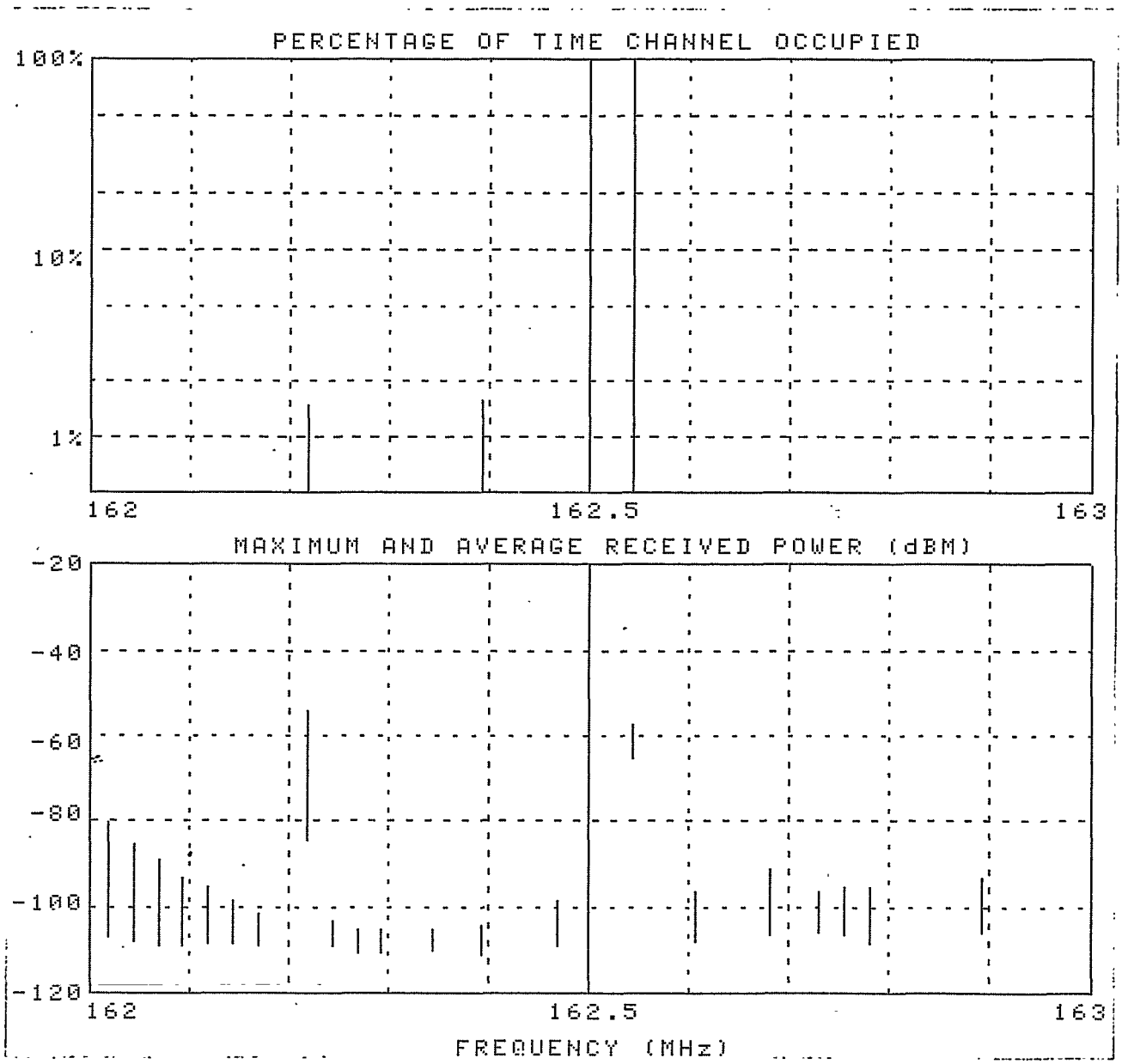

Figure 5.1. Usage summary plot for 162-163 MHz.

Table 5.2. Usage summary list for 163-164 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
43	163.05	.1	-106	-109	011200
49	163.2	3.2	-56	-98	350500
51	163.25	9.5	-53	-68	0
52	163.275	.1	-97	-108	010100
54	163.325	.1	-105	-109	160600
56	163.375	0	-91	-103	120200
57	163.394	.2	-101	-107	001100
58	163.413	5.3	-43	-69	022400
59	163.437	.1	-93	-107	091900
60	163.462	.5	-77	-85	130300
61	163.488	6.3	-79	-84	150500
62	163.513	4.9	-77	-84	140400
63	163.538	1.8	-64	-89	140400
65	163.587	.2	-67	-75	130300
69	163.675	.1	-103	-107	010100
72	163.75	0	-101	-103	120200
74	163.794	.1	-83	-99	001100
75	163.812	.1	-56	-103	120200
76	163.837	4.1	-56	-61	120200

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

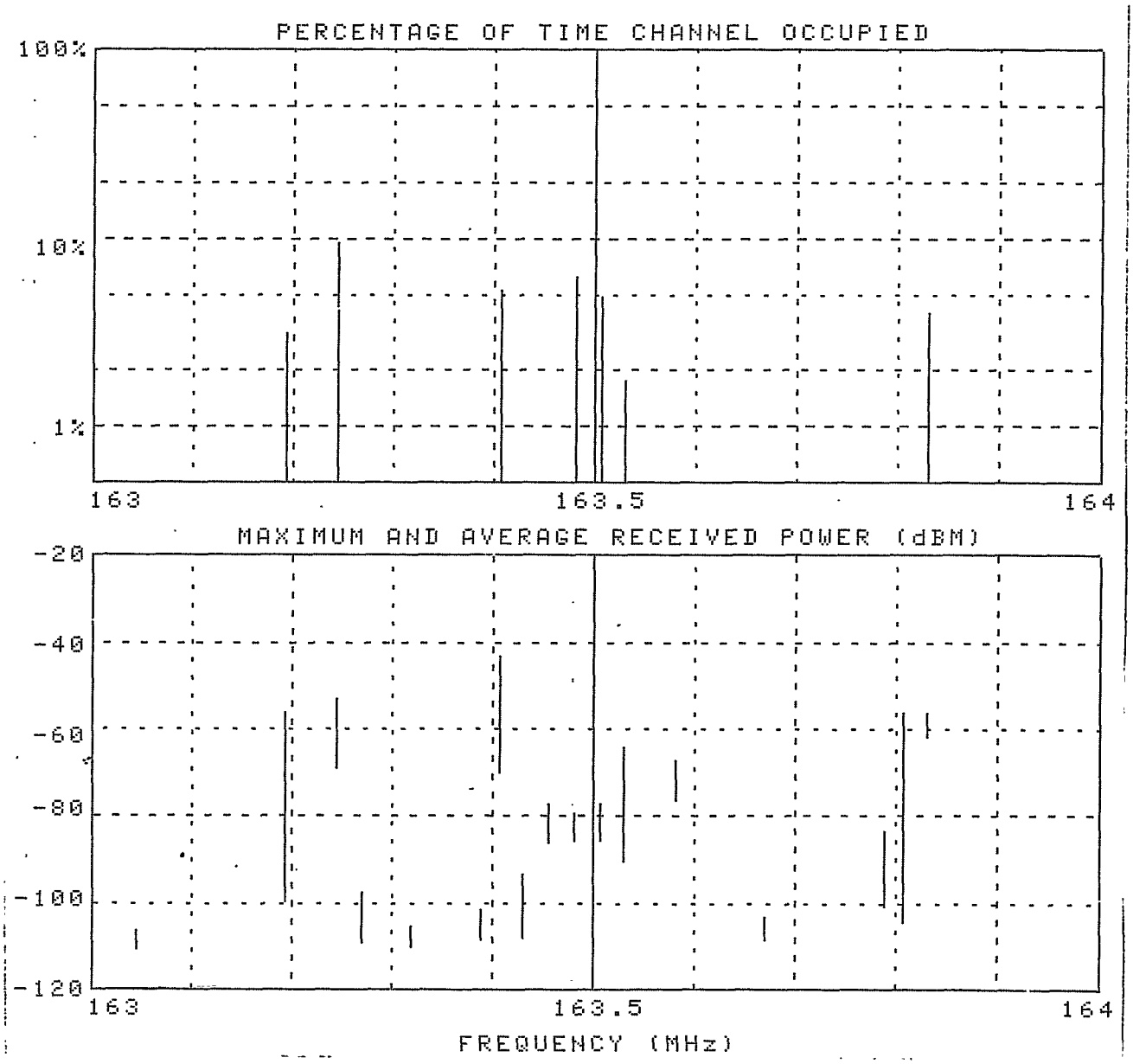

Figure 5.2. Usage summary plot for 163-164 MHz.

Table 5.3. Usage summary list for 164-165 MHz.

