



# RSMS OPERATIONS REPORT

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MEASUREMENT OF FEDERAL RADIO CHANNEL  
USAGE IN NORFOLK, VIRGINIA

138-150 MHz Band  
March 1978



**NATIONAL TELECOMMUNICATIONS AND  
INFORMATION ADMINISTRATION**

**Institute for Telecommunication Sciences  
Boulder, Colorado 80303**

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1. INTRODUCTION

These data provide the results of measurements made to determine the usage of Federal radio channels in the 138-150 MHz band at Norfolk, Virginia. These measurements were conducted during April 12-13, 1978 as part of the National Telecommunications and Information Administration/ Spectrum Management Support Program (NTIA/SMSMSP). 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<sup>o</sup>, Long. W76.328<sup>o</sup>, 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 138-150 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 320 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.

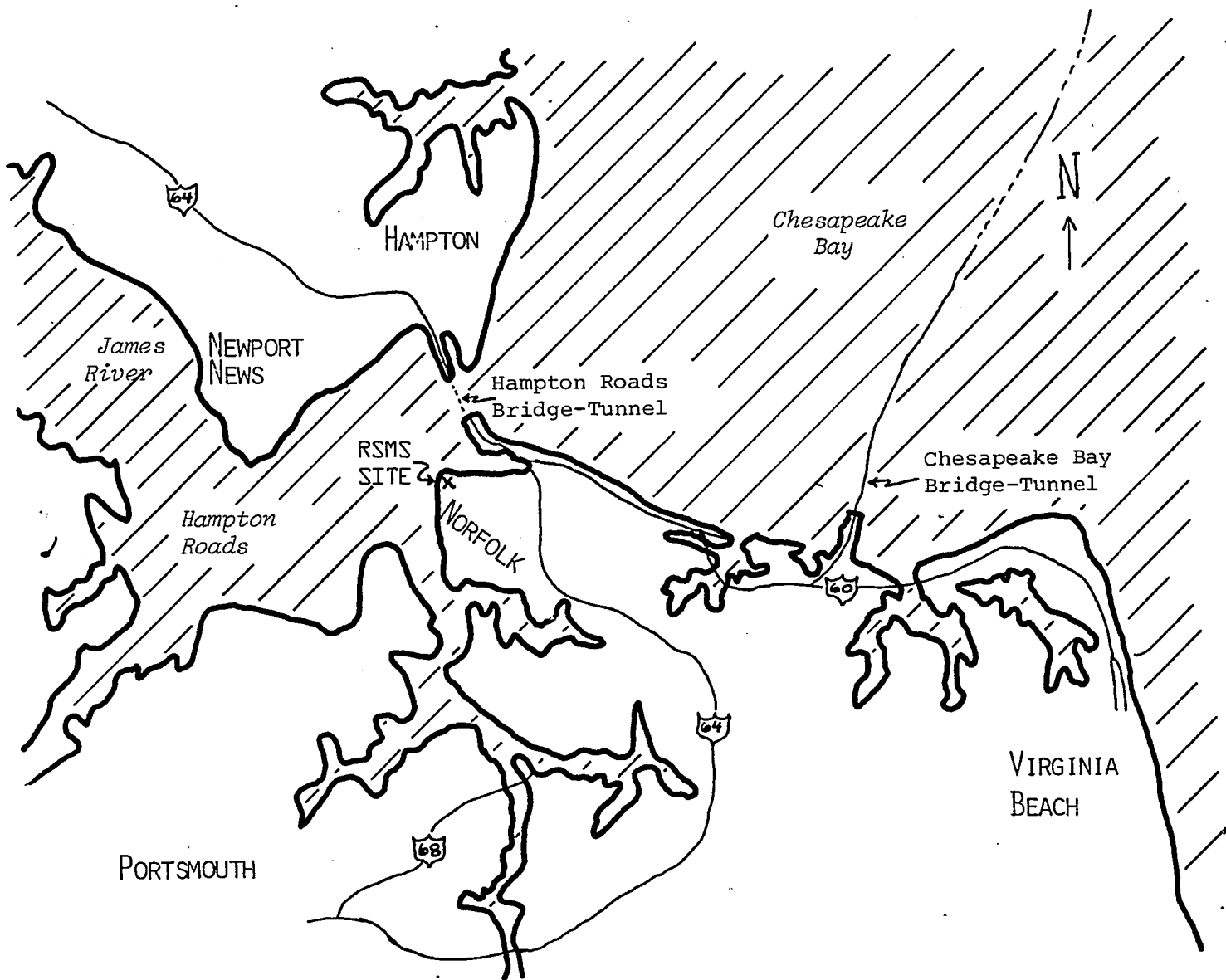


Figure 1.1. Map of Norfolk area, showing RSMS measurement site.

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2. SUMMARY

A usage summary for the 138-150 MHz band at Norfolk is provided in table 2.1. It shows 78 (24%) of the measured channels were used for at least 0.5% of the time. Measurements previously made at Norfolk in June 1974, did not include measurements for the 138-150 MHz band.

A time-of-day analysis of the measurements (fig. 6.1) shows that the heaviest usage (1%) occurred between 2 p.m. and 3 p.m. and usage of 0.5% or greater occurred between 6 a.m. and 10 p.m.

Analysis of the channel usage distribution (fig. 7.1) indicates that about 5% of the measured channels have a usage of at least 4%.

Table 2.1. Usage summary for 138-150 MHz band

Norfolk, Virginia NO GMF		April 1978 Scans 20899	Cass 174.139 Threshold (dBm) -112		
BAND (MHz)	CHANNELS MEASURED	MEASURED CHANNELS WITH USAGE			
		>=0.5%	0.5-0.1%	<=0.1%	
138-150	320 : 0	78 : 0	31 : 0	211 : 0	

NOTES:

- 1) Assigned channels used are given first, and unassigned channels second; i.e., assigned: unassigned. With NO GMF all channels are taken as assigned; i.e., zero unassigned channels.
- 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. 4-147).

3. MEASUREMENT PROCEDURES

Data were collected during Wednesday-Thursday, March 12-13, 1978. For 32 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 April 13 a continuous measurement was made from midnight to 5 p.m., collecting hourly statistics files on magnetic tape. This data was combined with 5 p.m. to midnight data obtained on April 12 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 1,376 measurements on each of the 320 channels measured in the band. Each channel is measured every two 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.

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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.

Usage data were collected using a vertically polarized omnidirectional discone antenna. 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 144 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 144 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 138-150 MHz band. Such data are shown in figure 3.2, where the correction factor  $C_{RA}$  is shown versus frequency. Power available at the antenna input of the transmission line  $P_A$  can be determined from the indicated received power at the receiver input  $P_{RR}$  by using

