RSMS OPERATIONS REPORT

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MEASUREMENT OF FEDERAL RADIO CHANNEL
USAGE IN NORFOLK, VIRGINIA
406-420 MHz Band

April 1978

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
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1. INTRODUCTION

These data provide the results of measurements made to determine the usage of Federal radio channels in the 406-420 MHz band at Norfolk, Virginia. These measurements were conducted during April 5-7, 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 406-420 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 556 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.

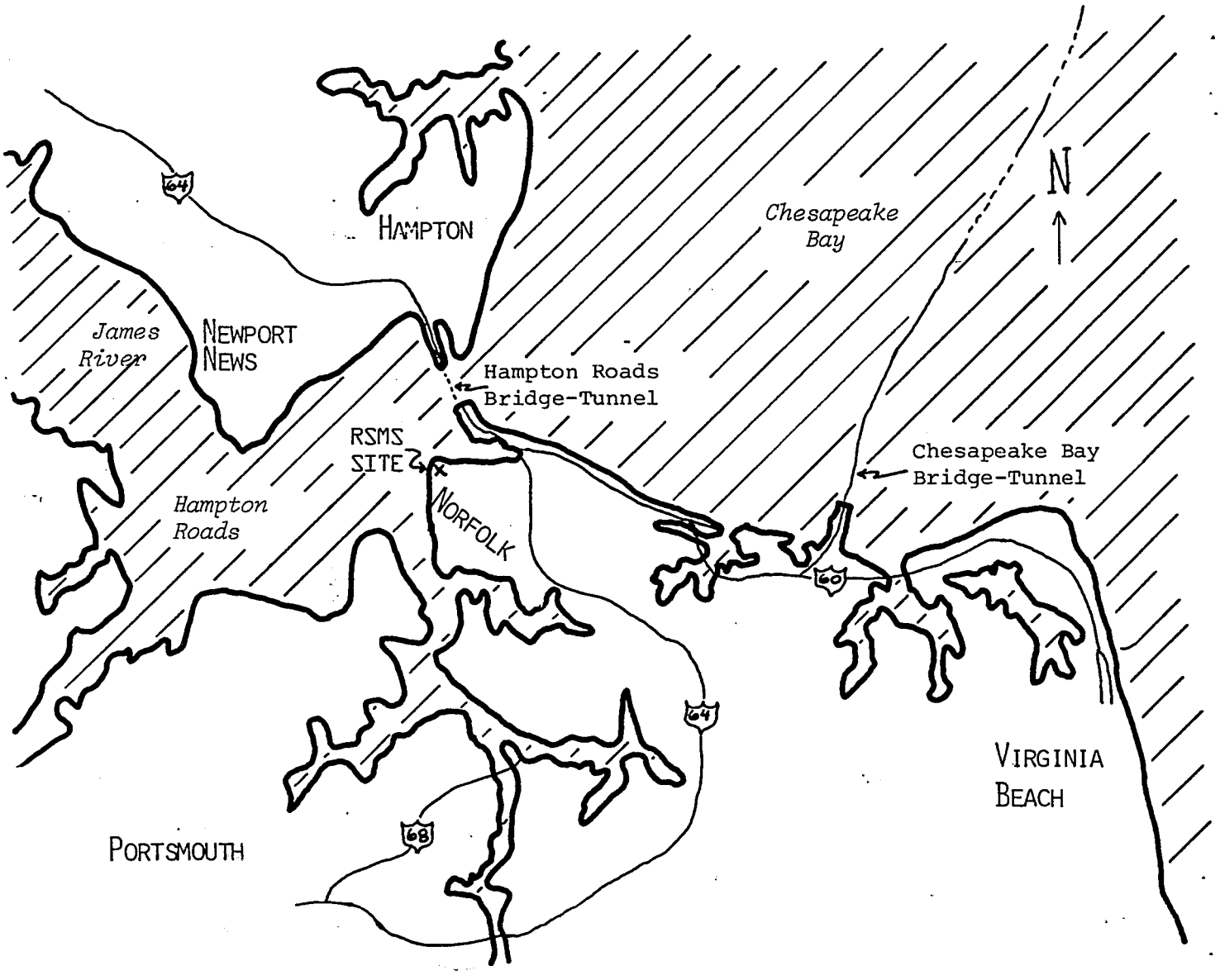

Figure 1.1. Map of Norfolk area, showing RSMS measurement site.

2. SUMMARY

A usage summary for the 406-420 MHz band at Norfolk is provided in table 2.1. It shows that only three (19%) of the measured channels assigned within 50 miles were used for at least 0.5% of the time. However, three measured channels without assignments within 50 miles on the exact measured channel center frequency also had a usage of at least 0.5%. Of these, two have assignments within 150 miles, and the third (408.65 MHz), which has no assignment associated with it, has a usage of only 0.7%.

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 ten assigned channels, one (10%) was in use 0.5% or more, and the other nine assigned channels showed an observed usage less than 0.5% of the time.

Time-of-day analysis of the 1978 measurements (figure 6.2) shows that the heaviest usage of the 16 fixed government channels assigned within 50 miles occurs between 8 and 9 a.m. and between 1 and 3 p.m., but this usage is only slightly greater than 0.5%.

Analysis of the channel usage distribution (figure 7.2) indicates that only one of the 16 assignments within 50 miles has a usage greater than 2%.

Table 2.1. Usage summary for 406-420 MHz band

Norfolk, Virginia — April 1978 — Cass 174.407
GMF 780101 — Scans 14665 — Threshold (dBm) -112

BAND (MHz)	CHANNELS MEASURED	MEASURED CHANNELS WITH USAGE >=0.5%	0.5-0.1%	<=0.1%
406-420	16 : 540	3 : 3	3 : 21	10 : 516

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 Wednesday-Friday, April 5-7, 1978. For 34 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 5-6 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 800 measurements on each of the 556 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 413 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 413 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 406-420 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

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

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

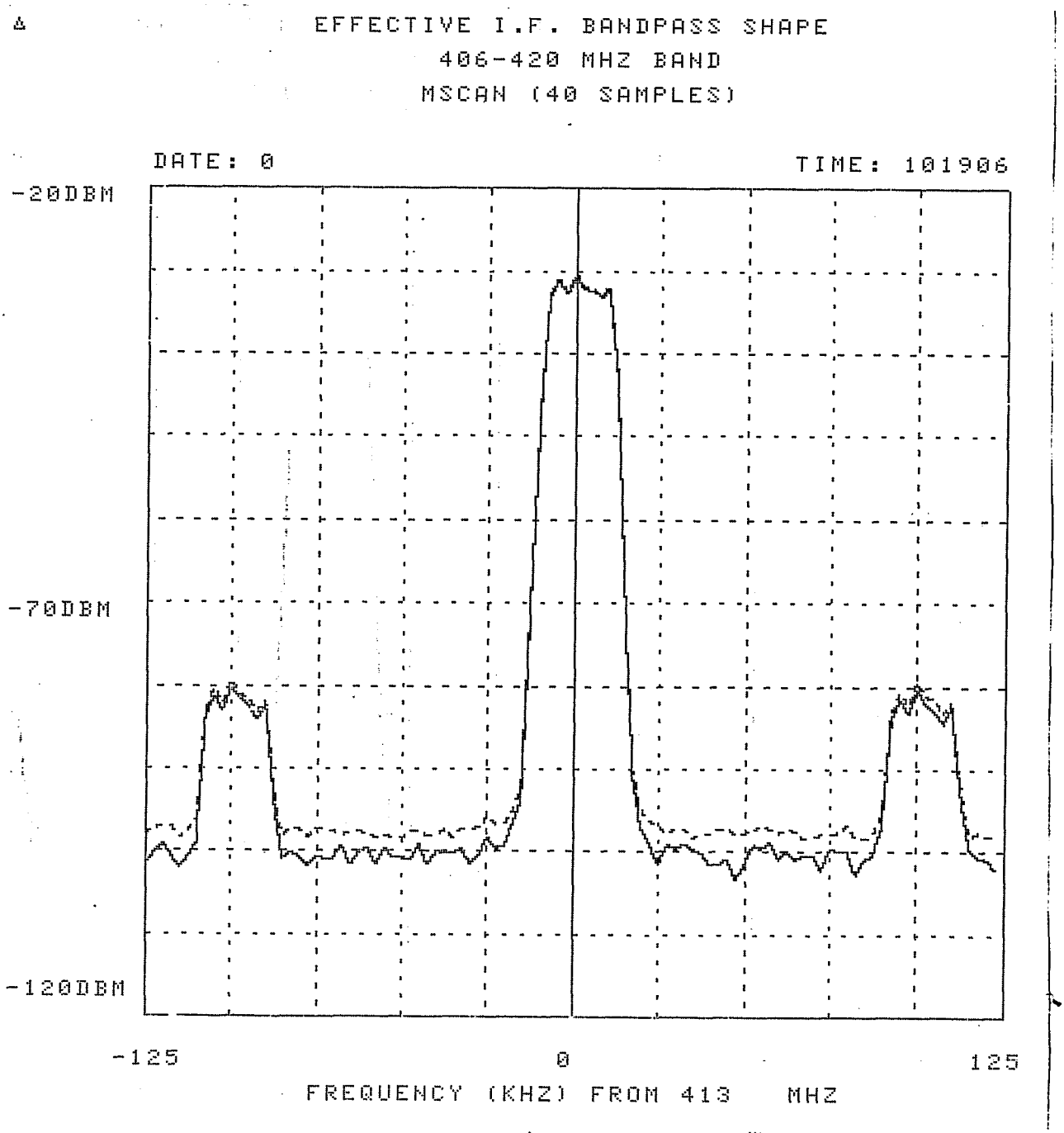

Figure 3.1. Effective IF bandpass shape. The dashed line is based on a single measurement per channel. The solid line is based on the minimum of 40 measurements per channel as per the MSCAN measurement routine, and is appropriate for the 406-420 MHz band measurements made at Norfolk. The responses at ± 100 kHz are caused by the signal generation used in making this test.