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
84	164.025	6.9	-76	-101	010100
86	164.075	.6	-76	-93	010100
88	164.125	0	-100	-107	120200
90	164.175	0	-110	-110	120200
95	164.3	4.3	-47	-50	120200
101	164.45	.1	-93	-104	0
102	164.475	.1	-95	-105	0
103	164.5	.1	-105	-109	040400
104	164.525	.1	-96	-106	0
107	164.6	.1	-92	-97	010100
111	164.7	.1	-98	-106	010100
112	164.725	.2	-102	-108	090900
122	164.962	.9	-69	-85	140400
123	164.987	.1	-95	-102	0

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

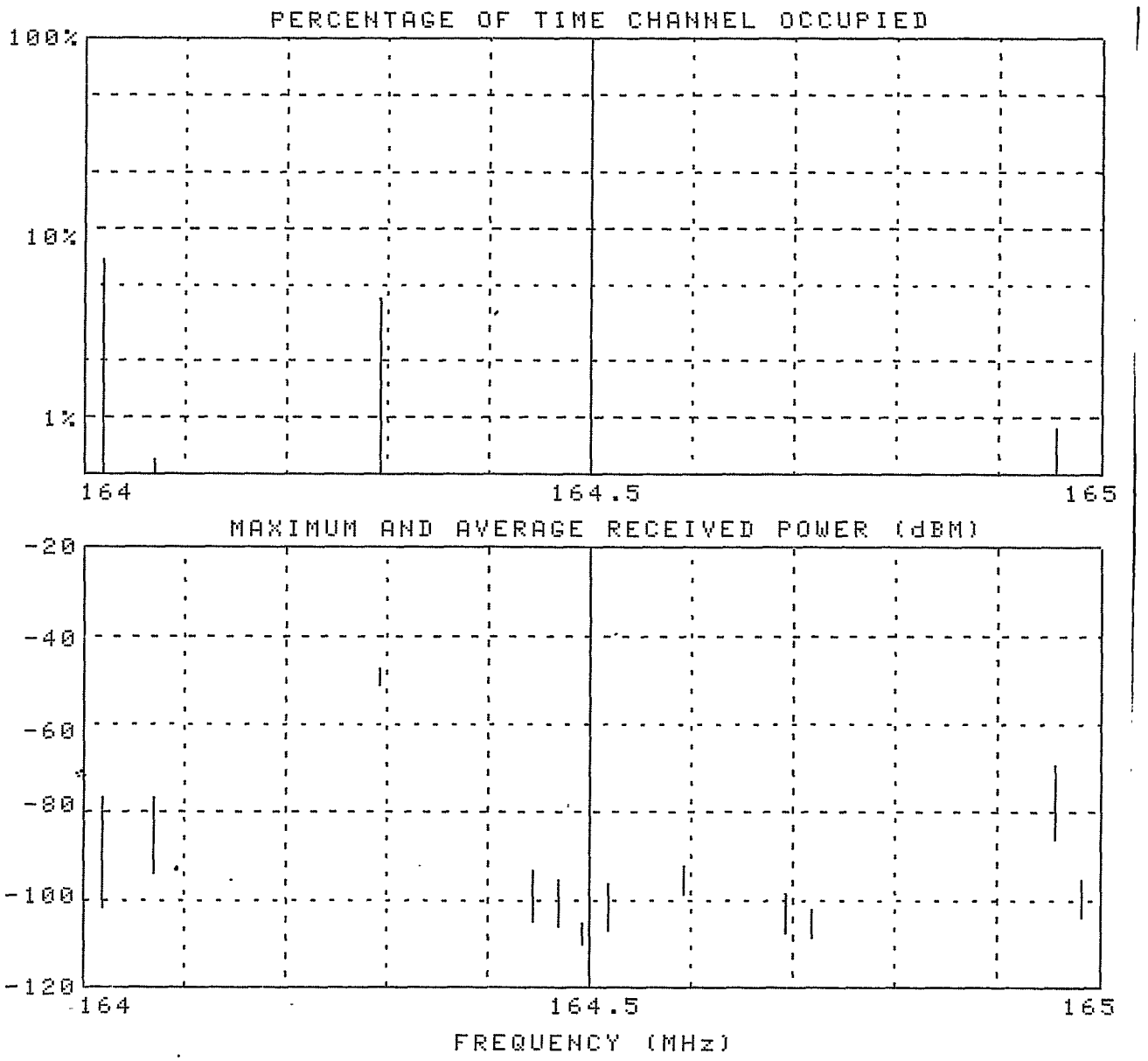

Figure 5.3. Usage summary plot for 164-165 MHz.

Table 5.4. Usage summary list for 165-166 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-CMF CODE
124	165.012	2.3	-79	-85	140400
126	165.062	6.4	-50	-70	120200
127	165.087	7.5	-95	-102	140400
128	165.112	3.9	-74	-77	130300
130	165.162	.2	-91	-96	020200
133	165.237	1.1	-47	-81	280800
134	165.262	.1	-105	-108	120200
135	165.287	1	-65	-72	260600
136	165.312	.4	-95	-102	010100
137	165.337	.5	-94	-99	110100
138	165.362	.1	-93	-102	007700
139	165.387	.1	-93	-104	007700
140	165.412	.1	-93	-104	010100
141	165.437	.1	-95	-105	020200
142	165.462	.1	-91	-102	0
143	165.487	.2	-92	-99	001100
144	165.512	.2	-91	-97	001100
145	165.537	.2	-92	-98	010100
147	165.587	.3	-97	-101	111200
158	165.85	.7	-54	-71	240400
162	165.95	.3	-68	-71	130300

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

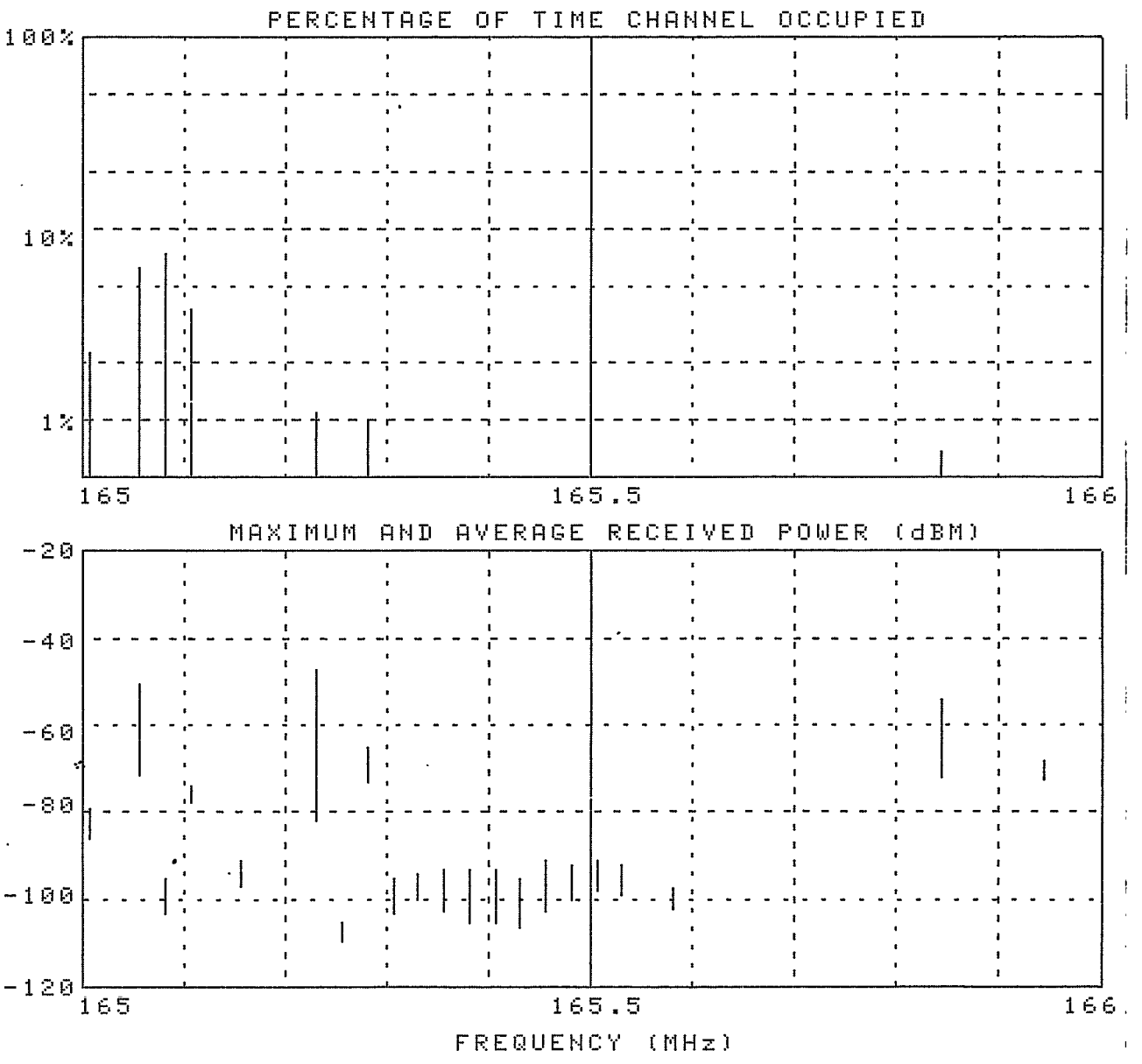

Figure 5.4. Usage summary plot for 165-166 MHz.