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

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



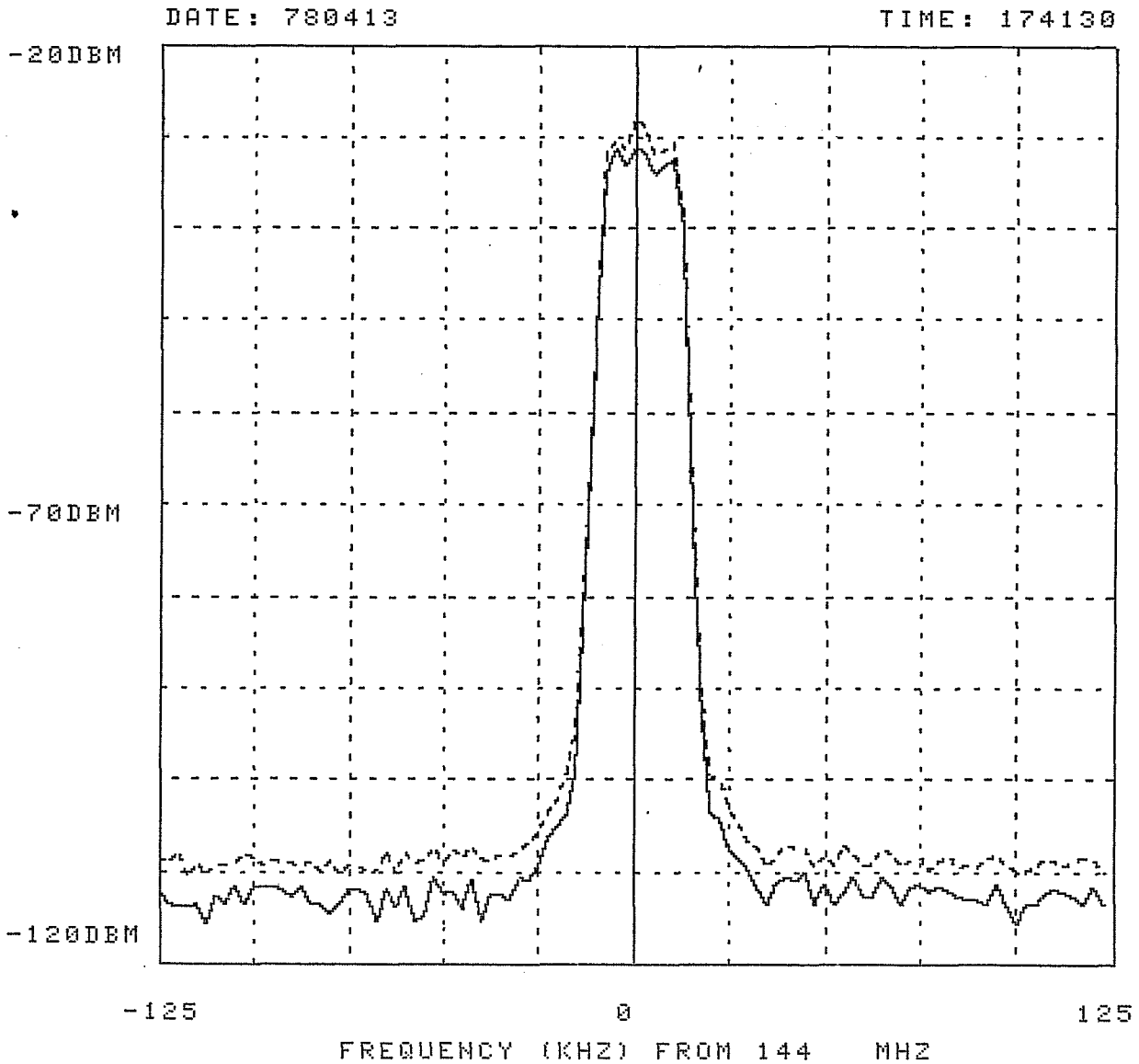


Figure 3.1. Effective IF bandpass shape. The dashed line is based on a single measurement per channel. The solid line is based on the minimum of 40 measurements per channel as per the MSCAN measurement routine, and is appropriate for the 138-150 MHz band measurements made at Norfolk.

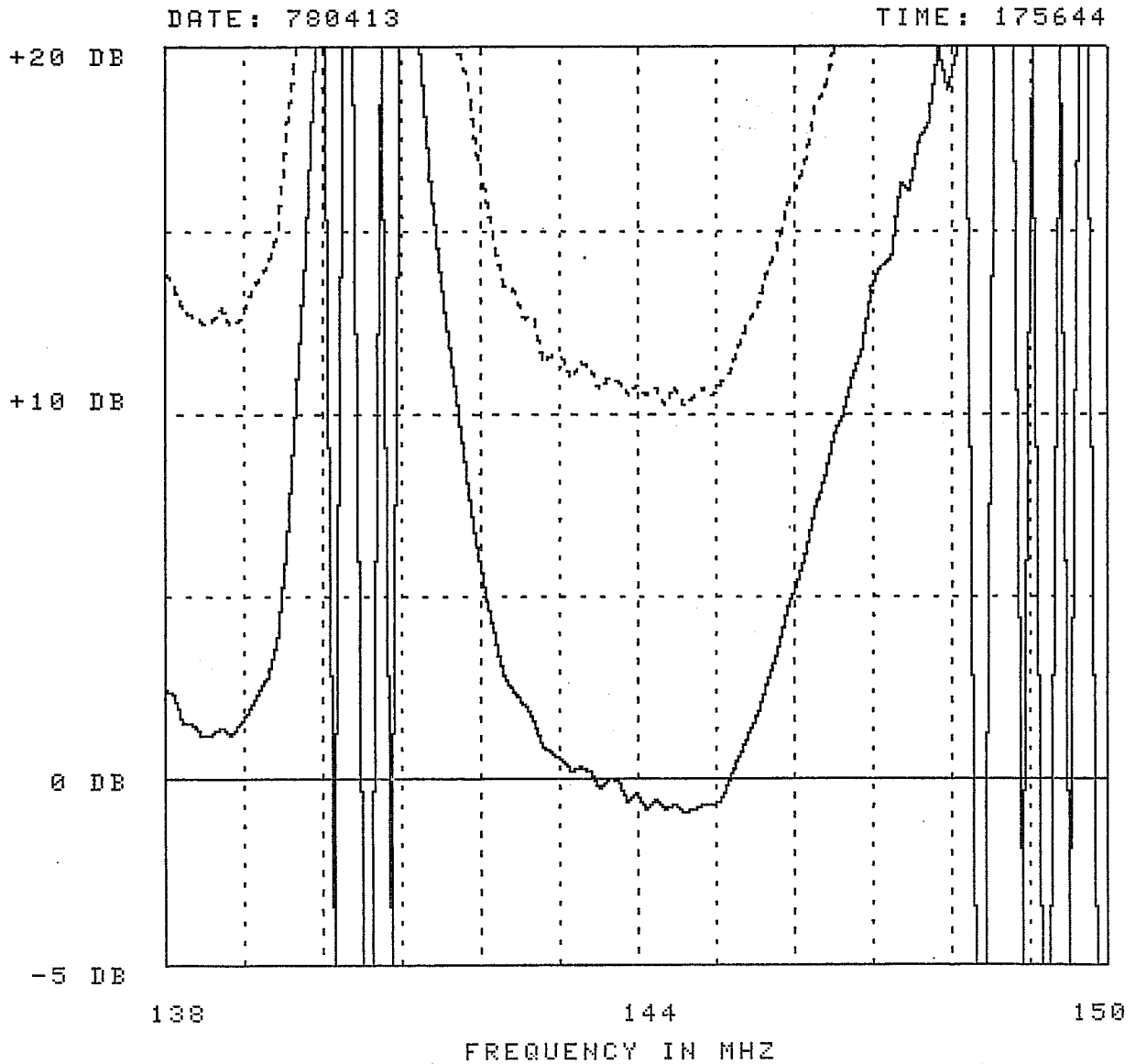


Figure 3.2. System correction factor  $C_{RA}$  (solid line) and noise figure (dashed line). Filter characteristics are included in these plots. A bandstop filter was used to attenuate a large signal at 140.75 MHz and a bandpass filter was adjusted to attenuate several large signals near 150 MHz.

## 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 <i>not</i> 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.

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However, Mini-GMF data for this band was not available on magnetic tape when the data were analyzed. The assignment codes given in the tables of section 5 were generated manually from a Mini-GMF code listing.

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 whole 138-150 band measurement period using program EDIT 138. Then the MSF and MGF are processed with program PLOT 138 to produce a band usage summary (table 2.1) along with channel-by-channel usage summary tables (tables 5.1 to 5.8), and plots (figs. 5.1 to 5.8).

Program EDIT 138 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. These data are processed with program TOD-138 (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).

Processing of the MSF by program DIST-138 produces channel usage distributions for all channels in the band (fig. 7.1).

## 5. CHANNEL OCCUPANCY AND AMPLITUDE STATISTICS

This section contains the results of measurements on the 138-150 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 16 hours of data which contained 20,899 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 5.8 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 320 channels measured in this band. The percent usage is rounded off to the nearest 0.1% (corresponding to 21 measurements out of 20,899). 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.

Data for the "Mini-GMF code" was not available on magnetic tape for this band so that the code space in the tables was filled with "---" when the listings were made. Later, the first "-" was changed to "+" if the frequency had a GMF assignment within 50 miles, and the second "-" was changed to a "+" if the Mini-GMF code was not zero (table 4.1). Hence, "---" implies a zero Mini-GMF code (no assignments), "++" implies a GMF assignment within 50 miles, and "-+" implies a non-zero Mini-GMF code but no GMF assignment within 50 miles.

The plots of usage in figures 5.1 to 5.8 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.

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Table 5.1. Usage Summary List For 138-139 MHz.