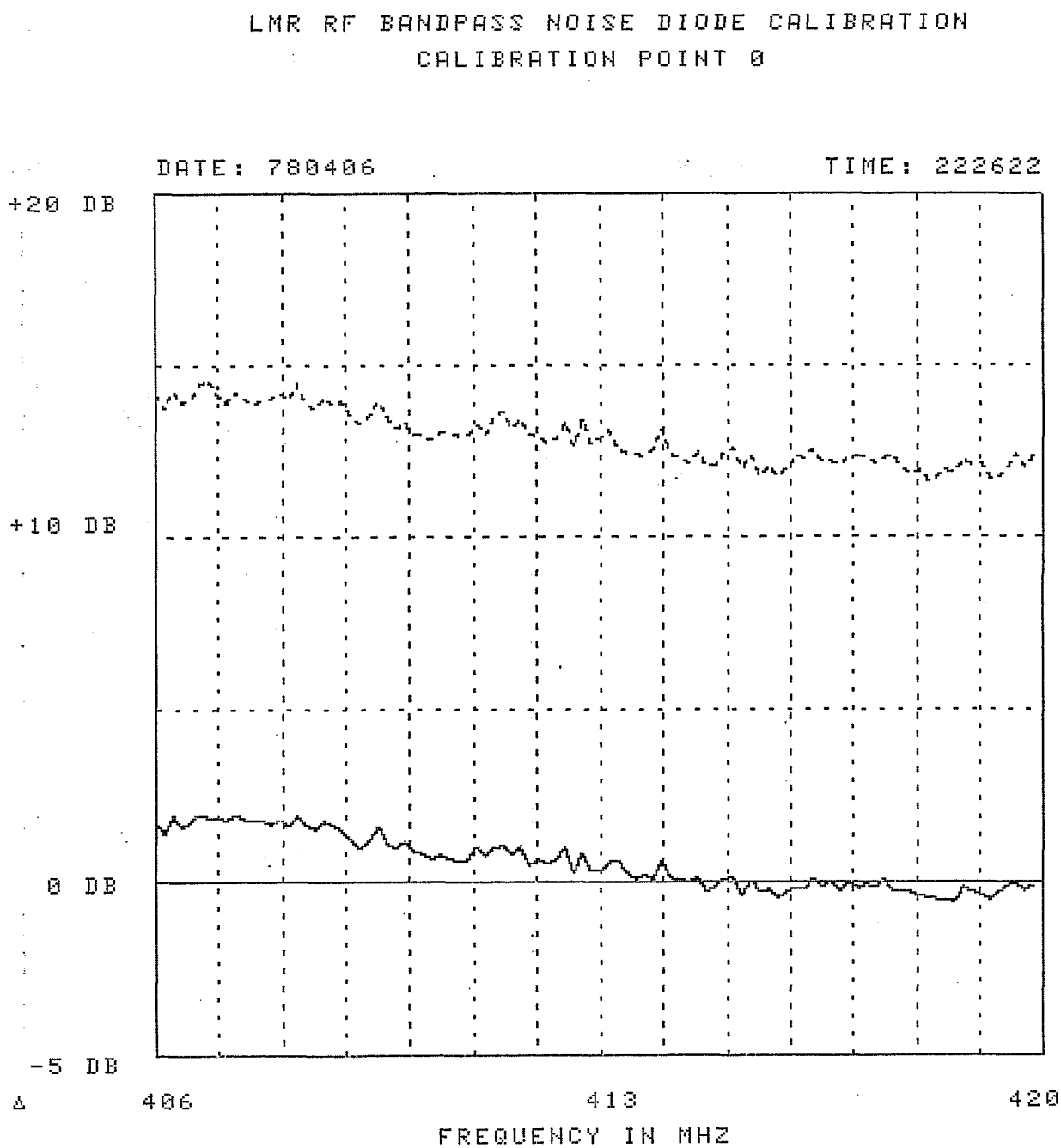

Figure 3.2. System correction factor C_{RA} (solid line) and noise figure (dashed line).

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 whole 406-420 band measurement period using program EDIT 406. Then the MSF and MGF are processed with program PLOT 406 to produce a band usage summary (table 2.1) along with channel-by-channel usage summary tables (tables 5.1 to 5.14), and plots (figs. 5.1 to 5.14).

Program EDIT 406 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-406 (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-406 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 406-420 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 14,665 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 5.14 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 556 channels measured in this band. The percent usage is rounded off to the nearest 0.1% (corresponding to 10 measurements out of 14,665). 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 5.14 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 406-407 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
35	406.975	9.1	-100	-109	010100

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

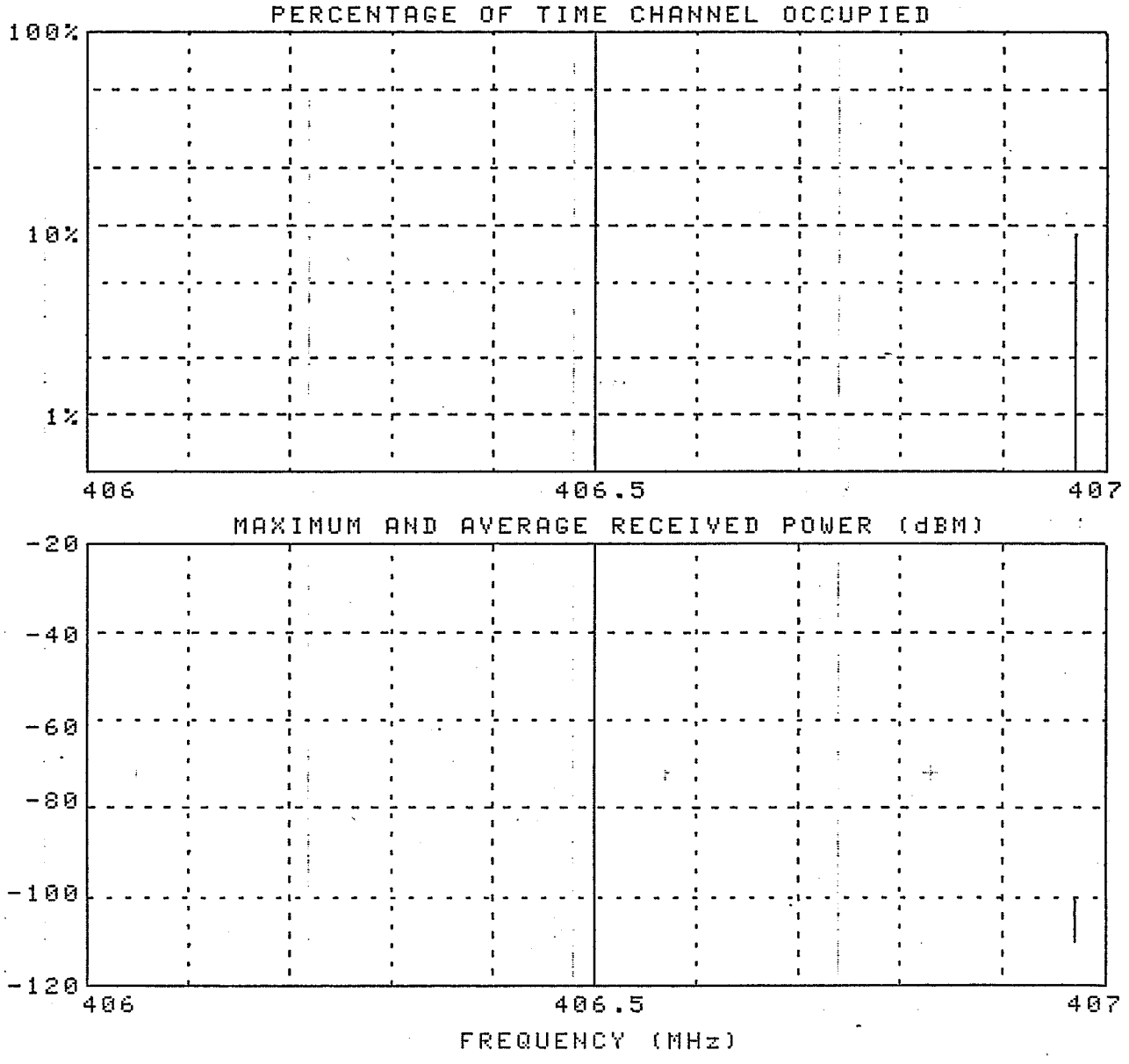

Figure 5.1. Usage summary plot for 406-407 MHz.

Table 5.2. Usage Summary List For 407-408 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
37	407.025	.1	-100	-104	001100
38	407.05	.1	-98	-103	0
40	407.1	.1	-99	-105	0
42	407.15	.1	-99	-105	0
43	407.175	.1	-101	-105	0
47	407.275	.1	-97	-105	020200
49	407.325	.1	-100	-106	010100
50	407.35	.9	-55	-95	120200
53	407.425	0	-102	-105	120200
55	407.475	2.4	-101	-106	120200

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

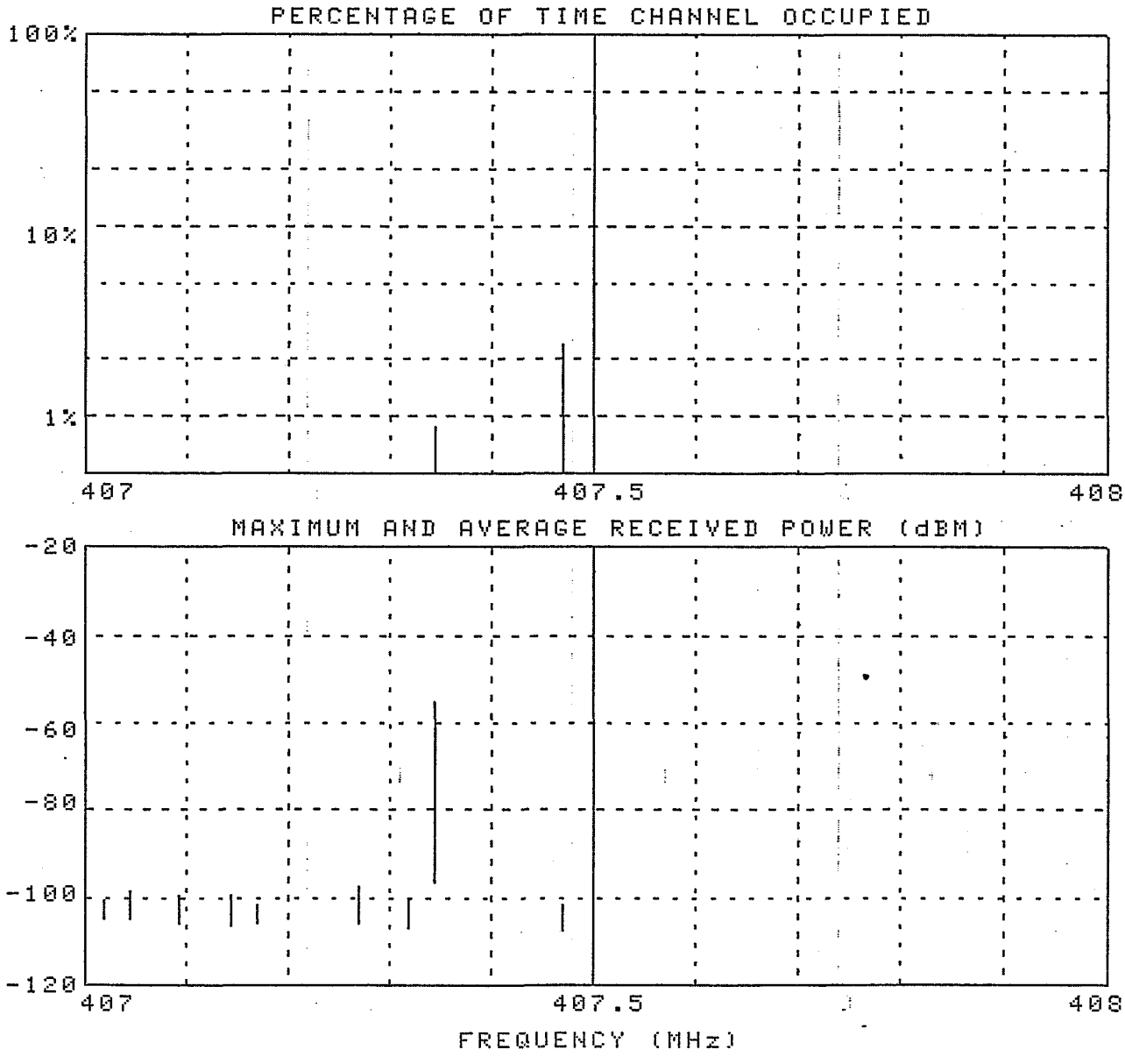

Figure 5.2. Usage summary plot for 407-408 MHz.

