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**RF ENVIRONMENT SURVEY  
OF  
SPACE SHUTTLE-RELATED  
ELECTROMAGNETIC ENVIRONMENT  
EXPERIMENT FREQUENCY BANDS**

**FINAL REPORT**

**1 NOVEMBER 1977**

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PREPARED FOR  
**GENERAL ELECTRIC SPACE SYSTEMS  
VALLEY FORGE SPACE CENTER  
KING of PRUSSIA, PENNSYLVANIA**



By

**NATIONAL SCIENTIFIC LABORATORIES  
2922 Telestar Court  
Falls Church, Virginia 22042**

Purchase Order No. A28000-U21159

Contract No. NAS-5-23734

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16. Abstract  Data survey of 1977 frequency assignments in frequency bands between 121 MHz and 65 GHz is given. Survey includes data from both government and non-government data files. Histograms are presented which show the total number of unclassified assignments versus frequency and total assigned power versus frequency. Study is confined to continental United States.					
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## EXECUTIVE SUMMARY

The primary objective of this study was the conduct of a survey and analysis of radio frequency assignments within the continental United States, for numerous frequency bands between 121 MHz and 65 GHz, in order to determine principal characteristics of transmitting equipments. The study consisted of an in depth survey of current frequency assignment data files, both government and non-government. The results of the survey have been presented in a narrative form as well as graphically in the form of histograms. The narrative presentation indicates, for each frequency band, the following characteristics:

- (1) Approximate number of assignments
- (2) Geographical distribution
- (3) General breakdown of assignment class
- (4) Primary users
- (5) Emission characteristics
- (6) Transmitter power ranges
- (7) Antenna characteristics

The histograms indicate the total number of assignments as a function of frequency and the total assigned power as a function of frequency. Additionally, the histograms were generated with and without inclusion of the experimental assignments. These analytical results, which will aid NASA in the interpretation of the results of the space Shuttle-borne Electromagnetic Environment Experiment (EEE), are presented in Section 3 of this study Report.

A secondary objective of the study was the determination of recommended generic analytical techniques which would most economically serve the purpose of determining the levels of RF energy expected to be received by the space-borne radio frequency experiment. The frequency bands have been classified as either (1) deterministic, (2) probabilistic, or (3) non-determinant.

Frequency bands which are classified as deterministic could be handled by straightforward computer simulation techniques in order to determine the expected levels of RF energy which will be received by the EEE experiment at orbital altitudes. The qualifications required for a band or portion of a band to be classified in this study as "deterministic" are that use of the band is primarily for known location, stationary, operational stations with known transmitters and antenna characteristics and known pointing elevation and azimuth angles. Additionally, the number of emitters in the band must be of a reasonable magnitude. Of the bands analyzed in the study, only the following are considered of this nature:

- Portions of the 614-960 MHz band used for UHF-TV channels 21-69.
- Portions of the 7900-7975 MHz band used for microwave line-of-sight transmissions.
- Portions of the 2655-2690 MHz band used for Instructional Television Fixed Service (ITFS) operations.

For frequency bands which are classified as "non-deterministic" it is not considered economically advantageous to attempt to simulate the expected levels of RF energy at orbital altitudes. These include:

- (1) 806-960 MHz portion of the 614-960 MHz band. Future use of this band is uncertain, and many changes from the current usage are expected.

- (2) 2290-2300 MHz portion of the 2200-2300 MHz band. Temporal and geographical characteristics of space-to-Earth, non-geostationary transmissions are uncertain.

In all other frequency bands, determination of expected levels of RF energy at orbital altitudes must be through statistical methods. These bands are classified as "probabilistic" and include:

- Those with a large number (>1000) of assignments.
- Those with a large percentage of mobile transmitters.
- Bands where detailed antenna pointing direction information is not available.
- Bands where antenna pointing directions are a function of time (e.g., search radars).
- Bands where the transmitter duty cycle is both low and nearly random (i.e., mobile systems).

The approach deemed most economical in conducting a probabilistic analysis involves assignment of average equivalent noise temperatures to specific geographical areas (sub-divisions of the U.S.), based upon the specified power spectral densities (dBW/20 kHz). These noise temperatures would then be translated to received power at orbital altitude via "average" antenna coupling levels. In many cases, these levels would be a function of the elevation angle of the orbital position, as seen from the center of each geographical sub-division. The result of this type of an analysis would be maps of "average" received RF energy versus orbital location.

Additionally, some frequency regions have assignments which are geographically designated PAC, LANT, USA, and US&P. These assignments are generally for military operations and may occur at any location in the Pacific Ocean, Atlantic Ocean, Continental United States, and United States and Possessions respectively. Consequently, each band in which these assignments were in the majority would require a review on a case-by-case basis to determine actual uses.

The final study objective was to determine any frequency band assignments which are of sufficient e.i.r.p. that they may cause physical damage to the spaceborne experiment. Survey of the data files for transmitters which may have physically damaging impact upon the spaceborne receiver has indicated that no assignments are of sufficient e.i.r.p. to violate the 2 Watt receiver input protection level designated in current performance specifications for the EEE.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
EXECUTIVE SUMMARY -----	iii
1. INTRODUCTION -----	1
2. STUDY DISCUSSION AND LIMITATIONS -----	4
3. RESULTS -----	7
3.1 121.5 MHz Band -----	7
3.2 243.0 MHz Band -----	10
3.3 399.9-410.0 MHz Band -----	15
3.4 450-470 MHz Band -----	20
3.5 614-960 MHz Band -----	24
3.6 1220-1285 MHz Band -----	31
3.7 1350-1450 MHz Band -----	37
3.8 1636.5-1670 MHz Band -----	43
3.9 2040-2110 MHz Band -----	49
3.10 2200-2300 MHz Band -----	54
3.11 2655-3690 MHz Band -----	58
3.12 2690-2700 MHz Band -----	63
3.13 4200-4400 MHz Band -----	66
3.14 4995-5000 MHz Band -----	71
3.15 5725-5925 MHz Band -----	73
3.16 5925-6425 MHz Band -----	78
3.17 6475-7000 MHz Band -----	81
3.18 7900-7975 MHz Band -----	85
3.19 9950-10050 MHz Band -----	90
3.20 10.6-10.7 GHz Band -----	95
3.21 10.95-11.2 GHz Band -----	99
3.22 12.5-12.75 GHz Band -----	101
3.23 13.1-15.7 GHz Band -----	104
3.24 17.7-24.0 GHz Band -----	112
3.25 27.5-35.2 GHz Band -----	116
3.26 35.5-43.0 GHz Band -----	123
3.27 50-65 GHz Band -----	129
 ANNEX A CALCULATION OF RF POWER LEVEL AT ORBITAL ALTITUDE IN THE 668-674 MHz FREQUENCY BAND -----	 A-1

1

LIST OF EMITTER AND POWER HISTOGRAMS

<u>BAND</u>	<u>PAGE</u>
242.5-243.5 MHz -----	14
1220-1285 MHz -----	35 & 36
1350-1450 MHz -----	41 & 42
1636-1670 MHz -----	47 & 48
2040-2110 MHz -----	52 & 53
2655-2690 MHz -----	62
4200-4400 MHz -----	69 & 70
5725-5925 MHz -----	76 & 77
7900-7975 MHz -----	88 & 89
9.9-10.0 GHz -----	93 & 94
10.6-10.7 GHz -----	98
13.0-15.7 GHz -----	110 & 111
27.5-35.2 GHz -----	121 & 122
35.0-43.0 GHz -----	127 & 128
50-65 GHz -----	133

## 1. INTRODUCTION

This Report, prepared by National Scientific Laboratories under subcontract to General Electric Company, describes the results of a study to examine the current utilization of anticipated frequency bands for the Electromagnetic Environment Experiment (EEE) within the continental United States. This information will aid NASA in the evaluation and interpretation of the results obtained by the proposed Shuttle-borne radio frequency experiment.

The study was conducted in the form of a survey of current frequency band assignments for both government and non-government agencies, and was directed at formulation of a general overview of expected radio frequency (RF) energy levels. The frequency bands of interest are given below:

121.5 MHz	5725-5925 MHz
243 MHz	5925-6425 MHz
399.9-410 MHz	6475-7000 MHz
450-470 MHz	7900-7975 MHz
614-960 MHz	9950-10050 MHz
1220-1285 MHz	10.6-10.7 GHz
1350-1450 MHz	10.95-11.2 GHz
1636.5-1670 MHz	12.5-12.75 GHz
2040-2110 MHz	13.1-15.7 GHz
2200-2300 MHz	17.7-24 GHz
2655-2690 MHz	27.5-35.2 GHz
2690-2700 MHz	35.5-43 GHz
4200-4400 MHz	50-65 GHz
4995-5000 MHz	

The study was conducted in 4 basic phases.

Phase I efforts involved the survey and analysis of current frequency band assignments contained in three primary data sources; the Government Master File (GMF), the non-Government or FCC data file and the International Frequency List (IFL). The GMF is maintained by the Office of Telecommunications on behalf of the Office of Telecommunication Policy, and contains assignments made to Government stations by the Frequency Assignment

Subcommittee of the International Radio Advisory Committee. The FCC data file contains assignments made to "civil" stations by the FCC in bands allocated domestically to non-Government operations.\* The IFL of the International Frequency Registration Board (IFRB) contains national assignments submitted to the IFRB for coordination beyond national borders. The IFL does not contain many national assignments which are not expected to cause or experience interference across national borders.

The information collected from the GMF and FCC data files for each frequency band includes:

- Center frequency
- Emission bandwidth
- Modulation type
- Transmitter power
- Type of service
- Location of transmitter
- Antenna characteristics
- Total number of emitters

The IFL was surveyed with regard to high power emitters which potentially could cause physical damage to the EEE.

Phase II of the study effort involved consolidation of the above data and subsequent reduction of this information to a narrative rather than tabular form. Areas of specific concern include:

- General overview of types of services, transmitter powers, antenna gains and modulations employed within a given frequency range.

\*The FCC data file does not contain the Chicago regional area assignments (i.e., public safety, industrial and transportation services).

- Determination of geographic areas of high or low "population" density.
- Pinpointing of extremely high power emitters.

Phase III of the study effort involved the classification of each frequency band in a manner which indicates the best analytical techniques to employ in each band in order to estimate expected RF energy activity. The three basic categories of classification include:

- Deterministic - that is, the data is generally reliable, in sufficient detail to permit precision computations and of a reasonably manageable magnitude.
- Probabilistic - that is, the data, while generally reliable, is lacking in detail and covers such a large number of emitters that statistical techniques best serve to economically characterize the emissions. This classification also includes bands used by large numbers of mobile units whose location and pointing directions vary with time.
- Non-determinate - that is, the data is unreliable in relation to RFI simulation or unavailable in sufficient detail to be useful for analysis.

Phase IV of the study was directed at development of a graphical means of presenting the data. Where the data was not of such a magnitude as to be unwieldy, two histograms were developed. The first histogram presents the total number of emitters in the band as a function of frequency and the second presents the total transmitter power as a function of frequency. Histograms are presented with and without inclusion of experimental assignments for comparison.

Such histograms were generated for those frequency bands in which there exists fewer than 1000 assignments within the continental United States.

## 2. STUDY DISCUSSION AND LIMITATIONS

Exact analytical quantification of levels of RF energy expected to be encountered at orbital altitudes from the multitude of services in these frequency bands is, in most bands, an impracticable task. Several factors contribute to this impracticability including geographical, temporal and electrical considerations. Some of these impacting variables, which must be precisely defined in order to perform a deterministic simulation, are listed below:

- Geographical
  - Shuttle sub-satellite latitude and longitude.
  - Location of terrestrial emitters, including mobile systems.
  - Number of actual units operating on a given frequency, since a single frequency assignment in the data files may indicate multiple users throughout the United States. Also, much of Canada and Mexico are visible to a satellite in a 400 km orbit.
  
- Temporal
  - Time of day for emitters visible to the Shuttle.
  - Day of the week, since peak activity in some bands would occur during week days.
  - Seasonal variations and local weather would impact RF energy attenuation in some frequency bands.

- Electrical

- Specific EEE experiment antenna pattern both in the main beam and in all side lobes.
- Possible Shuttle-produced EMI.
- Pointing direction of EEE experiment antenna.
- Specific antenna patterns of terrestrial systems both in azimuth and in elevation angles.
- Pointing azimuth and elevation angles of terrestrial systems including effects of scanning radars.

In general, any individual or agency wishing to use the RF spectrum for transmission of RF energy must file a request through proper channels. These requests lead to frequency assignments which appear in either the FCC or the Government Data Files. In theory, then, the data files reflect the actual assignments in the band. While this may be a fairly accurate statement, a current assignment does not necessarily mean that the individual or agency is using the band at any given time. Also, many experimental assignments may be for the purpose of screen room testing and thus would not impact the EEE RF environment.

Quantizing all of the above variables for all the frequency bands surveyed is not feasible. However, some frequency bands are well defined, and most, if not all, of these variables can be determined for specific portions of the band. In these cases it is considered feasible to analytically evaluate levels of RF energy expected to be viewed at orbital altitudes. This task, in general, is beyond the scope of this study effort. However, one such analysis has been performed and is included as Annex A to this Report, to demonstrate one feasible approach.

In frequency bands where it is not possible to determine all operational characteristics, much useful information may still be obtained by performing a general overview of current utilization, and presenting the results graphically as a function of frequency. This is the approach taken by NSL in response to the Statement of Work. The results presented in Section 3 of this Report include a general narrative description of the band and a graphical representation of each band in which there were less than 1000 current assignments within the United States. These graphical representations or histograms require some clarification such that proper technical interpretations may be achieved.

Each figure presents two histograms. The first histogram presents the number of emitters versus frequency and the other presents cumulative transmitter power versus frequency. Since many assignments in the frequency data files indicate a frequency range over which a transmitter is allowed to operate (these assignments are termed "band assignments"), a means of indicating this on the histograms was required. The o on the histogram indicates such transmitters. For instance, if a single band assignment allowed operation anywhere in the 1.5-2 GHz range, a o was placed at every frequency point in that range, although physically, the transmitter could only operate at one of the center frequencies. Thus, while it may appear that many transmitters exist, the fact that they are represented by a o indicates only the maximum that may occur at a given frequency. This also applies to the power versus frequency histograms. The X's on the histograms indicate fixed frequency transmitters.

In bands where experimental transmitters and non-experimental transmitters operate, two sets of histograms were developed. This was done since the duty cycles of experimental systems are not usually well defined.

### 3. RESULTS

#### 3.1 121.5 MHz Band

##### 3.1.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
117-975 132	AERONAUTICAL MOBILE (R)	
	201A 273 273A	

**201A** The frequencies 2 182 kHz, 3 023.5 kHz, 3 680 kHz, 8 364 kHz, 121.5 MHz, **Spa2** 156.8 MHz and 243 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles.

The same applies to the frequencies 10 003 kHz, 14 993 kHz and 19 993 kHz, but in each of these cases emissions must be confined in a band of ± 3 kHz about the frequency.

**273** In this band, the frequency 121.5 MHz is the aeronautical emergency frequency and **Mar2** where required the frequency 123.1 MHz is the aeronautical frequency auxiliary to 121.5 MHz; mobile stations of the maritime mobile service may communicate on these frequencies for safety purposes with stations of the aeronautical mobile service.

**273A** In the band 117.975-132 MHz and in the band 132-136 MHz where the aero- **Spa** nautical mobile (R) service is authorized, the use and development, for this service, of systems using space communication techniques may be authorized but limited initially to satellite relay stations of the aeronautical mobile (R) service. Such use and development shall be subject to co-ordination between administrations concerned and those having services operating in accordance with the Table, which may be affected.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
*117.975-121.9625	AERONAUTICAL MOBILE (R)	AERONAUTICAL MOBILE (R) NG67

\*FCC action pending 2/26/74.

NG67. The spacing between frequency assignments in this band shall be 25 kHz. The first and last assignable frequencies are those indicated in column 10.

### 3.1.2 Present Assignments

#### 3.1.2.1 Government Master File

- Assignment Class - The majority of assignments in this spectral region are for the aeronautical mobile service including aeronautical stations, aircraft stations and aerodrome control stations. In accordance with Footnote 201A of the ITU Radio Regulations, "the frequency 121.5 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles". The number of assignments in the 121.5 band is greater than 850. The areas of operation vary across the United States, but higher density operations appear in Alaska, California and Texas.

- Operating Agencies - Operating agencies of the assignments include Army, ERDA, Air Force, Coast Guard, and FAA. The latter agency comprises approximately 85% of the assignments.

- Emission - The emission characteristics of the assignments are almost exclusively 6.00A3 (6 kHz emission bandwidth, amplitude modulation).

- Transmitter Power- Maximum transmitter powers are .1 kW, although the number of such assignments is small. The majority of assignments utilize transmitter powers of 50 W.

- Antenna - The amount of information supplied by the data file on antenna characteristics is very limited. Only non-directional antennas are noted, numbering approximately 45.

### 3.1.2.2 Federal Communications Commission Data File

- Assignment Class - This band is composed of aviation assignments including aeronautical, aviation auxiliary, and search and rescue stations. There are approximately 150 assignments, one-third of which are mobile. Search and rescue units make up 1% of the total assignments. The majority of the stations are located in California, Florida, Montana, New York and Texas. There are 15 assignments authorized for use anywhere within the 48 contiguous states.

- Users - This band is used by private businesses and facilities.

- Emission - All assignments are amplitude modulated with an emission bandwidth of 6 kHz.

- Transmitter Power - The transmitter power given in the data file varies from 500 milliwatts to 50 Watts.

### 3.1.2.3 International Frequency List

- High Power Examination - All 9 assignments show powers of .05 kW or less.

### 3.1.2.4 Classification - Probabilistic

### 3.1.2.5 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.2 243.0 MHz Band

#### 3.2.1 Allocations

INTERNATIONAL					
Region 1	Region 2			Region 3	
235 - 267	FIXED MOBILE  201A 305 305A 308A 309				

**201A Spn2** The frequencies 2 182 kHz, 3 023.5 kHz, 5 680 kHz, 8 364 kHz, 121.5 MHz, 156.8 MHz and 243 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles.

The same applies to the frequencies 10 003 kHz, 14 993 kHz and 19 993 kHz, but in each of these cases emissions must be confined in a band of : 3 kHz about the frequency.

**305** In Nigeria, Sierra Leone and Gambia, the band 223-251 MHz is also allocated to the broadcasting service

**305A Spn2** In New Zealand, the band 235 - 239.5 MHz is also allocated to the aeronautical radionavigation service.

**308A Spn2** The bands 240 - 328.6 MHz and 335.4 - 399.9 MHz may also be used by the mobile-satellite service. The use and development of this service shall be subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**309** The frequency 243 MHz is the frequency in this band for use by survival craft stations and equipment used for survival purposes.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
225-328.6	FIXED MOBILE  G30 G100		The FAA provides air traffic control communications to the military services on selected frequencies in this band.

**G30** In the bands 138-144, 148-149.9, 150.05-150.8, 225-328.6, 335.4-399.9, 1427-1429 and 1429-1435 MHz, the fixed and mobile services are limited primarily to operations by the military services.

**G100** The mobile satellite service within the bands 240.0-328.6 and 335.4-399.9 MHz is limited to military systems.

### 3.2.2 Present Assignments

#### 3.2.2.1 Government Master File

● Assignment Class - The majority of assignments in this band are in the aeronautical mobile service, including aeronautical stations, aircraft stations and airdrome control stations. In accordance with Footnote 201A of the ITU Radio Regulations, "the frequency 243.0 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles." The number of assignments in the 243 MHz band is approximately 600. The areas of operation vary across the U.S., but major concentration are found in Alaska, California, Florida, Kentucky, New York and Texas.

● Operating Agencies - Operating agencies of the assignments include the Army, Navy, Air Force, NASA, Coast Guard and FAA. The latter agency comprises approximately 80% of the assignments.

● Emission - The emission characteristics of the assignments are almost exclusively those of single channel voice circuits, i.e., 6.00A3 (6 kHz emission bandwidth, amplitude modulation).

● Transmitter Power - The maximum transmitter power is .1 kW, although the number of such assignments is small. The majority of assignments utilize transmitter powers of 50 W or less.

● Antenna - The amount of information supplied by the data file on antenna characteristics is very limited. Only non-directional are noted, numbering approximately 60.

### 3.2.2.2 Federal Communications Commission Data File

- Assignment Class - This band contains 5 public safety (special emergency mobile) assignments, and 3 assignments are in the aeronautical service. The frequency 243 MHz is allocated for use by survival craft stations and equipment used for survival purposes. All aircraft and ship life-rafts are equipped with automatic beacons which transmit multiplex coded information in a 3.2 kHz bandwidth. The mobile units are located in Florida, 2 of the aeronautical are in New York and the remaining unit is located in a U.S. Possession.

- Users - The special emergency mobile units are operated by Herndon Ambulance Service, Inc. The remaining assignments are listed for Grumman Aerospace Corporation.

- Emission - The mobile assignments are frequency modulated, with an emission bandwidth of 20 kHz. The other assignments are amplitude modulated, with an emission bandwidth of 6 kHz.

- Transmitter Power - The power authorized for these assignments varies from 50 to 220 Watts.

### 3.2.2.3 International Frequency List

- High Power Examination - Most of the 26 assignments at 243.0 MHz indicate an average power of .1 kW. There are a few assignments at 1.25 kW and one assignment at 10 kW.

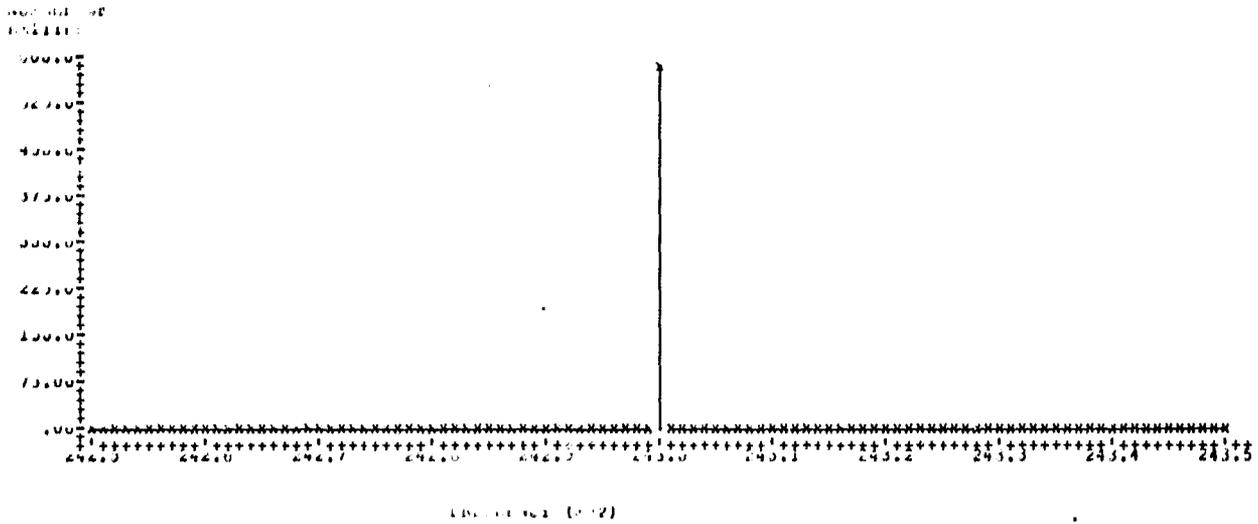
#### 3.2.2.4 Classification - Probabilistic

#### 3.2.2.5 Computer Histograms

Figure 3.2-1 presents the emitter and power histograms for the 243 MHz frequency band.