Table 5.5. Usage summary list for 166-167 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
170	166.15	0	-103	-107	110100
173	166.225	0	-101	-101	-130360
174	166.25	.8	-66	-76	-000060
180	166.4	.2	-54	-63	140400
182	166.437	0	-71	-95	180800
183	166.462	.1	-72	-92	030300
186	166.538	.5	-56	-94	150500
205	167	.1	-83	-97	130300

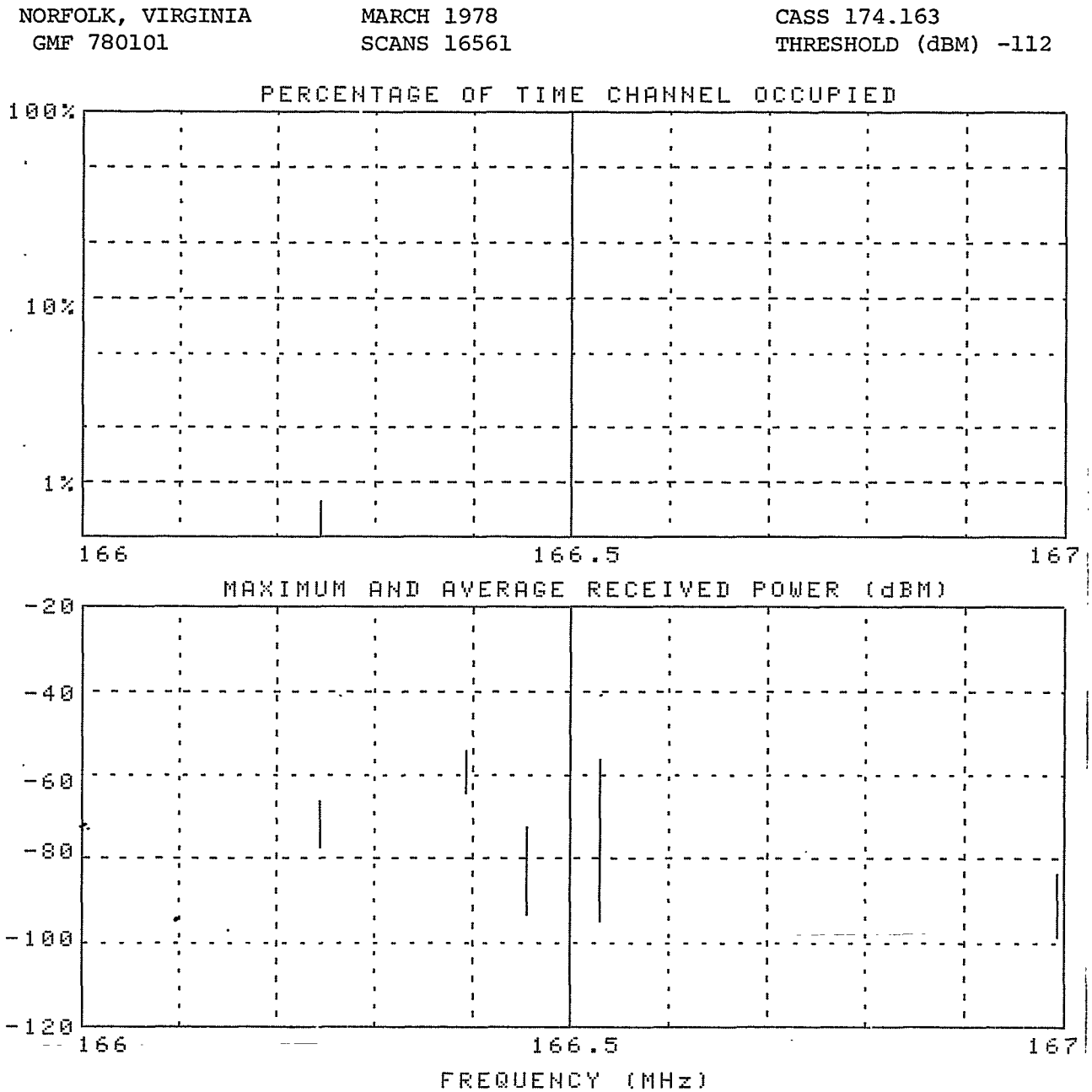

Figure 5.5. Usage summary plot for 166-167 MHz.

Table 5.6. Usage summary list for 167-168 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
207	167.05	1	-66	-69	010100
210	167.125	0	-108	-109	150500
215	167.237	.1	-97	-105	224600
225	167.487	0	-108	-108	220200
226	167.512	0	-105	-105	190900
228	167.562	0	-106	-109	390900
229	167.587	1.4	-77	-105	005500
230	167.612	1.5	-77	-87	009900
234	167.712	.1	-102	-108	169900
236	167.762	.1	-107	-110	007700
237	167.788	.1	-104	-110	005500
238	167.806	.1	-108	-110	0
239	167.825	.1	-102	-109	020200
240	167.85	.1	-102	-109	031400
241	167.875	.1	-106	-109	130300
242	167.9	.1	-95	-108	011200
243	167.925	.1	-105	-110	010100
244	167.95	.1	-107	-110	0
245	167.975	.1	-110	-111	090900
246	168	2.8	-95	-100	020200

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

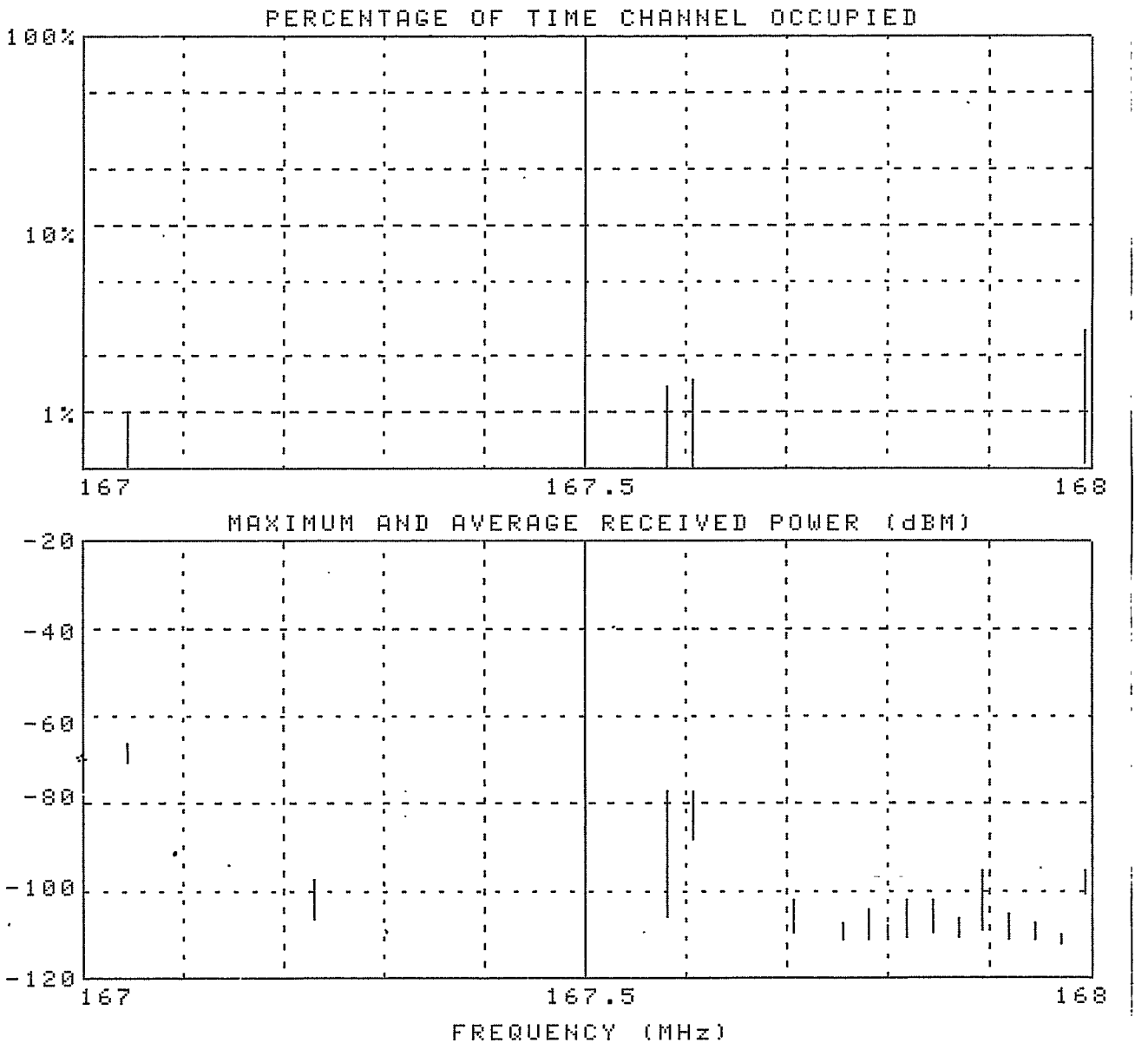

Figure 5.6. Usage summary plot for 167-168 MHz.