Table 5.3. Usage Summary List For 408-409 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
88	408.3	.2	-99	-103	0
89	408.325	.3	-97	-105	0
90	408.35	.2	-101	-104	0
91	408.375	.1	-99	-105	0
94	408.45	.1	-99	-107	0
95	408.475	.1	-98	-104	0
96	408.5	.2	-95	-104	0
97	408.525	.2	-99	-102	0
98	408.55	.2	-98	-105	0
99	408.575	.2	-100	-106	0
100	408.6	.1	-100	-107	0
101	408.625	.3	-100	-105	0
102	408.65	.7	-95	-103	0
103	408.675	.2	-99	-103	0
104	408.7	.1	-99	-103	0
105	408.725	.1	-101	-106	0
106	408.75	.3	-97	-105	0
107	408.775	.3	-99	-105	0
108	408.8	.1	-100	-106	010100
113	408.925	.2	-97	-104	0
114	408.95	.2	-99	-105	001100
115	408.975	.2	-100	-104	001100
116	409	.2	-97	-105	030300

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

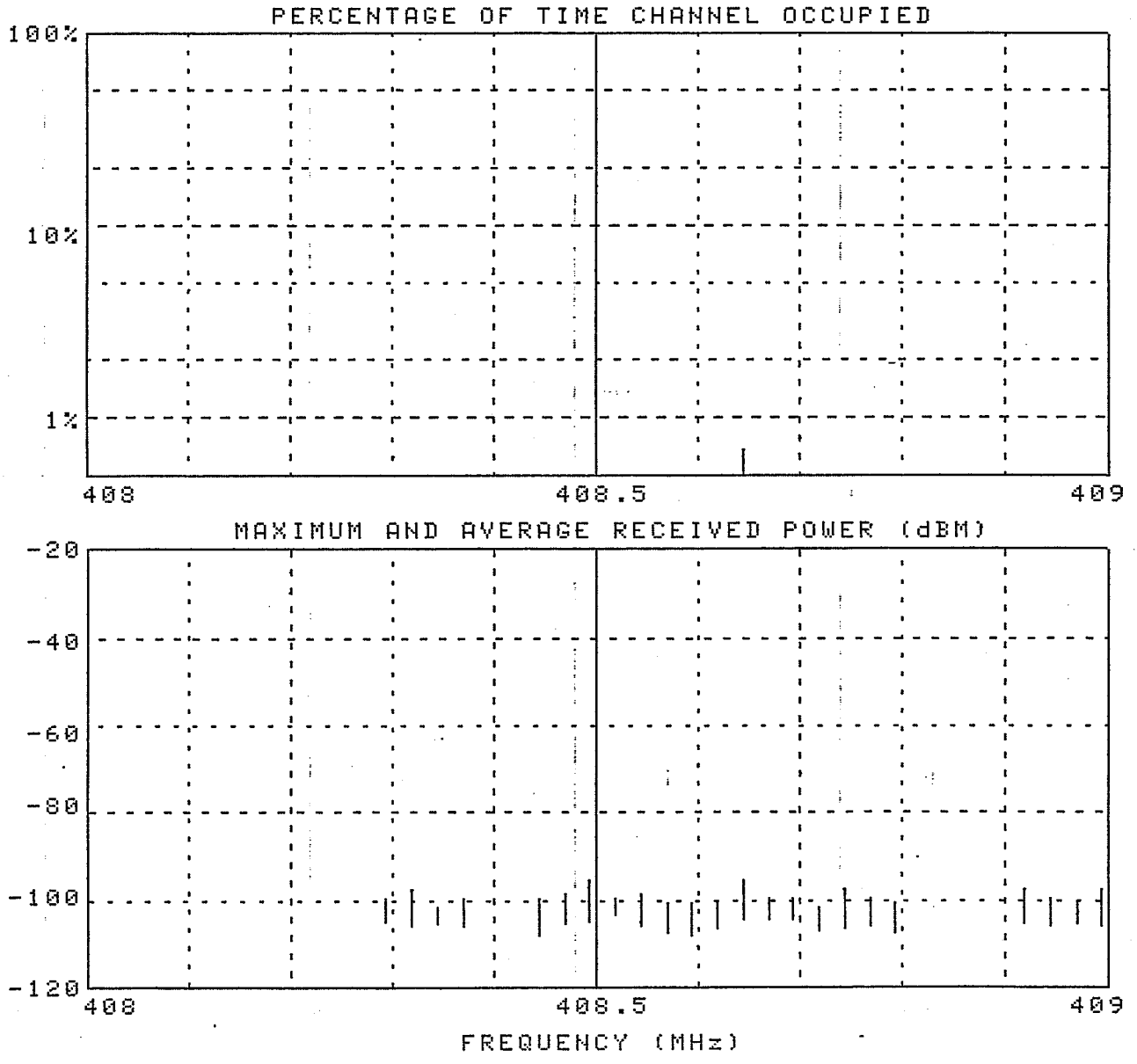

Figure 5.3. Usage summary plot for 408-409 MHz.

Table 5.4. Usage Summary List For 409-410 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
117	409.025	.2	-99	-105	021300
118	409.05	.2	-101	-106	011200
119	409.075	.2	-101	-105	020200
120	409.1	.1	-99	-104	010100
123	409.175	.1	-104	-108	0
156	410	0	-48	-77	002200

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

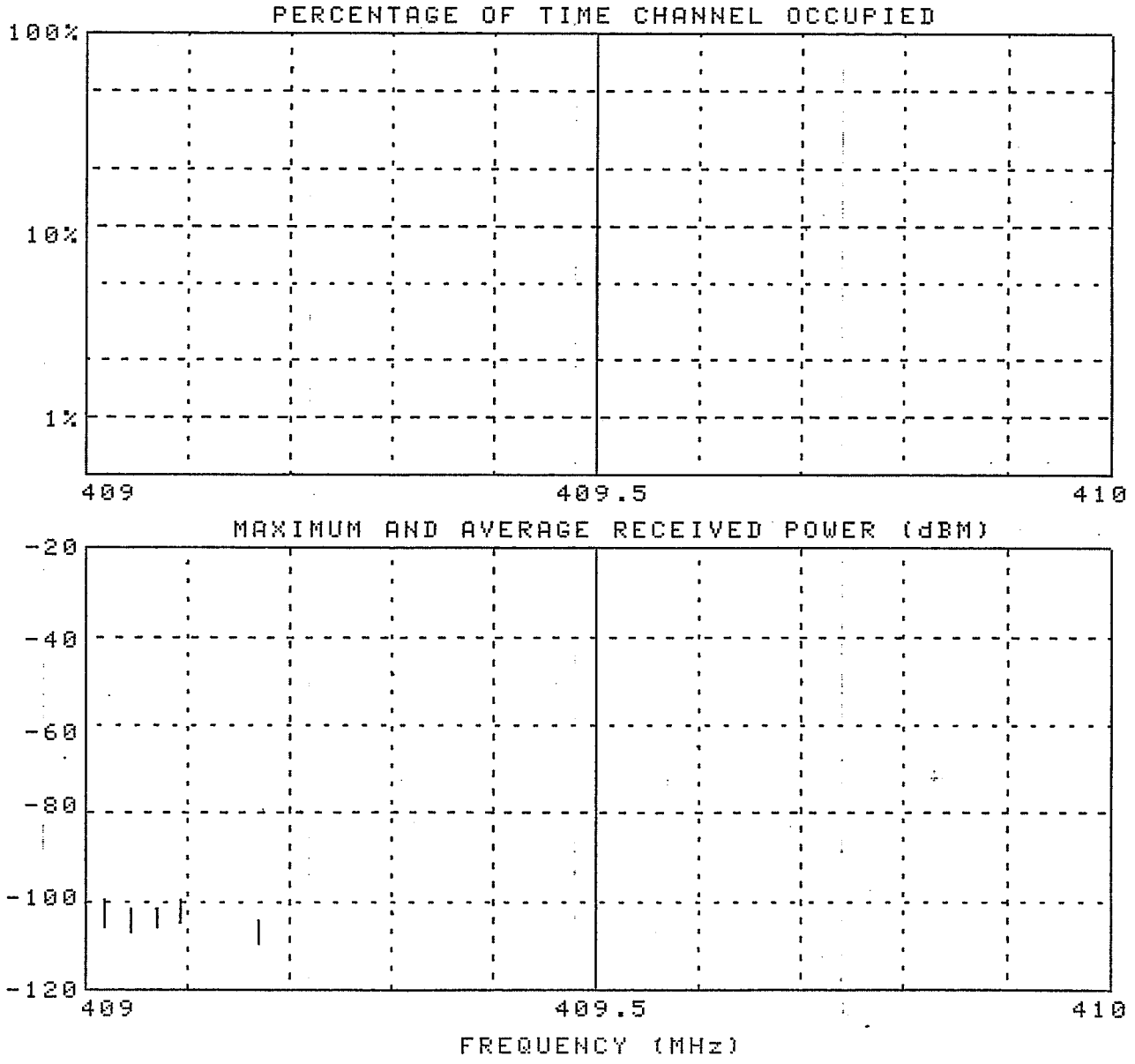

Figure 5.4. Usage summary plot for 409-410 MHz.

Table 5.5. Usage Summary List For 410-411 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
163	410.175	.1	-101	-105	002200
164	410.2	.1	-100	-105	012300
165	410.225	.2	-102	-106	002200
166	410.25	.1	-101	-106	002200
167	410.275	.1	-101	-105	002200
168	410.3	.1	-100	-106	002200
169	410.325	.1	-97	-104	002200
170	410.35	.1	-101	-106	002200
173	410.425	0	-99	-103	112300
174	410.45	.1	-97	-105	002200
175	410.475	.1	-102	-105	002200
180	410.6	.1	-101	-104	002200
186	410.75	.1	-98	-104	012300