FREQUENCY BAND : 242.5-243.5(MHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

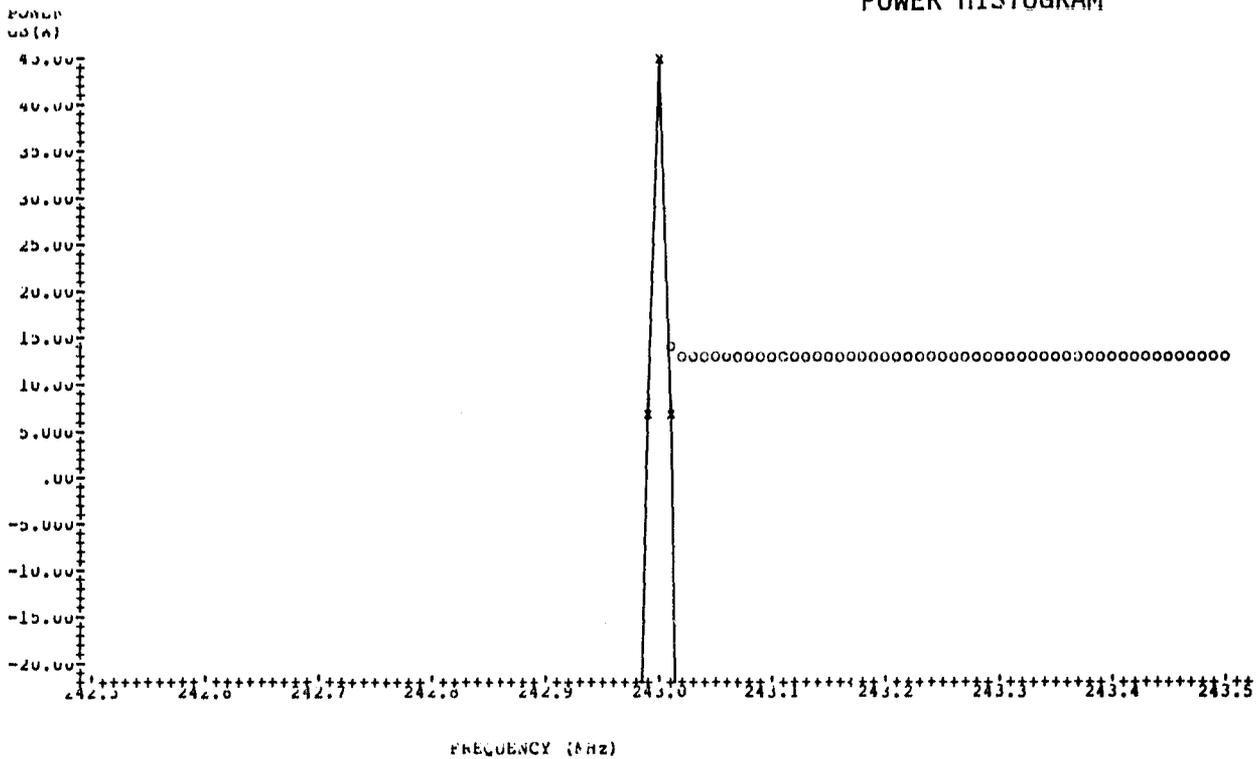


Figure 3.2-1 Non-Experimental Emitter and Power Histograms for the 242.5-243.5 MHz Band

### 3.3 399.9-410.0 MHz Band

#### 3.3.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
399.9 - 400.05	RADIONAVIGATION-SATELLITE 285C 311A	
400.05 - 400.15	STANDARD FREQUENCY-SATELLITE 312B 313 314	
400.15 - 401	METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (Maintenance telemetering) SPACE RESEARCH (Telemetering and tracking) 313 314	
401 - 402	METEOROLOGICAL AIDS SPACE OPERATION (Telemetering) 315A <i>Fixed</i> <i>Meteorological-Satellite (Earth-to-space)</i> <i>Mobile except aeronautical mobile</i> 314 315 315B 315C 316	
402 - 403	METEOROLOGICAL AIDS <i>Fixed</i> <i>Meteorological-Satellite (Earth-to-space)</i> <i>Mobile except aeronautical mobile</i> 314 315 315C 316	
403 - 406	METEOROLOGICAL AIDS <i>Fixed</i> <i>Mobile except aeronautical mobile</i> 314 315 316	
406 - 406.1	MOBILE-SATELLITE (Earth-to-space) 314 317A 317B	
406.1 - 410	FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY 233B 314	

- 285C** Emissions of the radionavigation-satellite service in the bands 149.9 -  
**Spa2** 150.05 MHz and 399.9 - 400.05 MHz may also be used by receiving earth stations of the space research service.
- 311A** In Bulgaria, Cuba, Greece, Hungary, Indonesia, Iran, Kuwait, Lebanon, the  
**Spa2** United Arab Republic, Syria and Yugoslavia, the band 399.9 - 400.05 MHz is also allocated to the fixed and J mobile services (see Recommendation No. Spa 8).
- 312B** In this band the standard frequency is 400.1 MHz. Emissions shall be  
**Spa2** confined in a band of  $\pm 25$  kHz about this frequency.
- 313** In Albania, Bulgaria, Greece, Hungary, Poland, the United Arab Republic,  
**Spa** Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 400.05 - 401 MHz is also allocated to the fixed and mobile services.
- 314** In the United Kingdom, the band 400.05-420 MHz is also allocated to the  
**Spa** radiolocation service; however, between 400.05 and 410 MHz the allocation to the radiolocation service is on a secondary basis.
- 315** In France, the band 401-406 MHz is allocated to the meteorological aids service.
- 315B** In Australia, the space operation service (telemetry) in the band 401-402 MHz  
**Spa** is a secondary service.
- 315C** In the band 401 - 403 MHz, earth exploration-satellite applications, other  
**Spa2** than the meteorological-satellite service, may also be used for Earth-to-space transmissions on condition that no harmful interference is caused to stations operating in accordance with the Table.
- 316** In Albania, Bulgaria, Greece, Hungary, Iran, Norway, Poland, Yugoslavia,  
 Roumania, Sweden, Switzerland, Czechoslovakia, Turkey and the U.S.S.R., the band 401-406 MHz is also allocated, on a primary basis, to the fixed service and mobile, except aeronautical mobile, service.
- 317A** The band 406 - 406.1 MHz is reserved solely for the use and development  
**Spa2** of low-power (not to exceed 5 W) emergency position-indicating radiobeacon (EPIRB) systems using space techniques.
- 317B** In Austria, Bulgaria, Chile, Cuba, Ethiopia, Hungary, India, Iran, Kenya,  
**Spa2** Kuwait, Liechtenstein, Malaysia, Uganda, Poland, the United Arab Republic, Rwanda, Sweden, Switzerland, Syria, Tanzania, Czechoslovakia and in the U.S.S.R., the band 406 - 406.1 MHz is also allocated to the fixed service and the mobile, except aeronautical mobile, service.
- 233B** In making assignments to stations of other services to which the bands  
**Spa2** 37.75 - 38.25 MHz, 150.05 - 153 MHz, 406.1 - 410 MHz, 2.690 - 2.700 MHz and 4.700 - 5.000 MHz are allocated, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
399.9-400.05	RADIONAVIGATION-SATELLITE G44	RADIONAVIGATION-SATELLITE	
400.05-400.15	STANDARD FREQUENCY-SATELLITE		
400.15-401	METEOROLOGICAL AIDS (Radiosonde) SPACE RESEARCH (Telemetry and tracking)	METEOROLOGICAL AIDS (Radiosonde) SPACE RESEARCH (Telemetry and tracking)	
401-402	METEOROLOGICAL AIDS (Radiosonde) SPACE OPERATION (Telemetry) Meteorological-Satellite (Earth-to-space)	METEOROLOGICAL AIDS (Radiosonde) SPACE OPERATION (Telemetry) Meteorological-Satellite (Earth-to-space)	
402-403	METEOROLOGICAL AIDS (Radiosonde) Meteorological-Satellite (Earth-to-space)	METEOROLOGICAL AIDS (Radiosonde) Meteorological-Satellite (Earth-to-space)	
403-406	METEOROLOGICAL AIDS (Radiosonde)	METEOROLOGICAL AIDS (Radiosonde)	
406-406.1	MOBILE-SATELLITE (Earth-to-space)	MOBILE-SATELLITE (Earth-to-space)	
406.1-410	FIXED MOBILE RADIO ASTRONOMY G5 G6	RADIO ASTRONOMY	The Channeling Plan for assignments in this band is shown in Section 4.3.9 of the Manual of Regulations and Procedures.

G5 In the bands 162.0125-173.2, 173.4-174, 406.1-410 and 410-420 MHz, the fixed and mobile services are all allocated on a primary basis to the Government non-military agencies.

G6 Military tactical fixed and mobile operations may be conducted nationally on a secondary basis; (1) to the meteorological aids service in the band 403-406 MHz; and (2) to the radio astronomy service in the band 406.1-410 MHz. Such fixed and mobile operations are subject to local coordination to ensure that harmful interference will not be caused to the services to which the bands are allocated.

G44 Military fixed and mobile operations may continue in the band 399.9-400 MHz until required to be reaccommodated to meet the needs of the radio-navigation-satellite service.

### 3.3.2 Present Assignments

#### 3.3.2.1 Government Master File

- Assignment Class - The majority of assignments in this frequency band are for the fixed and mobile services. The mobile users represent 50% of the assignments. The band is also used for experimental, meteorological aids, meteorological-satellites, radionavigation-satellites and radiodetermination (radiolocation). The 401-402 MHz portion of the frequency band contains assignments for Earth-to-space transmission for meteorological-satellites, such as GOES and LANDSAT. This is the principal data collection platform up-link band. In the 399.9-410.0 MHz band there are approximately 1500 assignments which are fairly well distributed throughout the U.S.

- Operating Agencies - This band is used by most government agencies.

- Emission - Frequency modulated systems represent 80% of the assignments. The emission bandwidths for these vary between 10 and 50 kHz, with a few bandwidths up to 800 kHz. The remaining assignments are amplitude modulated for the most part, with emission bandwidths from 2 to 600 kHz and as large as 3.34 MHz. A few pulse systems are registered with emission bandwidths of 10 and 50 kHz.

- Transmitter Power - The majority of assignments have a power of less than .1 kW, with a few as high as .25 kW. Exceptions to this are 14 assignments at 1 kW and 3 at 10 kW.

- Antenna - Approximately half of the assignments have nondirectional antennas. Various types of directional antennas are used throughout this band, with gains from 10 to 22 dB(i).

### 3.3.2.2 Federal Communications Commission Data File

- Assignment Class - The majority of assignments are in the common carrier service, specifically the domestic public land mobile. There are 80 experimental assignments, 63 of which are mobile. The remaining assignments are in a variety of services, many of which are mobile in nature. There are approximately 900 assignments in the 399.9-410.0 MHz frequency band. Geographically, the majority of assignments are in California, New Jersey, and Maryland. The remaining are assigned throughout the 48 contiguous states.

- Emission - The majority of assignments are frequency modulated, with emission bandwidths from .1 kHz to 14 MHz. The remaining assignments, which are amplitude modulated, vary in emission bandwidths from .1 kHz to 300 kHz. There are a few unmodulated assignments.

- Transmitter Power - The assignments in this band have powers ranging from 5 milliwatts to 300 Watts.

### 3.3.2.3 International Frequency List

- High Power Examination - The majority of the 900 assignments in this band have powers designated at .2 kW or less. The rest of the assignments list powers of 10 kW, for the most part, with a few assignments at 20 and 30 kW.

### 3.3.2.4 Classification - Probabilistic

### 3.3.2.5 Computer Histograms

Due to the large number of emitters in the band, histograms have not been generated.

### 3.4 450-470 MHz Band

#### 3.4.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
450-460	FIXED MOBILE 318B 318C' 318 319A	
460-470	FIXED MOBILE 318B 318C' <i>Meteorological-Satellite (Space-to Earth)</i> 318A 324B	

**318 Spa2** Radio altimeters may also be used until 31 December 1974 in the band 420-460 MHz. However, after this date, they may be authorized to continue to operate on a secondary basis except in the U.S.S.R. where they will continue to operate on a primary basis.

**318A Spa** In Bulgaria, Cuba, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 460-470 MHz may be used, on a primary basis, by the meteorological-satellite service subject to agreement among administrations concerned and those having services, or intending to introduce services, operating in accordance with the Table, which may be affected.

**318B Mar2** In the maritime mobile service, the frequencies 457.525 MHz, 457.550 MHz, 457.575 MHz, 467.525 MHz, 467.550 MHz and 467.575 MHz may be used by on-board communication stations. The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned. The characteristics of the equipment used shall conform to those specified in Appendix 19A.

**318C Mar2** In the territorial waters of Canada, the United States of America and the Philippines, the preferred frequencies for use by on-board communication stations shall be 457.525 MHz, 457.550 MHz, 457.575 MHz and 457.600 MHz paired, respectively, with 467.750 MHz, 467.775 MHz, 467.800 MHz and 467.825 MHz. The characteristics of the equipment used shall conform to those specified in Appendix 19A.

**319A Spa2** The band 449.75-450.25 MHz may be used for space telecommand and space research (Earth-to-space), subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**324B Spa2** Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1.690-1.700 MHz for space-to-Earth transmissions on condition that no harmful interference is caused to stations operating in accordance with the Table.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
450-460	G105	LAND MOBILE NG12 NG112	450-451 Remote pickup broadcast 451-454 Public safety Industrial Land transportation
460-470	Meteorological-satellite (Space-to-Earth)	LAND MOBILE	454-455 Domestic public 455-456 Remote pickup broadcast 456-459 Public safety Industrial Land transportation 459-460 Domestic public 460-462.5375 Public safety Industrial Land transportation 462.5375- 462.7375 Citizens radio 462.7375- 467.5375 Public safety Industrial Land transportation 467.5375- 467.7375 Citizen radio 467.7375- 470 Public safety Industrial Land transportation

G105 In the band 420-460 MHz, Radio Altimeter operations are limited to the military services and to existing equipments which may continue to operate until January 1, 1978 on the condition that harmful interference is not caused to stations of services operating in accordance with the U. S. National Table of Frequency Allocations.

NG12 Frequencies in the bands 454.40-455 MHz and 459.40-460 MHz may be assigned to domestic public land and mobile stations to provide a two-way air-ground public radiotelephone service.

NG112 The frequencies 25.04, 25.08, 150.980, 154.585, 159.480, 158.445, 454.000, and 459.000 MHz may be authorized to stations in the Petroleum Radio Service for use primarily in oil spill containment and cleanup operations and secondarily in regular land mobile communication.

### 3.4.2 Present Assignments

#### 3.4.2.1 Government Master File

- Assignment Class - There are approximately 640 assignments in the 450-470 MHz spectral region. The majority of assignments in this band are for mobile communications, including both surface-to-surface and air-to-surface communications. Approximately 10% of the assignments are of the latter class, with areas of operation indicated in the data files only as within the United States or Possessions. The areas of operation for the surface-to-surface mobile units vary across the United States, but higher density operations appear to occur near or within large cities and in general, along the eastern and western coasts.

- Operating Agencies - Operating agencies having assignments include the National Security Agency, ERDA, Air Force, Army, Department of the Interior, Veterans Administration and the Justice Department (FBI). The latter three agencies comprise approximately 85% of the assignments.

- Emission - The emission characteristics of the assignments are almost exclusively 16.00F9 (16 kHz emission bandwidth, frequency modulation).

- Transmitter Power - The transmitter powers employed vary depending on the type of service being provided. The assignments in this band represent base, mobile and non-portable stations. Maximum transmitter powers are 1.0 kW. However, the number of such assignments is rather small. A large number of assignments list powers of 1 Watt. The average transmitter power is on the order of 20-50 Watts, with a large number of Justice Department assignments at the 100 Watt level.

- Antenna - The amount of information supplied by the data file on antenna characteristics is very limited. Maximum gains of 15-20 dB are provided by horn antennas. Torroidal antenna patterns (constant gain in azimuth but not in elevation) were noted in some of the assignments. Eighty percent of the assignments do not give antenna information.

#### 3.4.2.2 Federal Communications Commission Data File

- Assignment Class - There are approximately 125,000 assignments in this band. Accordingly, this band was not analyzed with regard to the FCC data file.

#### 3.4.2.3 International Frequency List

- High Power Examination - The majority of the 1500 assignments have powers less than 1 kW. Thirty percent of the assignments have powers of 10 and 20 kW. A few assignments have powers of 40, 70 and 80 kW, and there is a single registration at 170 kW located in Gregory, Texas.

#### 3.4.2.4 Classification - Probabilistic

#### 3.4.2.5 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.5 614-960 MHz Band

#### 3.5.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
470—582 BROADCASTING	470—890 BROADCASTING	470—585 BROADCASTING
582—606 BROADCASTING RADIONAVIGATION 325 327 328 329		335 585—610 RADIONAVIGATION
606—790 BROADCASTING 329 330 330A 331 332 332A		330B 336 337
790—890 FIXED BROADCASTING 329 331 333 334		610—890 FIXED MOBILE BROADCASTING 330B 332 332A 338 339
890—942 FIXED BROADCASTING <i>Radiolocation</i> 329 331 333 339A	890—942 FIXED RADIOLOCATION 339A 340	890—942 FIXED MOBILE BROADCASTING <i>Radiolocation</i> 339 339A
942—960 FIXED BROADCASTING 329 331 333 339A	942—960 FIXED 339A	942—960 FIXED MOBILE BROADCASTING 338 339 339A

- 325 In the United Kingdom, the band 582-606 MHz is allocated on a primary basis to the aeronautical radionavigation service and on a secondary basis to the radiolocation service.
- 327 In France and the F. R. of Germany, the band 582-606 MHz is allocated on a primary basis to the broadcasting service and on a secondary basis to the radionavigation service.
- 328 In Belgium, the band 582-606 MHz is allocated on a primary basis to the radionavigation service and on a secondary basis to the broadcasting service.
- 329 In Israel, the band 582-960 MHz is also allocated to the fixed service and mobile, except aeronautical mobile, service.
- 329A In Argentina and Uruguay, the band 602 - 608 MHz is allocated to the radio astronomy service.  
Spa2
- 330 In Region 1, except the African Broadcasting Area\*, the radionavigation service may continue to operate in the band 606-610 MHz until the band is required for the broadcasting service.  
Spa
- 330A In the African Broadcasting Area\*, the band 606-614 MHz is allocated to the radio astronomy service.  
Spa
- 330B In India, the band 608 - 614 MHz is also allocated to the radio astronomy service.  
Spa2
- 331 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 645-960 MHz is also allocated to the aeronautical radionavigation service.
- 332 In Region 1, except the African Broadcasting Area\*, the band 606-614 MHz and in Region 3, the band 610-614 MHz may be used by the radio astronomy service. Administrations shall avoid using the band concerned for the broadcasting service as long as possible, and thereafter, as far as practicable, shall avoid the use of such effective radiated powers as will cause harmful interference to radio astronomy observations.  
Spa
- In Region 2, the band 608-614 MHz is reserved exclusively for the radio astronomy service until the first Administrative Radio Conference after 1 January, 1974 which is competent to review this provision; however, this provision does not apply to Cuba.
- 332A Within the frequency band 620 - 790 MHz, assignments may be made to television stations using frequency modulation in the broadcasting-satellite service subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected (see Resolutions Nos. Spa2 2 and Spa2 3). Such stations shall not produce a power flux density in excess of the value  $-129$  dBW/m<sup>2</sup> for angles of arrival less than 20° (see Recommendation No. Spa2 10) within the territories of other countries without the consent of the administrations of those countries.  
Spa2
- 333 In Region 1, stations of the fixed service using tropospheric scatter may operate in the band 790-960 MHz subject to agreements between the administrations concerned and affected. Such operations in the band 790-860 MHz shall be on a secondary basis to those of the broadcasting service.
- 334 In Belgium, France and Monaco, the band 790-860 MHz is allocated to the broadcasting service.
- 335 In Australia, the band 470-500 MHz is allocated to the fixed and mobile services.
- 336 In China, Korea, Japan and the Philippines, the band 585-610 MHz is also allocated to the broadcasting service.
- 337 In Australia, the band 585-610 MHz is allocated on a primary basis to the broadcasting service and on a secondary basis to the radionavigation service.
- 338 In Australia, the band 610-820 MHz is allocated to the broadcasting service; the bands 820-890 MHz and 942-960 MHz are allocated to the fixed service.
- 339 In India and Pakistan, the band 610-960 MHz is allocated to the broadcasting service.
- 339A Specific portions of the frequency band 900-960 MHz may also be used, on a secondary basis, for experimental purposes in connection with space research.  
Spa
- 340 In Region 2, the frequency 915 MHz is designated for industrial, scientific and medical purposes. Emissions must be confined within the limits of  $\pm 13$  MHz of that frequency. Radiocommunication services operating within these limits must accept any harmful interference that may be experienced from the operation of industrial, scientific and medical equipment.  
Spa2

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
806-902		LAND MOBILE NG30 NG43 NG63 NG65	806-881 Domestic public 881-902 (non-common carrier)
902-928 (ISM 915+ 13 MHz)	RADIOLOCATION G11 G59	NG63	
928-947		LAND MOBILE NG63 NG64	(non-common carrier)
947-960		FIXED NG9 NG10 NG40 NG58 NG63	

G11 Government fixed and mobile radio services, including low power radio control operations, are permitted in the band 902-928 MHz on a secondary basis.

G59 In the bands 902-928 MHz, 3100-3700 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz and 24.05-24.25 GHz, all Government non-military radiolocation shall be secondary to military radiolocation.

NG9 Aural broadcast intercity relay stations may be authorized to use the band 947-952 MHz on the condition that harmful interference will not be caused to other classes of stations operating in accordance with the Table of Frequency Allocations.

NG10 Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the highest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocations.

NG30 Stations in the international fixed public radio-communication service in Florida, south of 25°30' north latitude, may be authorized to use frequencies in the band 716-890 MHz on the condition that harmful interference will not be caused to the broadcasting service of any country. This is an interim allocation the termination of which will later be specified by the Commission when it is determined that equipments are generally available for use in bands allocated internationally to the fixed service.

NG40 Non-Government fixed stations which were authorized on April 16, 1958, to use frequencies in the band 890-942 MHz may, upon the showing that interference is being caused by or to their assignments, be authorized to use frequencies in the band 947-952 MHz provided the bandwidth of emission does not exceed 1100 kHz and provided that an engineering study by the Commission indicate that the proposed frequency assignment for such stations in the band 947-952 MHz is likely to result in the elimination of the interference occurring in the band 890-942 MHz, and will not cause interference to existing operations in the band 947-952 MHz.

NG43 Fixed stations in the domestic public radio services in Alaska, south of 56° north latitude and east of 134° west longitude, may be authorized to use frequencies in the band 800-830 MHz, on the condition that harmful interference will not be caused to the broadcasting service of any country.

NG58 Low-power broadcast auxiliary stations licensed pursuant to the provisions of § 74.437 of this chapter may be authorized to operate in the band 947-952 MHz subject to the condition that no harmful interference is caused to stations operating in accordance with the Table of Frequency Allocations.

NG63 Television Broadcast translator stations holding valid licenses on November 15, 1971, to operate in the frequency band 806-890 MHz (channels 70-83), may continue to operate in this band, pursuant to periodic license renewals, on a secondary basis to the land mobile radio service.

NG64 Broadcast auxiliary stations licensed as of July 10, 1970, to operate in the frequency band 942-947 MHz may continue to so operate pending a decision as to their disposition through a future rule making proceeding.

### 3.5.2 Present Assignments

#### 3.5.2.1 Government Master File

- Assignment Class - The majority of assignments in this band are in the radiolocation, broadcasting, experimental and fixed services. The remainder are in the mobile, radionavigation-satellite and radiodetermination services. The 260 assignments in this frequency band are located uniformly throughout the U.S.

- Operating Agencies - The agencies using this band include the Army, Air Force, Navy and the Department of Interior.

- Emission - The assignments in this band are frequency, pulse and amplitude modulated, with emission bandwidths ranging from 80 kHz to 30 MHz, 10 kHz to 40 MHz and 1 to 9 MHz respectively.

- Transmitter Power - For the most part the powers are significantly less than 1 kW. However, there are a few assignments with powers of 2, 10, 20 and 40 kW. There are two assignments with powers of 600 kW and 200 kW. The 600 kW assignment is listed for the Navy, in California and Virginia, for radiolocation land stations at 890 MHz. The 200 kW assignment is an Air Force experimental station in Nebraska at 902 MHz.

- Antenna - Fifty percent of the assignments have parabolic antennas with gains from 18 to 44 dB(i). The remaining assignments are an assortment of directional and non-directional antennas, including yagi array, log periodic, horn, quarterwave, helix, monopole and billboard antennas.

### 3.5.2.2 Federal Communications Commission Data File

● Assignment Class - The band from 614-960 MHz can be divided into several portions. The frequency range 614-806 MHz is used primarily for UHF TV. The range 806-890 MHz is used by TV translators but these translators will become secondary when the last license expires in 1979. The new primary allocation for the 806 to 902 MHz band is for land mobile systems as listed below:

#### LAND MOBILE

806-821 MHz - Conventional and trunked systems for private use

821-825 MHz - Reserved for land mobile

825-845 MHz - Cellular common carrier systems

845-851 MHz - Reserved for land mobile

851-866 MHz - Conventional and trunked systems for private use

866-870 MHz - Reserved for land mobile

870-890 MHz - Cellular common carrier systems

890-902 MHz - Reserved for land mobile

928-947 MHz - Reserved for land mobile

There already are a number of experimental mobile assignments issued in the band 806-942 MHz. The band 902-928 MHz is used for industrial, scientific and medical equipment.

The 947 to 960 MHz portion of the band is composed of fixed stations in the public safety, auxiliary broadcast, land transportation, industrial and experimental services.

The more than 16,000 transmitters in this band are located uniformly throughout the U.S.

There will be a major change in the make-up of this band, from what is shown in the data files now, in the next 5 years.

- Emission - The emission characteristics for the most part can be grouped according to use. The broadcast TV stations and TV translators have a video signal with a typical emission bandwidth of 5.7 MHz, amplitude modulated, and an audio signal frequency modulated with a typical emission bandwidth of 250 kHz. The experimental land mobile users typically employ emission bandwidths of 15, 16, and 36 kHz, frequency modulated. The fixed users employ varying bandwidths, from 36 to 500 kHz, frequency modulated for the most part.