Table 5.7. Usage summary list for 168-169 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
251	168.125	.1	-104	-108	050500
254	168.2	.9	-99	-107	0
255	168.225	1.8	-97	-105	031400
256	168.25	2.3	-96	-108	110100
257	168.275	2.1	-98	-109	011200
258	168.3	5.5	-97	-106	0
259	168.325	7.3	-95	-106	010100
260	168.35	11.2	-95	-109	0
261	168.375	7.1	-96	-106	020200
262	168.4	4.3	-95	-104	0
263	168.425	4	-92	-101	440400
264	168.45	.1	-105	-109	010100
265	168.475	.1	-104	-109	030300
266	168.5	.1	-99	-108	0
267	168.525	13.5	-42	-46	120200
268	168.55	.1	-103	-108	0
269	168.575	.1	-103	-109	040400
270	168.6	.1	-105	-109	010100
271	168.625	.1	-105	-109	0
272	168.65	.1	-104	-109	0
273	168.675	.1	-104	-108	0
274	168.7	.1	-101	-109	0
275	168.725	.1	-102	-109	060600
276	168.75	.1	-104	-109	0
277	168.775	.1	-103	-108	0
278	168.8	.1	-105	-109	010100
279	168.825	.1	-103	-108	0
280	168.85	.2	-101	-109	0
281	168.875	.1	-101	-107	011200
282	168.9	.1	-104	-108	010100
283	168.925	.1	-104	-108	001100
284	168.95	.1	-106	-109	0
285	168.975	.1	-103	-108	001100
286	169	.2	-99	-107	110100

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

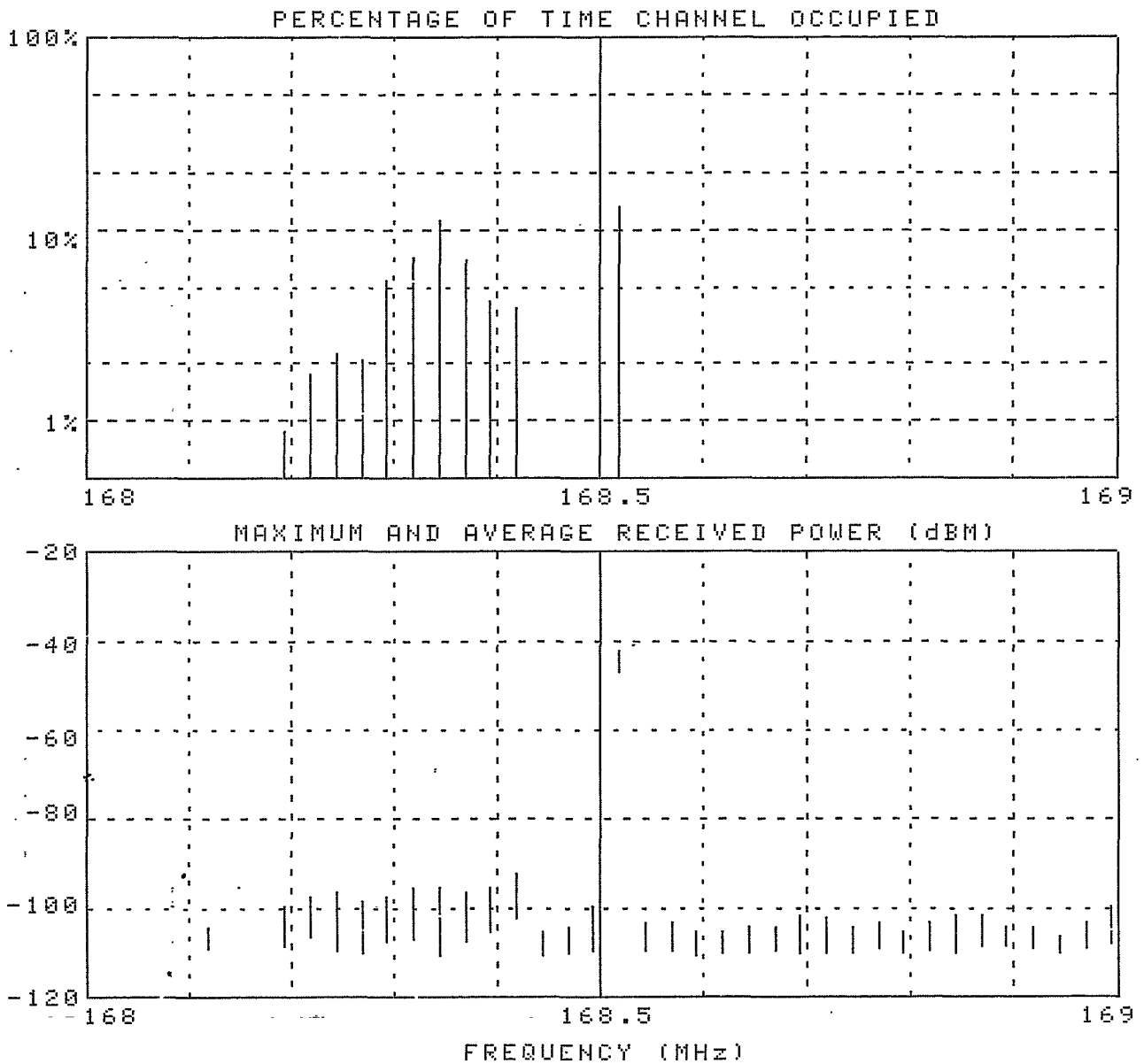

Figure 5.7. Usage summary plot for 168-169 MHz.

Table 5.8. Usage summary list for 169-170 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
287	169.025	.2	-99	-107	002200
288	169.05	.2	-100	-108	001100
289	169.075	.2	-101	-108	110100
290	169.1	.1	-103	-108	0
291	169.125	1.1	-93	-100	340400
292	169.15	.1	-102	-108	020200
293	169.175	.1	-103	-108	010100
294	169.2	.2	-100	-107	010100
295	169.225	.2	-96	-107	0
296	169.25	.2	-99	-108	001100
297	169.275	.1	-101	-108	001100
298	169.3	.1	-104	-109	0
299	169.325	.2	-95	-102	110100
300	169.35	.1	-107	-110	010100
301	169.375	.1	-107	-110	0
302	169.4	.1	-103	-109	070700
303	169.425	.1	-105	-110	0
304	169.45	.1	-100	-109	0
305	169.475	.1	-99	-107	0
306	169.5	.1	-102	-108	0
307	169.525	.1	-102	-108	0
313	169.675	.1	-104	-110	010100
316	169.75	0	-103	-106	110100
319	169.825	.1	-105	-109	010100
320	169.85	1	-51	-55	190900
321	169.875	.1	-92	-106	0
322	169.9	.1	-100	-106	0
323	169.925	.1	-93	-107	010100
324	169.95	.1	-92	-105	0

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

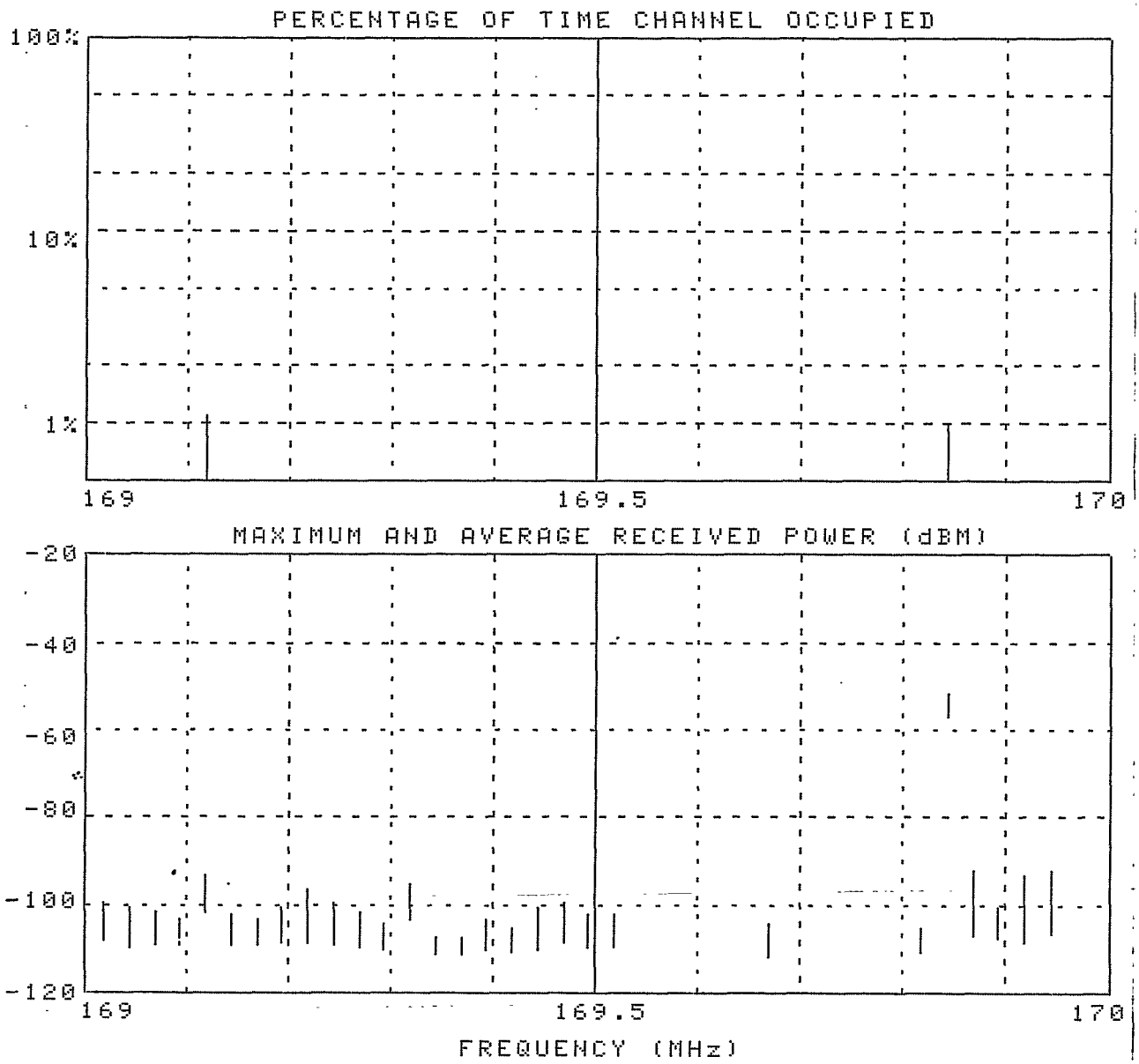

Figure 5.8. Usage summary plot for 169-170 MHz.