NORFOLK, VIRGINIA NO GMF		APRIL 1978 SCANS 20899	CASS 174.139 THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
3	138.075	.5	-81	-98	++
4	138.1	.4	-96	-108	--
7	138.175	.1	-87	-103	++
8	138.2	.3	-88	-109	--
10	138.25	.1	-90	-108	--
13	138.325	.1	-91	-107	--
14	138.35	.1	-93	-108	++
16	138.4	.8	-80	-108	++
20	138.5	.1	-88	-102	++
21	138.525	2.3	-30	-74	++
22	138.55	1.1	-89	-105	++
23	138.575	.1	-88	-104	++
24	138.6	2	-33	-102	++
25	138.625	.1	-80	-103	++
26	138.65	.7	-82	-103	++
27	138.675	4.4	-64	-92	++
28	138.7	.2	-76	-99	++
29	138.725	8.2	-36	-75	++
30	138.75	.2	-75	-102	++
31	138.775	.1	-75	-105	++
32	138.8	.2	-72	-106	++
33	138.825	1.3	-64	-100	++
34	138.85	6.4	-45	-90	++
35	138.875	.5	-65	-107	++
36	138.9	.1	-72	-99	++
37	138.925	.1	-75	-102	++
39	138.975	3.7	-72	-97	++
40	139	.1	-75	-103	++

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

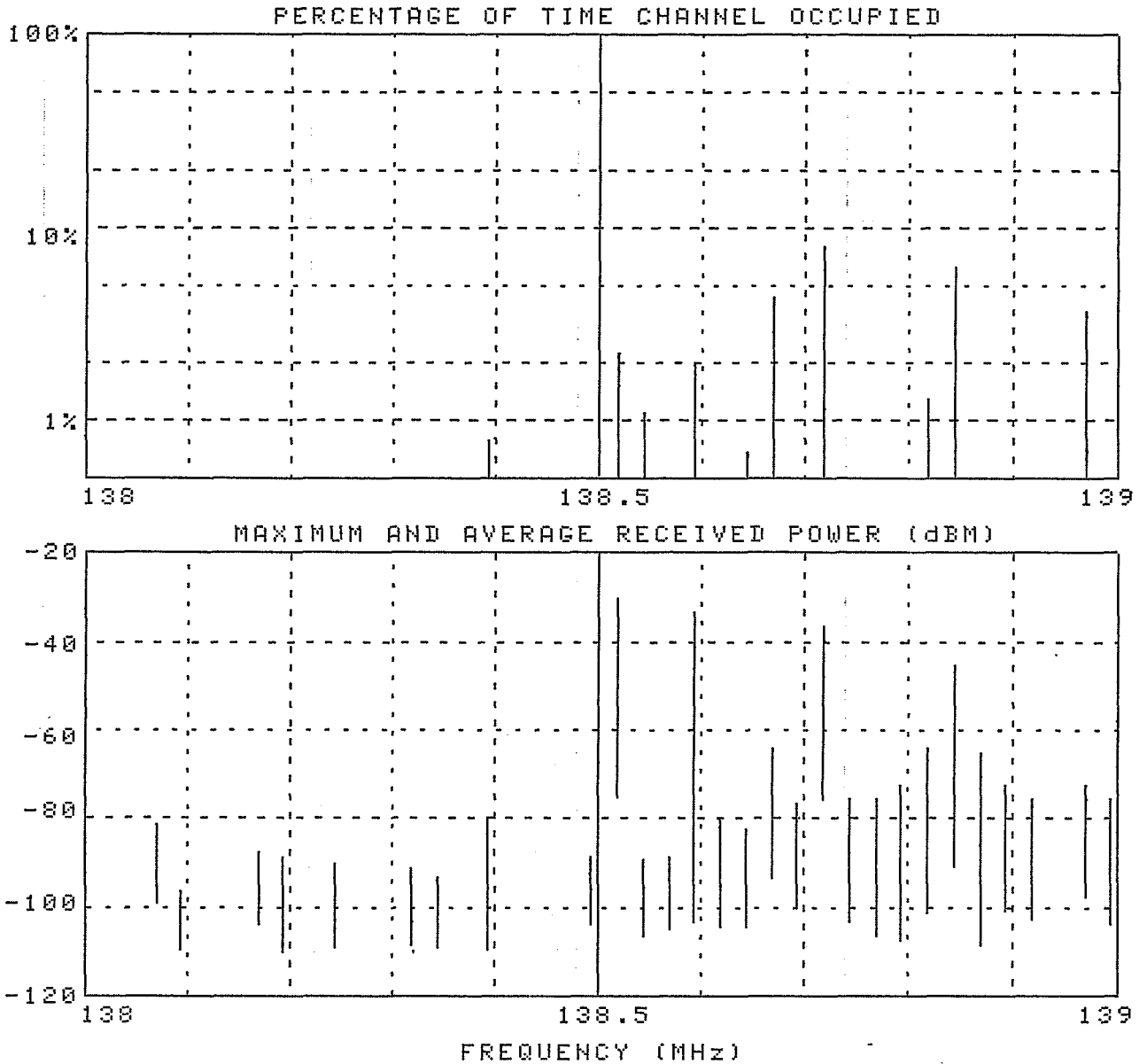


Figure 5.1. Usage summary plot for 138-139 MHz.

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Table 5.2. Usage Summary List For 139-140 MHz.

NORFOLK, VIRGINIA NO GMF		APRIL 1978 SCANS 20899	CASS 174.139 THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
43	139.075	.1	-87	-102	-+
46	139.15	.1	-84	-105	-+
55	139.375	.1	-89	-104	-+
58	139.45	.1	-95	-104	++
59	139.475	.4	-76	-97	++
60	139.5	12.1	-67	-82	-+
61	139.525	.9	-97	-108	++
66	139.65	.1	-109	-110	-+
68	139.7	.1	-91	-106	-+
71	139.775	.1	-90	-105	-+
75	139.875	.1	-108	-110	-+
76	139.9	.1	-96	-107	-+
77	139.925	.8	-101	-110	-+
79	139.975	.1	-108	-110	-+
80	140	.1	-100	-110	-+



NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

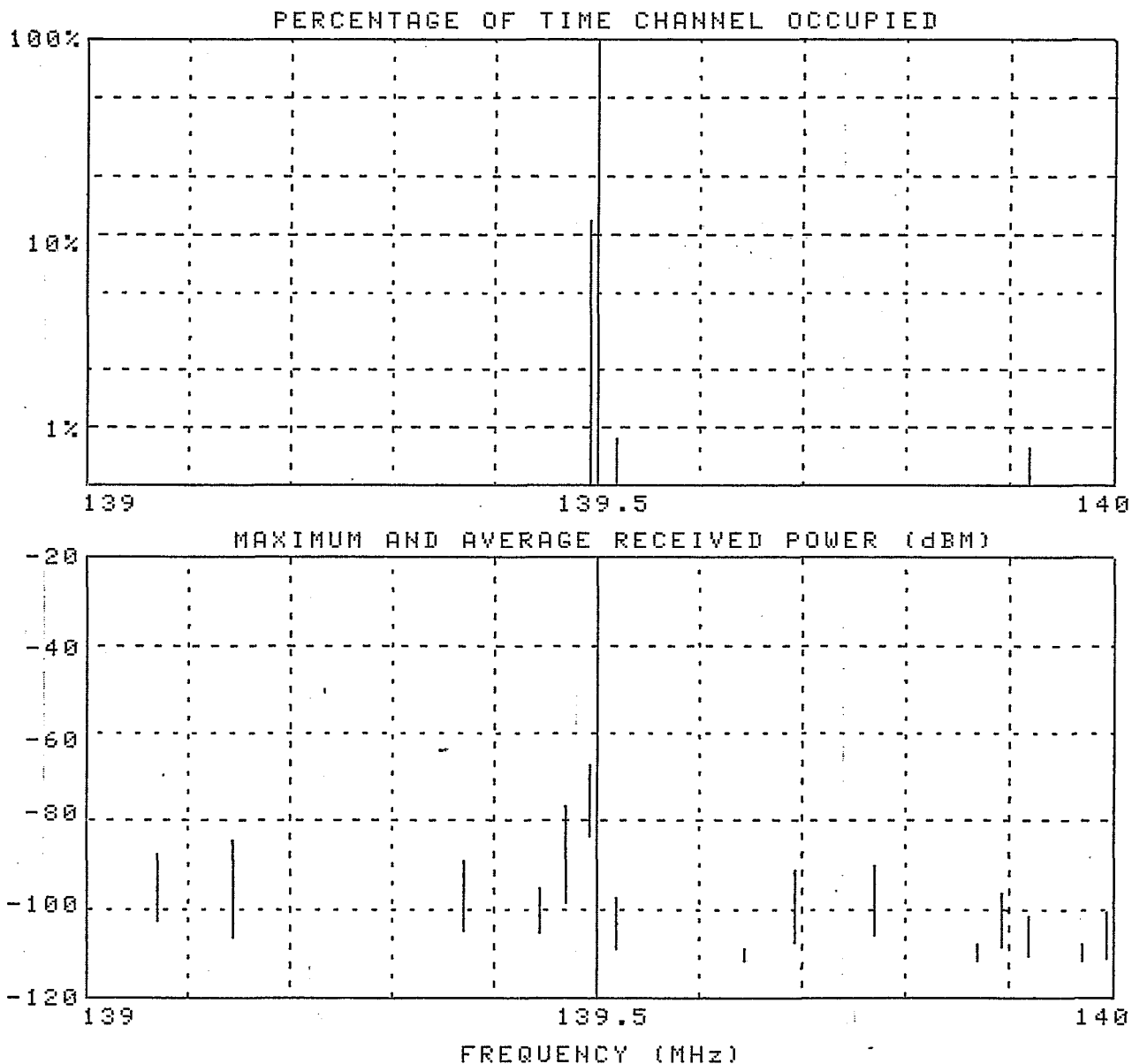


Figure 5.2. Usage summary plot for 139-140 MHz.

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Table 5.3. Usage Summary List For 140-141 MHz.

NORFOLK, VIRGINIA NO GMF		APRIL 1978 SCANS 20899	CASS 174.139 THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
81	140.025	.7	-93	-104	++
82	140.05	3.8	-35	-77	-+
83	140.075	2.6	-51	-88	++
84	140.1	.1	-103	-109	++
85	140.125	.1	-104	-110	++
86	140.15	2.1	-49	-92	++
87	140.175	8.8	-24	-81	++
88	140.2	.6	-70	-107	++
89	140.225	.4	-95	-103	++
90	140.25	1	-65	-87	++
91	140.275	1	-75	-92	++
93	140.325	.1	-107	-109	-+
94	140.35	3.2	-48	-92	-+
95	140.375	.3	-59	-85	-+
96	140.4	.1	-102	-109	-+
97	140.425	.1	-103	-109	-+
98	140.45	.2	-71	-103	++
99	140.475	.7	-30	-95	-+
100	140.5	.1	-98	-108	++
103	140.575	1.8	-55	-86	++
104	140.6	.1	-93	-108	++
105	140.625	.2	-81	-99	++
106	140.65	1.8	-87	-105	++
108	140.7	.3	-66	-95	++
109	140.725	0	-59	-99	++
110	140.75	.6	-96	-105	++
111	140.775	.5	-61	-98	++
112	140.8	.3	-68	-95	++
113	140.825	.4	-79	-97	-+
116	140.9	.1	-96	-105	-+
117	140.925	2	-57	-93	-+
120	141	1.3	-89	-100	++

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

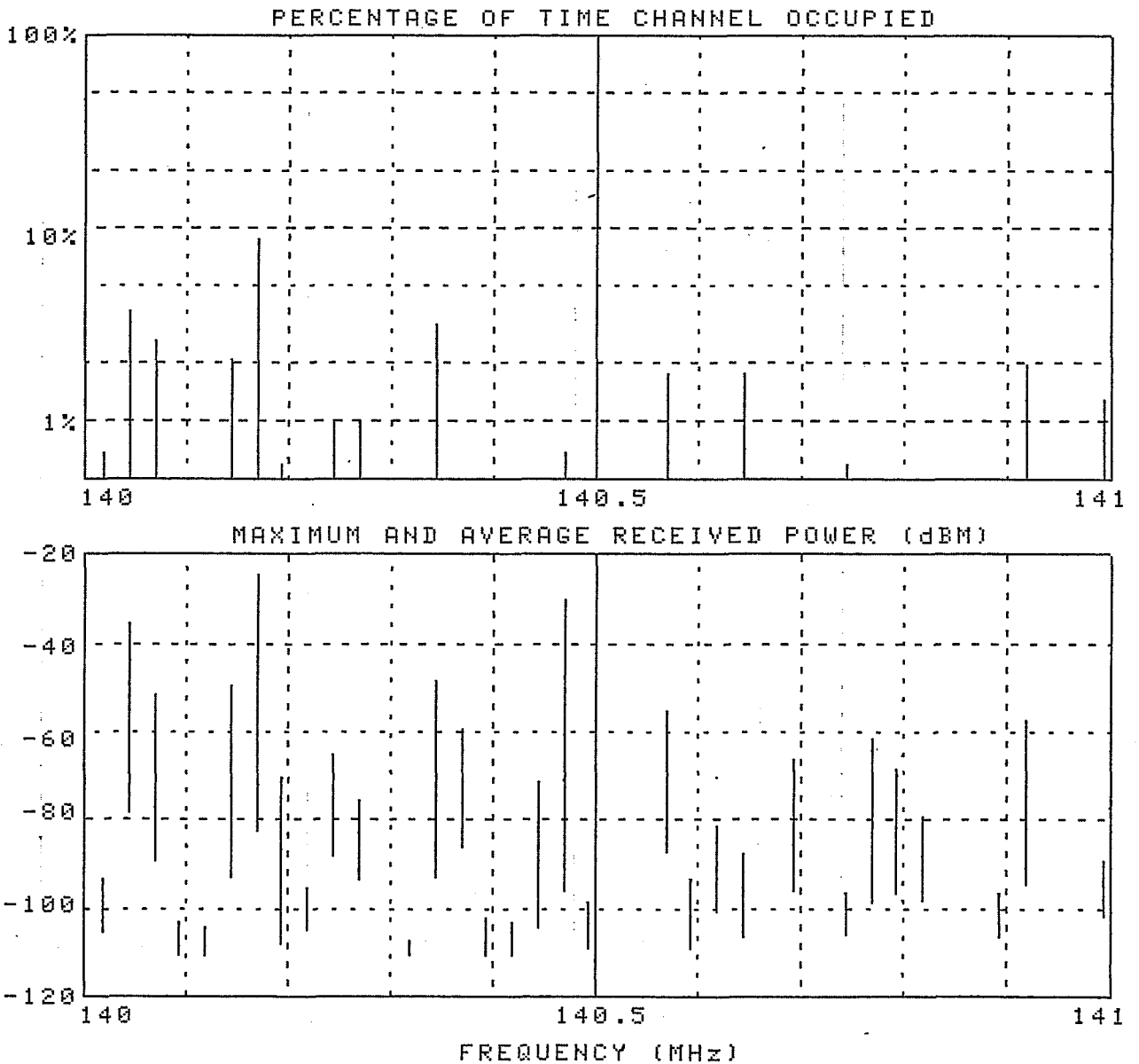


Figure 5.3. Usage summary plot for 140-141 MHz.

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Table 5.4. Usage Summary List For 141-142 MHz.