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

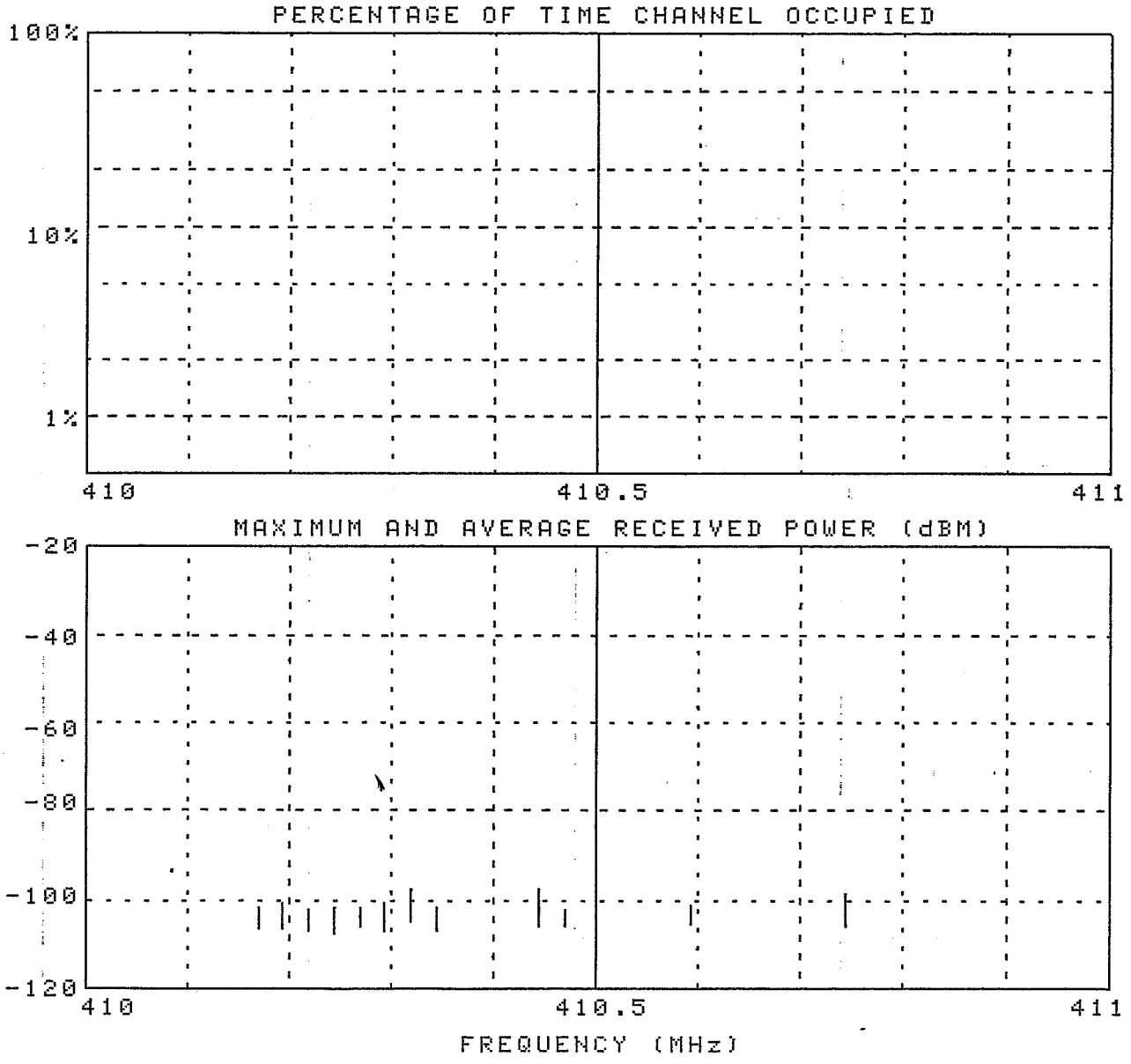

Figure 5.5. Usage summary plot for 410-411 MHz.

Table 5.6. Usage Summary List For 411-412 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

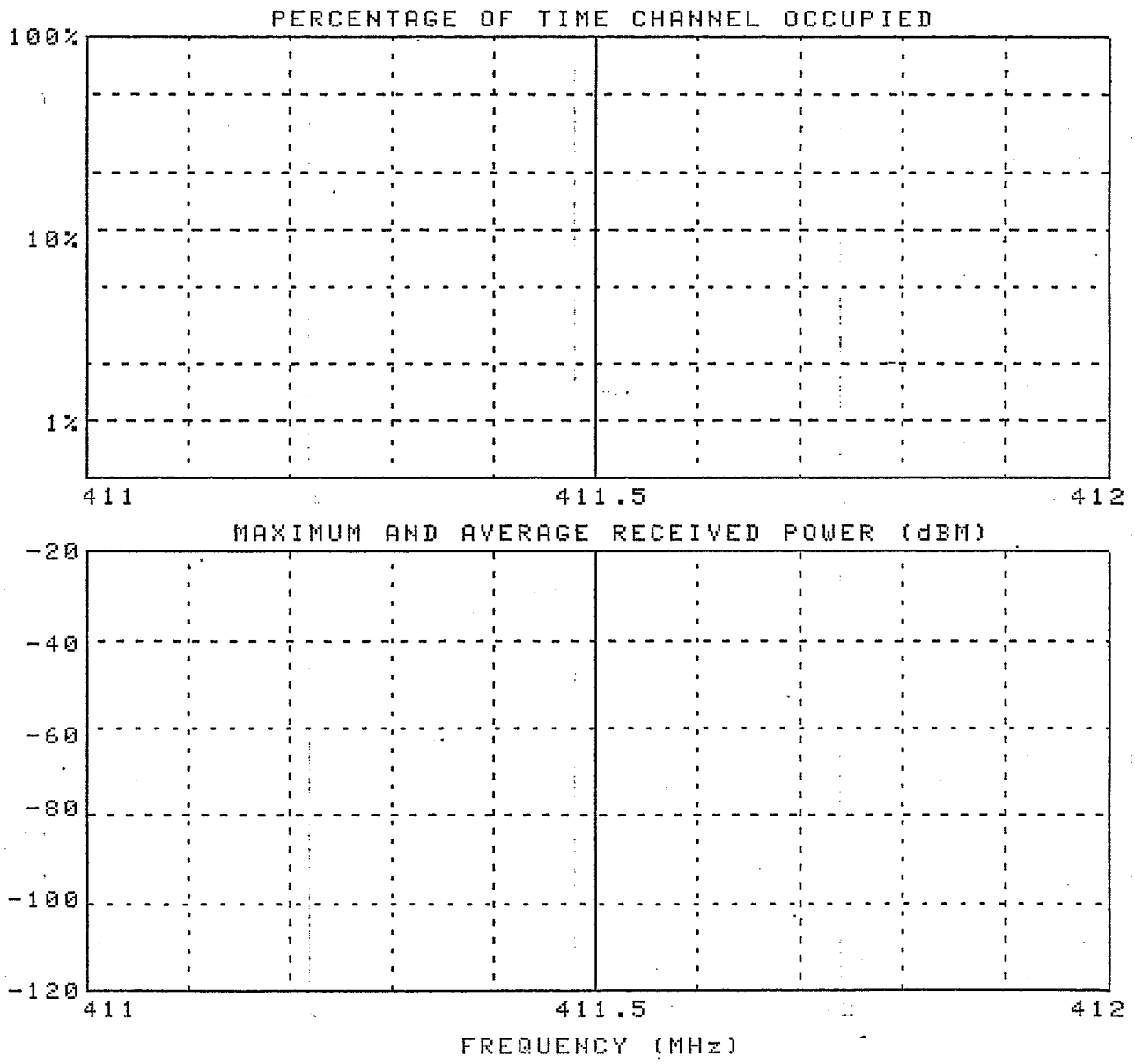

Figure 5.6. Usage summary plot for 411-412 MHz.

Table 5.7. Usage Summary List For 412-413 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
271	412.875	0	--	--	122400
276	413	0	--	--	122400

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

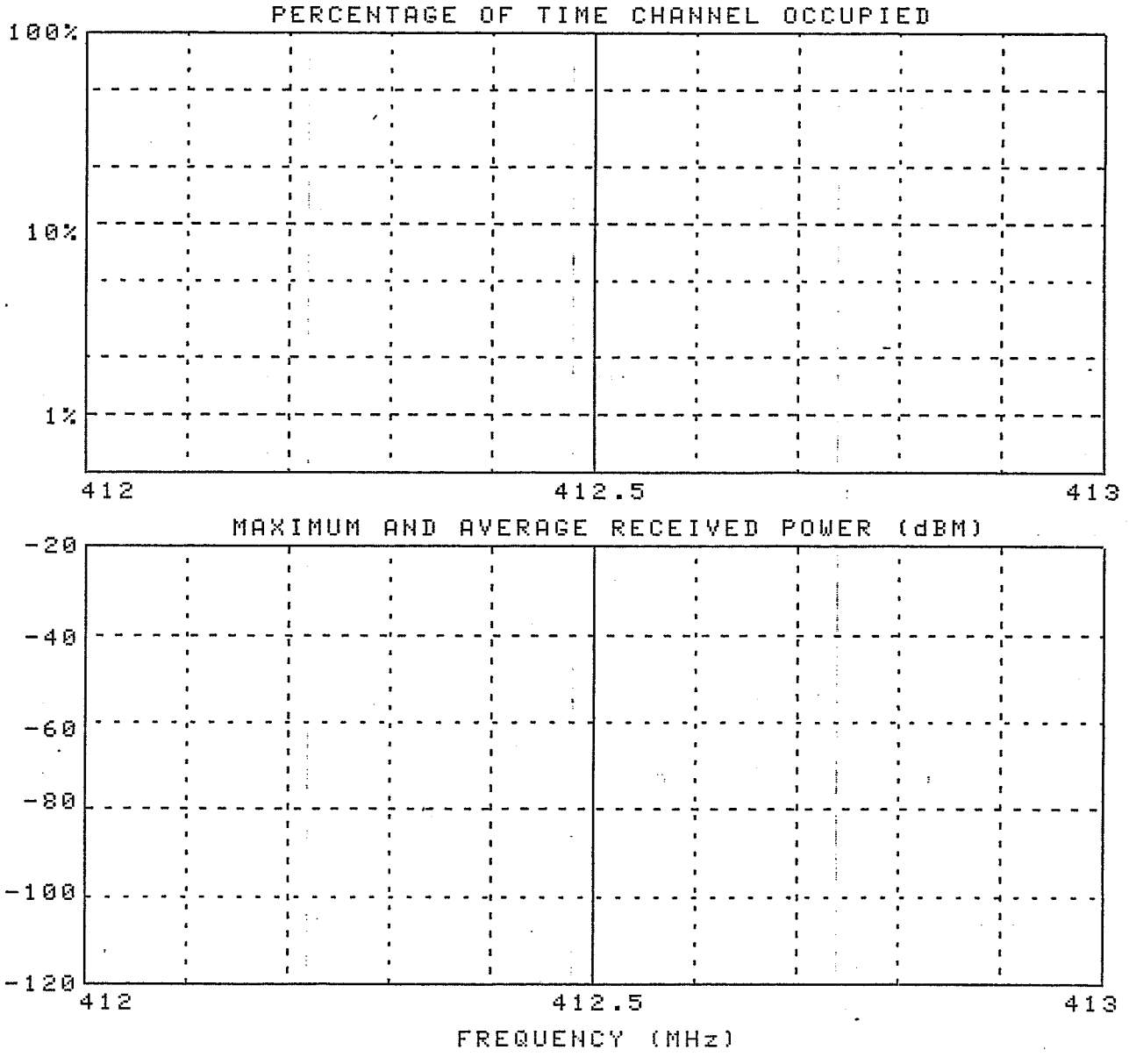

Figure 5.7. Usage summary plot for 412-413 MHz.