- Transmitter Power - The transmitter powers vary according to service. The TV broadcast service stations are allowed a maximum e.i.r.p., which is a function of the antenna elevation, and is above average local terrestrial elevation, computed on an individual basis. Generally, the TV stations which are concentrated around large cities have low elevations, which allow for a maximum e.i.r.p. of 5 megawatts. The FCC data list gives the powers for TV broadcast stations in e.i.r.p. The TV translators have powers typically of 100 Watts. The experimental land mobile stations list powers from 50 to 150 Watts. The fixed service transmitters specify powers from 5 milliwatts to 10 Watts, with a few larger powers, e.g., 1 kW, specified for some experimental assignments.

### 3.5.2.3 International Frequency List

- High Power Examination - There are approximately 13,000 assignments in the band 614 to 960 MHz. Fifty percent of these assignments have transmitter powers less than 1 kW, and the remainder span a large range from 1 kW to 1260 kW. A few select portions of the band specify a lower transmitted power. The band 888 to 920 MHz lists powers of 50 kW or less, and the band 947 to 960 MHz indicates powers of 10 kW or less.

### 3.5.2.4 Classification

The majority of the 614-960 MHz band is classified as probabilistic or non-deterministic, due to large numbers of mobile transmissions. The lower portion of the band, however, is used for UHF television broadcasting, and emission spectra and station populations are known to a fairly high degree of accuracy. It is for this reason that a select portion of the band, namely 668-674 MHz, is classified deterministic and has been chosen for the detailed analysis presented as Annex A. The 512-806 MHz portion of the band is classified as deterministic.

### 3.5.2.5 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.6 1220-1285 MHz Band

#### 3.6.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
1 215--1 300		
RADIOLOCATION		
Amateur		
	342 343 344 345	

- 342** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 1 215-1 300 MHz is also allocated to the fixed service.
- 343** In Belgium, France, Norway, the Netherlands, Portugal and Sweden, the band 1 215-1 300 MHz is also allocated to the radionavigation service.
- 344** In China, India, Indonesia, Japan, Pakistan, the Portuguese Oversea Provinces in Region 1 south of the equator, and in Switzerland, the band 1 215-1 300 MHz is also allocated to the fixed and mobile services.
- 345** In the F. R. of Germany, the band 1 250-1 300 MHz is allocated to the amateur service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
1215-1300	RADIOLOCATION	Amateur
	G12 G55 G56 G111	

- G12** The allocation for the band 1215-1300 MHz does not of itself necessarily preclude Government aeronautical radionavigation operations in this band in certain specific cases where necessary and where fully coordinated.
- G55** Authority to operate a joint-use radar (Air Defense/Air Traffic Control) in the band 216-225, 420-450, 1215-1300 and 2300-2500 MHz may be issued to the agency responsible for the technical operation and maintenance of that radar. Despite this dual usage, such radars shall be authorized in the radiolocation service. Present and future requirements for air defense needs shall take precedence over any secondary usage for air traffic control purposes.
- G56** Government radiolocation in the bands 1215-1300, 2900-3100, 5350-5650 and 9300-9500 MHz is primarily for the military services; however, limited secondary use is permitted by other Government agencies in support of experimentation and research programs.
- G111** In the band 1215-1250 MHz, the frequency 1227.6 MHz with emissions limited to  $\pm 12$  MHz bandwidth, is also allocated to the Radionavigation Satellite Service, for satellite down link transmissions only. The power flux density at the earth's surface from such transmissions shall not exceed  $-152\text{dBW/m}^2/4\text{kHz}$ . The Radionavigation Satellite Service shall not cause harmful interference to the Amateur Service and shall accept any harmful interference that may be caused by the Amateur Service.

### 3.6.2 Present Assignments

#### 3.6.2.1 Government Master File

- Assignment Class - The majority of assignments in this band are for the radiolocation service, with a few experimental and aeronautical surveillance radar stations listed. The number of assignments in the 1220-1285 MHz spectral region is approximately 300. There is a NASA experimental research non-geostationary satellite in operation at 1274.8299 MHz. The areas of operation vary across the United States, but higher density operations appear to occur in Alaska, California and Florida.

- Operating Agencies - Operating agencies include Navy, Army, Air Force and FAA, with some use by NASA and the Coast Guard.

- Emission - The majority of the assignments employ pulse modulation, with emission bandwidths from 100 kHz to 10 MHz. There are a few assignments with 20 MHz bandwidth. Approximately 10% of the assignments employ frequency modulation (averaging 20 MHz emission bandwidth) or amplitude modulations (with emission bandwidths of 0.1 and 375 kHz). One assignment of note is an experimental Air Force radar assignment at 1275 MHz in Shemya, Alaska. This radar has an emission bandwidth of 200 MHz, and operates with a peak power of 16.8 MW.

- Transmitter Power - Of special note, there are 7 assignments operating over the frequency range 1250-1350 MHz with powers of 10 or 13 Megawatts. These assignments are in the radiolocation, experimental research or surveillance radar service. One assignment at 1275 MHz, with a power of 16.8 MW, is described above. Of the remaining assignments, one third designate powers of 1000 kW to 8000 kW, one third are in the range of 100 to 600 kW and the remaining are equal to or less than 50 kW.

- Antenna - The majority of the antennas described in the files are parabolic, with gains up to 47 dB(i).

#### 3.6.2.2 Federal Communications Commission Data File

- Assignment Class - Half of the assignments in this band are experimental research, including two mobile units. The other half of the assignments are designated for the public safety service, with the majority being mobile units. There are approximately 50 assignments in the 1220-1285 MHz spectral region. The majority of assignments are in Kentucky, Maryland and New York. The two experimental mobile units are authorized to operate anywhere within the 48 contiguous states.

- Emission - The majority of assignments are frequency or pulse modulated, with emission bandwidths of 20 kHz to 22.08 MHz, and 100 kHz to 85 MHz respectively. There are a few amplitude modulated assignments with no bandwidths specified.

- Transmitter Power - The powers given vary from 13 milliwatts to 70.7 Megawatts. This last assignment is allocated to Westinghouse Communication Services at Fort Meade, Maryland.

#### 3.6.2.3 International Frequency List

- High Power Examination - This band has 8 assignments, with the majority having powers of 1200 kW. Two assignments with higher designated powers are noted, one being 2000 kW and the other 2200 kW.

#### 3.6.2.4 Classification - Probabilistic

#### 3.6.2.5 Computer Histograms

Figure 3.6-1 presents the non-experimental emitter and power histograms and Figure 3.6-2 presents the same including experimental stations.

EMITTER HISTOGRAM

FREQUENCY BAND : 1220.0-1285.0(MHz)  
 NON-EXPERIMENTAL

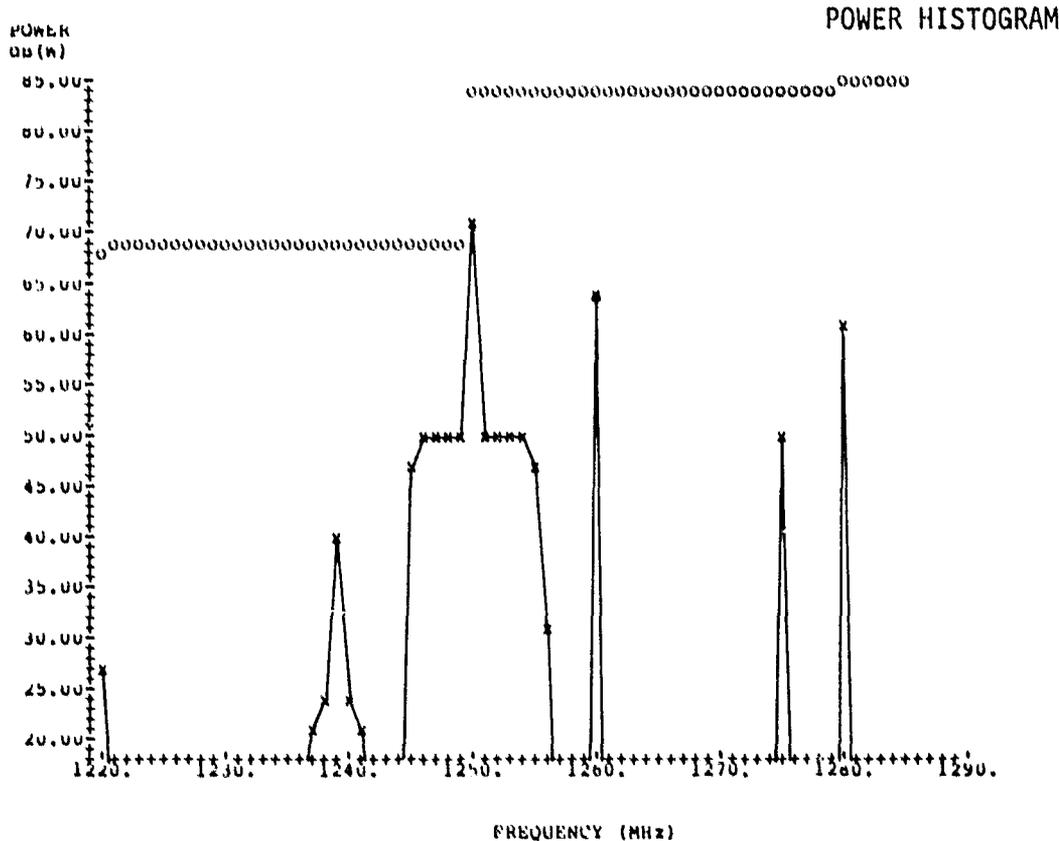
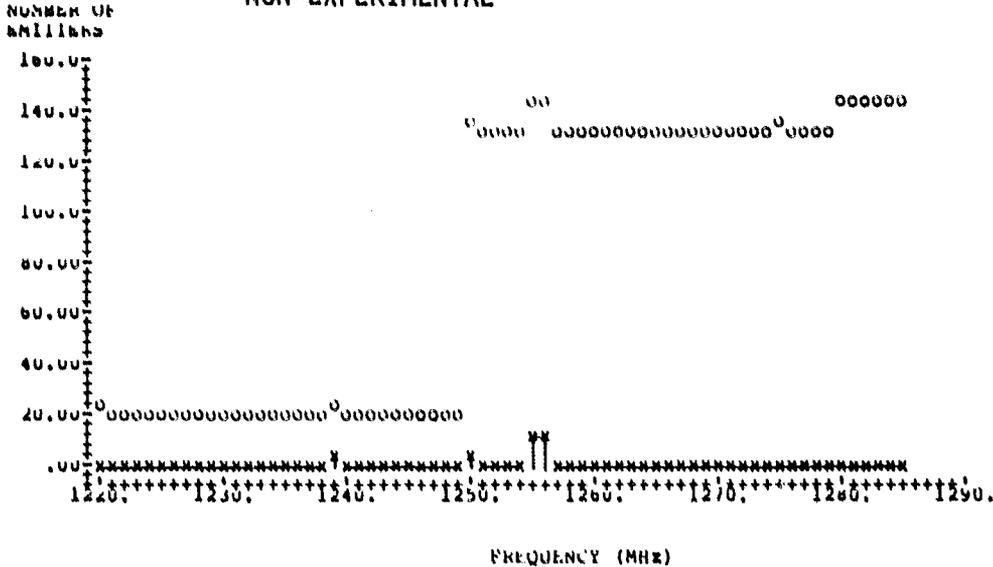
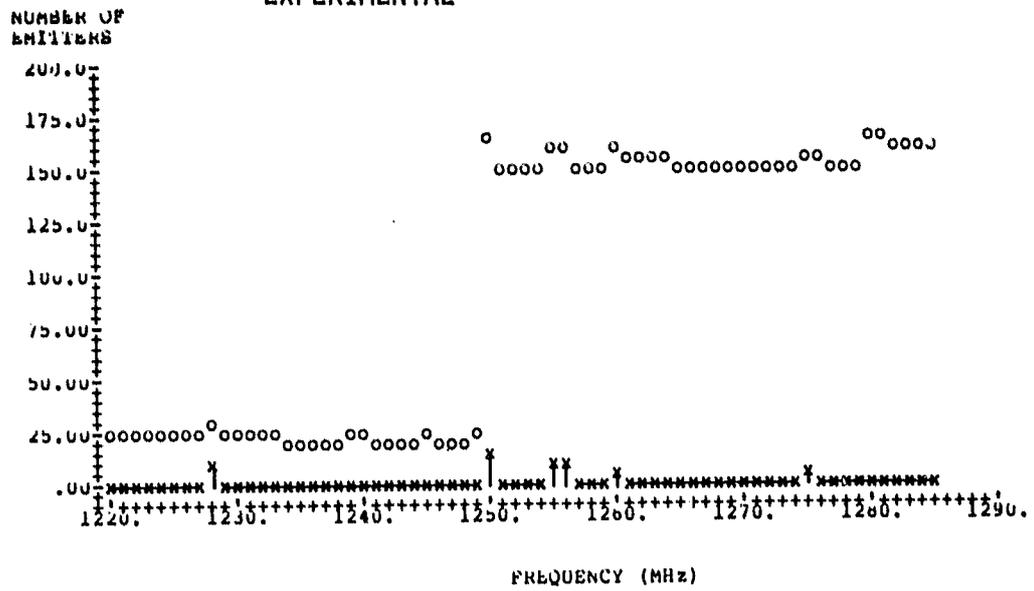


Figure 3.6-1 Non-Experimental Emitter and Power Histograms for the 1220-1285 MHz Band

EMITTER HISTOGRAM

FREQUENCY BAND : 1220.0-1285.0(MHz)

EXPERIMENTAL



POWER HISTOGRAM

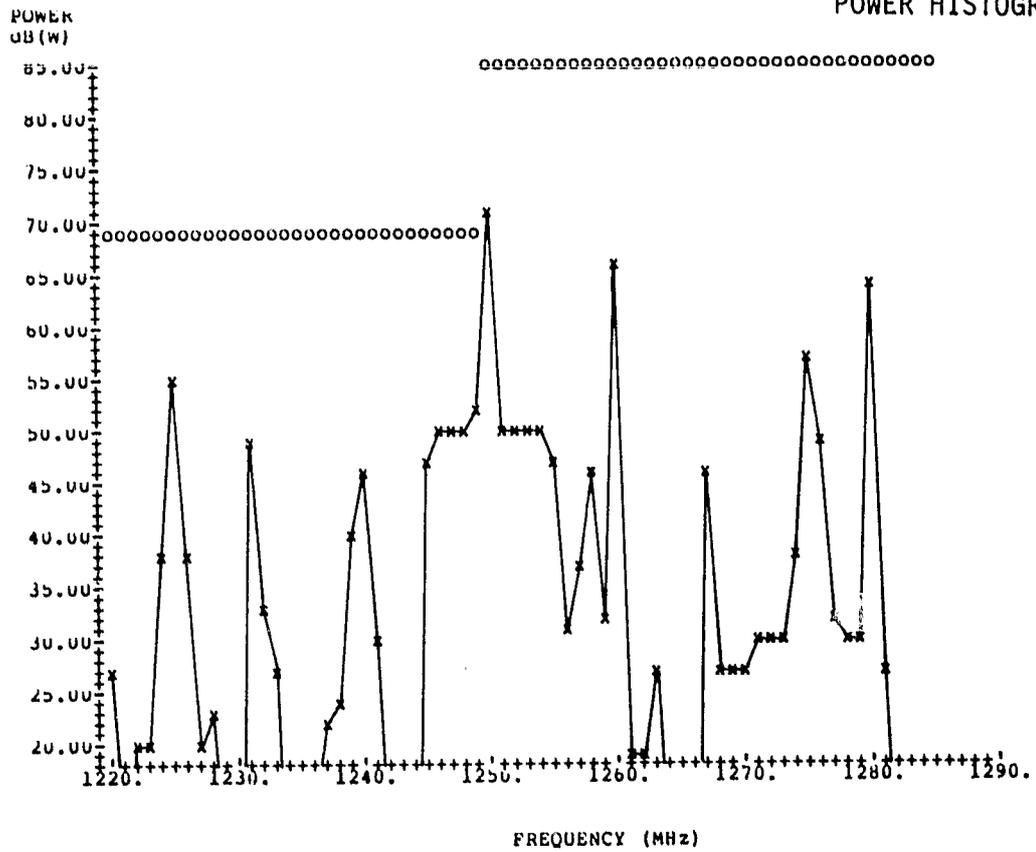


Figure 3.6-2 Emitter and Power Histograms for the 1220-1285 MHz Band Including Experimental Assignments

### 3.7 1350-1450 MHz Band

#### 3.7.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
1 350—1 400 FIXED MOBILE RADIOLOCATION 349 349A	1 350—1 400  RADIOLOCATION  349 349A	
1 400—1 427 RADIO ASTRONOMY		
1 427—1 429 SPACE OPERATION (Telecommand) FIXED MOBILE except aeronautical mobile		
1 429—1 525 FIXED  MOBILE except aeronautical mobile	1 429—1 435 FIXED  MOBILE	1 429—1 525 FIXED  MOBILE
	1 435—1 525  MOBILE  <i>Fixed</i>	

349 In Region 2 and Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the existing installations of the radionavigation service may continue to operate, temporarily, in the band 1 350-1 400 MHz.

349A Radio astronomy observations on the Hydrogen line displaced towards lower frequencies are carried out in a number of countries under national arrangements. Administrations should bear in mind the needs of the radio astronomy service in their future planning of the band 1 350 - 1 400 MHz.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
1350-1400	RADIOLOCATION Fixed Mobile G2 G27	
1400-1427	RADIO ASTRONOMY G45	RADIO ASTRONOMY
1427-1429	FIXED MOBILE except aeronautical mobile SPACE OPERATION (Telecommand) G30	SPACE OPERATION (Telecommand) Land Mobile (Telemetry and telecommand) Fixed (Telemetry,
1435-1535	MOBILE (Aeronautical telemetry)	MOBILE (Aeronautical telemetry)

- G2 In the bands 216-225, 420-450, 1300-1400, 2300-2450, 2700-2900, 5650-5925 and 9000-9200 MHz, the Government radiolocation is limited to the military services.
- G27 The fixed and mobile services are limited to the military services.
- G30 In the bands 138-144, 148-149.9, 150.05-150.8, 225-328.6, 335.4-399.9, 1427-1429 and 1439-1435 MHz, the fixed and mobile services are limited primarily to operations by the military services.
- G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

### 3.7.2 Present Assignments

#### 3.7.2.1 Government Master File

- Assignment Class - In general, the assignment class can be divided into two portions. Below 1400 MHz the assignments are almost exclusively experimental - either development or testing. Above 1400 MHz the assignments are primarily for telemetering mobile stations of an aeronautical nature. There are 140 assignments in this frequency band. The number of assignments is divided evenly between the two classes. Locations of these assignments are primarily around DOD test facilities as well as military installations. Consequently, a fairly large density appears in California and the Southwest. The 1400-1427 MHz portion of the band is an exclusive radio astronomy allocation.

- Operating Agencies - The agencies which have assignments in the band are confined to the DOD, specifically, the Air Force, Army and Navy. Each has approximately an equal number of assignments.

- Emission - The emission characteristics are fairly consistent. The majority of the assignments employ frequency modulation, with emission bandwidths of 1 MHz. Approximately 5% of the assignments are pulsed systems (radar), with emission bandwidths on the order of 1-10 MHz.

- Transmitter Power - The maximum transmitter power identified is 4000 kW employed by a Navy radar installation at China Lake, California. Four assignments are 40 kW, all at Camp Pendleton, California. In general, the high power systems are in the 1350-1400 MHz range, while the powers in the 1427-1450 MHz portion of the band are at the 10-30 Watt level.

- Antenna - Antennas employed for the radars in the 1350-1400 MHz portion of the band typically are 20-30 dB(i) gain arrays or reflectors. Those employed for the airborne system in the upper portion of the band are 0-3 dB(i) gain stubs or blades.

#### 3.7.2.2 Federal Communication Commission Data File

- Assignment Class - There are 17 assignments in the 1350-1450 MHz spectral region; of these, 13 are experimental assignments, 3 industrial, and 1 aeronautical.

The areas of operation are California (11 assignments), Maryland (4) and 1 assignment each in New Jersey and Maine.

- Users - The band is used by Westinghouse Communication Services, McDonnell Douglas Radio Services Corporation and Raytheon Service Co.

- Emission - Most of the assignments are frequency modulated, with bandwidths ranging from 500 kHz to 3 MHz. There are 2 amplitude modulated assignments, with bandwidths of 2.1 kHz. The remaining assignments are pulse modulated, with bandwidths from 100 kHz to 10 MHz.

- Transmitter Power - The maximum transmitter power is 3.6 kW. The remaining assignments vary from 500 milliwatts to 1 kW.

### 3.7.2.3 International Frequency List

- High Power Examination - In general, the frequency band can be divided into two portions. The 1350-1380 MHz frequency band contains assignments with the majority having powers from 500 to 2200 kW and one having a power of 6000 kW. The frequency band 1380-1450 MHz contains assignments with the majority having low powers, with the exception of 8 emitters at 20 kW.

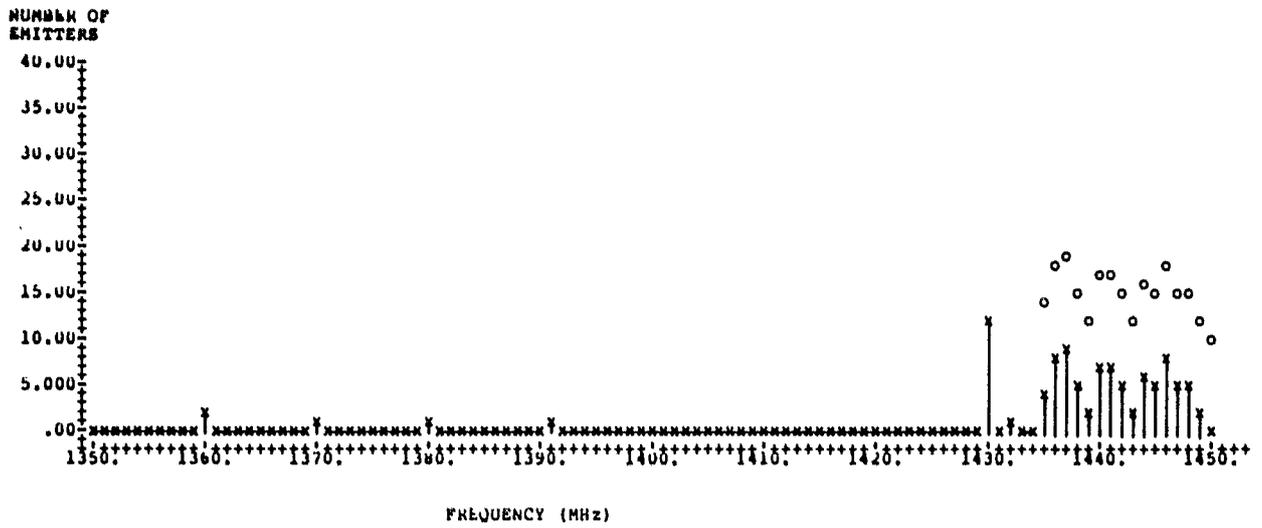
### 3.7.2.4 Classification - Probabilistic

### 3.7.2.5 Computer Histograms

Figure 3.7-1 presents the non-experimental emitter and power histograms for the 1350-1450 MHz band. Figure 3.7-2 presents the same including experimental assignments.