Table 5.9. Usage summary list for 170-171 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
330	170.1	.1	-98	-108	010100
331	170.125	0	-100	-106	-110190
332	170.15	3	-43	-72	-000090
333	170.175	.1	-97	-107	-010190
338	170.3	.1	-98	-108	0
340	170.35	14.6	-61	-79	130300
342	170.4	4.7	-62	-64	130300
344	170.45	.1	-108	-110	010100
345	170.475	1.1	-57	-101	-001190
346	170.5	.1	-101	-108	110100
347	170.525	.1	-100	-108	001100
348	170.55	.1	-103	-108	010100
349	170.575	.1	-99	-109	010100
350	170.6	.4	-79	-93	180800
351	170.625	.1	-103	-110	0
353	170.675	.1	-107	-110	0
354	170.7	.1	-99	-109	0
355	170.725	.1	-101	-109	0
356	170.75	.1	-99	-109	0
357	170.775	.1	-106	-109	0
358	170.8	.1	-105	-110	0
359	170.825	.1	-103	-110	010100
360	170.85	.1	-102	-110	0
362	170.9	.1	-107	-110	0
363	170.925	.1	-102	-109	030300
364	170.95	.1	-105	-109	140400
365	170.975	.1	-105	-110	0
366	171	.1	-107	-110	130300

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

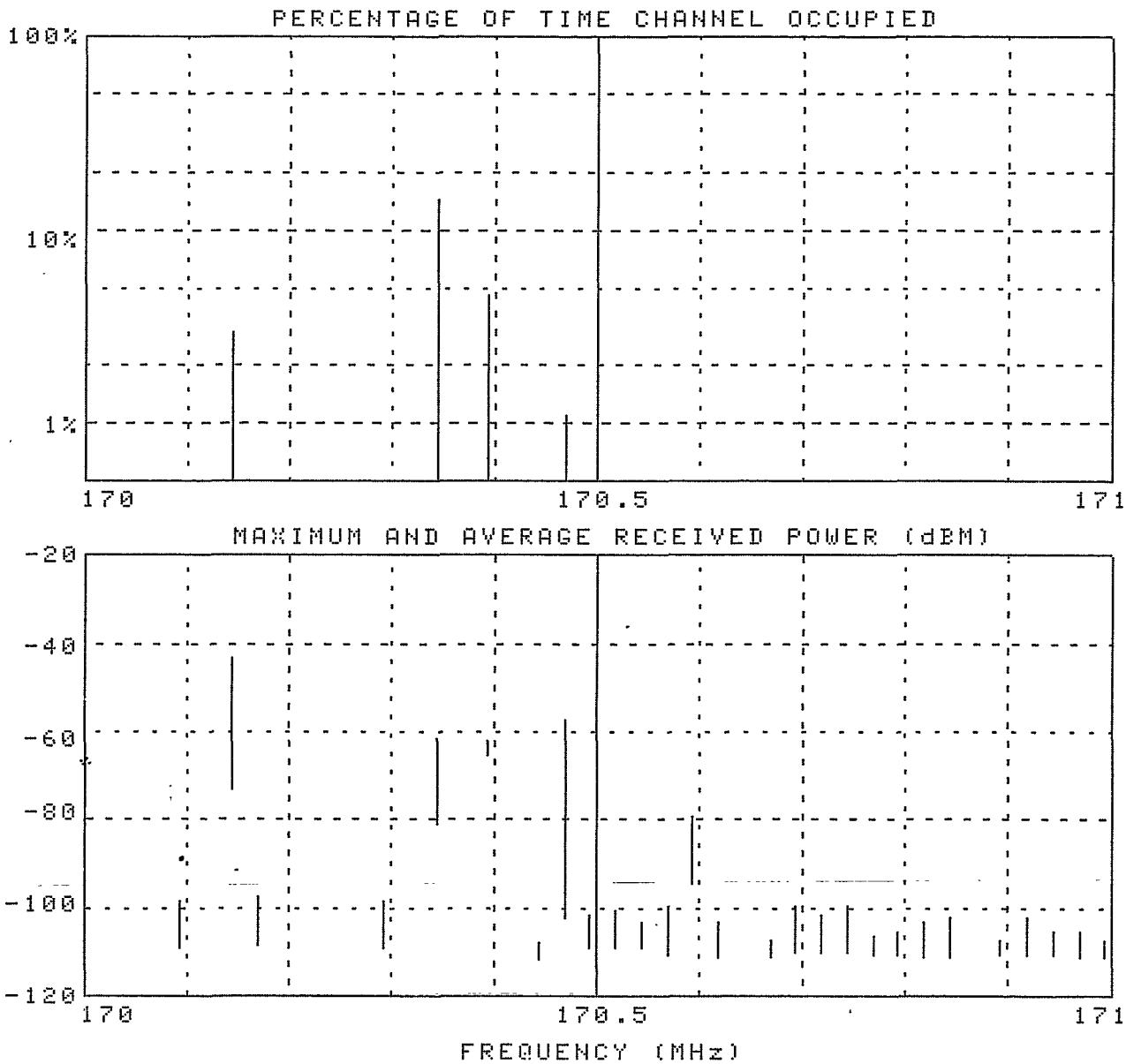

Figure 5.9. Usage summary plot for 170-171 MHz.

Table 5.10. Usage summary list for 171-172 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
367	171.025	.1	-102	-109	0
370	171.1	.1	-101	-109	0
371	171.125	.1	-105	-109	0
372	171.15	.1	-102	-108	130300
373	171.175	.1	-103	-108	0
374	171.2	.1	-98	-108	010100
375	171.219	.1	-105	-110	0
376	171.237	.1	-107	-110	020200
378	171.287	.1	-105	-109	130300
379	171.312	.1	-105	-109	010100
380	171.337	.5	-103	-109	110100
381	171.362	.1	-101	-109	020200
382	171.387	.1	-100	-109	010100
383	171.406	.1	-103	-109	0
384	171.425	3.5	-56	-96	-000090
385	171.45	.1	-101	-109	020200
387	171.5	.1	-108	-110	0
390	171.575	.1	-108	-110	0
391	171.6	.1	-104	-109	020200
392	171.625	.1	-94	-107	0
393	171.65	.1	-103	-109	0
399	171.8	2.1	-93	-101	0
400	171.825	.1	-104	-110	0
404	171.925	.1	-104	-109	0
407	172	.1	-105	-109	010100

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

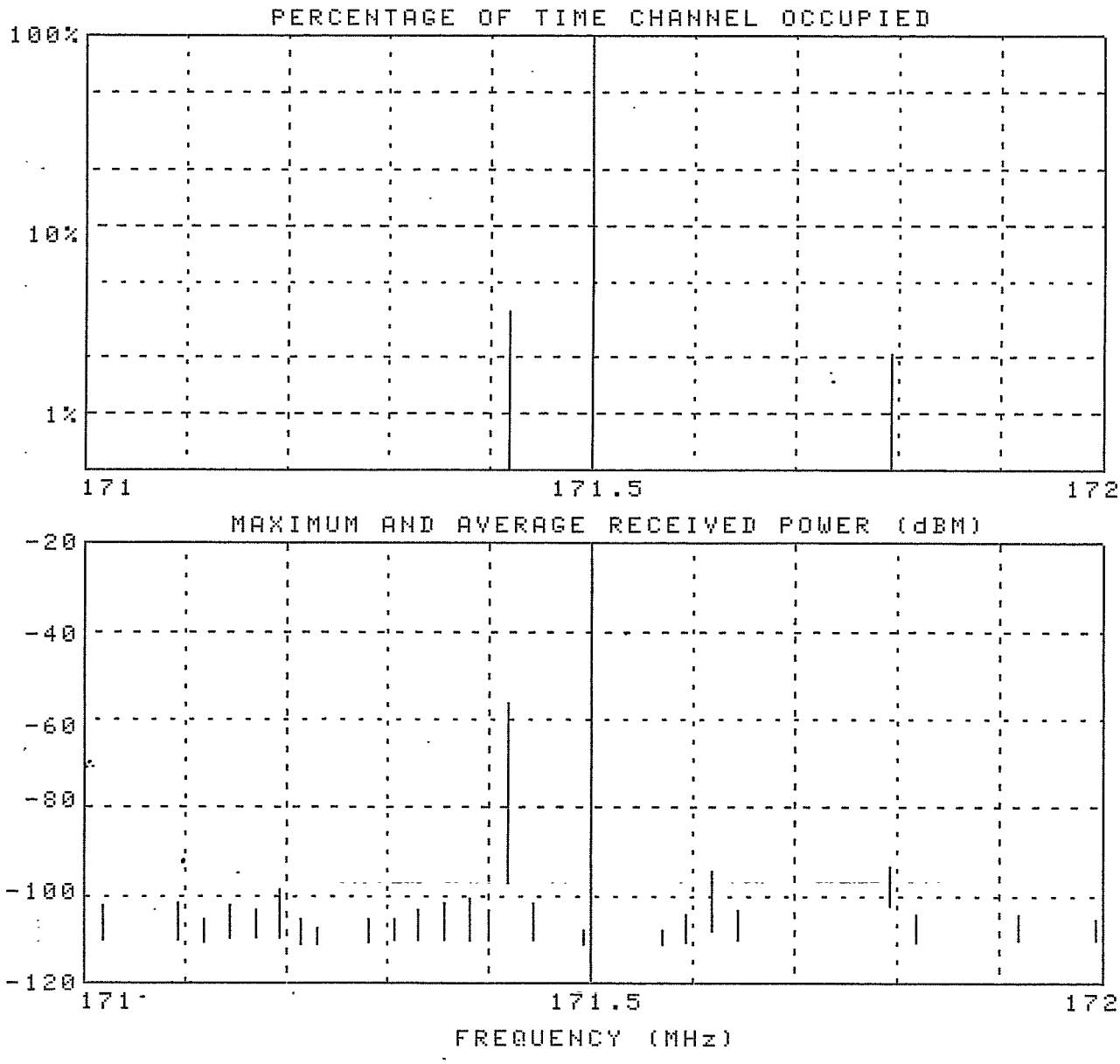

Figure 5.10. Usage summary plot for 171-172 MHz.