Table 5.8. Usage Summary List For 413-414 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
277	413.025	0	--	--	122400
278	413.05	0	--	--	112300
282	413.15	0	--	--	132500
287	413.275	.2	-73	-78	112300
297	413.525	.2	-100	-105	122400

△ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

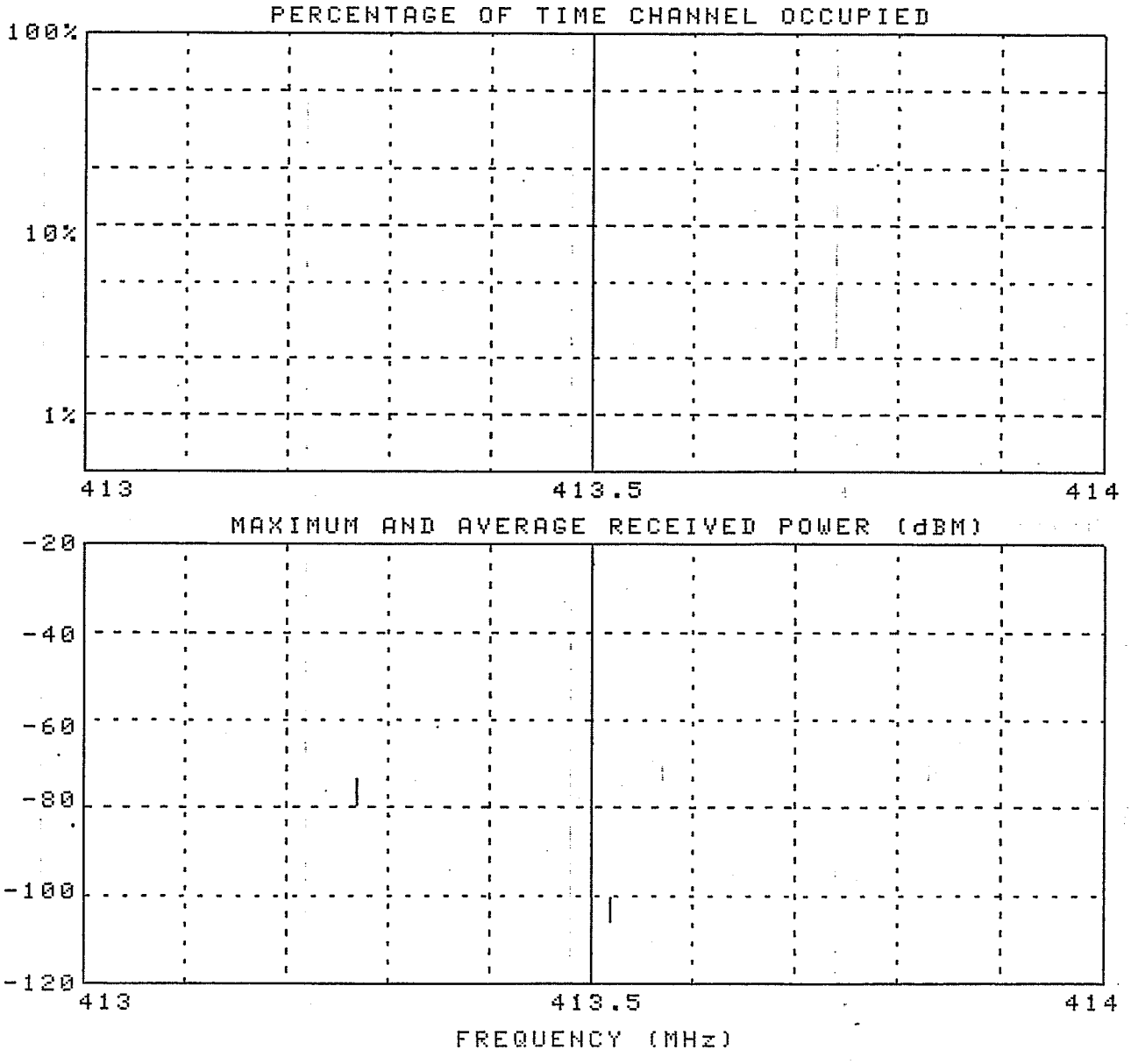

Figure 5.8. Usage summary plot for 413-414 MHz.

Table 5.9. Usage Summary List For 414-415 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

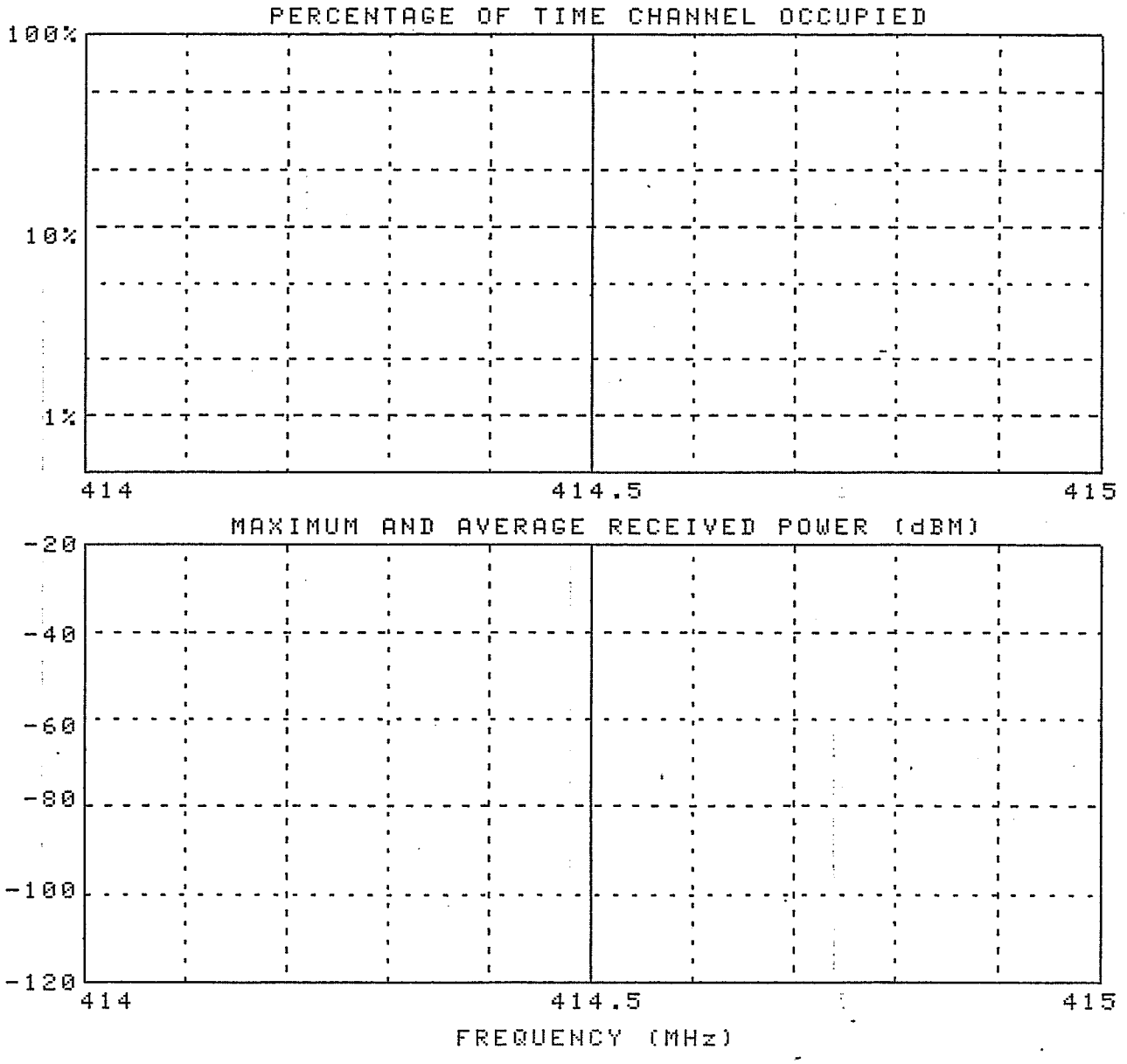

Figure 5.9. Usage summary plot for 414-415 MHz.

Table 5.10. Usage Summary List For 415-416 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
364	415.2	.2	-76	-87	092900
368	415.3	.2	-69	-72	112300
381	415.625	0	--	--	232500
389	415.825	.1	-104	-109	002200

△ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

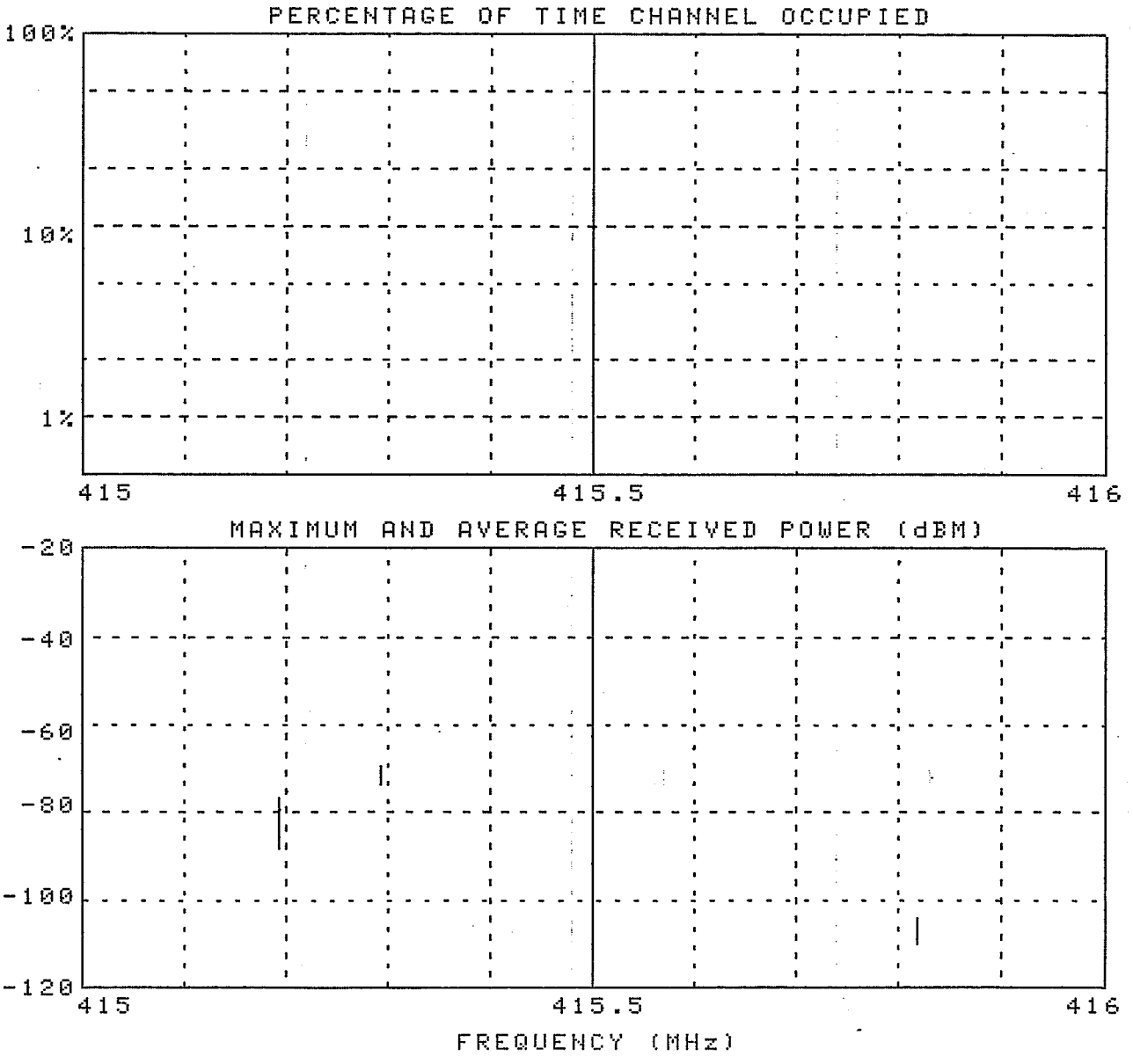

Figure 5.10. Usage summary plot for 415-416 MHz.