NORFOLK, VIRGINIA NO GMF		APRIL 1978 SCANS 20899	CASS 174.139 THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
142	141.55	.1	-96	-105	-+
152	141.8	.4	-68	-99	-+
159	141.975	3.4	-90	-106	++

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

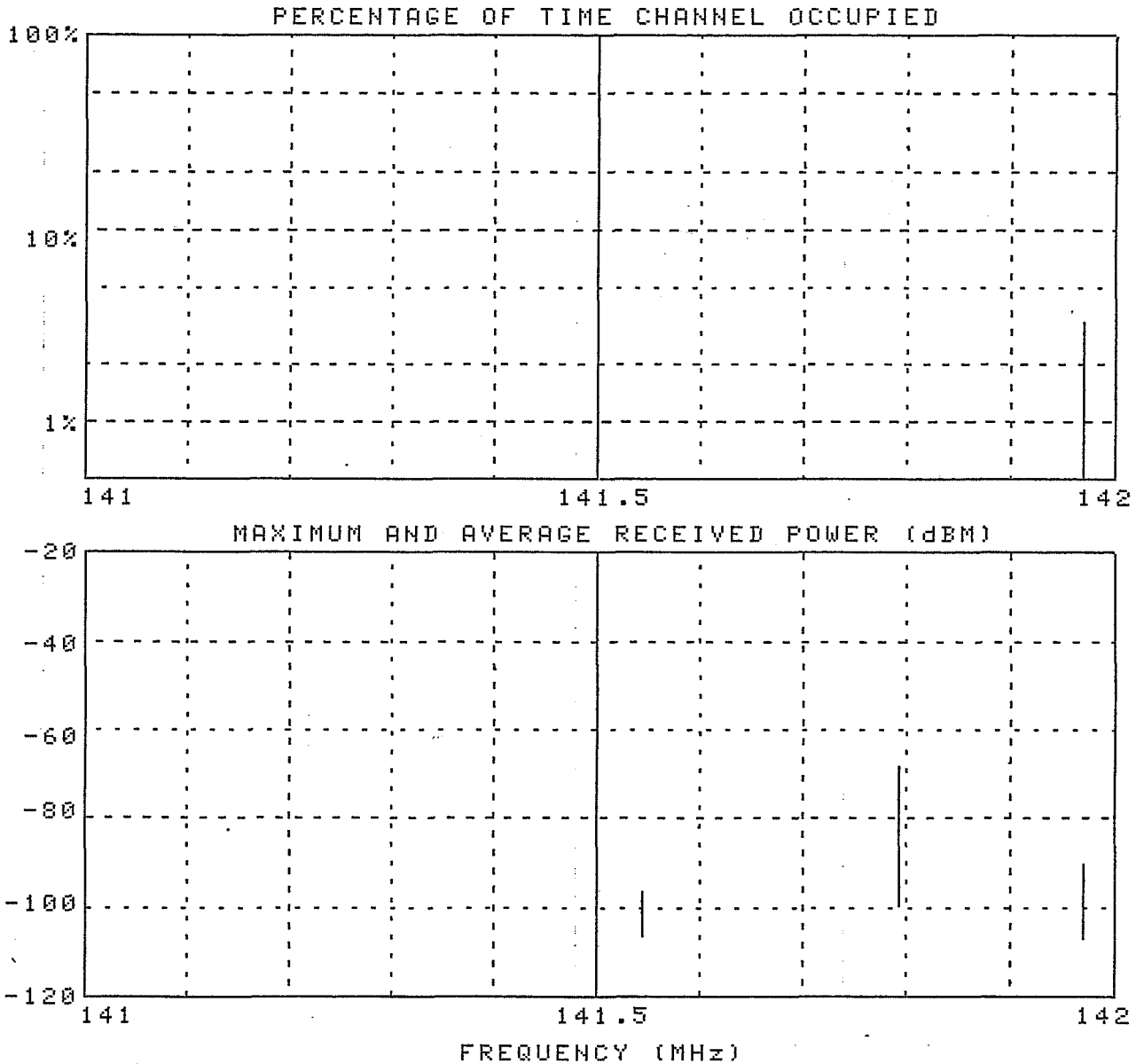


Figure 5.4. Usage summary plot for 141-142 MHz.

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Table 5.5. Usage Summary List For 142-143 MHz.

NORFOLK, VIRGINIA NO GMF		APRIL 1978 SCANS 20899	CASS 174.139 THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
161	142.025	.2	-92	-105	++
162	142.05	4.1	-23	-78	++
163	142.075	2.4	-78	-104	-+
164	142.1	.7	-104	-110	-+
166	142.15	.1	-103	-109	-+
170	142.25	.1	-106	-110	-+
173	142.325	.6	-88	-96	++
175	142.375	.1	-93	-107	-+
177	142.425	.1	-95	-103	-+
178	142.45	.1	-88	-96	-+
179	142.475	2.4	-56	-92	-+
180	142.5	3.3	-49	-72	++
182	142.55	.2	-76	-98	-+
183	142.575	.5	-49	-60	-+
184	142.6	.5	-100	-107	++
185	142.625	1.2	-45	-59	++
186	142.65	3.5	-20	-75	++
187	142.675	.6	-89	-107	++
188	142.7	8.4	-15	-77	-+
189	142.725	4.6	-79	-109	++
190	142.75	.1	-92	-107	++
191	142.775	2	-71	-97	++
192	142.8	.1	-98	-108	-+
195	142.875	1.2	-36	-92	-+
197	142.925	.2	-105	-109	-+
199	142.975	.1	-88	-104	-+
200	143	.1	-93	-102	-+

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

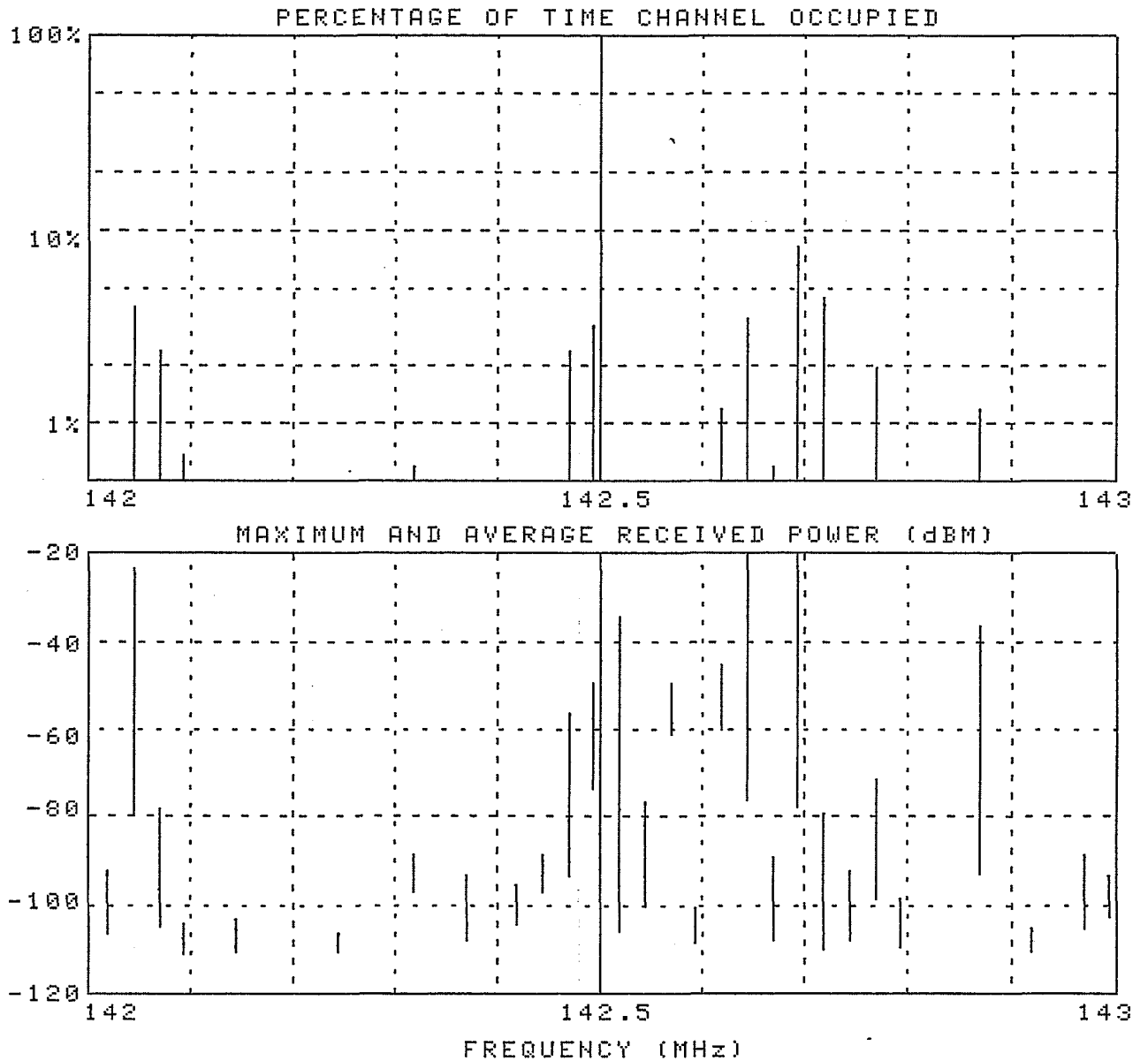


Figure 5.5. Usage summary plot for 142-143 MHz.