Table 5.11. Usage summary list for 172-173 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
408	172.025	.1	-102	-109	0
409	172.05	.1	-104	-108	0
410	172.075	.1	-103	-109	0
411	172.1	.1	-105	-110	0
415	172.2	.1	-103	-109	020200
418	172.275	.1	-105	-110	0
419	172.3	.1	-105	-109	030300
420	172.325	.1	-102	-110	010100
422	172.375	.1	-106	-110	111200
428	172.525	.1	-100	-109	0
431	172.6	.1	-104	-109	0
433	172.65	.1	-103	-108	0
437	172.75	0	-103	-106	110100
438	172.775	.1	-98	-107	001100
439	172.8	.7	-89	-104	010100

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

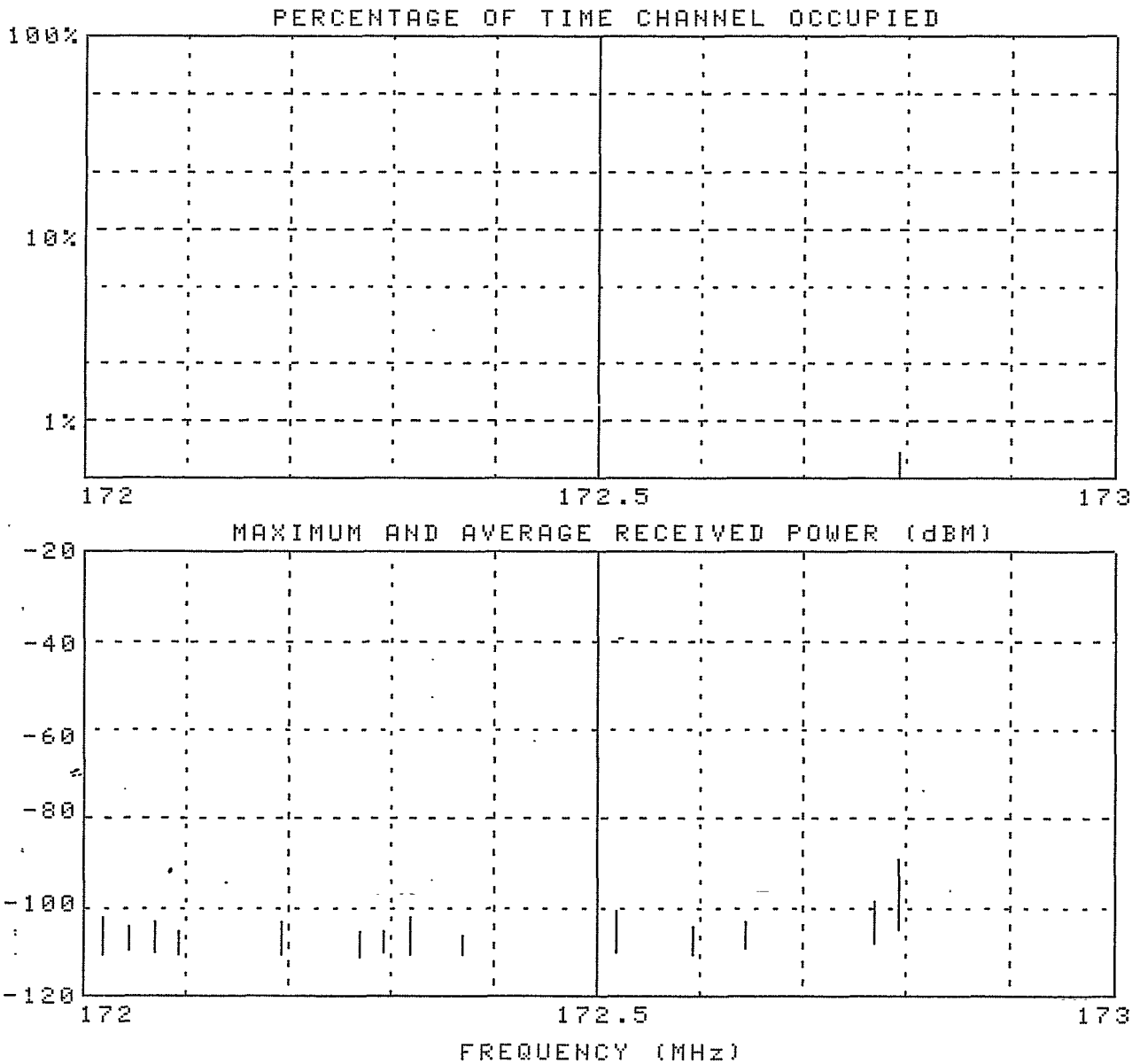

Figure 5.11. Usage summary plot for 172-173 MHz.

Table 5.12. Usage summary list for 173-174 MHz.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
448	173.025	.2	-95	-97	010100
452	173.125	0	-101	-106	110100
456	173.413	6.8	-87	-92	230300
457	173.437	0	-102	-109	110100
458	173.462	1.9	-97	-105	230300
459	173.488	7.2	-56	-69	120200
460	173.513	0	-106	-107	120200
462	173.562	1	-63	-82	130300
463	173.587	4.4	-81	-94	140400
464	173.613	.3	-64	-76	120200
465	173.638	0	-102	-105	110100
466	173.663	2	-67	-78	120200
467	173.687	1.2	-67	-76	120200
468	173.712	.1	-100	-105	0
469	173.738	.1	-102	-107	0
470	173.763	.1	-101	-104	010100
471	173.788	.1	-103	-105	0

NORFOLK, VIRGINIA
GMF 780101

MARCH 1978
SCANS 16561

CASS 174.163
THRESHOLD (dBM) -112

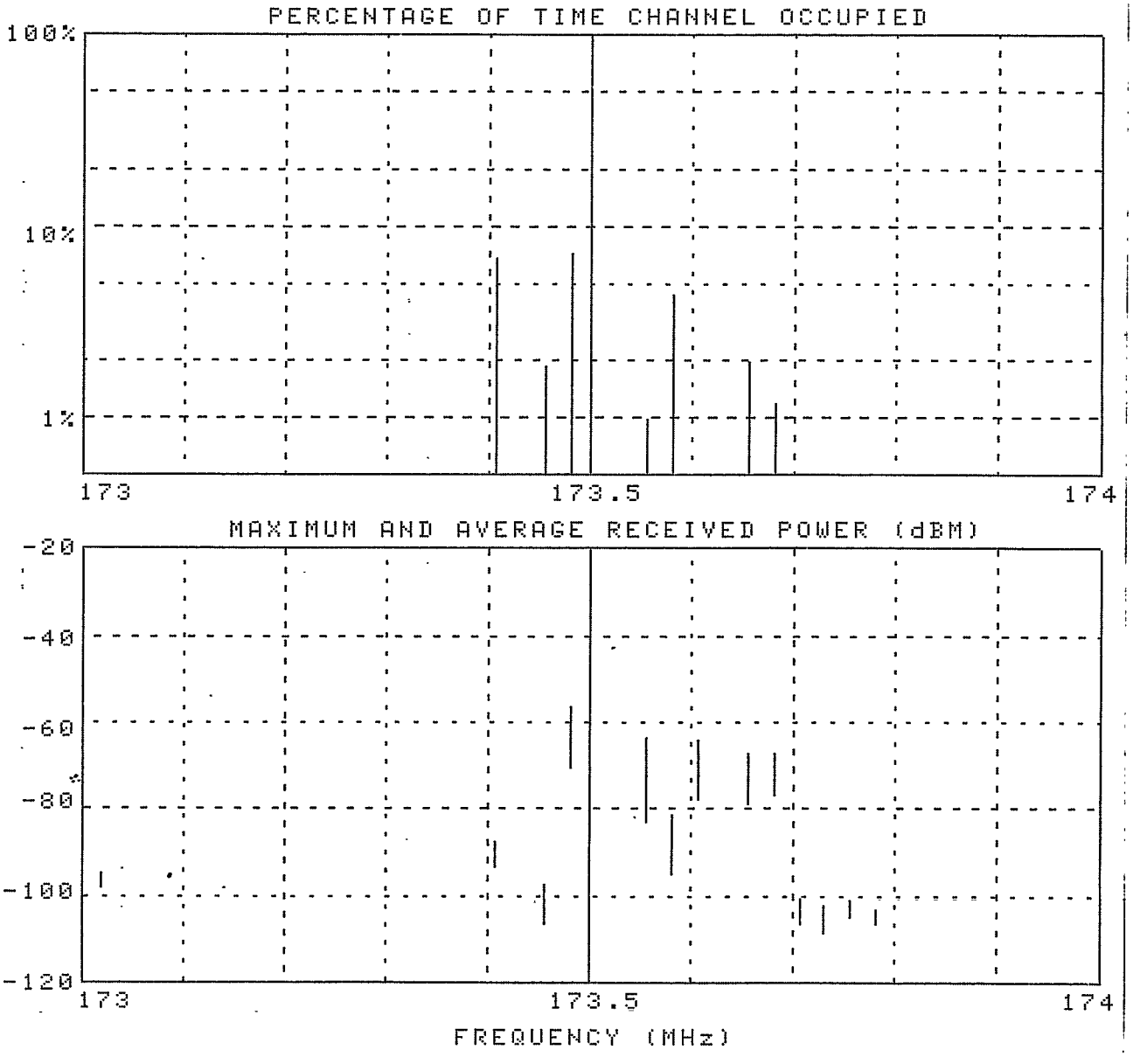

Figure 5.12. Usage summary plot for 173-174 MHz.