Table 5.11. Usage Summary List For 416-417 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
398	416.05	.4	-83	-105	002200
422	416.65	.1	-95	-106	003300
427	416.775	0	--	--	283900
436	417	23.7	-92	-106	023500

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

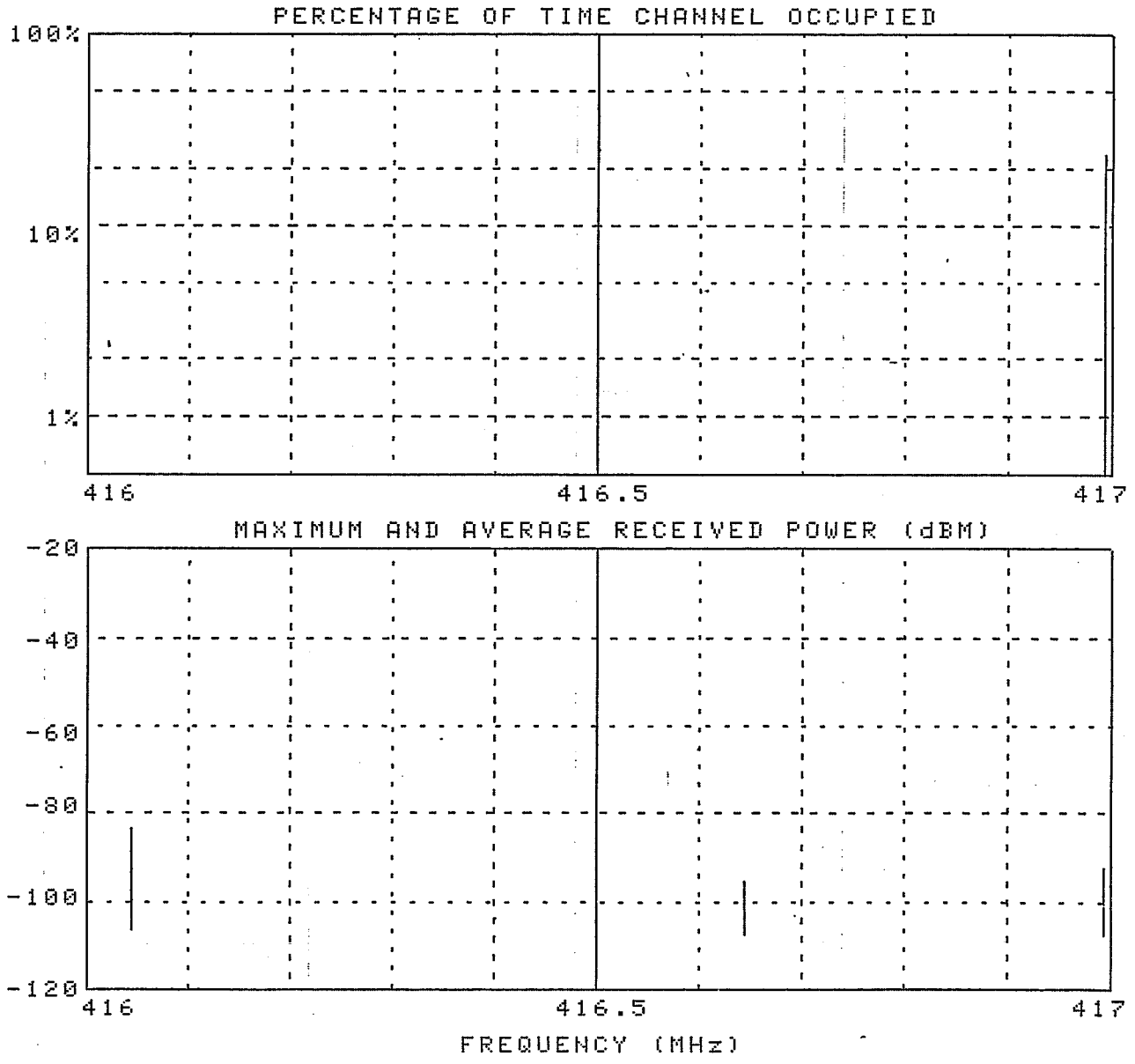

Figure 5.11. Usage summary plot for 416-417 MHz.

Table 5.12. Usage Summary List For 417-418 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE

△ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

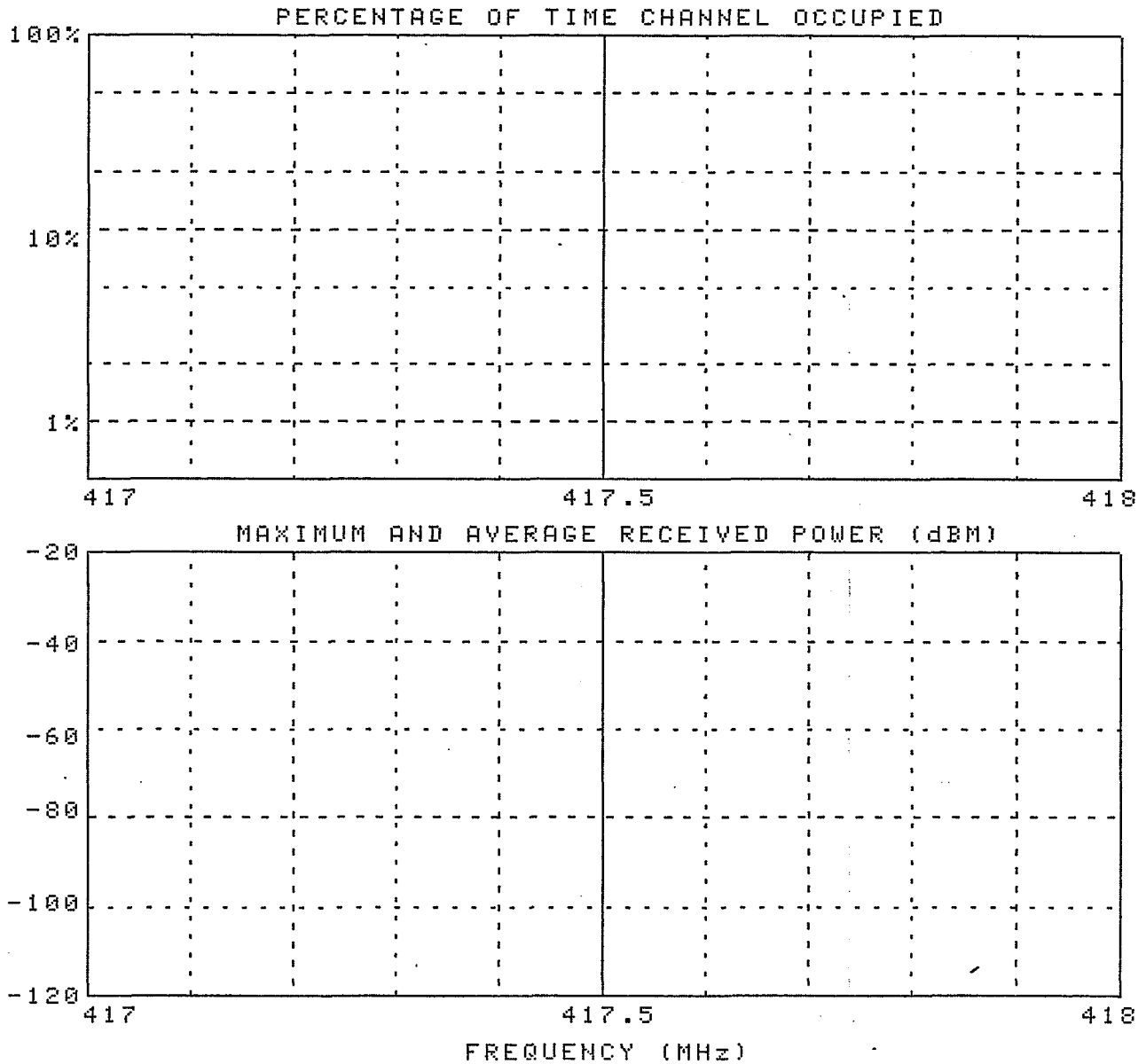

Figure 5.12. Usage summary plot for 417-418 MHz.

Table 5.13. Usage Summary List For 418-419 MHz.

NORFOLK, VIRGINIA APRIL, 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE
488	418.3	0	--	--	152700
501	418.625	1	-58	-64	112300
502	418.65	.1	-98	-106	002200

△ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

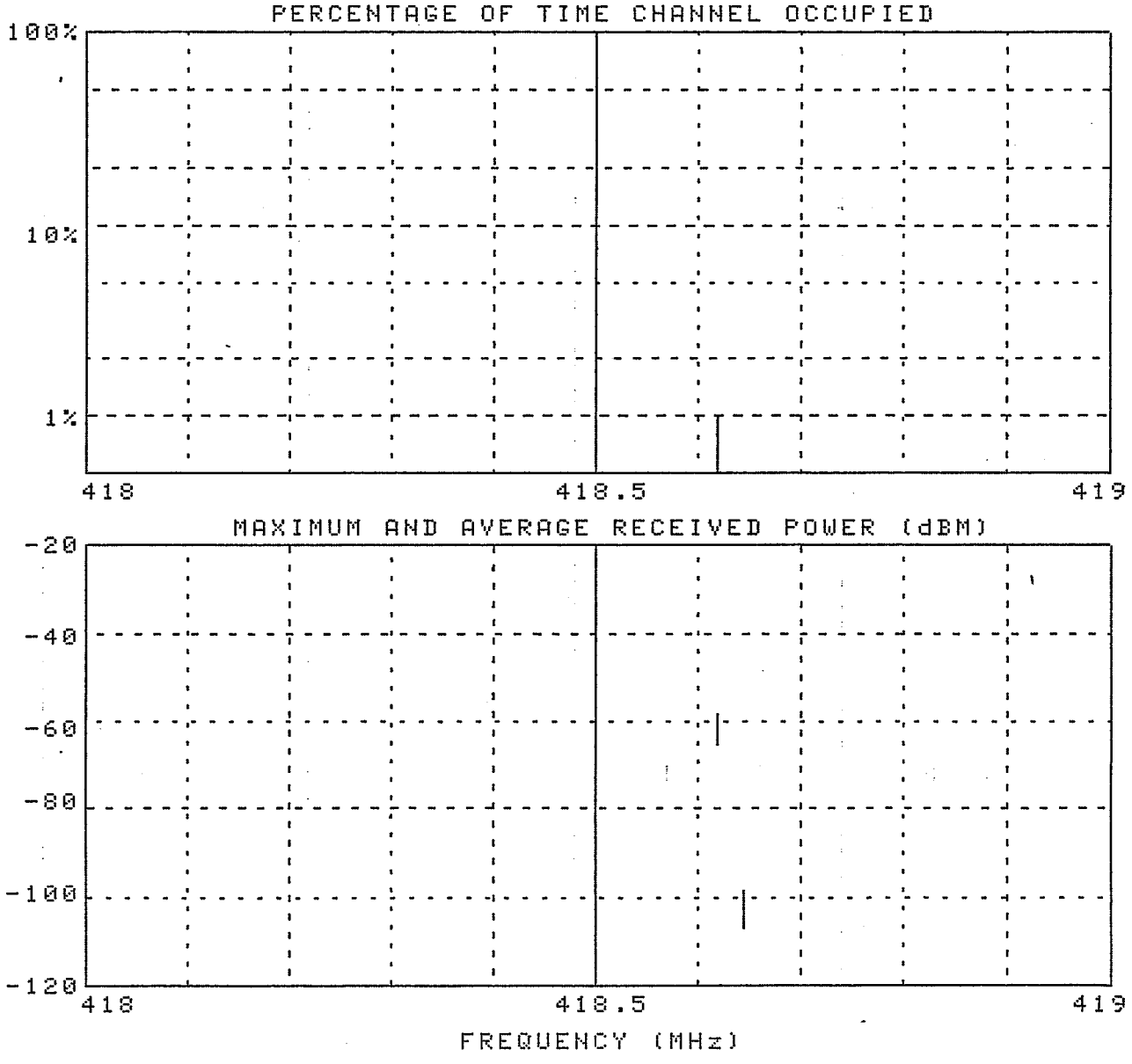

Figure 5.13. Usage summary plot for 418-419 MHz.