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Table 5.6. Usage Summary List For 143-144 MHz.

NORFOLK, VIRGINIA		APRIL 1978	CASS 174.139		
NO GMF		SCANS 20899	THRESHOLD (dBm) -112		
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
201	143.025	.1	-95	-104	--
202	143.05	.1	-95	-103	--
203	143.075	.1	-94	-104	--
204	143.1	.1	-92	-103	--
205	143.125	.2	-87	-105	--
206	143.15	.1	-92	-103	--
207	143.175	.1	-95	-103	--
208	143.2	.1	-77	-101	--
209	143.225	.1	-97	-103	--
210	143.25	.1	-95	-104	--
211	143.275	.1	-94	-105	--
212	143.3	.1	-93	-104	--
213	143.325	.1	-99	-105	--
214	143.35	.1	-96	-105	--
215	143.375	.1	-94	-104	--
216	143.4	1.2	-84	-100	++
217	143.425	.1	-100	-104	--
218	143.45	1.4	-91	-104	--
219	143.475	2.7	-76	-89	--
220	143.5	.6	-89	-99	++
221	143.525	.2	-93	-103	--
222	143.55	3	-39	-93	++
223	143.575	2.1	-81	-94	++
224	143.6	24.5	-37	-46	++
225	143.625	6.5	-38	-101	--
226	143.65	.9	-78	-92	++
227	143.675	.2	-97	-104	++
228	143.7	.2	-94	-101	--
229	143.725	.3	-92	-101	--
230	143.75	.3	-92	-99	--
231	143.775	.4	-91	-100	--
232	143.8	.3	-91	-101	--
233	143.825	.3	-88	-100	--
234	143.85	.2	-91	-103	--
235	143.875	.1	-97	-103	--
236	143.9	.1	-93	-102	--
237	143.925	.2	-94	-104	--
238	143.95	.1	-88	-103	--
239	143.975	.1	-78	-104	--
240	144	.1	-96	-104	--



NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

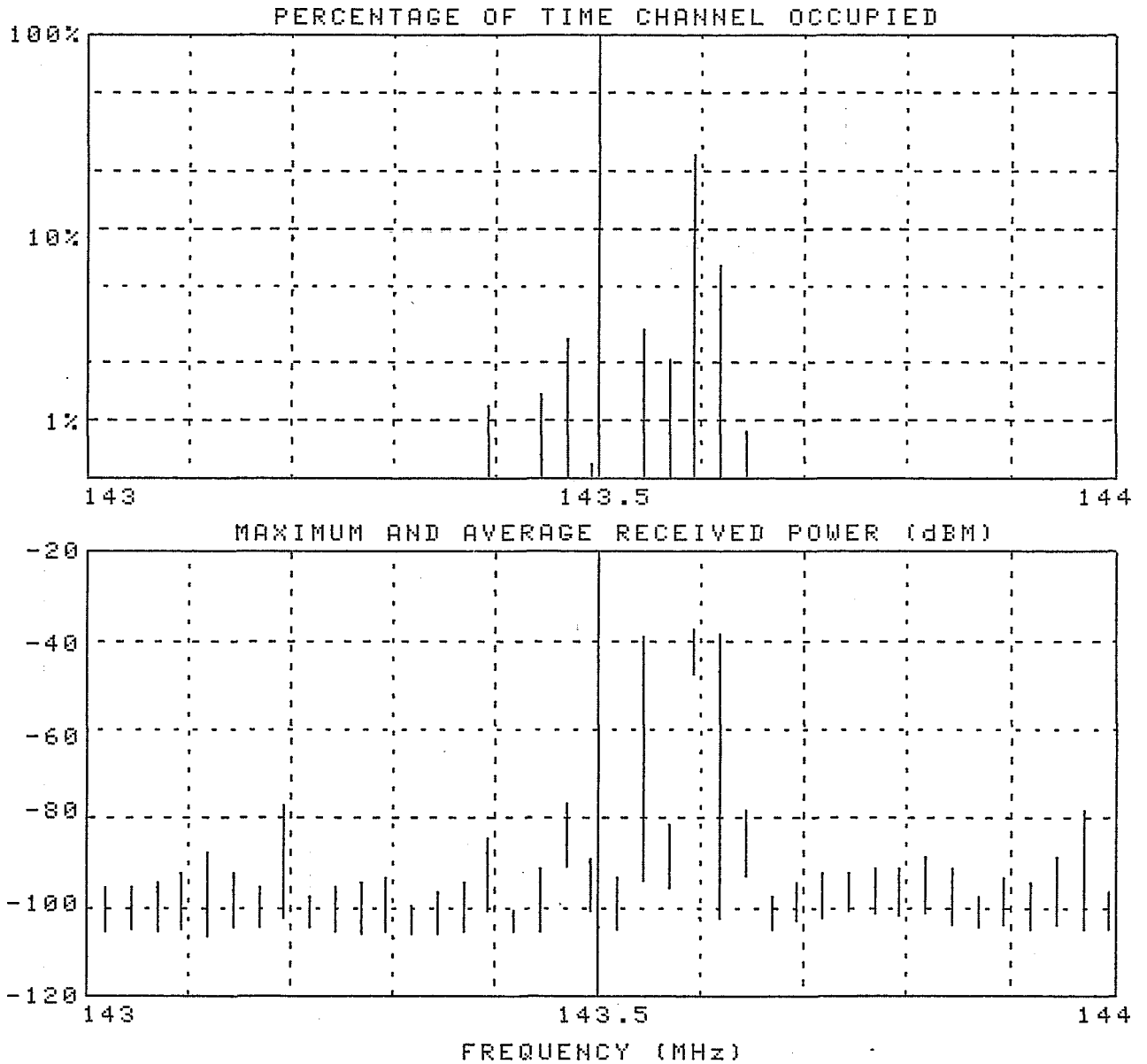


Figure 5.6. Usage summary plot for 143-144 MHz.

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Table 5.7. Usage Summary List For 148-149 MHz.

NORFOLK, VIRGINIA		APRIL 1978		CASS 174.139	
NO GMF		SCANS 28899		THRESHOLD (dBm) -112	
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
243	148.075	.6	-90	-105	-+
244	148.1	3.3	-79	-105	-+
246	148.15	.1	-87	-102	-+
248	148.2	6.9	-83	-102	-+
249	148.225	5.8	-82	-103	-+
250	148.25	1.3	-75	-99	-+
251	148.275	.1	-105	-109	++
252	148.3	1.5	-91	-103	-+
253	148.325	1	-71	-94	++
254	148.35	3.3	-27	-73	++
255	148.375	59.4	-60	-93	-+
256	148.4	.1	-91	-107	-+
257	148.425	3.7	-55	-84	-+
259	148.475	4.4	-75	-99	++
266	148.65	28.3	-80	-96	-+
267	148.675	.3	-96	-104	-+
272	148.8	19.4	-91	-102	-+
278	148.95	2.2	-95	-109	++
288	149	.1	-85	-98	++