6. OCCUPANCY BY TIME-OF-DAY

Consecutive hourly statistics files of usage data collected 24 hours of the day during March 29, 1978 were used to generate the hourly band occupancy vs. time-of-day plot shown in figures 6.1 and 6.2.

Figure 6.1 is for all of the 479 channels measured in the 162-174 MHz band, and figure 6.2 is for the 77 channels measured that have exact channel center GMF assignments within 50 miles of the Norfolk RSMS measurement site. Note that the ordinate scale of figures 6.1 and 6.2 go to 10%.

The very high usage shown in both figures in the 2100-2200 and 2300-2400 time blocks was caused by an unknown intermittant phenomenon. During the duration of this phenomenon, all channels were affected by a noise-like signal somewhat higher than the occupancy threshold amplitude. The pheonomenon could have been a system hardware malfunction, increasing system noise, or it could have been a broadband noise-like signal. Since it occurred when the RSMS was unoccupied, we were not able to definitely establish a cause. It is reasonable to expect, however, that LMR usage for these hours was actually similar to usage in adjacent time blocks.

MARCH 1978
NORFOLK, VIRGINIA

MTAPE 174
CHANNELS = 479

162-174 OCCUPANCY VS TIME-OF-DAY
ALL CHANNELS IN BAND

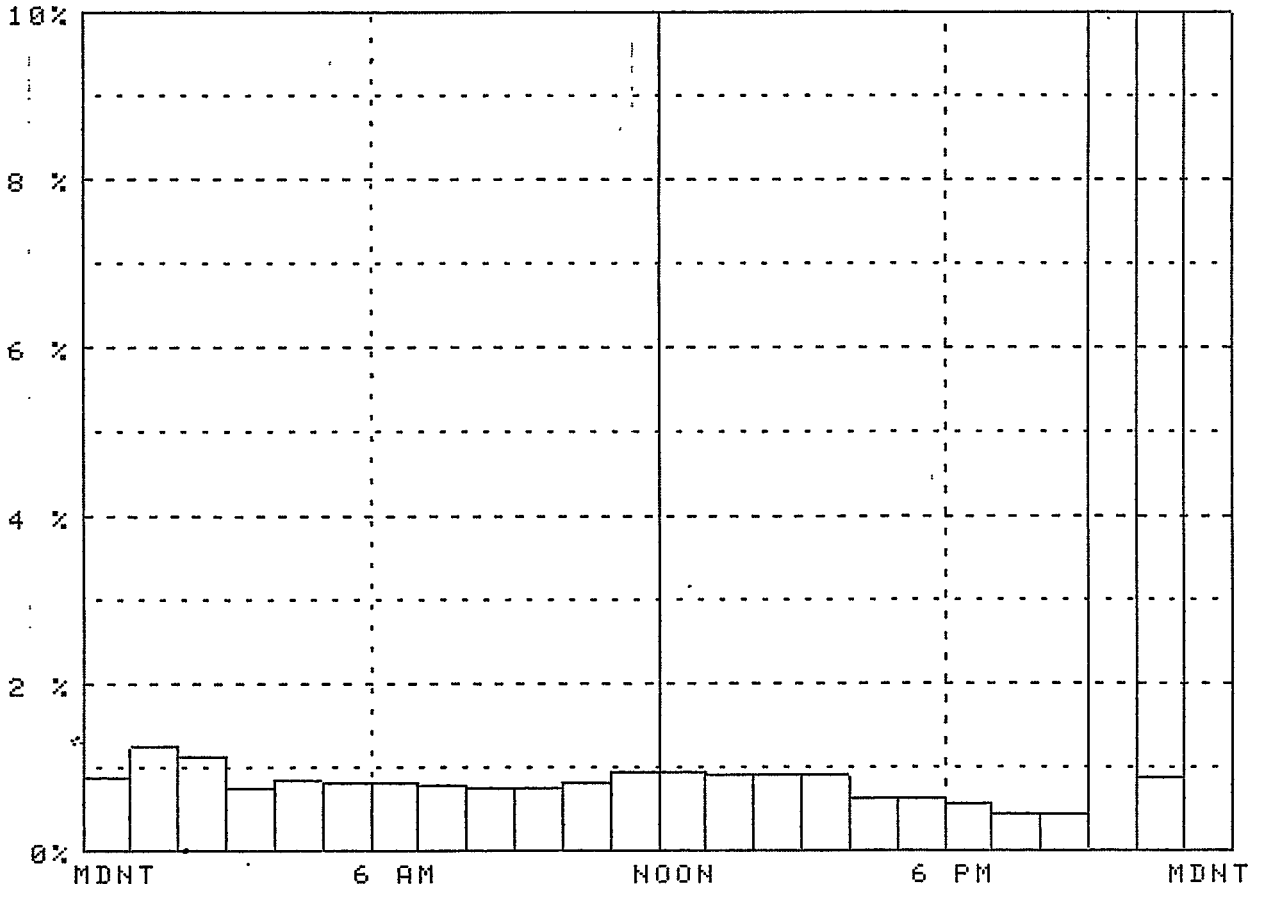

Figure 6.1. Occupancy versus time-of-day for the 162-174 MHz band.

MARCH 1978
NORFOLK, VIRGINIA

MTAPE 174
CHANNELS = 77

162-174 OCCUPANCY VS TIME-OF-DAY
FIXED GOVERNMENT ASSIGNMENTS < 50 MI

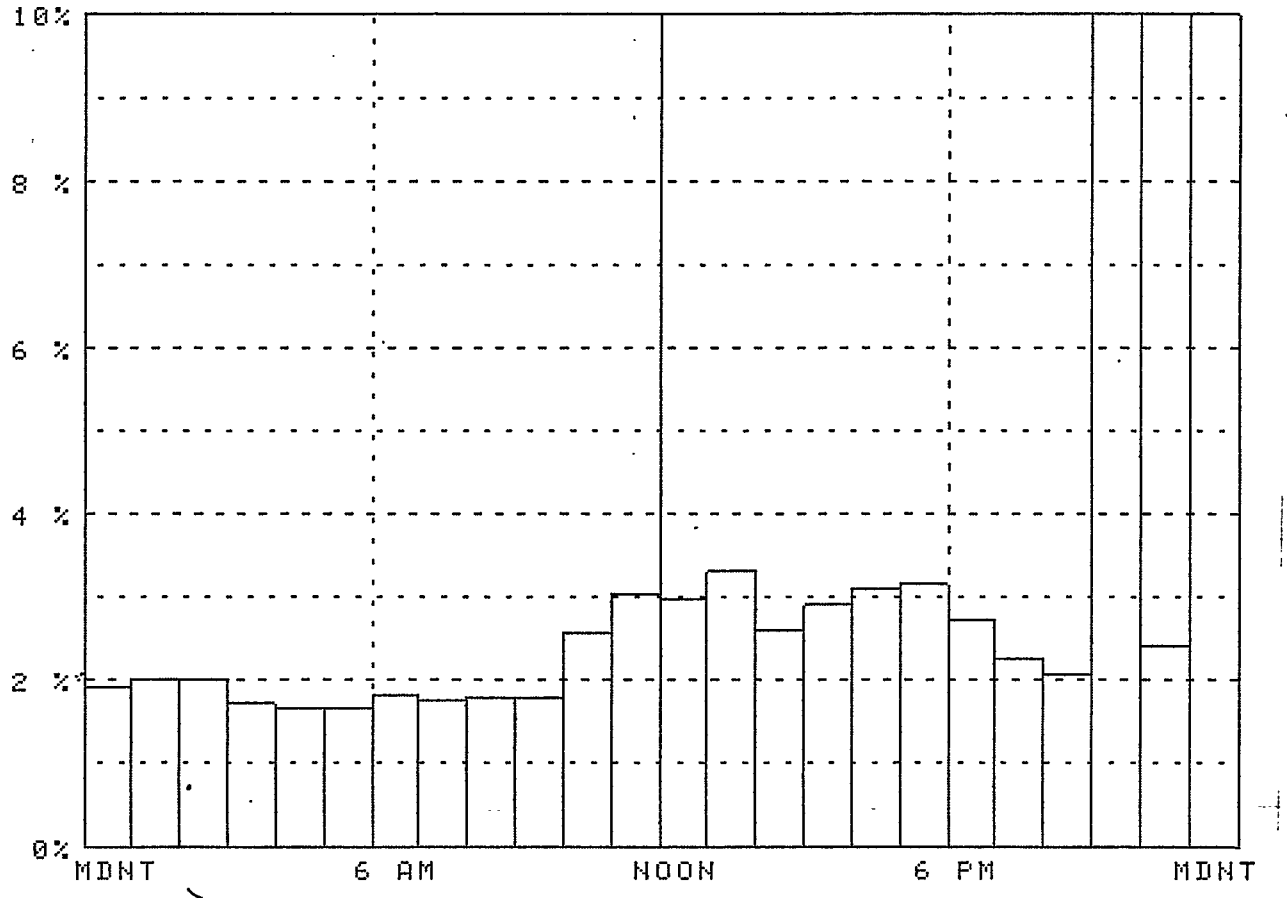

Figure 6.2. Occupancy versus time-of-day for the 162-174 MHz band.