Table 5.14. Usage Summary List For 419-420 MHz.

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INDEX	FREQUENCY (MHz)	USAGE (%)	MAXIMUM (dBM)	AVERAGE (dBM)	MINI-GMF CODE

Δ NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112

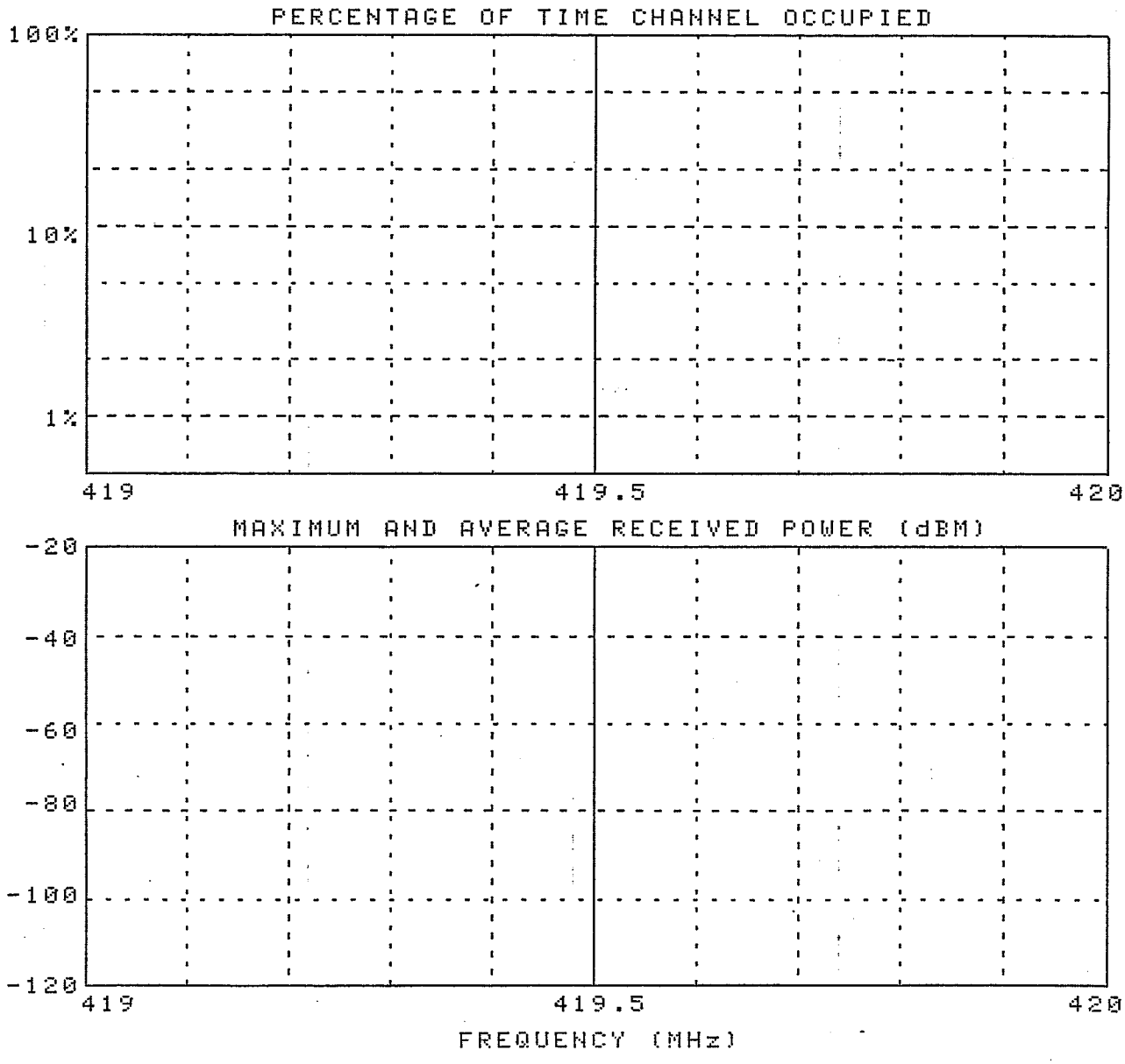

Figure 5.14. Usage summary plot for 419-420 MHz.

6. OCCUPANCY BY TIME-OF-DAY

Consecutive hourly statistics files of usage data collected 24 hours of the day during April 5-6, 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 556 channels measured in the 406-420 MHz band, and figure 6.2 is for the 16 channels measured that have exact channel center GMF assignments within 50 miles of the Norfolk RSMS measurement site. Note that the ordinate scale of figure 6.1 goes to 10% while figure 6.2 only goes to 5%. Usage of fixed government channels assigned within 50 mi was largest for the 8-9 a.m. and 1-3 p.m. hours, and none of the hours shown have a usage greater than 1%.

NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112
APPLICABLE ONLY TO ALL CHANNELS.
INCLUDED ARE 556 OF THE 556 CHANNELS MEASURED.

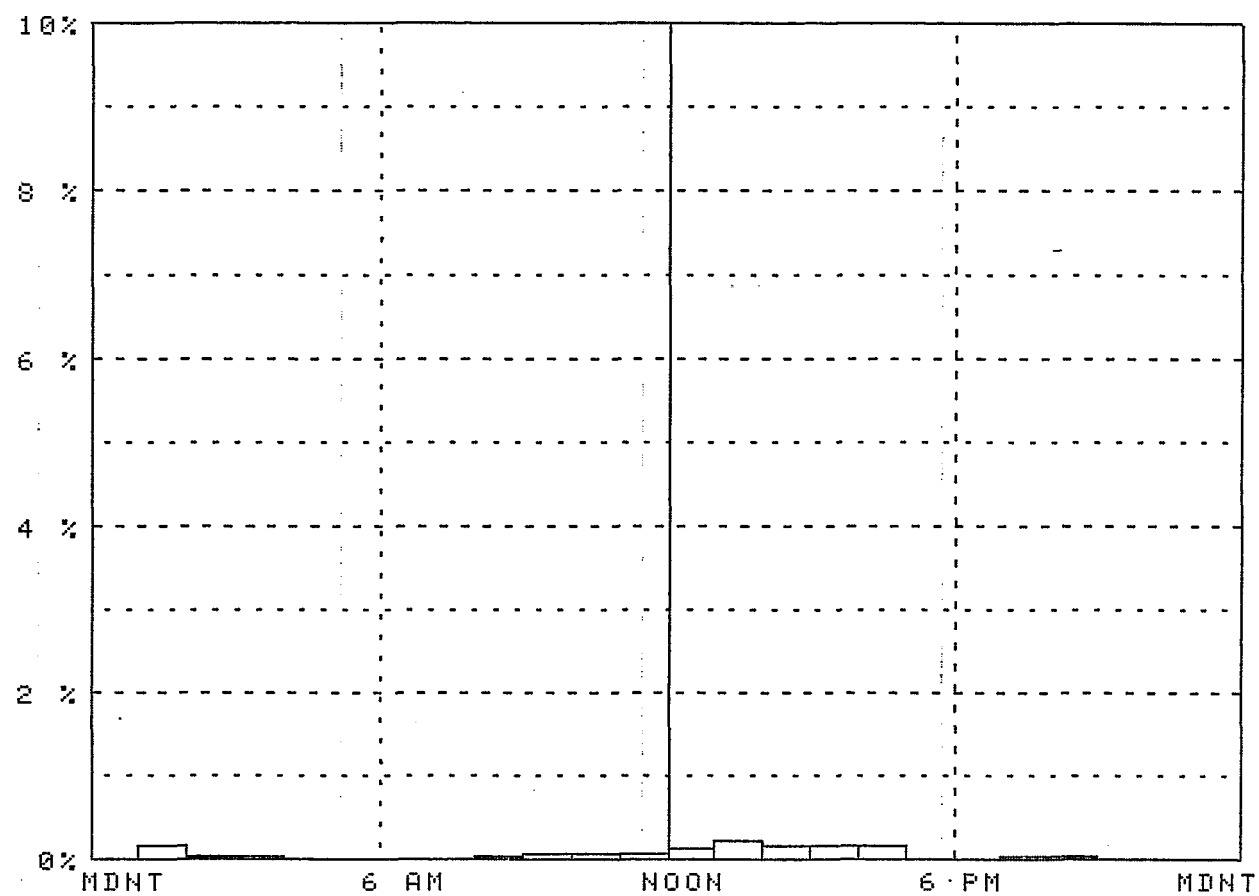

Figure 6.1. Occupancy versus time-of-day for 406-420 MHz band.

NORFOLK, VIRGINIA APRIL 1978 CASS 174.407
GMF 780101 SCANS 14665 THRESHOLD (dBM) -112
APPLICABLE ONLY TO FIXED GOV'T CHANNELS WITHIN 50 MI.
INCLUDED ARE 16 OF THE 556 CHANNELS MEASURED.