FREQUENCY BAND : 1350.0-1450.0(MHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

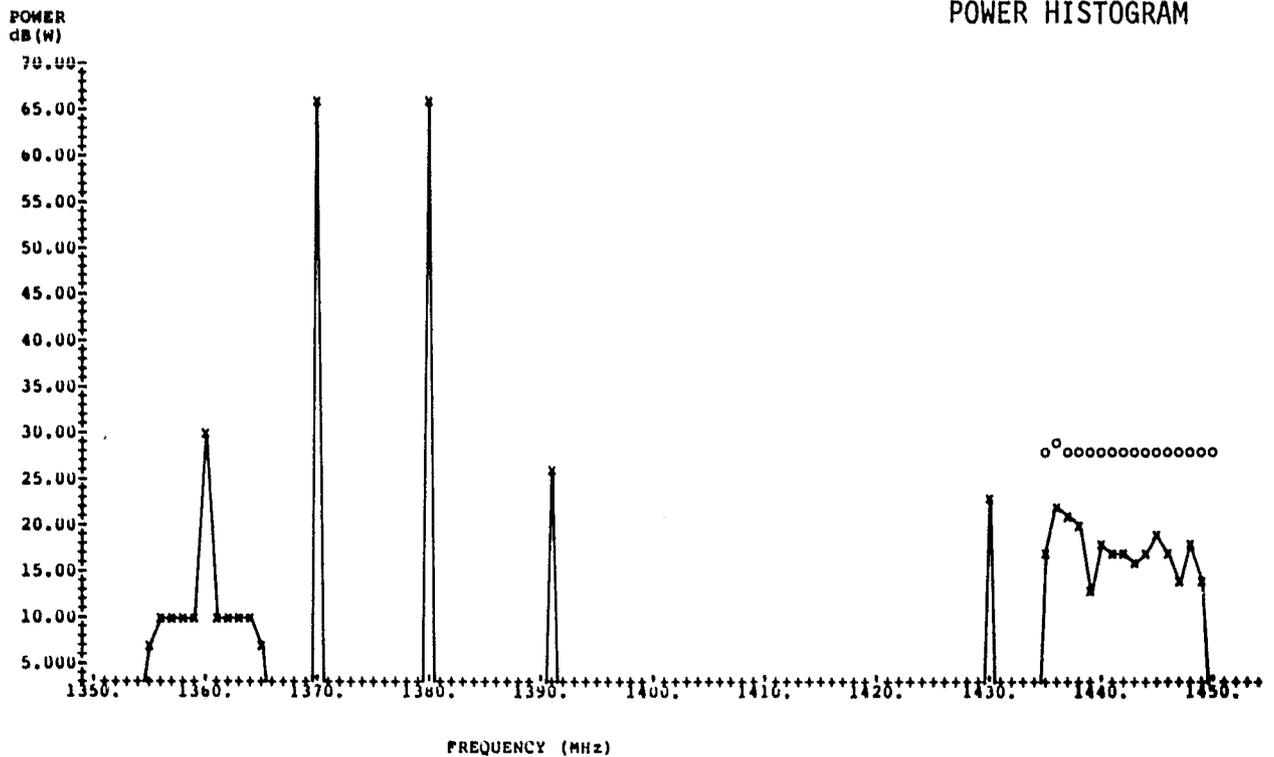
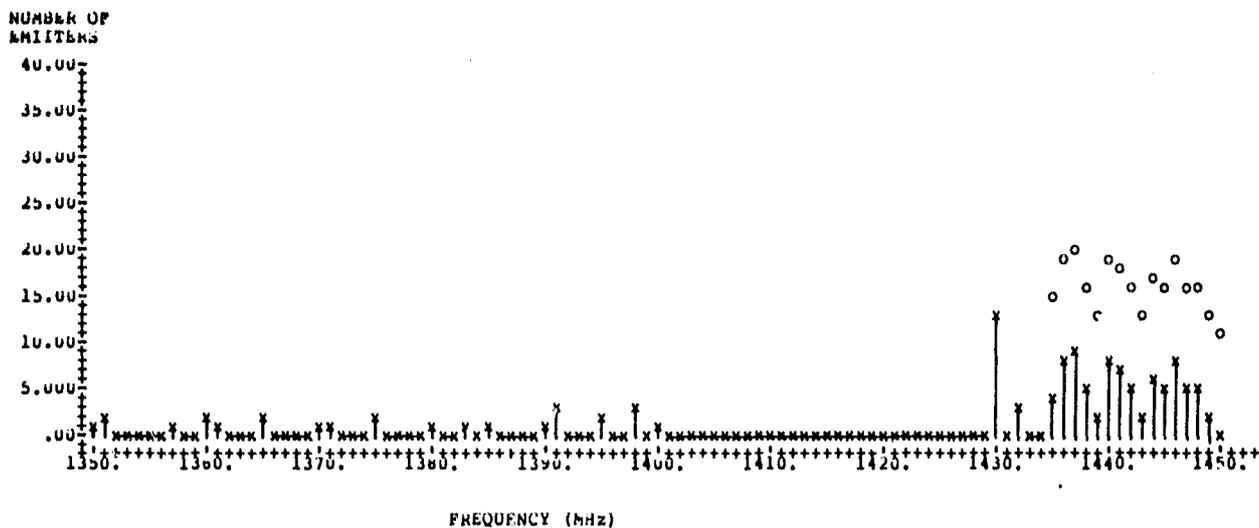


Figure 3.7-1 Non-Experimental Emitter and Power Histograms for the 1350-1450 MHz Band

FREQUENCY BAND : 1350.0-1450.0(MHz)  
 EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

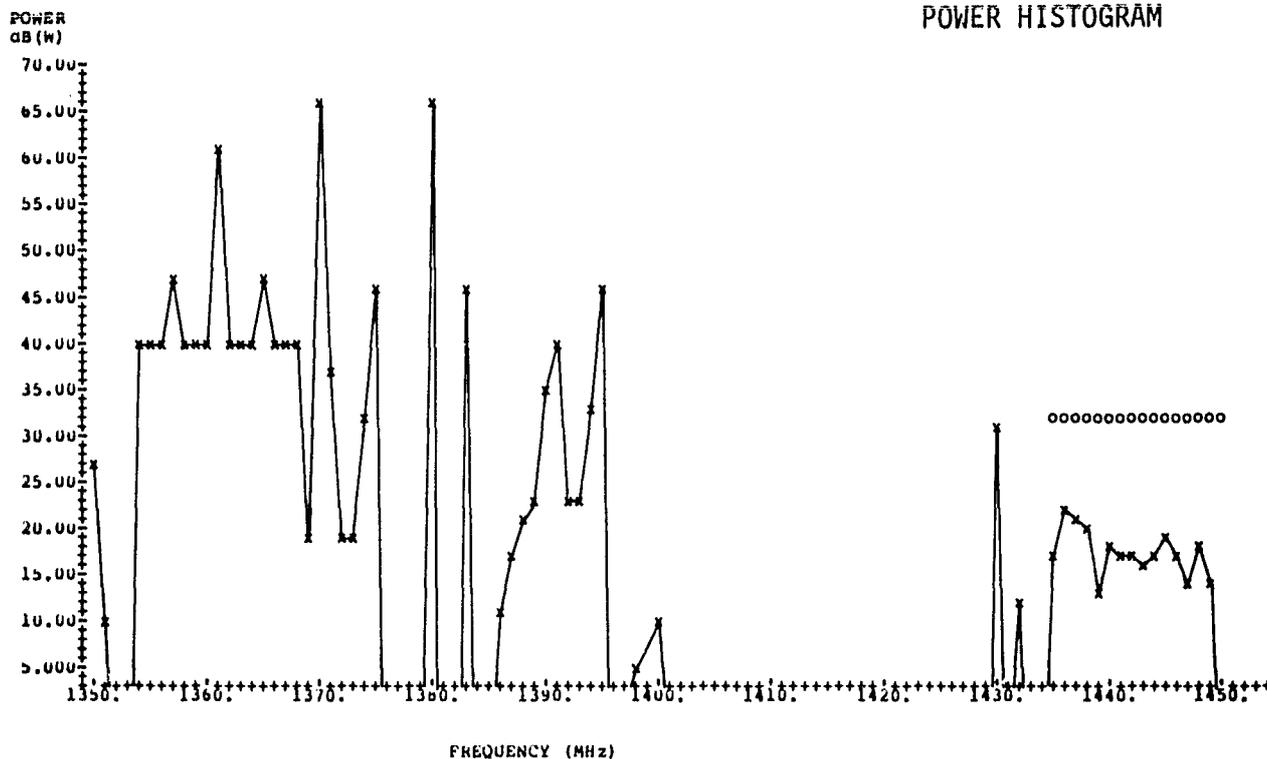


Figure 3.7-2 Emitter and Power Histograms for the 1350-1450 MHz Band Including Experimental Assignments

### 3.8 1636.5-1670 MHz Band

#### 3.8.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
1 636.5 - 1 644	MARITIME MOBILE-SATELLITE 352 352D 352H	
1 644 - 1 645	AERONAUTICAL MOBILE-SATELLITE (R) MARITIME MOBILE-SATELLITE 352 352D 352I	
1 645 - 1 660	AERONAUTICAL MOBILE-SATELLITE (R) 352 352D 352J	
1 660 - 1 670	METEOROLOGICAL AIDS RADIO ASTRONOMY 353A 354 354A 354B	

**352** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa** U.S.S.R., the band 1 535-1 660 MHz is also allocated to the fixed service. As  
 regards the category of the fixed service in the band 1 535-1 540 MHz, see Resolu-  
 tion No. Spa 3.

**352D** In Austria, Indonesia and the F. R. of Germany, the band 1 540-1 660 MHz is  
**Spa** also allocated to the fixed service.

**352H** The use of the band 1 636.5 - 1 644 MHz is limited to transmissions from  
**Spa2** earth to space stations in the maritime mobile-satellite service for commu-  
 nication and/or radiodetermination purposes. Transmissions from ship sta-  
 tions directly to coast stations, or between ship stations, are also authorized  
 when such transmissions are used to extend or supplement the ship-to-satellite  
 links.

**352I** The use of the band 1 644 - 1 645 MHz is limited to transmissions from  
**Spa2** earth to space stations in the aeronautical mobile-satellite (R) and maritime  
 mobile-satellite services for communication and/or radiodetermination purposes.  
 Transmissions from mobile stations directly to land stations, or between mobile  
 stations, of the aeronautical mobile (R) and maritime mobile services, are also  
 authorized. The utilization of this band is subject to prior operational co-  
 ordination between the two services.

**352J** The use of the band 1 645 - 1 660 MHz is limited to transmissions from  
**Spa2** earth to space stations in the aeronautical mobile-satellite (R) service for  
 communication and/or radiodetermination purposes. Transmissions from air-  
 craft stations in the aeronautical mobile (R) service directly to terrestrial aro-  
 nautical stations, or between aircraft stations, are also authorized when such  
 transmissions are used to extend or supplement the aircraft-to-satellite links.

**353A** In view of the successful detection by astronomers of two hydroxyl spectral lines in the regions of 1 665 MHz and 1 667 MHz, administrations are urged to give all practicable protection in the band 1 660 - 1 670 MHz for future research in radio astronomy particularly by eliminating air-to-ground transmissions in the meteorological aids service in the band 1 664.4 - 1 668.4 MHz as soon as practicable.

**354** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 1 660-1 690 MHz, 3 165-3 195 MHz, 4 800-4 810 MHz, 5 800-5 815 MHz and 8 680-8 700 MHz are also used for radio astronomy observations.

**354A** In Bulgaria, Cuba, Ethiopia, Hungary, Israel, Jordan, Kenya, Kuwait, Lebanon, Uganda, Pakistan, Poland, the United Arab Republic, Roumania, Syria, Tanzania, Czechoslovakia, the U.S.S.R. and Yugoslavia, the bands 1 660 - 1 670 MHz and 1 690 - 1 700 MHz are also allocated to the fixed service and the mobile, except aeronautical mobile, service.

**354B** In Australia, Cyprus, Spain, Ethiopia, Indonesia, Israel, New Zealand, Portugal, the Spanish Provinces in Africa, the United Kingdom, Sweden and Switzerland, the band 1 660-1 670 MHz is also allocated, on a secondary basis, to the fixed service, and the mobile, except aeronautical mobile, service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
1636.5-1644	MARITIME MOBILE-SATELLITE	MARITIME MOBILE-SATELLITE
1644-1645	AERONAUTICAL MOBILE-SATELLITE (K) MARITIME MOBILE-SATELLITE	AERONAUTICAL-MOBILE SATELLITE (R) MARITIME MOBILE-SATELLITE
1645-1660	AERONAUTICAL MOBILE-SATELLITE (R)	AERONAUTICAL MOBILE-SATELLITE (R)
1660-1670	METEOROLOGICAL AIDS (Radiosonde) RADIO ASTRONOMY	METEOROLOGICAL AIDS (Radiosonde) RADIO ASTRONOMY

### 3.8.2 Present Assignments

#### 3.8.2.1 Government Master File

- Assignment Class - All of the assignments are experimental except for one airborne radar altimeter. Two of the assignments are for Earth-to-space transmissions by NASA to ATS-6, to support the PLACE experiment. The government master file contains only 6 assignments in this band. Geographically, the assignments are not centralized to one area.

- Operating Agencies - The operating agencies are NASA, ERDA and the Air Force.

- Emission - The emissions are frequency modulated except for the radar altimeter. The emission bandwidths are 1 to 12 MHz.

- Transmitter Power - The transmitter powers employed are 1 kW for the space systems, and 20 Watts, 75 Watts and 1 kW for the terrestrial systems.

- Antenna - The terrestrial systems use parabolic antennas with gains on the order of 18-25 dB(i). The space systems (Earth-to-space) employ 35 dB(i) gain reflectors.

#### 3.8.2.2 Federal Communications Commission Data File

- Assignment Class - This band is comprised almost exclusively of industrial mobile users through the U.S. There are a few assignments for mobile auxiliary broadcast, radioastronomy, aviation, forestry and industrial radiolocation. There are a total of 215 assignments with mobile units authorized to operate throughout the U.S.

- Users - With the exception of one assignment to the state of Maryland, the assignments are all allocated to private interests.

- Emission - The mobile industrial users, which basically make up the band, have emission bandwidths of 3 kHz, and use amplitude modulation. The remaining assignments vary from 25 kHz - 10 MHz, frequency modulated, and 1 - 10 kHz, amplitude modulated.

- Transmitter Power - The majority of assignments use powers of 100 W. The remaining few range from 25 W to 350 W.

### 3.8.2.3 International Frequency List

- High Power Examination - In this band there are 2 assignments at 30 kW, with the remaining assignments being less than 2.1 kW. Many assignments do not designate the power.

### 3.8.2.4 Classification - Probabilistic

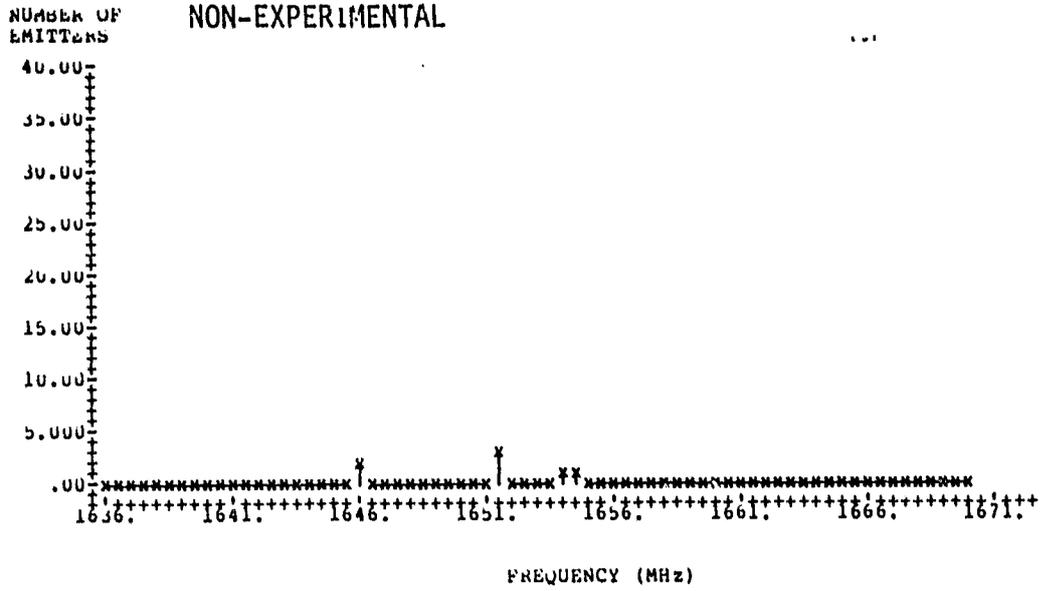
### 3.8.2.5 Computer Histograms

Figure 3.8-1 presents the non-experimental emitter and power histograms. Figure 3.8-2 presents the same including experimental stations.

EMITTER HISTOGRAM

FREQUENCY BAND : 1636.0-1670.0(MHz)

NON-EXPERIMENTAL



POWER HISTOGRAM

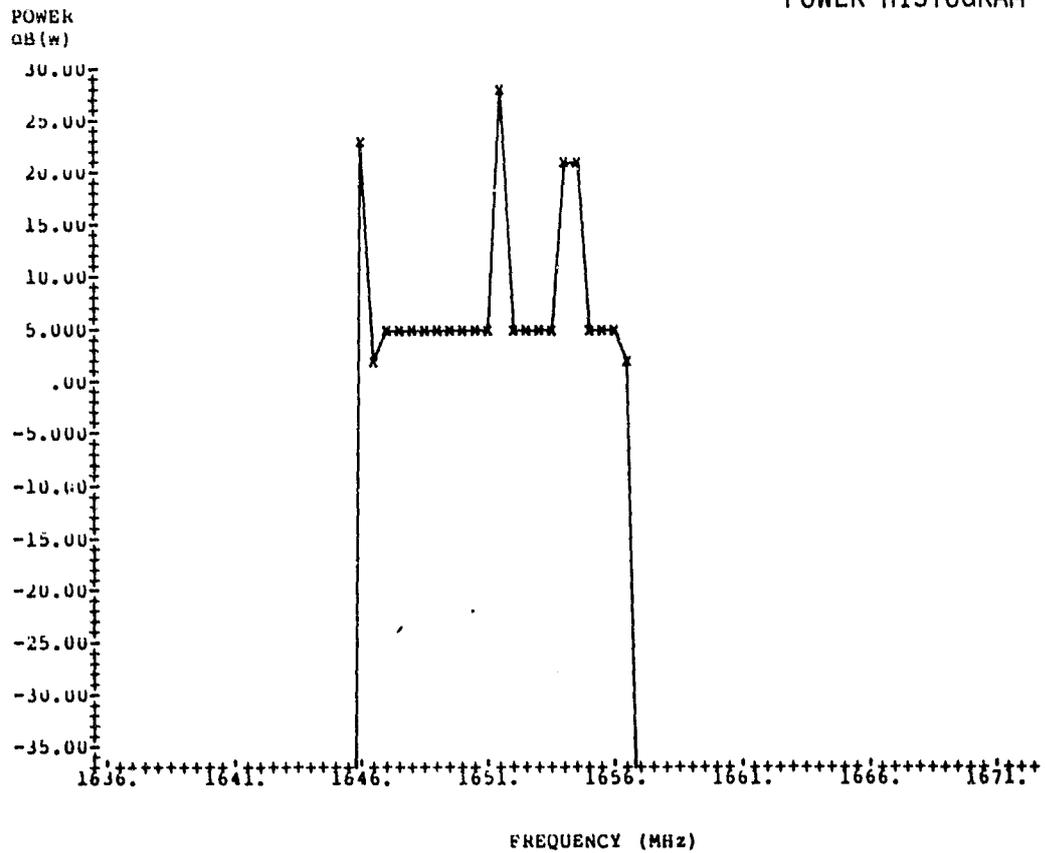


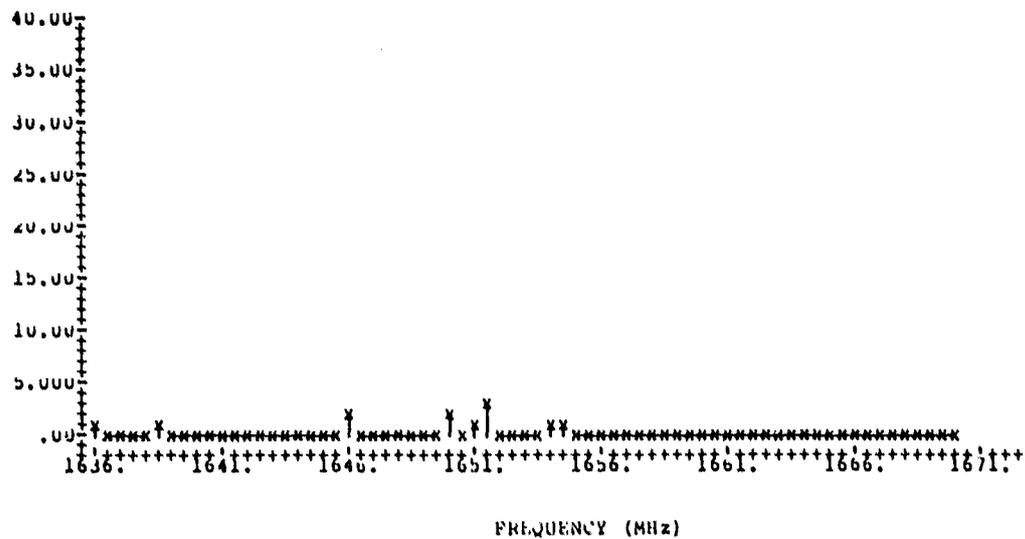
Figure 3.8-1 Non-Experimental Emitter & Power Histograms for the 1636-1670 MHz Band

# EMITTER HISTOGRAM

FREQUENCY BAND : 1636.0-1670.0(MHz)

NUMBER OF  
EMITTERS

EXPERIMENTAL



# POWER HISTOGRAM

POWER  
dB(W)

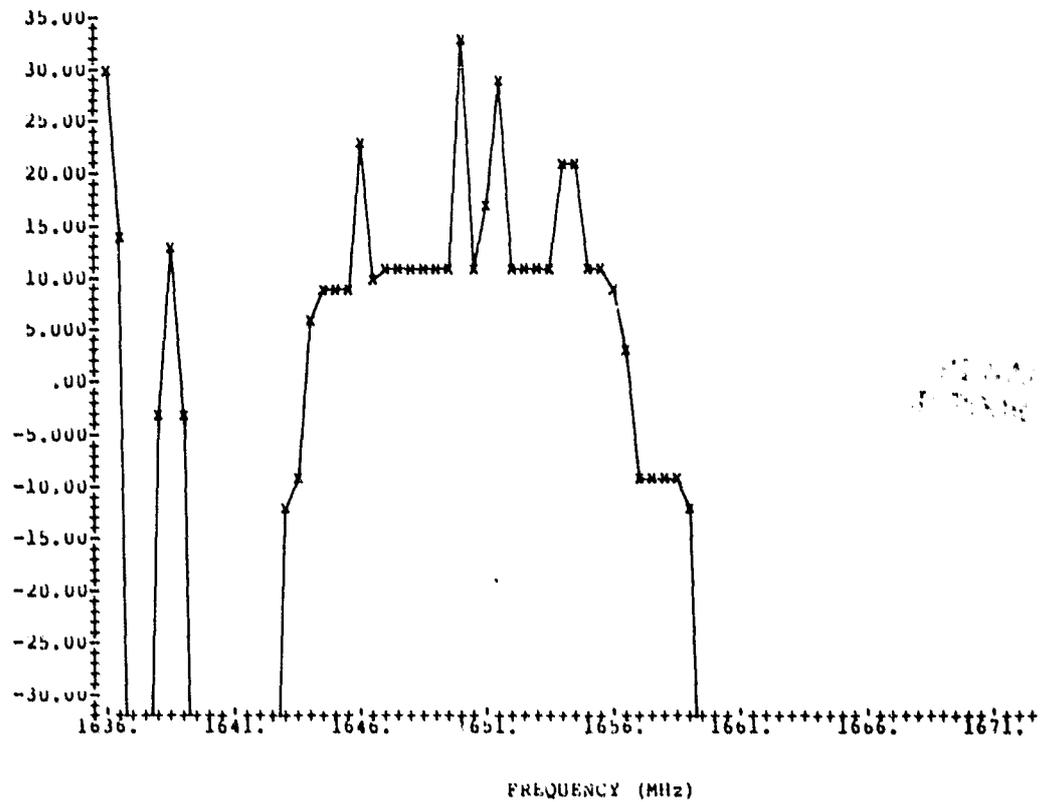


Figure 3.8-3 Emitter & Power Histograms for the 1636-1670 MHz Band Including Experimental Assignments

### 3.9 2040-2110 MHz Band

#### 3.9.1 Allocations

INTERNATIONAL					
Region 1		Region 2		Region 3	
1 790	2 290	1 790	2 290		
FIXED			FIXED		
Mobile			MOBILE		
356	356AB	356ABA			
356AC			356A	356AB	356ABA

**356** In Switzerland, the band 1 710 - 2 290 MHz is allocated to the fixed service and the mobile, except the aeronautical mobile, service and the band 1 770 - 1 790 MHz is also allocated, on a secondary basis, to the meteorological-satellite service.

**356A** In Region 2, in Australia and Japan, the band 1 750 - 1 850 MHz may also be used for Earth-to-space transmissions, and in Regions 2 and 3, the band 2 200 - 2 290 MHz may also be used for space-to-Earth transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356AB** In Regions 2 and 3 and in Spain, in the band 2 025 - 2 120 MHz Earth-to-space transmissions in the earth exploration-satellite service may be authorized with equality of right to operate with stations of other space radiocommunication services in this band and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356ABA** In Region 2, in Australia and Spain, in the band 2 025 - 2 120 MHz and in Regions 1 and 3, in the band 2 110 - 2 120 MHz Earth-to-space transmissions in the space research service may be authorized with equality of right to operate with other space radiocommunication services in these bands and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356AC** In Region 1, in the band 2 026 - 2 120 MHz, Earth-to-space transmissions in the earth exploration-satellite service may be authorized with equality of right to operate with stations of other space radiocommunication services in this band and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected (see No. 356AB).