7. CHANNEL USAGE DISTRIBUTIONS

Figures 7.1 and 7.2 are channel usage distributions made from the same data used to develop the usage information provided in section 5 on the channel-by-channel basis. Figure 7.1 is for all of the 479 channels measured in the 162-174 MHz band, and figure 7.2 is for the 77 channels measured that have exact channel center GMF assignments within 50 mi of the Norfolk RSMS measurement site. Ten percent of the fixed government channels assigned within 50 mi have a usage less than 7%.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112
APPLICABLE ONLY TO ALL CHANNELS.
INCLUDED ARE 479 OF THE 479 CHANNELS MEASURED.

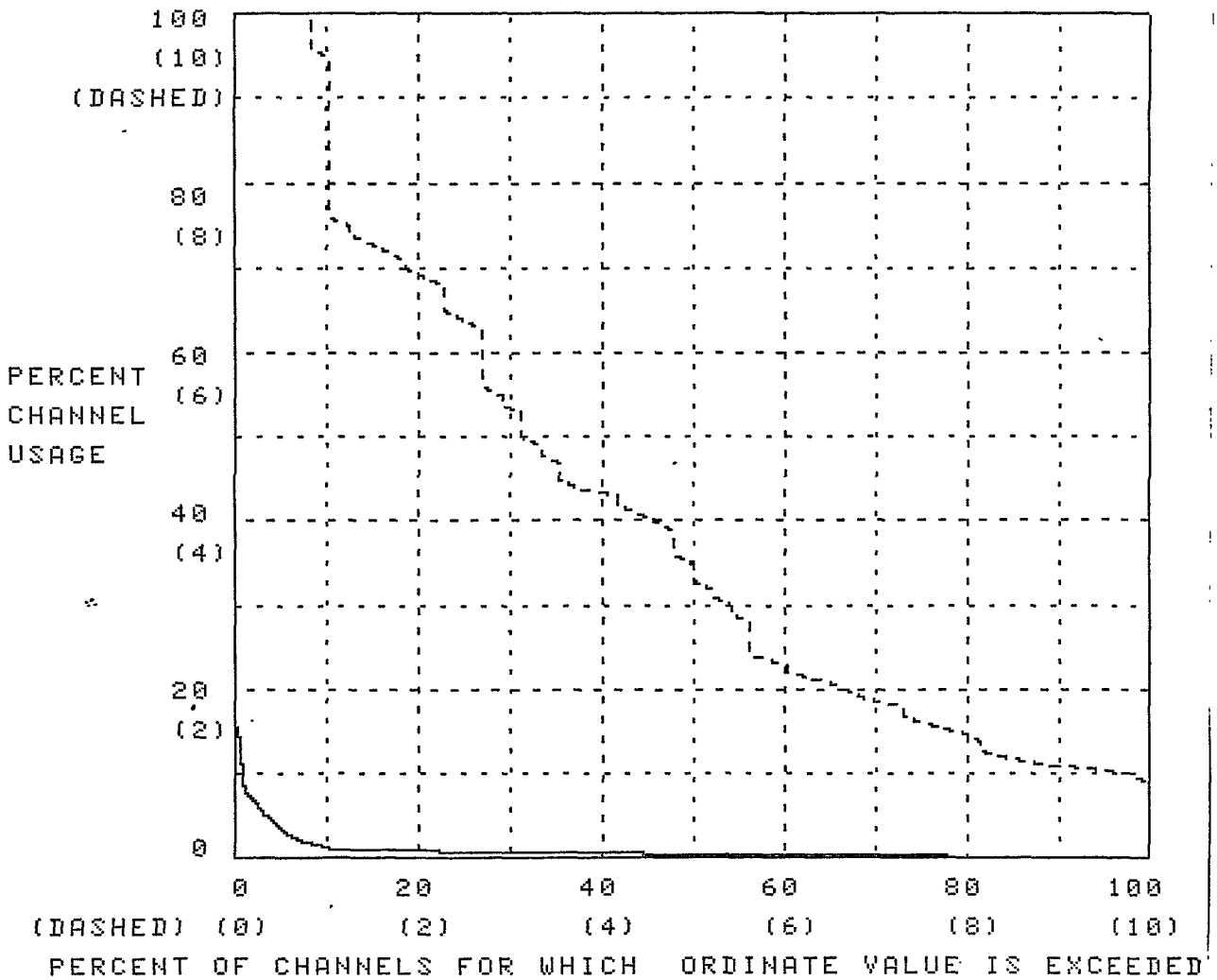

Figure 7.1. Channel usage distribution for 162-174 MHz band.

NORFOLK, VIRGINIA MARCH 1978 CASS 174.163
GMF 780101 SCANS 16561 THRESHOLD (dBM) -112
APPLICABLE ONLY TO FIXED GOV'T CHANNELS WITHIN 50 MI.
INCLUDED ARE 77 OF THE 479 CHANNELS MEASURED.

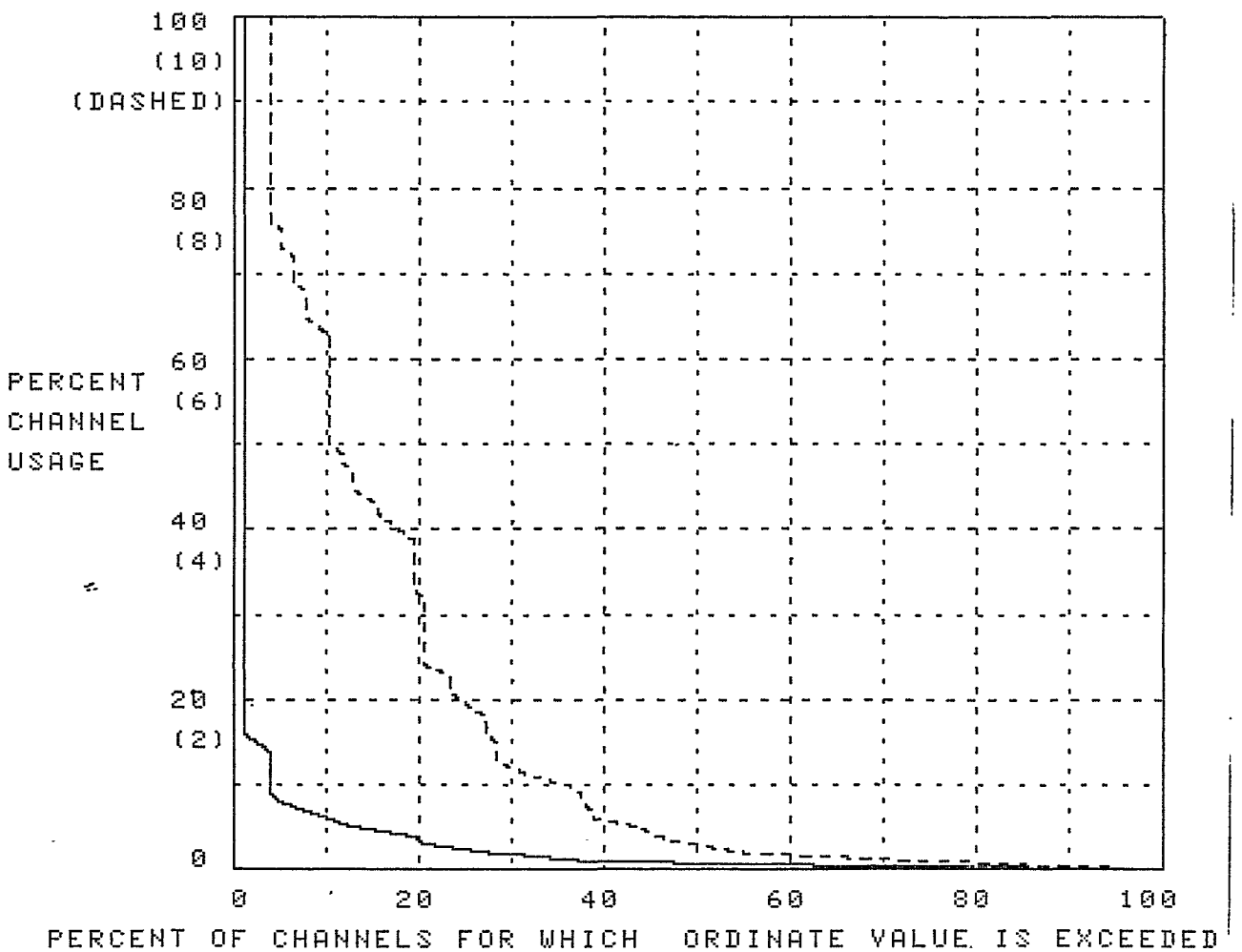

Figure 7.2. Channel usage distribution for 162-174 MHz band.