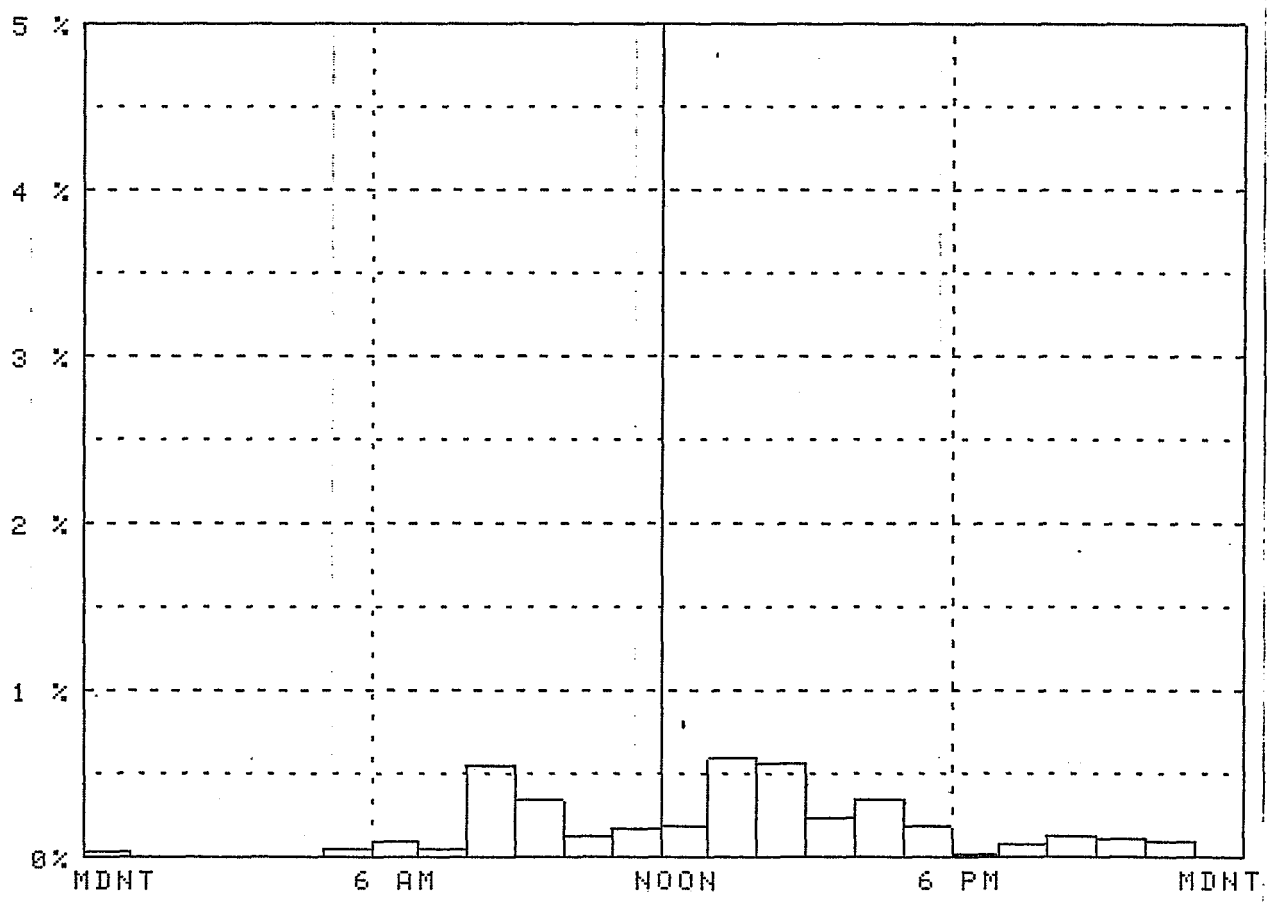

Figure 6.2. Occupancy versus time-of-day for 406-420 MHz band.

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 556 channels measured in the 406-420 MHz band, and figure 7.2 is for the 16 channels measured that have exact channel center GMF assignments within 50 mi of the Norfolk RSMS measurement site. Less than 10% of the fixed government channels assigned within 50 mi have a usage greater than 2%.

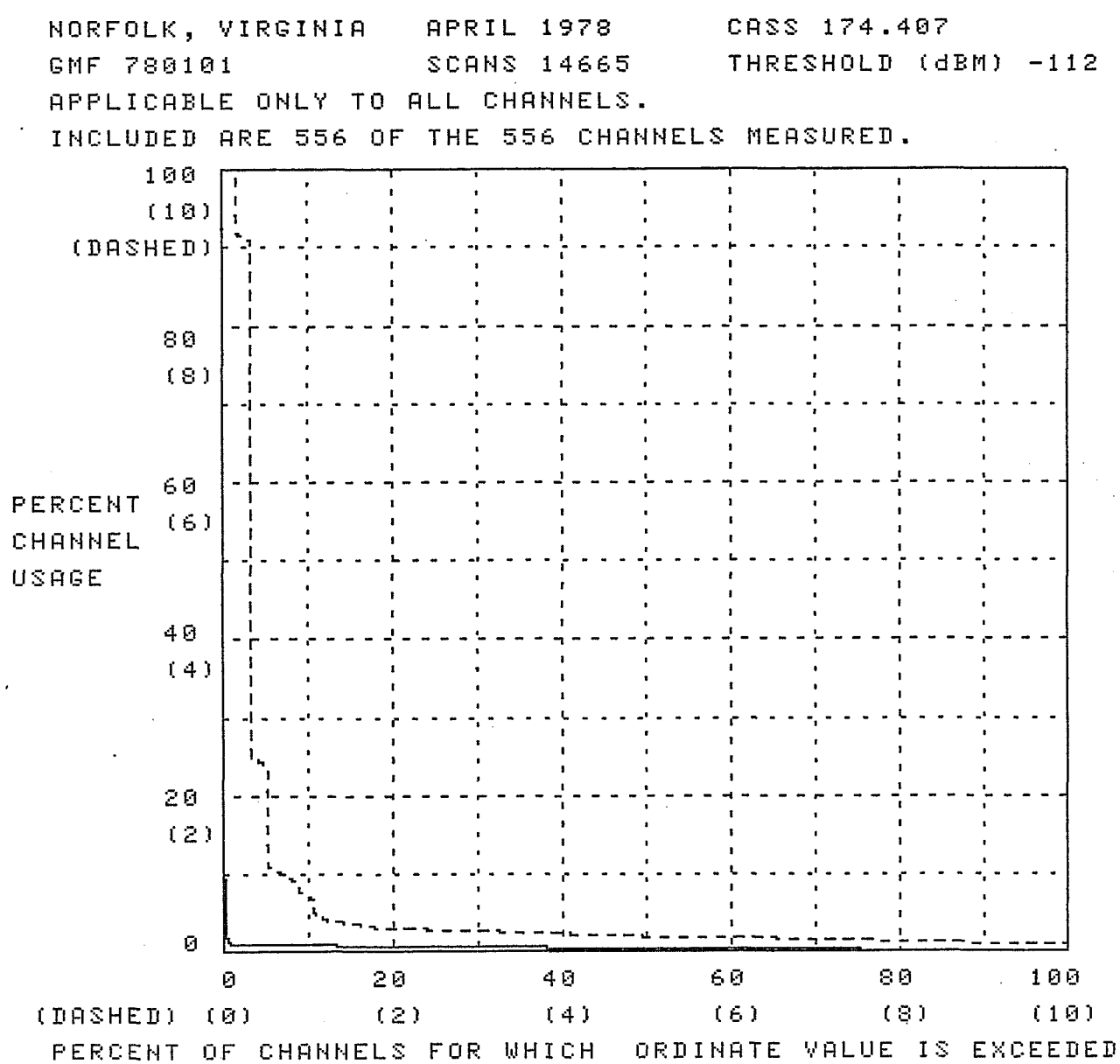

Figure 7.1. Channel usage distribution for 406-420 MHz band.

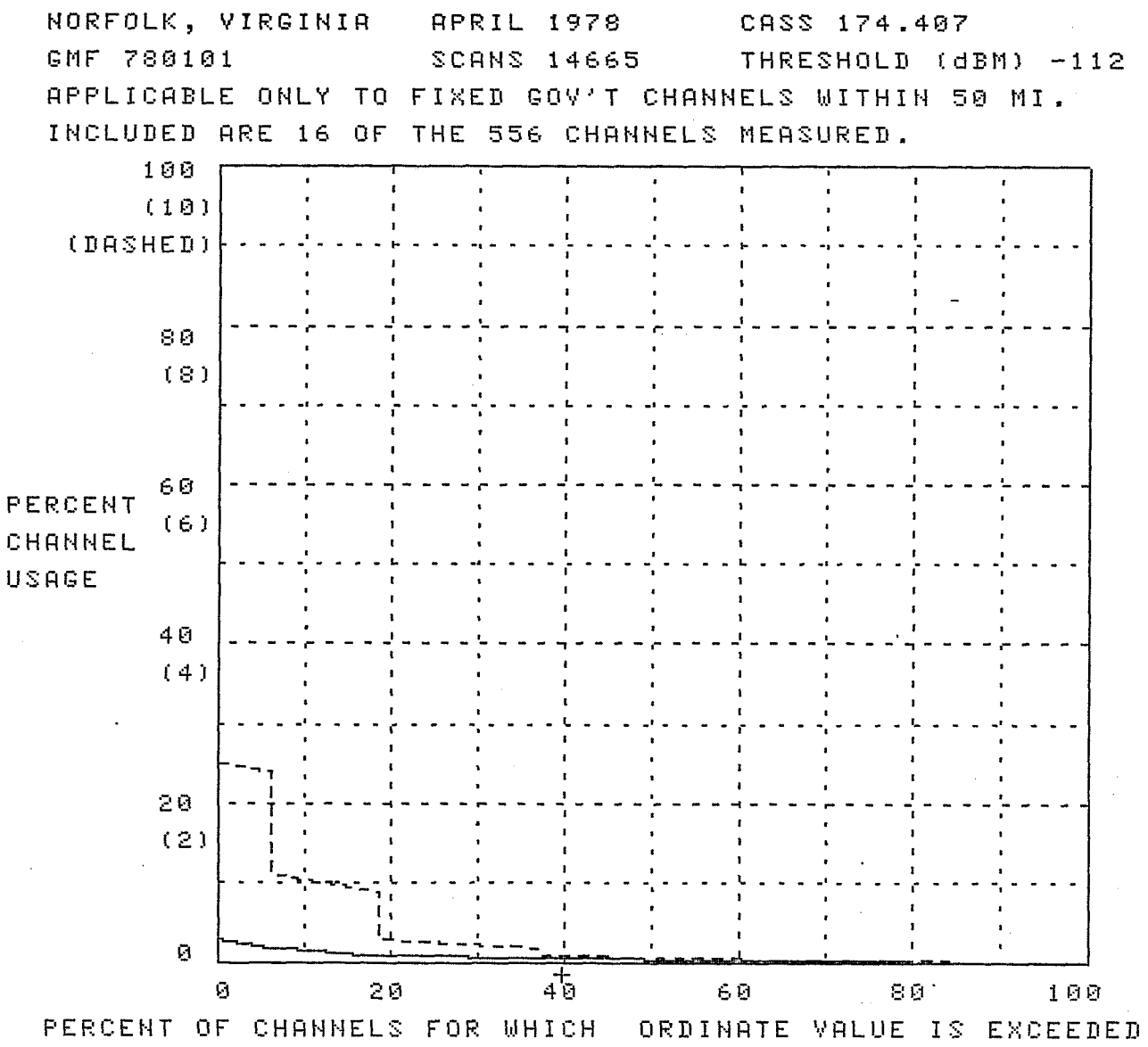

Figure 7.2. Channel usage distribution for 406-420 MHz band.

8. ACKNOWLEDGMENTS

This informal report was prepared as part of the NTIA/FMSD program in support of the Federal frequency management program. Planning, data collection, and data analysis involved the participation of a number of persons with various organizations. Special acknowledgment is made to Mr. R. J. Matheson, Mr. G. Falcon, Mr. R. Juneau, Ms. C. Montgomery, and Mr. J. Smilley of NTIA/ITS, and Cmdr. C. L. Stewart, Degaussing Division, U.S. Naval Base at Norfolk. The assistance of various agency representatives in siting and logistical support has been commendable.