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
1990-2110		FIXED MOBILE NG11

NG11 Television inter-city relay stations may be authorized to use frequencies in this band on the condition that harmful interference will not be caused to stations operating in accordance with the Table of Frequency Allocations.

### 3.9.2 Present Assignments

#### 3.9.2.1 Government Master File

- Assignment Class - The assignment class is almost exclusively experimental research, including Earth-to-space transmissions to low orbit, geostationary and deep space spacecraft (at the band edge 2110 MHz). There are approximately 100 assignments in the band. Most of the assignments are located at the NASA Space Tracking and Data Acquisition stations in Guam, Hawaii, California, North Carolina and Alaska.

- Operating Agencies - The only agency with assignments in the band is NASA, with transmissions occurring from Rosman, N. C.; Fairbanks, Alaska; Goldstone, Calif.; Merritt Island, Florida; Guam and Hawaii. Operation would generally occur only on an intermittent basis.

- Emission - In general, the emission bandwidths range from 1 to 3 MHz, employing FM techniques.

- Transmitter Power - The majority of the assignments indicate a 10 kW level of RF output. Most of the time, however, especially when working low-orbit spacecraft, 100-200 Watts is sufficient. The higher power capabilities are provided as backup safety systems, for instance, when a spacecraft tumbles, and commands must pass through receiver antennas with a gain of no more than 0 dB(i).

- Antenna - Antennas employed are parabolic reflectors with gains ranging from 20-40 dB(i).

### 3.9.2.2 Federal Communications Commission Data File

- Assignment Class - This band is used almost exclusively by the Auxiliary Broadcast for Television Intercity Relay and Television Pick-up. There are two point-to-point fixed microwave assignments and one fixed experimental assignment. There are approximately 500 assignments throughout the United States.

- Users - The users of this band are mainly television and radio stations and state agencies.

- Emission - Most of the assignments are frequency modulated, with emission bandwidths from 1 to 18 MHz. There are a few auxiliary broadcast assignments, with emission bandwidths of 25 MHz. The experimental assignments have emission bandwidths of 5 MHz. The fixed microwave assignments have emission bandwidths of 3 MHz and 800 kHz.

- Transmitter Power - The transmitter powers in this band vary from 1 to 16 Watts, with a few less than 1 Watt.

### 3.9.2.3 International Frequency List

- High Power Examination - The majority of the 500 assignments are less than 1 kW. One fifth of the assignments have powers between 1 kW and 50 kW. Thirty assignments designate powers of 160 kW.

### 3.9.2.4 Classification - Probabilistic

### 3.9.2.5 Computer Histograms

Figure 3.9-1 presents the non-experimental emitter and power histograms. Figure 3.9-2 presents the same include experimental assignments.

EMITTER HISTOGRAM

FREQUENCY BAND : 2040.0-2110.0(MHz)

NON-EXPERIMENTAL

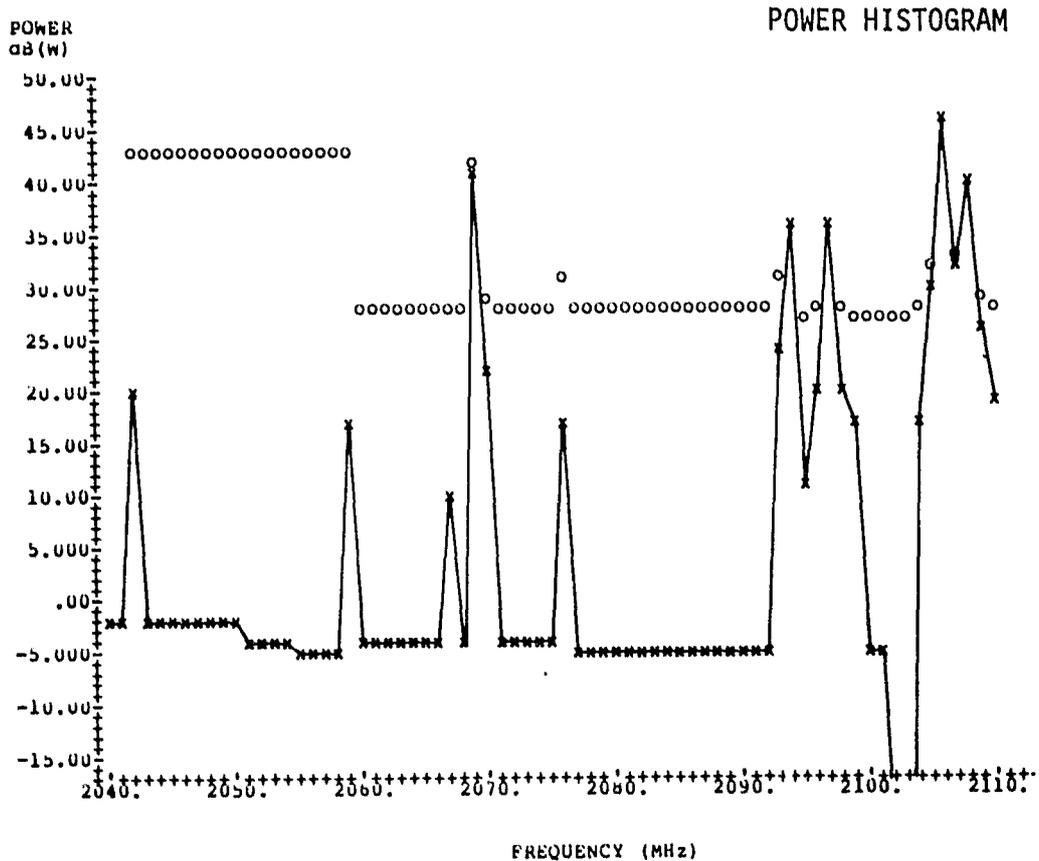
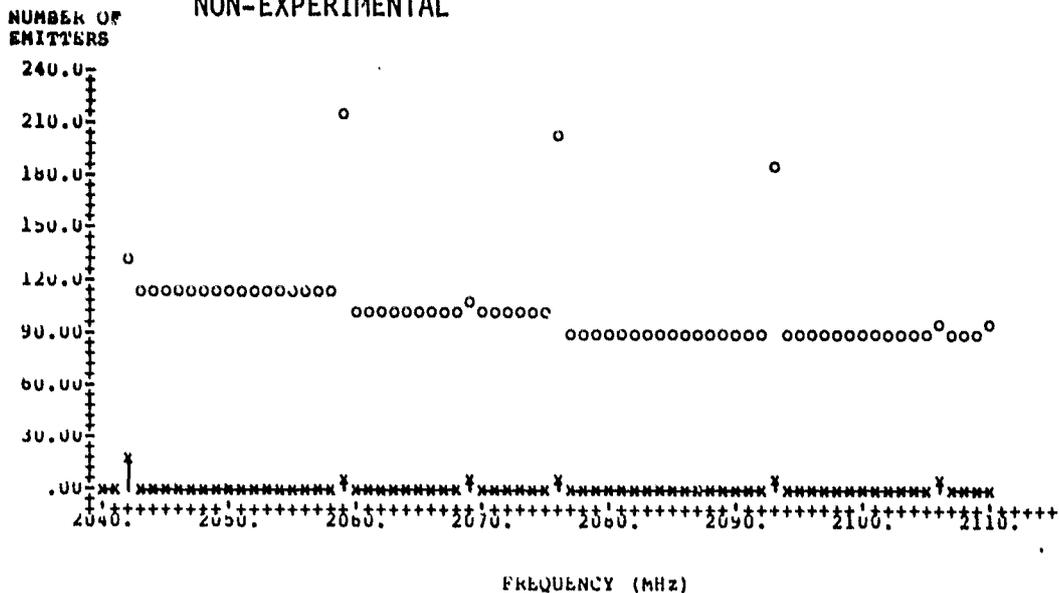
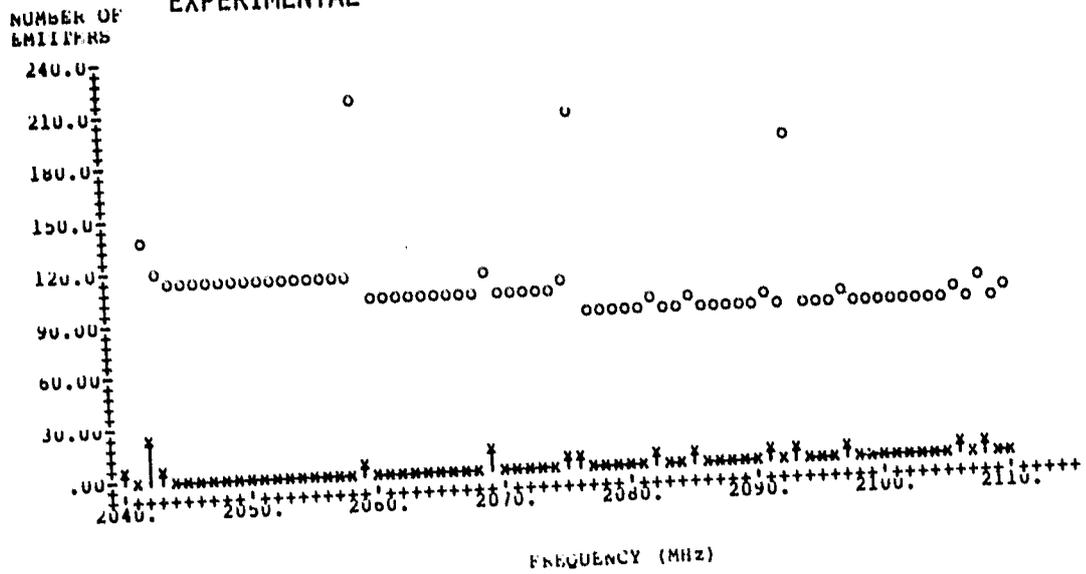


Figure 3.9-1 Non-Experimental Emitter and Power Histograms for the 2040-2110 MHz Band

# EMITTER HISTOGRAM

FREQUENCY BAND : 2040.0-2110.0(MHz)

EXPERIMENTAL



# POWER HISTOGRAM

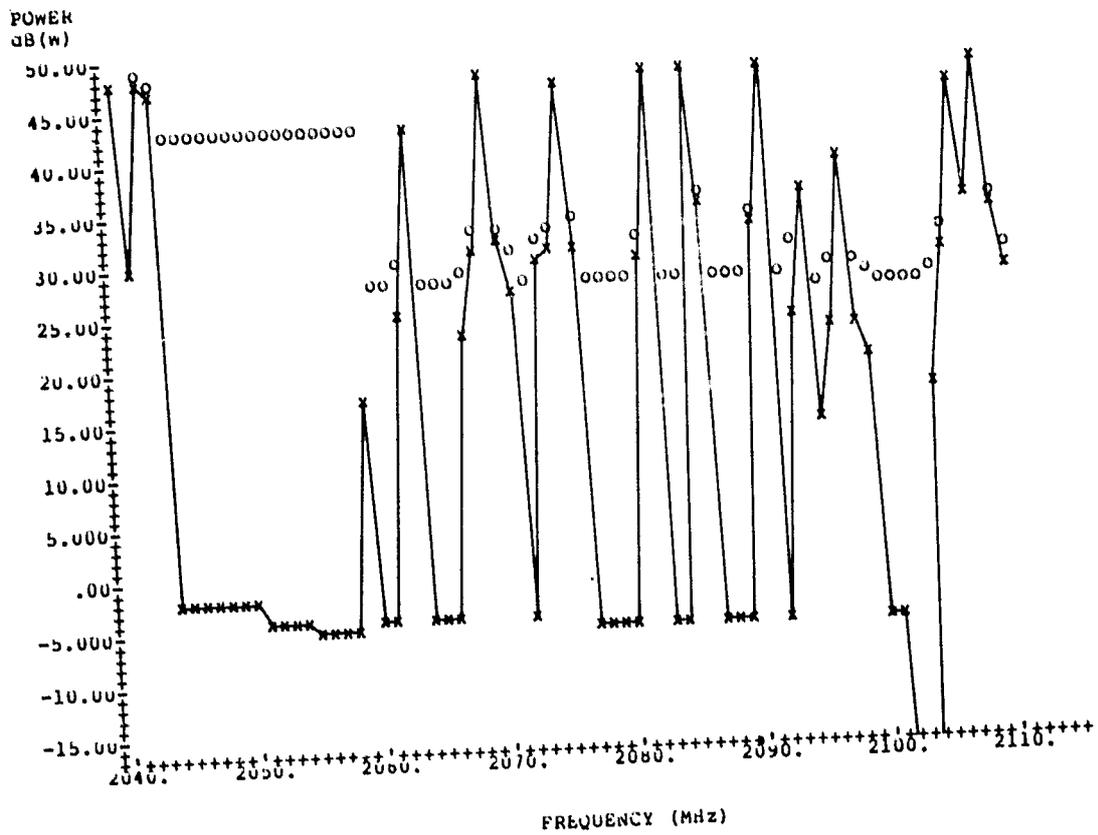


Figure 3.9-2 Emitter and Power Histograms for the 2040-2110 MHz Band Including Experimental Assignments

### 3.10 2200-2300 MHz Band

#### 3.10.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
<b>1 790 - 2 290</b> FIXED <i>Mobile</i> 356 356AB 356ABA 356AC	<b>1 790 - 2 290</b> FIXED MOBILE 356A 356AB 356ABA	
<b>2 290 - 2 300</b> FIXED SPACE RESEARCH (Space-to-Earth) <i>Mobile</i> 356C	<b>2 290 - 2 300</b> FIXED MOBILE SPACE RESEARCH (Space-to-Earth)	

**356 Spa2** In Switzerland, the band 1 710 - 2 290 MHz is allocated to the fixed service and the mobile, except the aeronautical mobile, service and the band 1 770 - 1 790 MHz is also allocated, on a secondary basis, to the meteorological-satellite service.

**356A Spa2** In Region 2, in Australia and Japan, the band 1 750 - 1 850 MHz may also be used for Earth-to-space transmissions, and in Regions 2 and 3, the band 2 200 - 2 290 MHz may also be used for space-to-Earth transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356AB Spa2** In Regions 2 and 3 and in Spain, in the band 2 025 - 2 120 MHz Earth-to-space transmissions in the earth exploration-satellite service may be authorized with equality of right to operate with stations of other space radiocommunication services in this band and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356ABA Spa2** In Region 2, in Australia and Spain, in the band 2 025 - 2 120 MHz and in Regions 1 and 3, in the band 2 110 - 2 120 MHz Earth-to-space transmissions in the space research service may be authorized with equality of right to operate with other space radiocommunication services in these bands and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**356AC Spa2** In Region 1, in the band 2 096 - 2 120 MHz, Earth-to-space transmissions in the earth exploration-satellite service may be authorized with equality of right to operate with stations of other space radiocommunication services in this band and subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected (see No. 356AB).

**356C Spa** In Austria, the space research service in the band 2 290-2 300 MHz is a secondary service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
2200-2290	FIXED (LOS only) MOBILE (LOS only including aeronautical telemetering, but excluding flight testing of manned aircraft) SPACE RESEARCH (Space-to-Earth) G101	
2290-2300	SPACE RESEARCH (Space-to-Earth) (Deep space only) FIXED MOBILE except aeronautical mobile G101	SPACE RESEARCH (Space-to-Earth) (Deep space only)

G101 In the band 2200-2300 MHz, telemetering, tracking, ranging, analog/digital data and/or voice from operational space stations may be accommodated on a co-equal basis with fixed, mobile and space research services.

### 3.10.2 Present Assignments

#### 3.10.2.1 Government Master File

- Assignment Class - The assignments for the most part are experimental or mobile stations (specifically telemetering). There are a few maritime mobile, aeronautical mobile and space tracking and telemetering stations. The space stations are assigned throughout the spectral region 2200 to 2300 MHz. There are approximately 800 assignments distributed throughout the U.S.

- Operating Agencies - The Air Force, Army and Navy are the users most often listed in the data files. However, other agencies such as NASA, Coast Guard, National Security Agency, ERDA, also make use of this band. The space stations are operated by NASA and the Air Force.

- Emission - Most assignments are frequency modulated, with emission bandwidths from .1 kHz to 10 MHz. There are some bandwidths in the range 10 MHz to 30 MHz. A few assignments are pulse modulated, with bandwidths up to 1 MHz.

- Transmitter Power - The transmitter powers for the most part are less than .1 kW, with a few 1 kW assignments. One exception is an Air Force experimental research assignment at 2250 MHz, with a transmitter power of 2 kW, and an emission bandwidth of 10 MHz, pulse modulated.

- Antenna - Antennas of various kinds are used in this frequency band, ranging from parabolics with gains of 30 dB(i) to horizontally omnidirectional antennas with gains of 8 dB(i).

#### 3.10.2.2 Federal Communications Commission Data File

- Assignment Class - This frequency band is almost exclusively made up of industrial users (mainly mobile units). The remaining few assignments are experimental mobile units and public safety assignments. There are a total of 435 assignments located throughout the 48 contiguous states.

- Emission - The majority of assignments are amplitude modulated, with bandwidths ranging from 2 to 8 kHz. The remaining assignments are frequency modulated, with bandwidths of 250 kHz to 20 MHz.

- Transmitter Power - The transmitter powers designated vary from 100 milliwatts to 2 kW.

### 3.10.2.3 International Frequency List

- High Power Examination - The majority of the 1200 assignments are less than 1 kW. Ten percent of the assignments have powers between 1 and 50 kW. There are 24 assignments which designate powers of 160 kW. Five percent of the assignments do not specify powers.

### 3.10.2.4 Classification - Probabilistic, non-deterministic

### 3.10.2.4 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.11 2655-2690 MHz Band

#### 3.11.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
2 655 2 690 FIXED 364C 364D MOBILE except aeronautical mobile BROADCASTING- SATELLITE 361B 364H	2 655 2 690 FIXED 364C 364D FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile BROADCASTING-SATELLITE 361B 364H	
363 364 364F 364G	364E 364F 364G	

**361B** The use of the band 2 500 - 2 690 MHz by the broadcasting-satellite service is limited to domestic and regional systems for community reception and such use is subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected (see Resolutions Nos. Spa2 - 2 and Spa2 - 3). The power flux density at the Earth's surface shall not exceed the values given in Nos. 470NH 470NK.

**363** In the F. R. of Germany, the band 2 550-2 690 MHz is allocated to the fixed service; and the band 2 690-2 700 MHz is also allocated to the fixed service.

**364** In Region 1, tropospheric scatter systems may operate in the band 2 550 - 2 690 MHz, subject to agreement between the administrations concerned and those having terrestrial radiocommunication services, operating in accordance with the Table, which may be affected.

**364C** When planning new tropospheric scatter radio-relay links in the band 2 500 - 2 690 MHz, all possible measures shall be taken to avoid directing the antennae of these links towards the geostationary satellite orbit.

**364D** Administrations shall make all practicable effort to avoid developing new tropospheric scatter systems in the band 2 655 - 2 690 MHz.

**364F** In Bulgaria, Iran, Portugal and the U.S.S.R., the band 2 500 - 2 690 MHz is allocated to the fixed service and the mobile, except aeronautical mobile, service.

**364G** Radio astronomy observations in the band 2 670 - 2 690 MHz are carried out in a number of countries under national arrangements. Administrations should bear in mind the needs of the radio astronomy service in their future planning of this band.

**364H** In the design of systems in the broadcasting-satellite service, administrations are urged to take all necessary steps to protect the radio astronomy service in the band 2 690 - 2 700 MHz.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
2655-2690		BROADCASTING-SATELLITE FIXED NG8 NG47 NG101 NG102	(Note: Also fixed-satellite by non-Government footnote)

**NG8** Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocation.

**NG47** In the band 2500-2690 MHz, the television channels 2650-2658 MHz, 2662-2668 MHz, and 2674-2680 MHz and the corresponding response frequencies 2686.9375 MHz, 2687.9375 MHz and 2688.9375 MHz may be assigned to operational fixed stations in the public safety services (Part 89 of this chapter) on a primary basis and to operational fixed stations in other services on a secondary basis. Such assignments are subject to the condition that all operational fixed stations must comply with the technical standards applicable to stations in the instructional television fixed service contained in Subpart I of Part 74 of this chapter. All other frequencies in this band for terrestrial operations are available for assignment only to stations in the instructional television fixed service. Stations authorized in this band as of July 16, 1971, which do not comply with the above provisions may continue to operate on their presently assigned frequencies on a co-equal basis with other stations operating in accordance with the table of frequency allocations. Requests for subsequent license renewals or modifications of existing licenses will be considered; however, expansion of systems comprised of such stations will not be permitted. In Alaska, however, frequencies within the band 2655-2690 MHz are not available for assignment to terrestrial stations.

**NG101** The use of the band 2500-2690 MHz by the broadcasting satellite service is limited to domestic and regional systems for community reception of educational television programming and public service information. Such use is subject to agreement among administrations concerned and those having services operating in accordance with the table, which may be affected. Unless such agreement includes the use of higher values, the power flux density at the earth's surface produced by emissions from a space station in this service shall not exceed those values set forth in Part 73 of the rules for this frequency band.

**NG102** The frequency bands 2500-2535 MHz (space-to-earth) and 2655-2690 MHz (earth-to-space) are allocated for use in the fixed-satellite service as follows:

(a) For common carrier use in Alaska, for intra-Alaska service only, and, in the mid and western Pacific area including American Samoa, the Trust Territory of the Pacific Islands, Guam and Hawaii:

(b) For educational use in the contiguous United States, Alaska, and the mid and western Pacific area including American Samoa, the Trust Territory of the Pacific Islands, Guam and Hawaii.

Such use is subject to agreement with administrations having services operating in accordance with the table, which may be affected. In the band 2500-2535 MHz, unless such agreement includes the use of higher values, the power flux density at the earth's surface produced by emissions from a space station in this service shall not exceed the values set forth in Part 25 of the rules for this frequency band.

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### 3.11.2 Present Assignments

#### 3.11.2.1 Government Master File

- Assignment Class - In this frequency band there is only one assignment, an experimental research station transmitting from space.

- Operating Agencies - This assignment is for the ATS-6 satellite under control of Goddard Space Flight Center.

- Emission - This assignment is frequency modulated, with an emission bandwidth of 40 MHz.

- Transmitter Power - The specified transmitter power is .015 kW.

- Antenna - The parabolic antenna has a gain of ~45 dB(i).

#### 3.11.2.2 Federal Communications Commission Data File

- Assignment Class - The assignments in this band are mainly auxiliary broadcast (Instructional Television Fixed Service, ITFS), with some public safety stations. The majority of assignments are located in California, New Jersey, New York, Pennsylvania and Wisconsin. The remaining assignments are distributed throughout the U.S.

- Emission - The majority of assignments (ITFS) are combined amplitude and frequency modulated signals (one carrying the sound portion, the other carrying video for TV broadcasting). Other assignments indicate emission bandwidths of 5.75 to 6 MHz, amplitude modulated; 17 MHz, frequency modulated; and a single assignment with a 500 kHz, pulse modulated; and 2 kHz, frequency modulated, signal.

- Transmitter Power - The transmitter powers vary from 130 microwatts to 100 Watts.

#### 3.11.2.3 International Frequency List

- High Power Examination - There are 115 assignments in this band. Powers designated are less than .1 kW, except 10 at 10 kW and 1 at 1 kW.

#### 3.11.2.4 Classification

Overall, the band is classified as probabilistic. However, since the ITFS is fairly well defined in the U.S., both technically and geographically, certain portions of the band can be analyzed in a deterministic manner.

#### 3.11.2.5 Computer Histograms

Figure 3.11-1 presents the emitter and power histograms for the 2655-2690 MHz band.