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

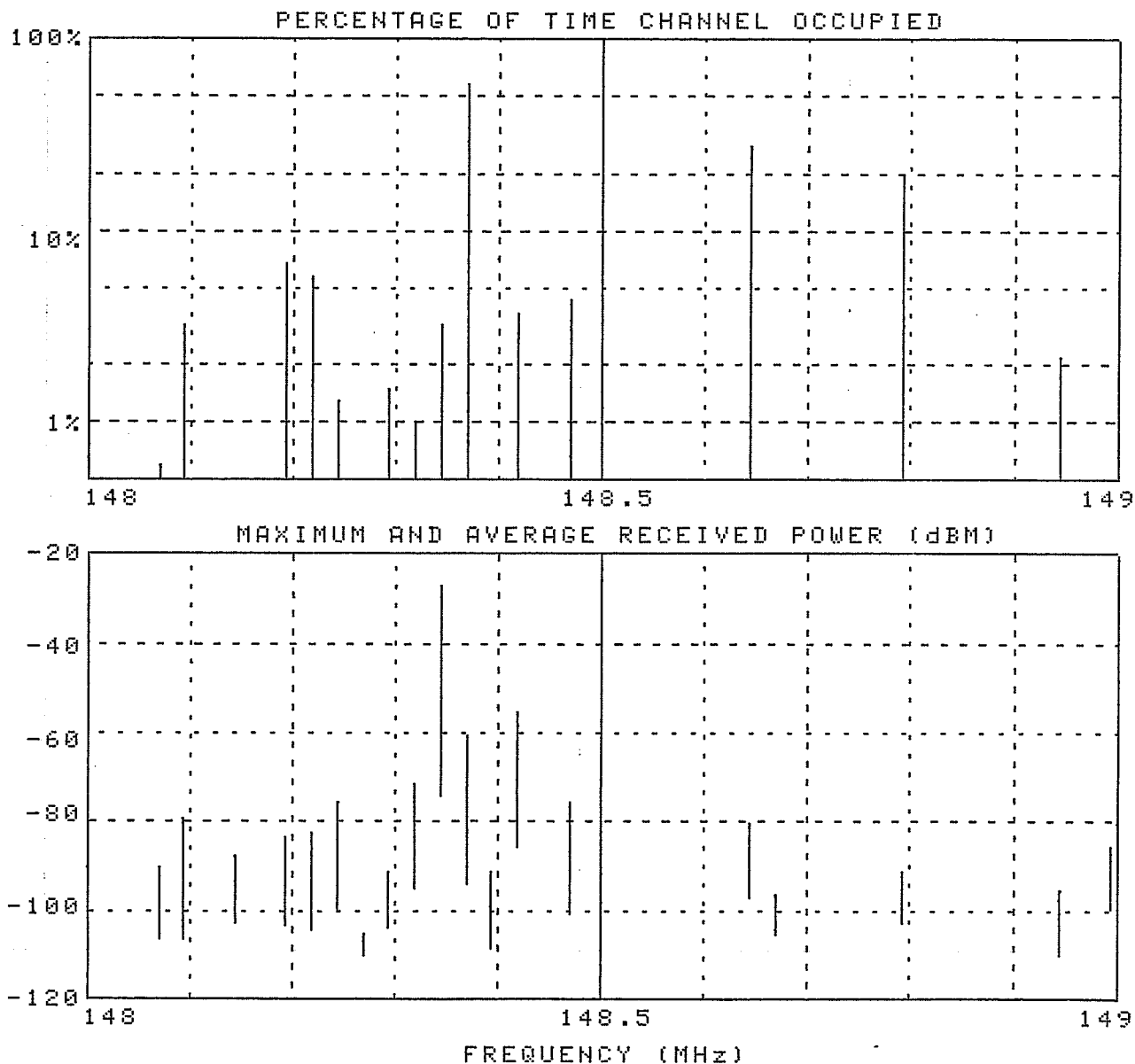


Figure 5.7. Usage summary plot for 148-149 MHz.

FOR OFFICIAL USE ONLY

Table 5.8. Usage Summary List For 149-150 MHz.

NORFOLK, VIRGINIA		APRIL 1978		CASS 174.139	
NO GMF		SCANS 20899		THRESHOLD (dBm) -112	
INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBm)	AVERAGE (dBm)	MINI-GMF CODE
281	149.025	2.7	-36	-98	-+
282	149.05	.3	-94	-101	++
283	149.075	.6	-76	-103	++
284	149.1	21.4	-81	-96	++
291	149.275	1	-79	-97	-+
292	149.3	4	-83	-97	++
296	149.4	3.2	-45	-85	++
297	149.425	.8	-87	-98	++
299	149.475	.4	-82	-98	++
303	149.575	.6	-92	-102	-+
315	149.875	.1	-101	-109	++

NORFOLK, VIRGINIA  
NO GMF

APRIL 1978  
SCANS 20899

CASS 174.139  
THRESHOLD (dBm) -112

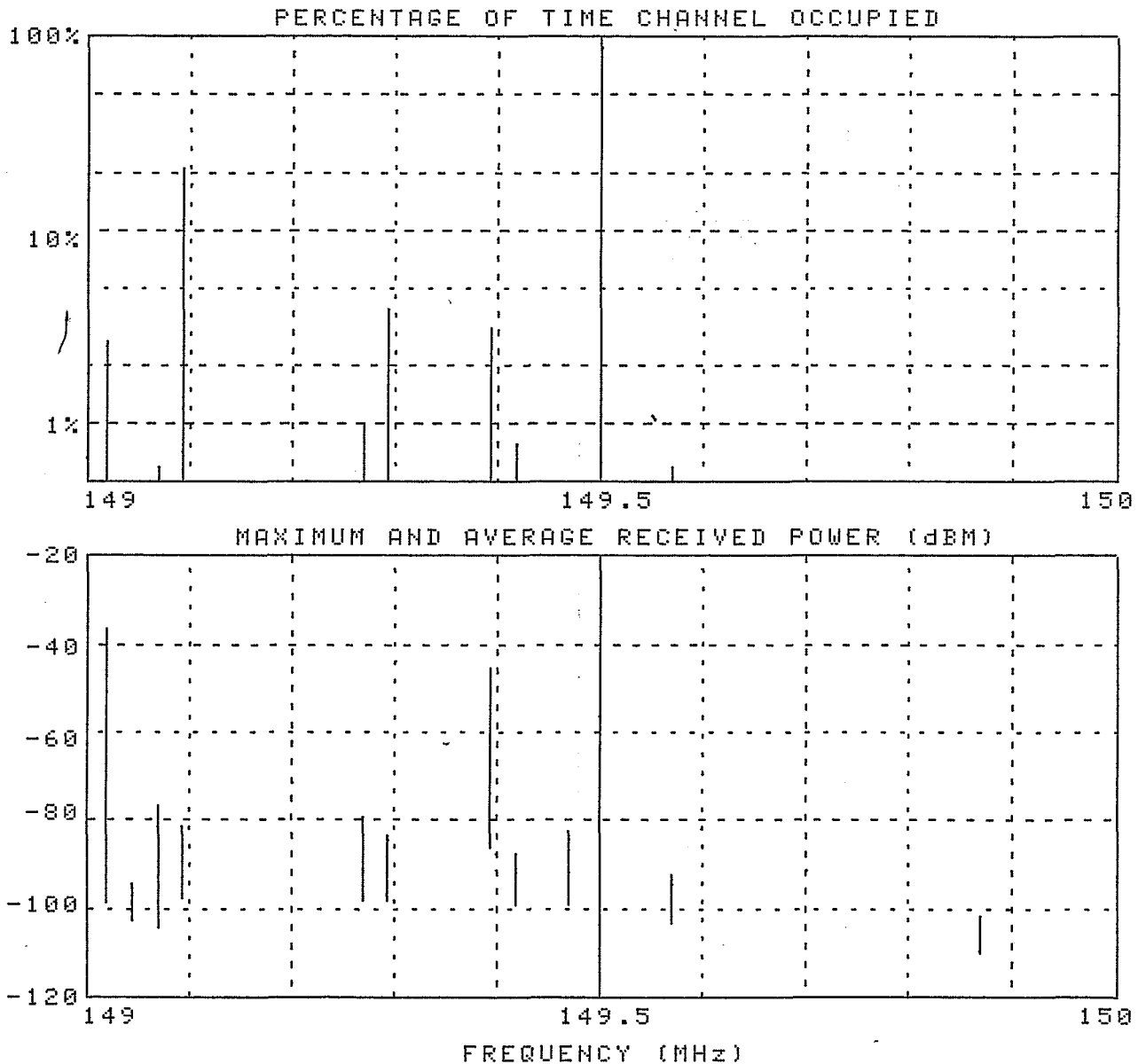


Figure 5.8. Usage summary plot for 149-150 MHz.

6. OCCUPANCY BY TIME-OF-DAY

Hourly statistics files of usage data collected for each hour of the day (sec. 3) were used to generate the hourly band occupancy vs. time-of-day plot shown in figure 6.1 for all of the 320 channels measured in the 138-150 MHz band. Note that the ordinate scale of figure 6.1 goes to 10%.

The heaviest usage (1%) occurred between 2 p.m. and 3 p.m., and usage of 0.5% or greater occurred between 6 a.m. and 10 p.m.