# EMITTER HISTOGRAM

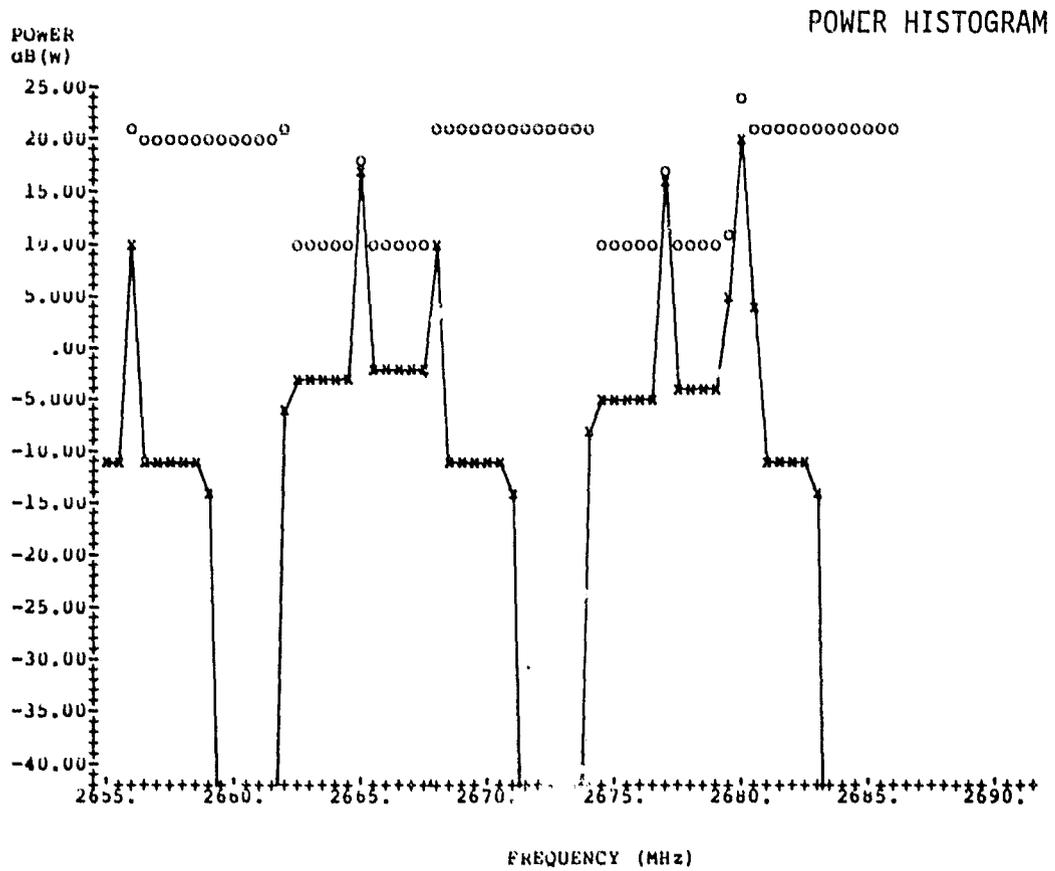
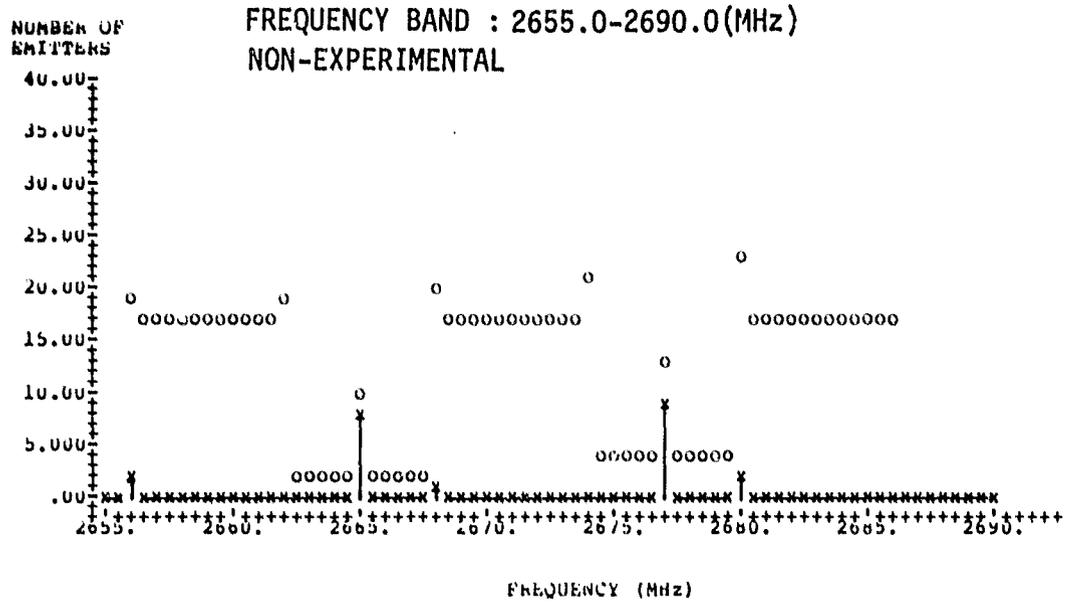


Figure 3.11-1 Non-Experimental Emitter and Power Histograms for the 2655-2690 MHz Band

### 3.12 2690-2700 MHz Band

#### 3.12.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
2 690 - 2 700	RADIO ASTRONOMY	
	233B 363 364A 364B	

**233B** In making assignments to stations of other services to which the bands  
**Spa2** 37.75-38.25 MHz, 150.05-153 MHz, 406.1-416 MHz, 2 690 - 2 700 MHz and 4 700 - 5 000 MHz are allocated, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference.

**363** In the F. R. of Germany, the band 2 550-2 690 MHz is allocated to the fixed  
**Spa** service; and the band 2 690-2 700 MHz is also allocated to the fixed service.

**364A** In Bulgaria, Cuba, Hungary, India, Israel, Kuwait, Lebanon, Morocco,  
**Spa2** Pakistan, the Philippines, Poland, the United Arab Republic, Roumania, Czechoslovakia, the U.S.S.R. and Yugoslavia, the band 2 690 - 2 700 MHz is also allocated to the fixed and mobile services.

**364B** In Algeria, Bulgaria, Hungary, Poland, the United Arab Republic, Yugoslavia,  
**Spa** Roumania, Czechoslovakia and the U.S.S.R., tropospheric scatter systems may operate in the band 2 690-2 700 MHz under agreements concluded between administrations concerned and those having services operating in accordance with the Table, which may be affected.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
2690-2700	RADIO ASTRONOMY G45	RADIO ASTRONOMY

**G45** No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

### 3.12.2 Present Assignments

#### 3.12.2.1 Government Master File

- Assignment Class - The band is allocated exclusively to the radio-astronomy service. A radionavigation land station and surveillance radar station are the only other assignments in this band. They are located in California and Texas respectively.

- Operating Agencies - The radionavigation station is operated by the Naval Air Station, and the surveillance radar is operated by the Air Force.

- Emission - The assignments are pulse modulated, with emission bandwidths of 1.44 MHz and 11 MHz.

- Transmitter Power - The transmitter powers are 230 and 600 kW.

- Antenna - The Navy specifies a parabolic antenna with a gain of 34 dB(i), and the Air Force specifies a parabolic antenna with a gain of 20 dB(i).

#### 3.12.2.2 Federal Communications Commission Data File

- Assignment Class - The assignments in this band are almost exclusively experimental, with 40 of them being mobile units. A large concentration of the total 42 assignments are located in Wisconsin and Texas.

- Users - Private industry is the primary user in this band.

- Emission - The assignments are frequency modulated, with emission bandwidths of 6 kHz.

- Transmitter Power - The transmitter power varies from 100 milliwatts to 75 Watts.

#### 3.12.2.3 International Frequency List

- High Power Examination - There are 22 assignments in the band. The majority are radioastronomy stations. A few stations specify powers less than 1 kW, and there is one assignment of 460 kW and two assignments of 500 kW.

#### 3.12.2.4 Classification

For the most part, this is a quiet frequency band allocated exclusively to the radioastronomy service for continuum measurements. Classification is not applicable.

#### 3.12.2.5 Computer Histograms

Histograms are not considered appropriate for this band.

### 3.13 4200-4400 MHz Band

#### 3.13.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
4 200 - 4 400		
AERONAUTICAL RADIONAVIGATION		
	352A 379A 381 382 383	

**352A**      The bands 1 558.5 - 1 636.5 MHz, 4 200 - 4 400 MHz, 5 000 - 5 250 MHz  
**Spa2**      and 15.4 - 15.7 GHz are reserved on a world-wide basis for the use and develop-  
 ment of airborne electronic aids to air navigation and any directly associated  
 ground-based or satellite-borne facilities.

**379A**      The standard frequency-satellite service and the time signal-satellite service  
**Spa2**      may be authorized to use the frequency 4 202 MHz for space to-Earth transmis-  
 sions and the frequency 6 427 MHz for Earth-to-space transmissions. Such  
 transmissions shall be confined within the limits of  $\pm 2$  MHz of these frequencies  
 and shall be subject to agreement between the administrations concerned and  
 those having services, operating in accordance with the Table, which may be  
 affected.

**381**      In China and the Philippines, the band 4 200-4 400 MHz is also allocated,  
 on a secondary basis, to the fixed service.

**382**      In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
 U.S.S.R., the band 4 200-4 400 MHz is also allocated to the fixed and mobile  
 services subject to causing no harmful interference to the aeronautical radio-  
 navigation service used by aircraft on international air routes in these countries.

**383**      In Austria, Denmark, Norway, the F. R. of Germany, Sweden and Switzerland,  
 the band 4 200-4 210 MHz is also allocated, on a secondary basis, to the fixed  
 service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
4200-4400	AERONAUTICAL RADIONAVIGATION G58	AERONAUTICAL RADIONAVIGATION

**G58**      No stations will be authorized to transmit in the band 4200-4400 MHz  
 except altimeter stations and experimental stations. Experimental  
 stations will not be authorized to develop equipment for operational  
 use in this band other than equipment related to altimeter stations.

### 3.13.2 Present Allocations

#### 3.13.2.1 Government Master File

- Assignment Class - The assignments in this band are made up of users in the experimental and aeronautical radionavigation service (altimeters). The 39 assignments are mainly located in the western portion of the U.S.

- Operating Agencies - The Navy and Air Force are the primary users, with some assignments used by the Departments of Commerce, Interior, Army, NASA, and ERDA.

- Emission - The assignments are mainly pulse modulated, with emission bandwidths from 600 kHz to 180 MHz. There are some frequency modulated systems, with bandwidths from 100 kHz to 110 MHz, and a few amplitude modulated assignments, varying from .01 to 6 kHz.

- Transmitter Power - The transmitter powers vary from .5 Watts to .5 kW. There are four exceptions to this. One Air Force experimental testing assignment operating over the range 4200-4990 MHz specifies a transmitter power of 2 kW, with an emission bandwidth of 20 MHz, pulse modulated. There are three Air Force experimental testing assignments operating over the same range, with specified transmitter powers of 5 kW, and emission bandwidths of 6 kHz and 50 kHz, amplitude and pulse modulated respectively. The other assignment is unmodulated. The antenna designated for these three assignments has a gain of 30 dB(i).

- Antenna - The antennas specified in this band are horns, arrays and parabolic reflectors with gains up to 40 dB(i) on the latter.

### 3.13.2.2 Federal Communications Commission Data File

- Assignment Class - This band is used for industrial, experimental and aviation radionavigation service. There are a total of 19 assignments in this band, located in California and Oklahoma.

- Emission - The assignments in this band are mainly frequency modulated, with bandwidths of 20 kHz. The remaining assignments are amplitude modulated, with emission bandwidths of 2 kHz, and pulse modulated, with emission bandwidths of 10, 32, and 110 MHz.

- Transmitter Power - The majority of transmitter powers specified are on the order of 200 Watts. The remaining powers vary from 1 milliwatt to 20 kW.

### 3.13.2.3 International Frequency List

- High Power Examination - The 73 assignments in this band list transmitter powers of less than .01 kW.

### 3.13.2.4 Classification - Probabilistic

### 3.13.2.5 Computer Histograms

Figure 3.13-1 presents the non-experimental emitter and power histograms. Figure 3.13-2 presents the same including experimental assignments.

FREQUENCY BAND : 4200.0-4400.0(MHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM

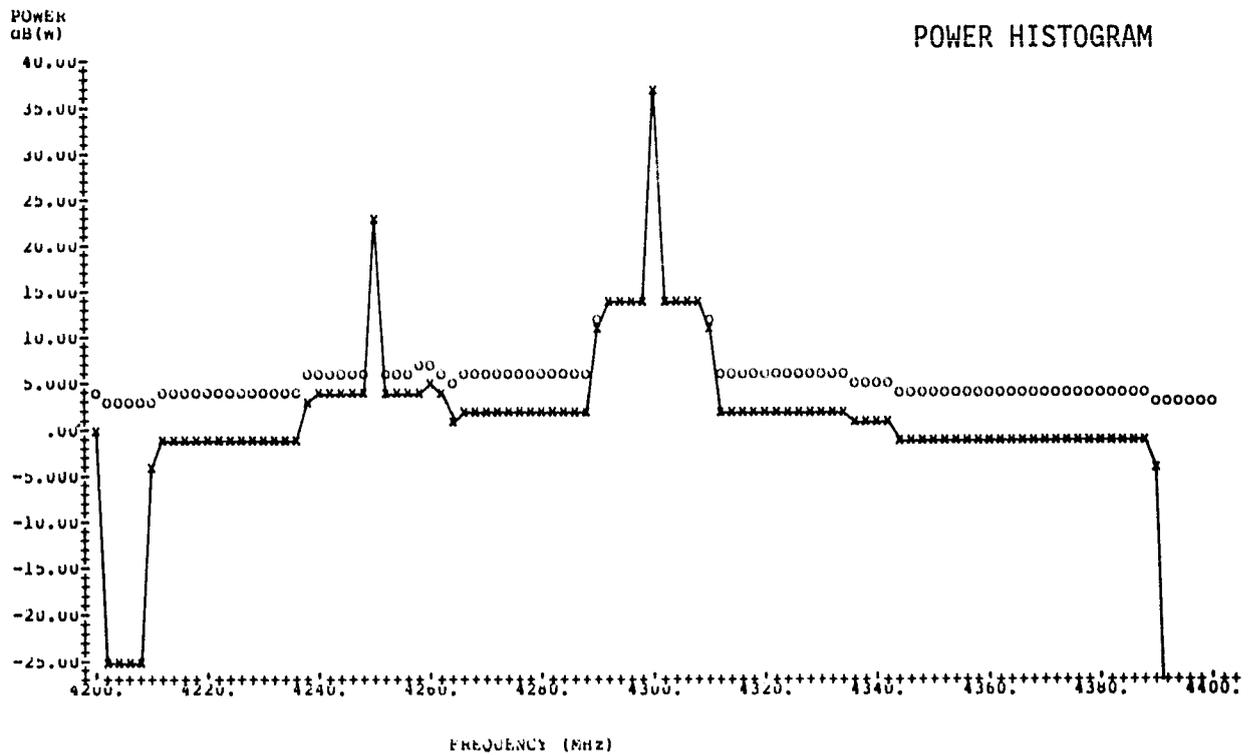
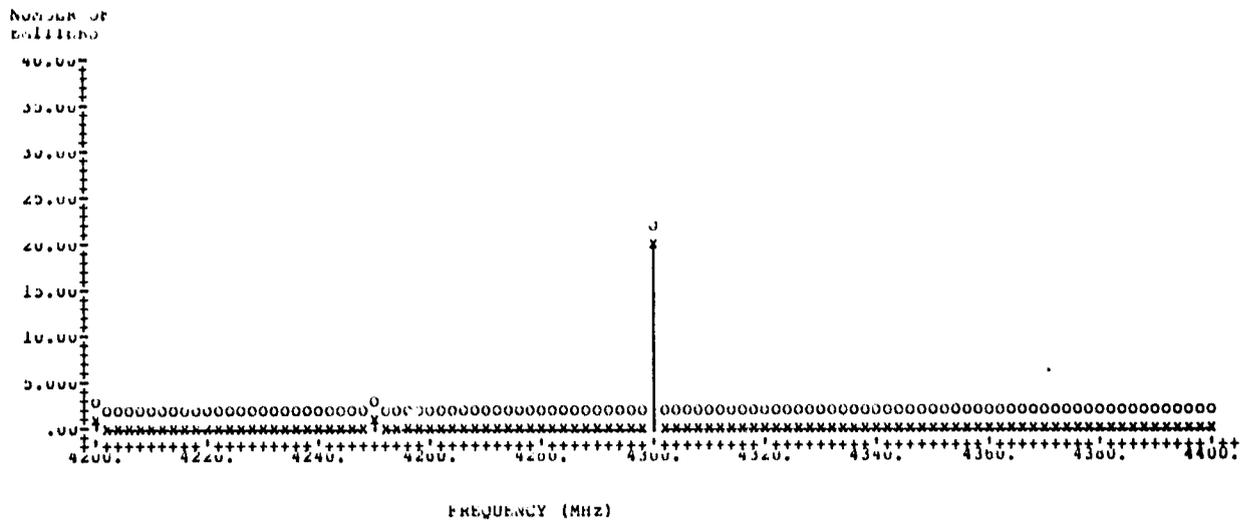
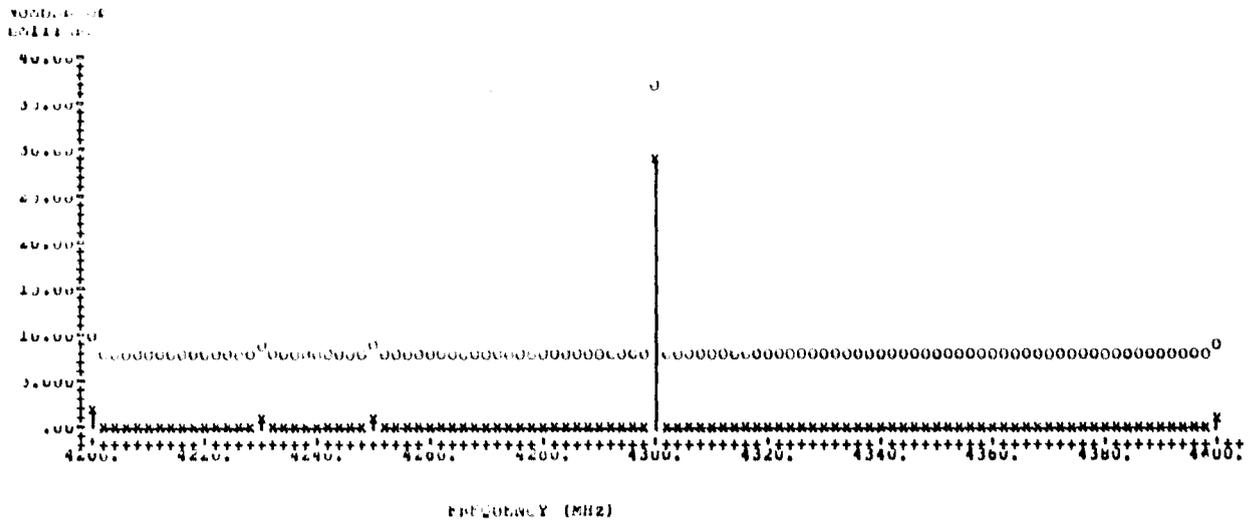


Figure 3.13-1 Non-Experimental Emitter and Power Histograms for the 4200-4400 MHz Band

FREQUENCY BAND : 4200.0-4400.0(MHz)  
EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

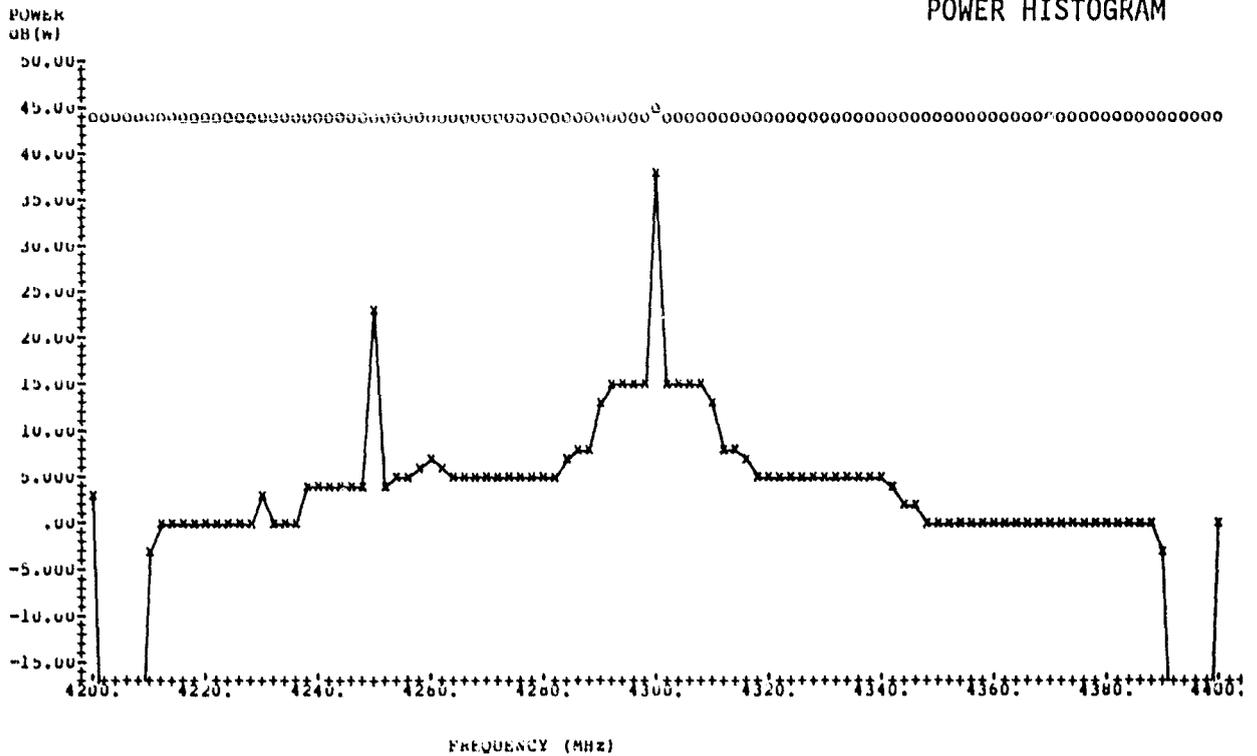


Figure 3.13-2 Emitter and Power Histograms for the 4200-4400 MHz Band Including Experimental Assignments

### 3.14 4995-5000 MHz Band

#### 3.14.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
4 990 - 5 000 FIXED MOBILE RADIO ASTRONOMY 233B	4 990 - 5 000 RADIO ASTRONOMY  383A	4 990 - 5 000 FIXED MOBILE RADIO ASTRONOMY 233B

**233B** In making assignments to stations of other services to which the bands **Spa2** 37.75-38.25 MHz, 150.05-153 MHz, 406.1-410 MHz, 2.690-2.700 MHz and 4.700-5.000 MHz are allocated, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference.

**383A** In Cuba, the band 4.990-5.000 MHz is also allocated to the fixed and mobile **Spa2** services, and the provisions of No. 233B apply.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
4990-5000	RADIO ASTRONOMY G45	RADIO ASTRONOMY

**G45** No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

#### 3.14.2 Present Assignments

##### 3.14.2.1 Government Master File

There are no assignments in the frequency range 4995-5000 MHz in the Government Master File. This band is an exclusive radioastronomy allocation.

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#### 3.14.2.2 Federal Communications Commission Data File

- Assignment Class - This frequency band contains one fixed experimental assignment located in California.
- User - This sole assignment in this band is for Rockwell International Corporation.
- Emission - The assignment is amplitude modulated, with an emission bandwidth of 2 kHz.
- Transmitter Power - The transmitter power specified is 100 milliwatts.

#### 3.14.2.3 International Frequency List

- High Power Examination - There are 15 assignments in this band, with 11 of them being radioastronomy stations. Two of the remaining assignments have transmitter powers of 1 kW, and the remainder are equal to or less than .05 kW.

#### 3.14.2.4 Classification

This is a quiet band, allocated exclusively to the radioastronomy service. Classification is not applicable.

#### 3.14.2.5 Computer Histograms

Histograms are not considered appropriate for this band.

### 3.15 5725-5925 MHz Band

#### 3.15.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
<b>5 725 5 850</b> FIXED-SATELLITE (Earth-to-space) RADIOLOCATION <i>Amateur</i> 354 388 390 391 391A	<b>5 725 5 850</b> RADIOLOCATION <i>Amateur</i> 389 391 391A	
<b>5 850 5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 391	<b>5 850 5 925</b> RADIOLOCATION <i>Amateur</i> 391	<b>5 850 5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE <i>Radiolocation</i> 391

- 354** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 1 660-1 690 MHz, 3 165-3 195 MHz, 4 800-4 810 MHz, 5 800-5 815 MHz and 8 680-8 700 MHz are also used for radio astronomy observations.
- 388** In the F. R. of Germany, the band 5 650-5 775 MHz is allocated to the amateur service and the band 5 775-5 850 MHz is allocated to the fixed service.
- 389** In China, India, Indonesia, Japan and Pakistan, the band 5 650-5 850 MHz is also allocated to the fixed and mobile services.
- 390** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 5 800-5 850 MHz is allocated to the fixed, mobile and fixed-satellite services.
- 391** The frequency 5 800 MHz is designated for industrial, scientific and medical purposes. Emissions must be confined within the limits of  $\pm 75$  MHz of that frequency. Radiocommunication services operating within those limits must accept any harmful interference that may be experienced from the operation of industrial, scientific and medical equipment.
- 391A** Radio astronomy observations are being carried out in the bands 5 750-5 770 MHz and 36 458-36 488 GHz in a number of countries under national arrangements. Administrations are urged to take all practicable steps to protect radio astronomy observations in these bands from harmful interference.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
5650-5925 (ISM 5800 $\pm$ 75 MHz)	RADIOLOCATION	Amateur

### 3.15.2 Present Assignments

#### 3.15.2.1 Government Master File

- Assignment Class - This band is used primarily for experimental and radiolocation (mobile) stations. The other services assigned in this band are for surveillance radar, radiolocation land stations and radionavigation mobile stations. The approximately 150 stations are located throughout the U.S.

- Operating Agencies - This band is used primarily by the Army, Air Force and Navy. There is a NASA experimental research station (ATS-6) transmitting from space at 5765 MHz.

- Emission - The emissions are almost entirely pulse modulated, with emission bandwidths from 4 to 35 MHz. There are a few frequency modulated assignments, with an emission bandwidth of 1.4 MHz. The few amplitude modulated assignments have bandwidths of .01, .1 and 2 kHz.

- Transmitter Power - The transmitter powers vary from .0001 to 4 kW, with 11 assignments in the 250 to 300 kW range and two assignments at 1000 kW.

- Antenna - A variety of antennas are used throughout this band. The only gains listed, however, are 30 to 44 dB(i) for parabolic antennas.

#### 3.15.2.2 Federal Communications Commission Data File

- Assignment Class - There are 12 assignments in this band. Of these 12, half are experimental systems; a third are fixed common carrier systems and one is used for industrial, scientific and medical purposes. There is also one communication-satellite earth station assignment. The assignments are concentrated in California.

- Emission - The majority of assignments are frequency modulated, with emission bandwidths from 19.8 to 36 MHz. There is one pulse modulated system, with an emission bandwidth of 20 MHz, and two amplitude modulated systems, with bandwidths of .1 and 190 kHz.

- Transmitter Power - The transmitter power varies from 36 milliwatts to 2.8 kilowatts.

#### 3.15.2.3 International Frequency List

- High Power Examination - This frequency band of 90 assignments can be divided into two portions, with one portion, 5725 to 5840 MHz, having transmitter powers of less than 1 kW, and 10 assignments having powers of 250 kW. The second portion, 5843 to 5925 MHz indicates powers of 1 kW or less.

#### 3.15.2.4 Classification - Probabilistic

#### 3.15.2.5 Computer Histograms

Figure 3.15-1 presents the non-experimental emitter and power histograms. Figure 3.15-2 presents the same including experimental assignments.

FREQUENCY BAND : 5725.0-5925.0(MHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM

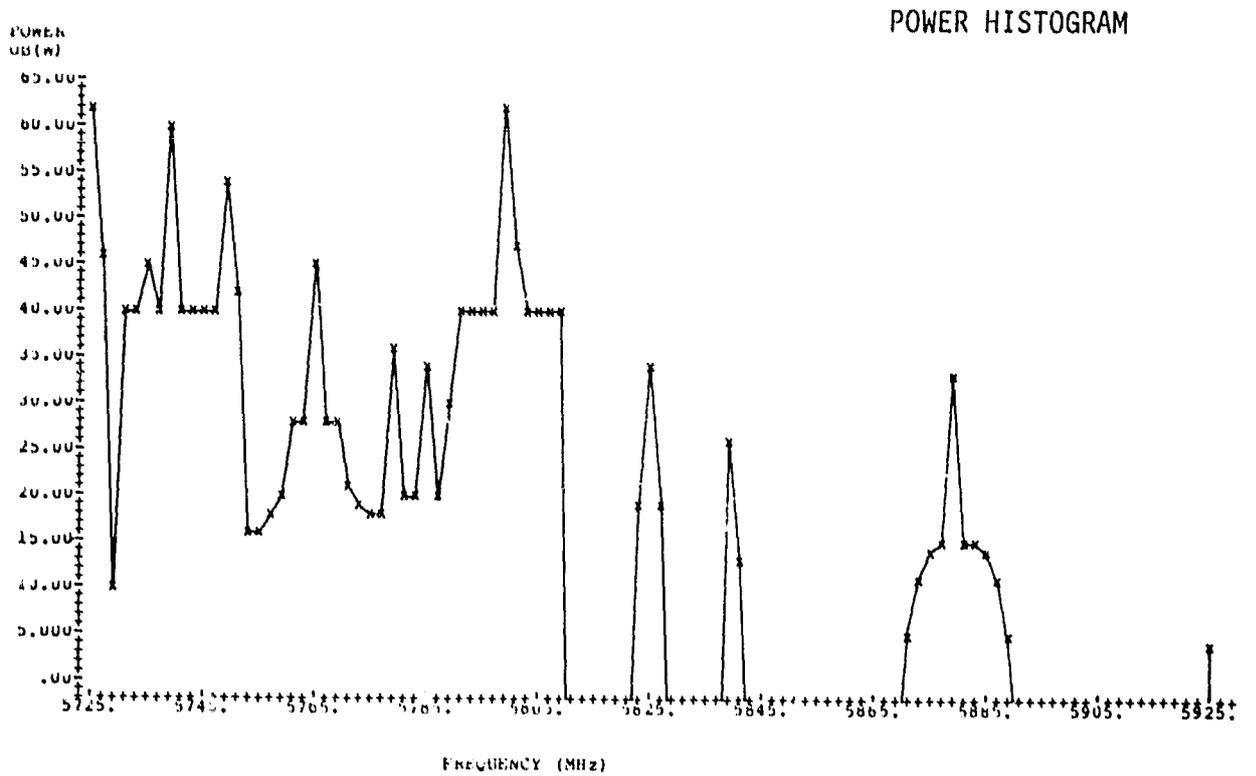
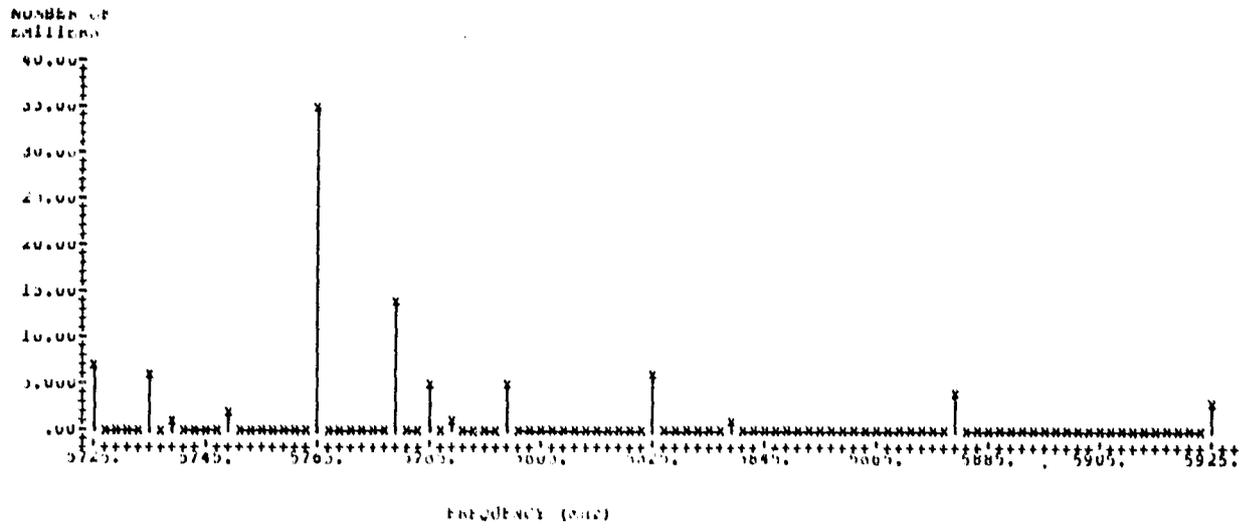
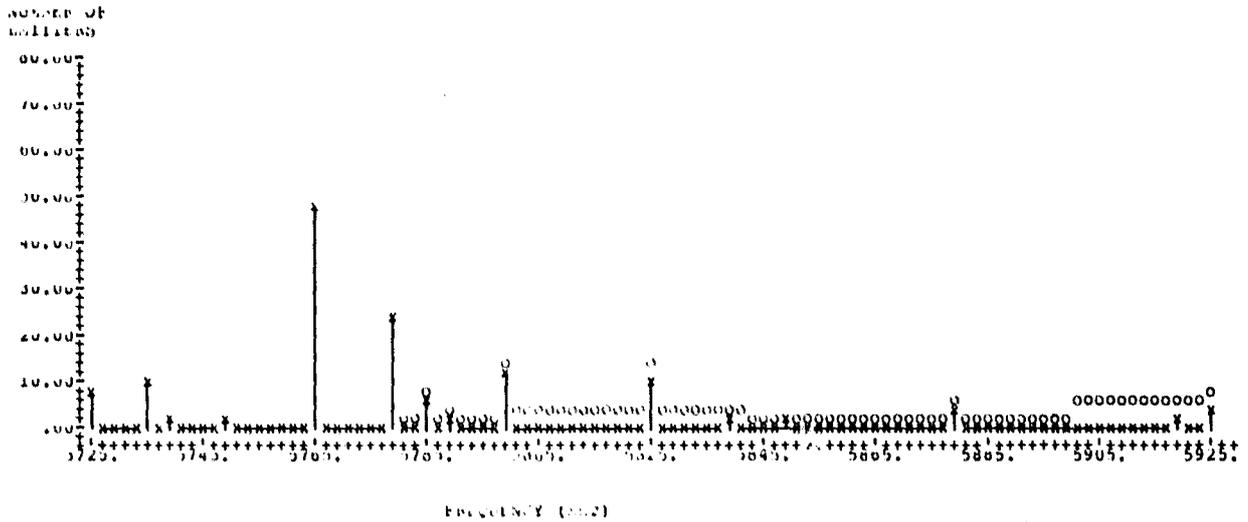


Figure 3.15-1 Non-Experimental Emitter and Power Histograms for the 5725-5925 MHz Band

FREQUENCY BAND : 5725.0-5925.0(MHz)  
 EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

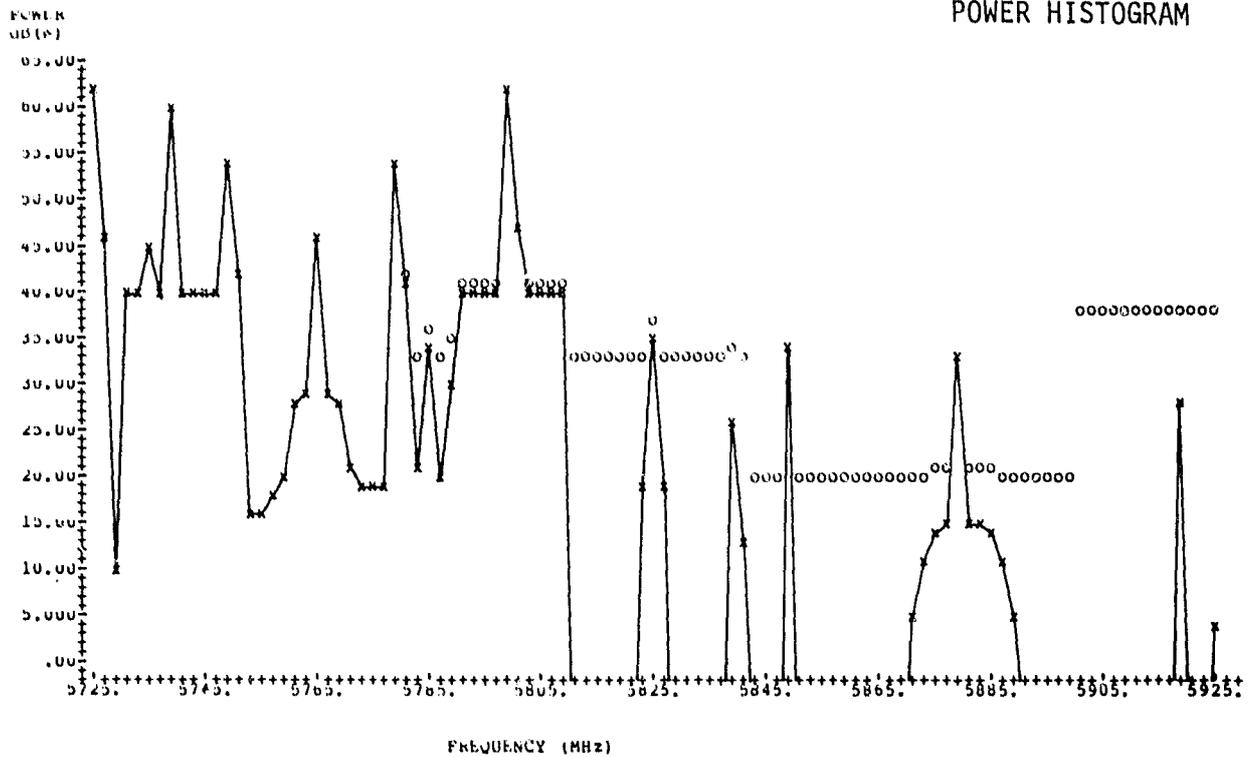


Figure 3.15-2 Emitter and Power Histograms for the 5725-5925 MHz Band Including Experimental Assignments

3.16 5925-6425 MHz Band

3.16.1 Allocations

INTERNATIONAL

Region 1	Region 2	Region 3
5925	6425	
FIXED FIXED-SATELLITE (Earth-to-space) MOBILE		

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
5925-6425		FIXED FIXED-SATELLITE (Earth-to-space) NG41	Domestic public

NG41 Frequencies in the bands 3700-4200 MHz, 5925-6425 MHz, and 10.7-11.7 GHz may also be assigned to stations in the international fixed public and international control services located in U.S. Possessions in the Caribbean area.

3.16.2 Present Assignments

3.16.2.1 Government Master File

- Assignment Class - The majority of assignments in this band are for fixed stations or radiobeacon mobile stations. The remainder of the assignments are for fixed-satellite earth stations and experimental stations. The 119 assignments are located in a limited number of states. Alaska contains the majority of assignments. The remaining stations are located in Alabama, California, Florida, Hawaii, Maryland, Nevada, New Mexico, and North Carolina.

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- Operating Agencies - This band is used primarily by the Air Force and ERDA. Other agencies with assignments are the Department of Interior, NASA, Army and the Department of Transportation.

- Emission - The majority of assignments are frequency modulated. The fixed stations usually employ emission bandwidths of 4 or 12 MHz. The radiobeacon mobile stations have unmodulated signals. The experimental stations specify emission bandwidths of 40 MHz, frequency modulated, with the exception of an assignment which operates over the frequency band 5925 to 6425 MHz. This assignment lists four emission characteristics: 500 MHz bandwidth frequency modulated, 500 MHz bandwidth pulse modulated, 2 MHz bandwidth amplitude modulated, and 2 MHz bandwidth frequency modulated.

- Transmitter Power - The transmitter powers vary from .3 Watt to . 5 kW, with the majority of assignments at 1 Watt. There are a few experimental stations which specify transmitter powers of 10 kW.

- Antenna - The typical antenna used in this band is a parabolic with a gain of 43 dB(i).

#### 3.16.2.2 Federal Communications Commission Data File

- Assignment Class - The majority of assignments are fixed common carrier, including earth stations for use in domestic and international regions. The remaining assignments are experimental, many of which are mobile. One assignment operating over the 5925 to 6425 MHz frequency range is used only for telemetry, tracking and control, except in emergencies. This assignment is used by AT&T, IT&T, RCAC, WUI and Comsat, and specifies a power of 12.5 kW. This assignment has 2 units, one amplitude modulated and the other frequency modulated, both with emission bandwidths of 30 MHz.

The approximately 28,000 assignments in this band are located throughout the U.S., with a large number of assignments in Alaska, Arizona, California, and New York.

- Users - The majority of users in this band are telephone companies.
- Emission - The majority of assignments are frequency modulated, with emission bandwidths typically of 30 MHz.
- Transmitter Power - The transmitter power varies from 36 milliwatts to 12.5 kW.

#### 3.16.2.3 International Frequency List

- High Power Examination - The majority of the more than 10,000 assignments in this band specify powers less than 1 kW. Approximately 2% of the assignments have specified powers of 2 kW. The remaining assignments give powers varying from 1 kW to 470 kW. There are four assignments with the 470 kW power specification.

#### 3.16.2.4 Classification - Probabilistic

#### 3.16.2.5 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.17 6475-7000 MHz Band

#### 3.17.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
6 425 7 250	FIXED MOBILE	
	379A 392AA 392B 393	

**379A** The standard frequency-satellite service and the time signal-satellite service may be authorized to use the frequency 4 202 MHz for space-to-Earth transmissions and the frequency 6 427 MHz for Earth-to-space transmissions. Such transmissions shall be confined within the limits of  $\pm 2$  MHz of these frequencies and shall be subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**392AA** In Brazil, Canada and the United States of America, the band 6 625 - **Spa2** 7 125 MHz is also allocated, on a secondary basis, to the fixed-satellite service for space-to-Earth transmissions. In Region 2, the power flux density produced by space stations in this band shall be in accordance with the provisions of No. 470NM. In Regions 1 and 3, it shall be at least 6 dB lower. Receiving earth stations in this band may not impose restrictions on the locations or technical parameters of existing or future terrestrial stations of other countries.

**392B** The band 7 145 - 7 235 MHz may be used for Earth-to-space transmissions **Spa2** in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

**393** In Italy, the band 6 450-6 575 MHz is also allocated to the radiolocation service. **Spa**

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
6425-6575		MOBILE
6575-6625		FIXED NG8
6625-6875		FIXED FIXED-SATELLITE (Space-to-Earth) NG8 NG103
6875-7125		FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE NG11 NG103

NG8 Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocation.

NG11 Television inter-city relay stations may be authorized to use frequencies in this band on the condition that harmful interference will not be caused to stations operating in accordance with the Table of Frequency Allocations.

NG103 In the band 6025-7125 MHz, the fixed satellite service (space to earth) has equal rights with the fixed and mobile services within the United States. Internationally, however, it is secondary with respect to the services of other countries operating in accordance with the table and receiving earth stations in this band may not impose restrictions on the locations or technical parameters of existing or future terrestrial stations of other countries.

### 3.17.2 Present Assignments

#### 3.17.2.1 Government Master File

- Assignment Class - Of the ten assignments in this band, are all experimental. The assignments are located throughout the U.S.
- Operating Agencies - The majority of assignments are allocated to the Air Force.
- Emission - The majority of assignments are pulse modulated, with emission bandwidths of 200 kHz. There are two frequency modulated assignments, with bandwidths of 7.3 and 10 MHz.
- Transmitter Power - The transmitter power varies from .1 Watts to 400 Watts.
- Antenna - The majority of assignments use a blade antenna with a gain of 2 dB(i). There is one parabolic antenna used, with a gain of 39 dB(i).

### 3.17.2.2 Federal Communications Commission Data File

- Assignment Class - The majority of assignments from 6475 to 6725 MHz are for the industrial service. Other services using this band are the common carrier, public safety, experimental, aviation and land transportation. The assignments in the band 6725 to 6825 MHz are mainly used by the industrial and public safety services. There are, however, other services used in this portion of the band. The last portion of the band, 6875 to 7000 MHz, is almost exclusively used for auxiliary broadcast (5 of these are remote pickup mobile units).

The majority of the over 11,000 assignments in this band are distributed throughout the U.S.

- Emission - The majority of assignments are frequency modulated. The assignments in the first portion of the band (6475 to 6875 MHz) have emission bandwidths of 10 MHz for the most part. The assignments in the remainder of the band use emission bandwidths of 25 MHz typically.

- Transmitter Power - The majority of assignments have transmitter powers of 1 to 4 Watts. There are a few assignments indicating powers of 200 Watts, and one with a specified power of 8.5 kW.

### 3.17.2.3 International Frequency List

- High Power Examination - There are more than 3000 assignments in this band, with powers varying up to 160 kW.

#### 3.17.2.4 Classification - Probabilistic

#### 3.17.2.4 Computer Histograms

Due to the large number of emitters in this band, histograms have not been generated.

### 3.18 7900-7975 MHz Band

#### 3.18.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
7 900 7 975	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
7900-8975	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE G107 G108	

G107 Military earth stations in the band 7250-7750 and 7900-8400 MHz and 20.2-21.2, 30-31, 92-93, 102-103, 140-141 and 150-151 GHz may be fixed, transportable or located on board a ship or aircraft.

G108 Planning and use of the bands 7300-7750, 7900-7975 and 8025-8400 MHz by mobile earth stations and the band 8025-8400 MHz by stations of earth resources satellite systems, necessitate the development of technical and/or operational sharing criteria to ensure the maximum degree of electromagnetic compatibility with existing and planned systems within these bands.

#### 3.18.2 Present Assignments

##### 3.18.2.1 Government Master File

- Assignment Class - This band is predominantly used for the fixed and fixed-satellite services. There are some experimental assignments in this band. The more than 400 assignments are located throughout the U. S.

- Operating Agencies - The Federal Aviation Administration is the major user, although some other government agencies make use of the band.

- Emission - Emissions are almost exclusively frequency modulated, with bandwidths from 910 kHz to 45 MHz. There are two experimental assignments, with bandwidths of 185 MHz, operating over the frequency range of 7900 to 8500 MHz.

- Transmitter Power - The transmitter powers in this band are 330 Watts or less, except for one experimental assignment over the frequency range 7900-8400 MHz, with a power of 10 kW.

- Antenna - The majority of assignments employ parabolic antennas with gains up to 46 dB(i). Other antennas used in this band include horns with 16 to 28 dB(i) gain, fly swatters with gains of 42 dB(i), and earth station antennas with gains of 57 dB(i).

#### 3.18.2.2 Federal Communications Commission Data File

- Assignment Class - There are two industrial, two common carrier, and one experimental assignment in this band. They are located in Florida, Arizona and New Jersey.

- Emission - Most of the assignments are frequency modulated, with emission bandwidths of 2, 10 and 25 MHz. There is one pulse modulated system, with a bandwidth of 40 MHz.

- Transmitter Power - The assignments specify transmitter powers of 1 Watt, 1.5 Watts and 75.36 megawatts. The 75.36 MW assignment is an experimental assignment at 7970 MHz, with an emission bandwidth of 2 MHz (frequency modulated), and 40 MHz (pulse modulated).

#### 3.18.2.3 International Frequency List

- High Power Examination - The 150 assignments in this band specify transmitter powers less than .01 kW.

#### 3.18.2.4 Classification

Overall, the band is considered probabilistic. However, certain portions of the band which are used by the FAA for point-to-point microwave transmission of air traffic control information are fairly well defined and could be analyzed in a deterministic manner.

#### 3.18.2.5 Computer Histograms

Figure 3.18-1 presents the non-experimental emitter and power histogram. Figure 3.18-2 presents the same including experimental assignments.