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NORFOLK, VIRGINIA

CHANNELS = 320

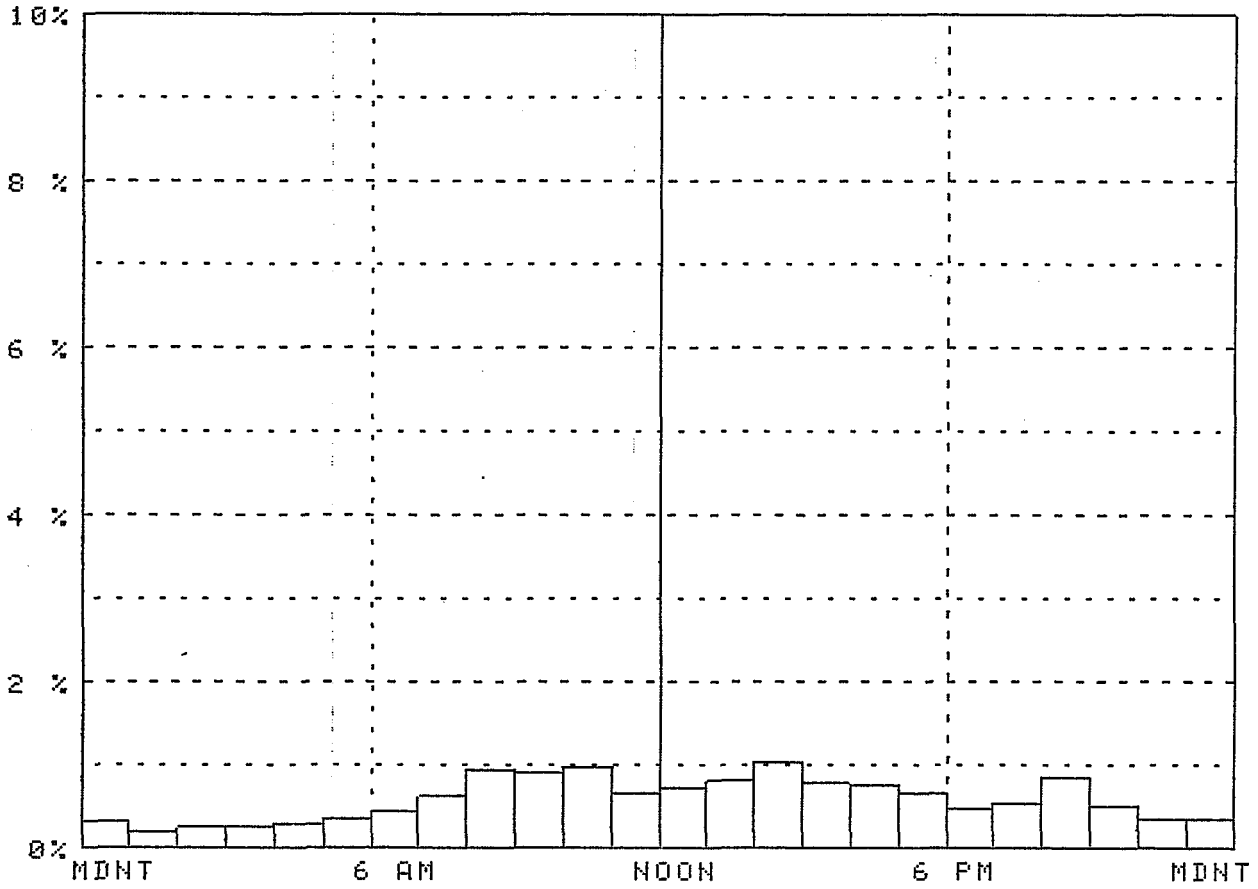


Figure 6.1. Occupancy versus time-of-day for 138-150 MHz band.

7. CHANNEL USAGE DISTRIBUTIONS

Figure 7.1 is a channel usage distribution made from the same data used to develop the usage information provided in section 5 on the channel-by-channel basis. It is for all of the 320 channels measured in the 138-150 MHz band. About 5% of the measured channels have a usage of at least 4%.



NORFOLK, VIRGINIA    APRIL 1978    CASS 174.139  
NO GMF                    SCANS 20899    THRESHOLD (dBm) -112  
APPLICABLE ONLY TO ALL CHANNELS.  
INCLUDED ARE 320 OF THE 320 CHANNELS MEASURED.

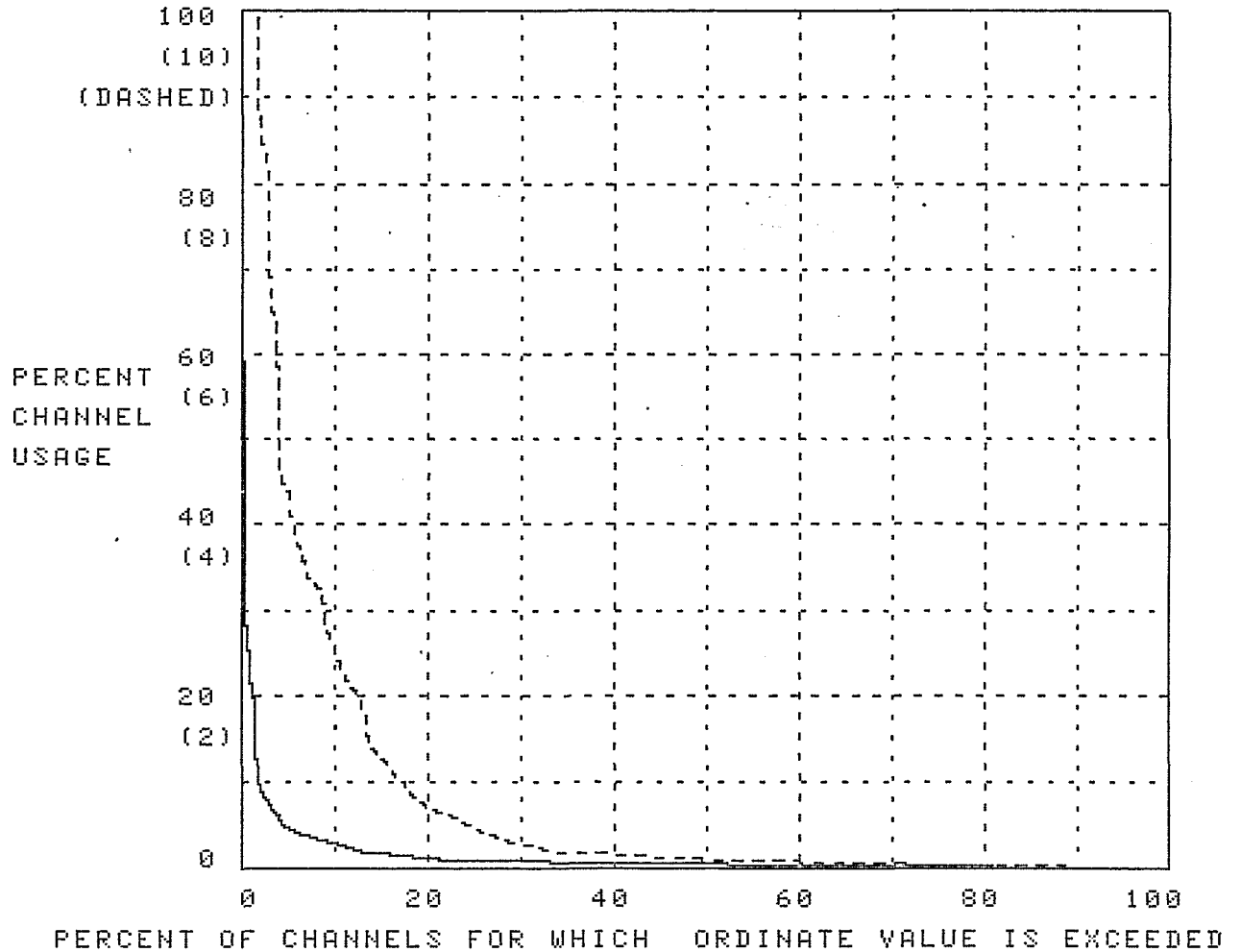


Figure 7.1. Channel usage distribution for 138-150 MHz band.

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