FREQUENCY BAND : 7900.0-7975.0(MHz)  
 NON-EXPERIMENTAL

EMITTER HISTOGRAM

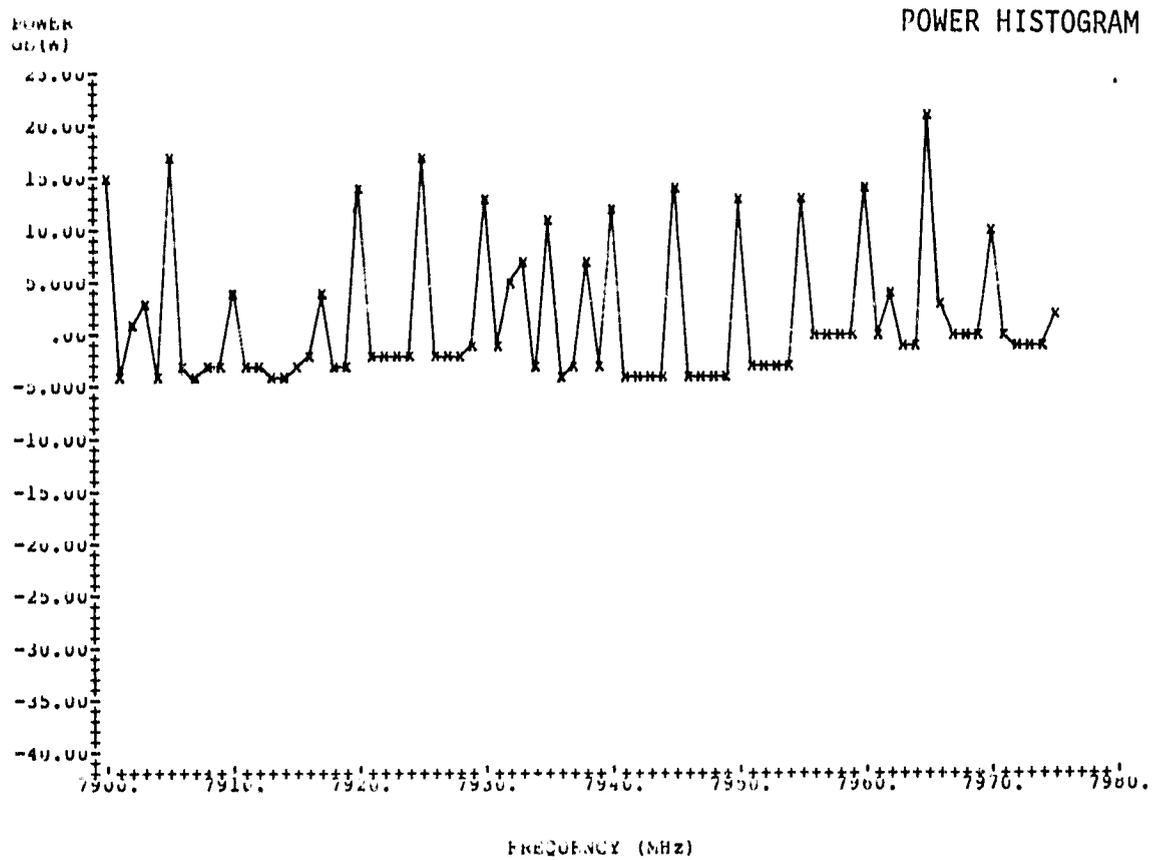
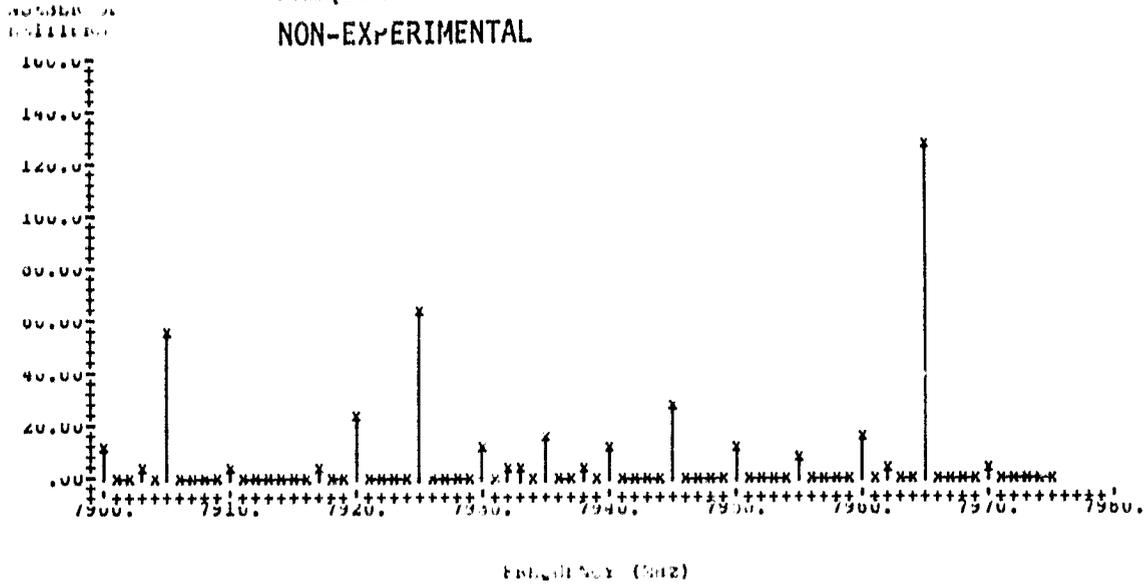
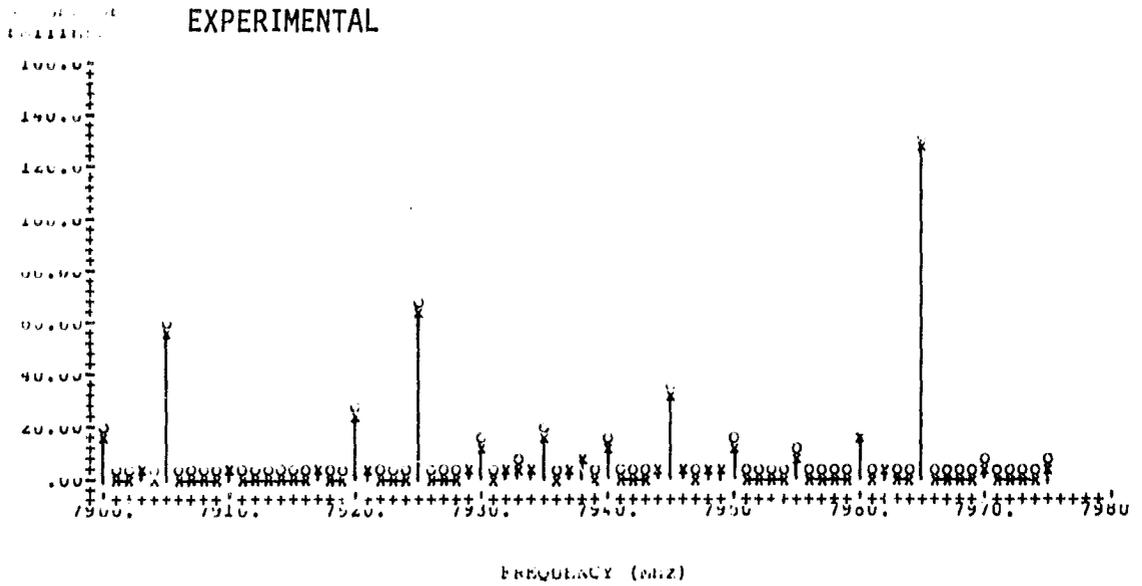


Figure 3.18-1 Non-Experimental Emitter and Power Histograms for the 7900-7975 MHz Band

FREQUENCY BAND : 7900.0-7975.0(MHz)

EXPERIMENTAL



POWER HISTOGRAM

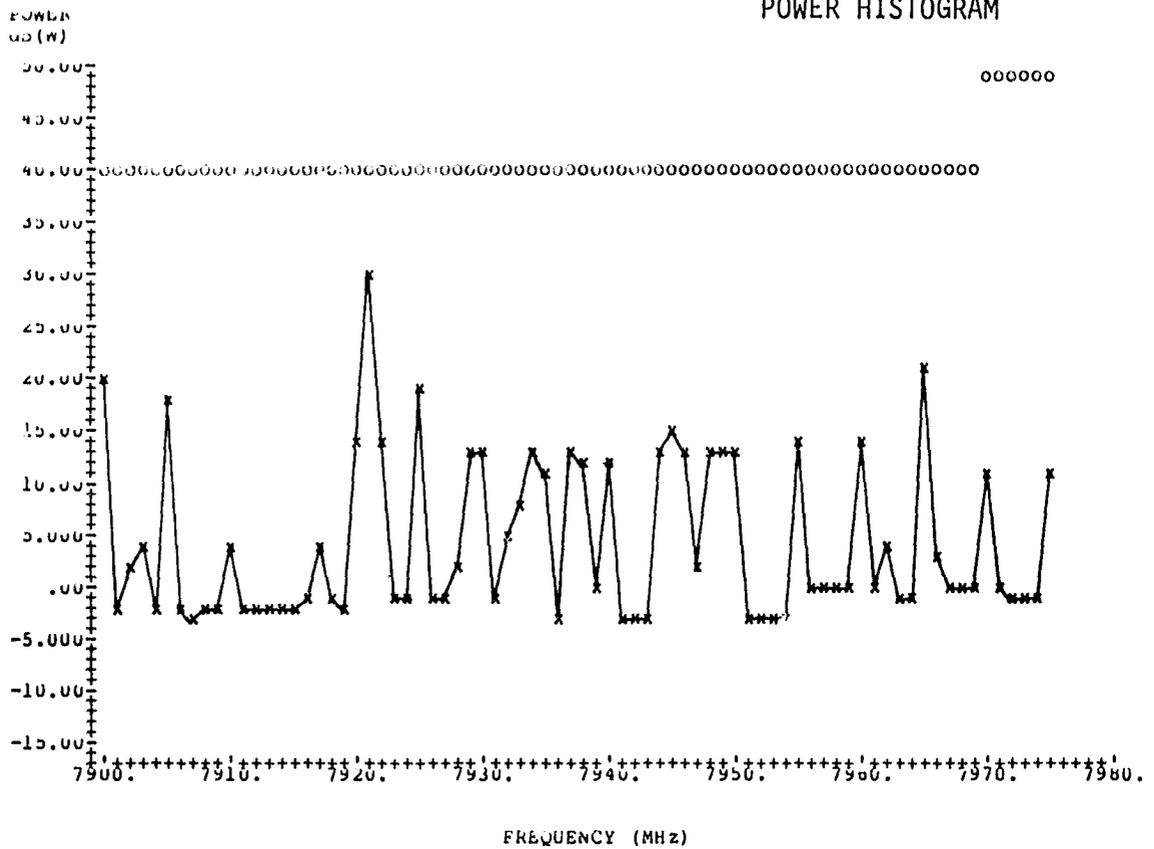


Figure 3.18-2 Emitter and Power Histograms for the 7900-7975 MHz Band Including Experimental Assignments

C-2

### 3.19 9950-10050 MHz Band

#### 3.19.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
9 800 — 10 000	RADIOLOCATION <i>Fixed</i> 400 401 401A	
10 000 — 10 500	RADIOLOCATION <i>Amateur</i> 401A 402 403	

- 400** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 9 800-10 000 MHz is also allocated to the fixed and radiolocation services.
- 401** In India, Indonesia, Japan and Sweden, the fixed and radiolocation services operate on a basis of equality in the band 9 800-10 000 MHz.
- 401A** The band 9 975-10 025 MHz may be used by weather radar on meteorological-satellites.
- 402** In Japan and Sweden, the band 10 000-10 500 MHz is also allocated to the fixed and mobile services.
- 403** In the F. R. of Germany and Switzerland, the band 10 000-10 250 MHz is also allocated to the fixed and mobile services; the band 10 250-10 500 MHz is allocated to the amateur service.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
9500-10000	RADIOLOCATION G36	Radiolocation	
10000-10500	RADIOLOCATION G32	Amateur Radiolocation NG42	Although the band 10000-10500 MHz presently seems most suitable as a common frequency band for such survey operations in different countries, future development, if required, should be directed to the band 34.0-35.6 GHz, within the overall band 33.4-36.0 GHz, with no new development below 10000 MHz.

**G32** Except for weather radars or meteorological satellites in the band 9975-10025 MHz and for Government survey operations (see footnote US108), Government radiolocation in the band 10000-10500 MHz is limited to the military services.

**G36** Except for weather radars on meteorological-satellites in the band 9975-10025 MHz, all Government non-military radiolocation in the band 9500-10000 MHz shall be secondary to the military services.

**NG42** Non-Government stations in the radiolocation service shall not cause harmful interference to the amateur service.

### 3.19.2 Present Assignments

#### 3.19.2.1 Government Master File

- Assignment Class - The assignments in this band are mainly for experimental and radiolocation use. Of the approximately 50 assignments in this band, 60% are mobile. All are located throughout the U.S. and Possessions.

- Operating Agencies - The Air Force, Navy and Army are the primary users in the band.

- Emission - The majority of assignments are frequency modulated, with emission bandwidths varying from 1 kHz to 40 MHz. There are 2 exceptions to this. One assignment is an Army mobile radiolocation station with an emission bandwidth of 500 MHz, and the other is an Air Force experimental research assignment with a bandwidth of 1 GHz. There are a few amplitude modulated assignments, with emission bandwidths up to 40 MHz, and a few pulse modulated assignments, one with an emission bandwidth of 1 GHz.

- Transmitter Power - The transmitter powers vary from .1 Watt to 5 kW, with 4 exceptions. Two Air Force experimental research assignments have powers of 20 kW, and two assignments have powers of 250 and 500 kW, all with emission bandwidths of 1 GHz.

- Antenna - There are several types of antennas used in this band, e.g., horn, conical, cavity slot and parabolics with gains up to 67 dB(i).

### 3.19.2.2 Federal Communications Commission Data File

- Assignment Class - The majority of assignments in this band are used for industrial radiolocation. The remaining assignments are used for experimental and public safety purposes. Of the approximately 80 assignments in this band, 85% are mobile. The assignments are located throughout the U. S.

- Emission - The majority are frequency modulated assignments, with bandwidths ranging from 20 kHz to 40 MHz. The few amplitude modulated assignments have emission bandwidths from 2 kHz to 20 MHz.

- Transmitter Power - The transmitter power varies from 30 milliwatts to 50 Watts, with one assignment having a power of 100 Watts.

### 3.19.2.3 International Frequency List

- High Power Examination - There are only five assignments in this frequency range, with the powers specified at .05 kW, .75 kW and 2 kW.

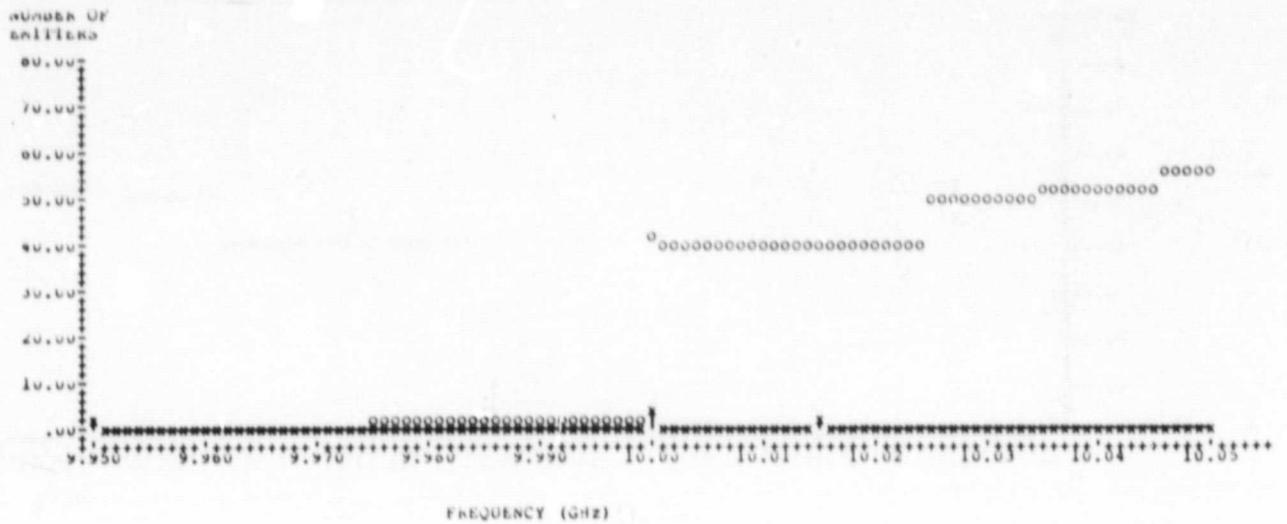
### 3.19.2.4 Classification - Probabilistic

### 3.19.2.5 Computer Histograms

Figure 3.19-1 presents the non-experimental emitter and power histograms. Figure 3.19-2 presents the same including experimental stations.

FREQUENCY BAND : 9.9-10.0 (GHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

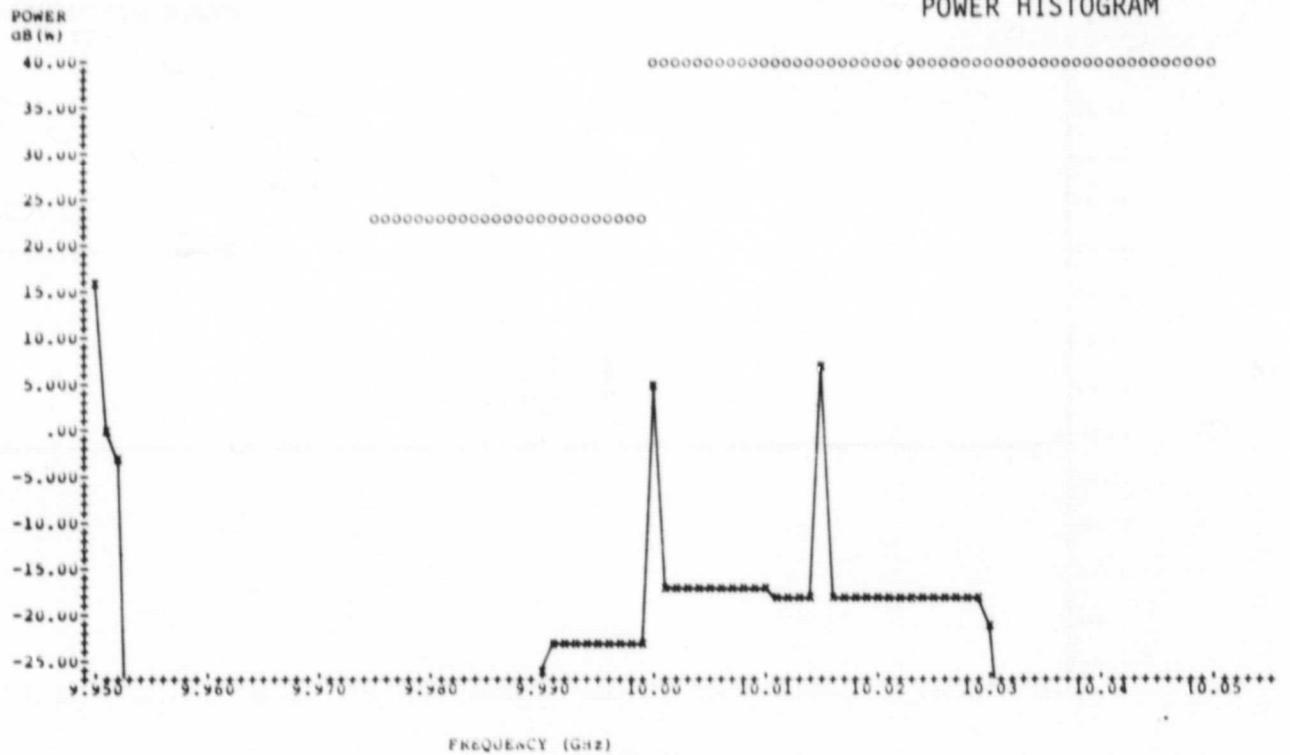
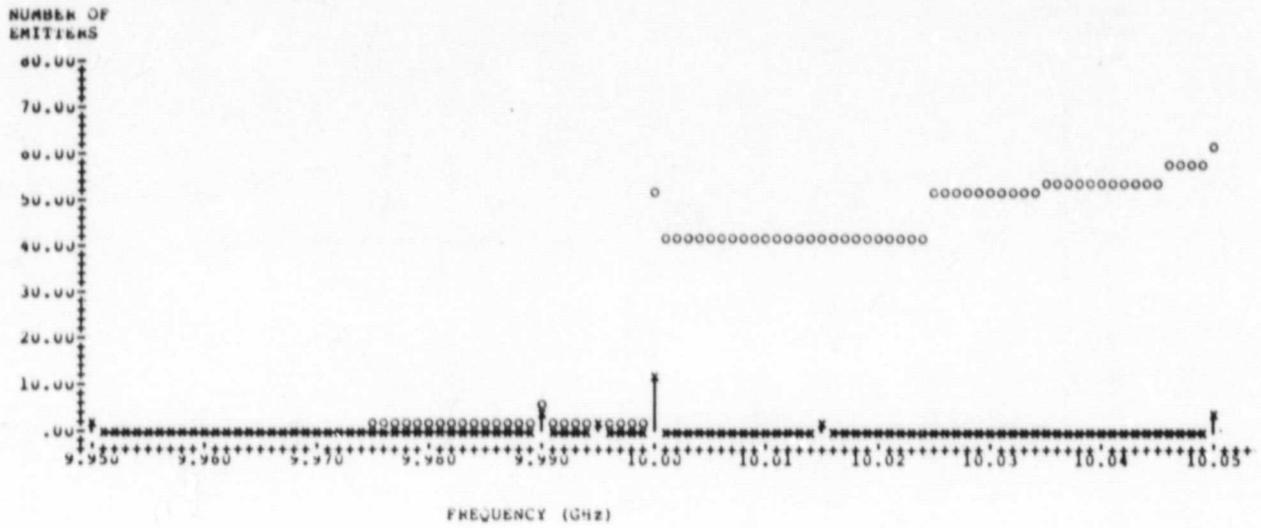


Figure 3.19-1 Non-Experimental Emitter and Power Histograms for the 9.9-10.0 GHz Band

FREQUENCY BAND : 9.9-10.0(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

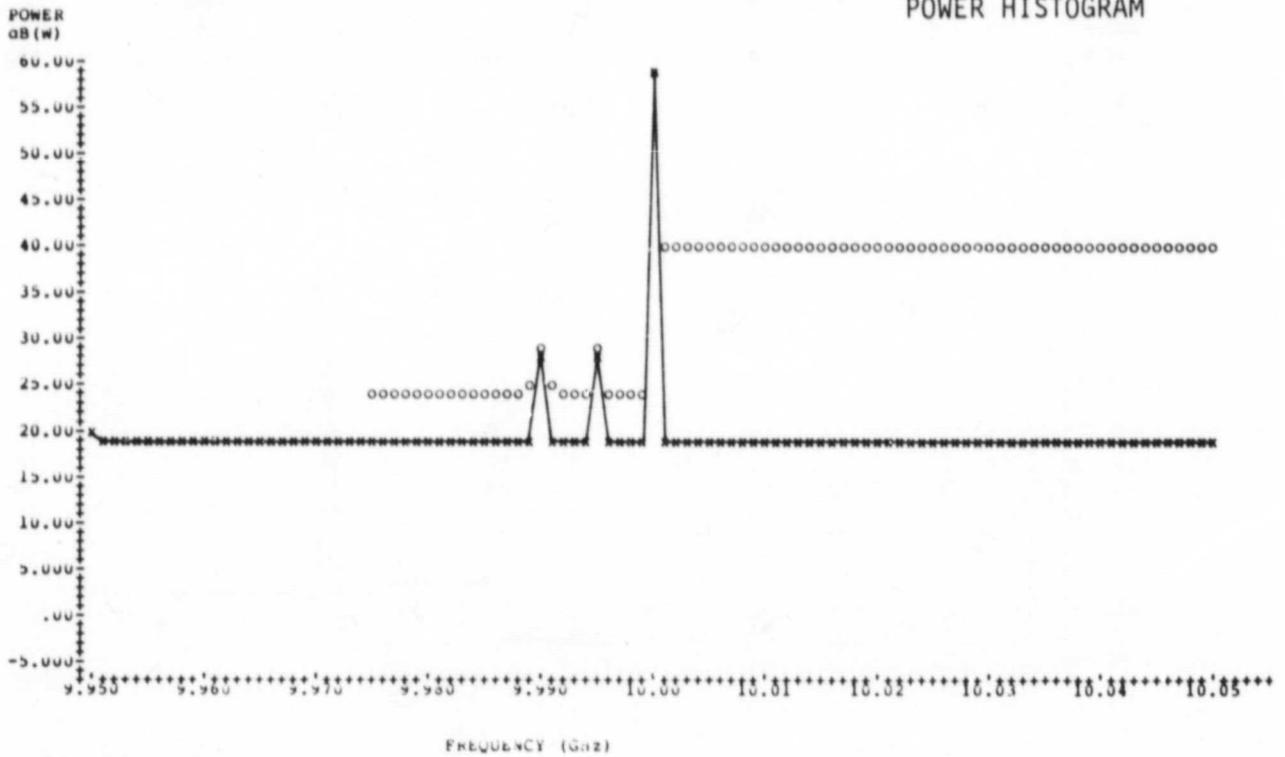


Figure 3.19-2 Emitter and Power Histograms for the 9.9-10.0 GHz Band Including Experimental Assignments

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### 3.20 10.6-10.7 GHz Band

#### 3.20.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
10.6 - 10.68	FIXED MOBILE RADIO ASTRONOMY <i>Radiolocation</i> 404A	
10.68 - 10.7	RADIO ASTRONOMY 405B	

**404A** In the F.R. of Germany, in the band 10.6 - 10.68 GHz, the radio astronomy service is a secondary service.

**405B** In Algeria, Bulgaria, Cuba, Hungary, Japan, Kuwait, Lebanon, Pakistan, Poland, the United Arab Republic, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 10.68-10.7 GHz is also allocated to the fixed and mobile services.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
10.55-10.68		MOBILE
10.68-10.7	RADIO ASTRONOMY G45	RADIO ASTRONOMY

**G45** No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

### 3.20.2 Present Assignments

#### 3.20.2.1 Government Master File

- Assignment Class - There is only one assignment at 10.6 GHz, for an experimental testing station in Oklahoma.

- Operating Agency - Air Force.

- Emission - Unmodulated signal.

- Transmitter Power - .2 Watts.

- Antenna - Although the type of antenna is not noted, the gain is given as 39 dB(i).

#### 3.20.2.2 Federal Communications Commission Data File

- Assignment Class - The assignments in this band are for mobile units used for public safety, industrial, and experimental purposes. One assignment is point-to-point microwave at 10.7 GHz. There are approximately twenty assignments which are located throughout the U.S. 10.68-10.7 GHz is an exclusive radioastronomy allocation.

- Emission - The assignments are frequency modulated, with emission bandwidths from 25 kHz to 25 MHz, and amplitude modulated, with bandwidths from 20 kHz to 12.25 MHz.

- Transmitter Power - The transmitter powers vary from 5 milliwatts to 6 Watts.

### 3.20.2.3 International Frequency List

- High Power Examination - Of the 14 assignments in this band, only 4 have transmitter powers specified, and they are less than 1 kW.

### 3.20.2.4 Classification - Probabilistic.

### 3.20.2.5 Computer Histograms

Figure 3.20-1 presents the non-experimental emitter and power histograms.

FREQUENCY BAND : 10.6-10.7(GHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM

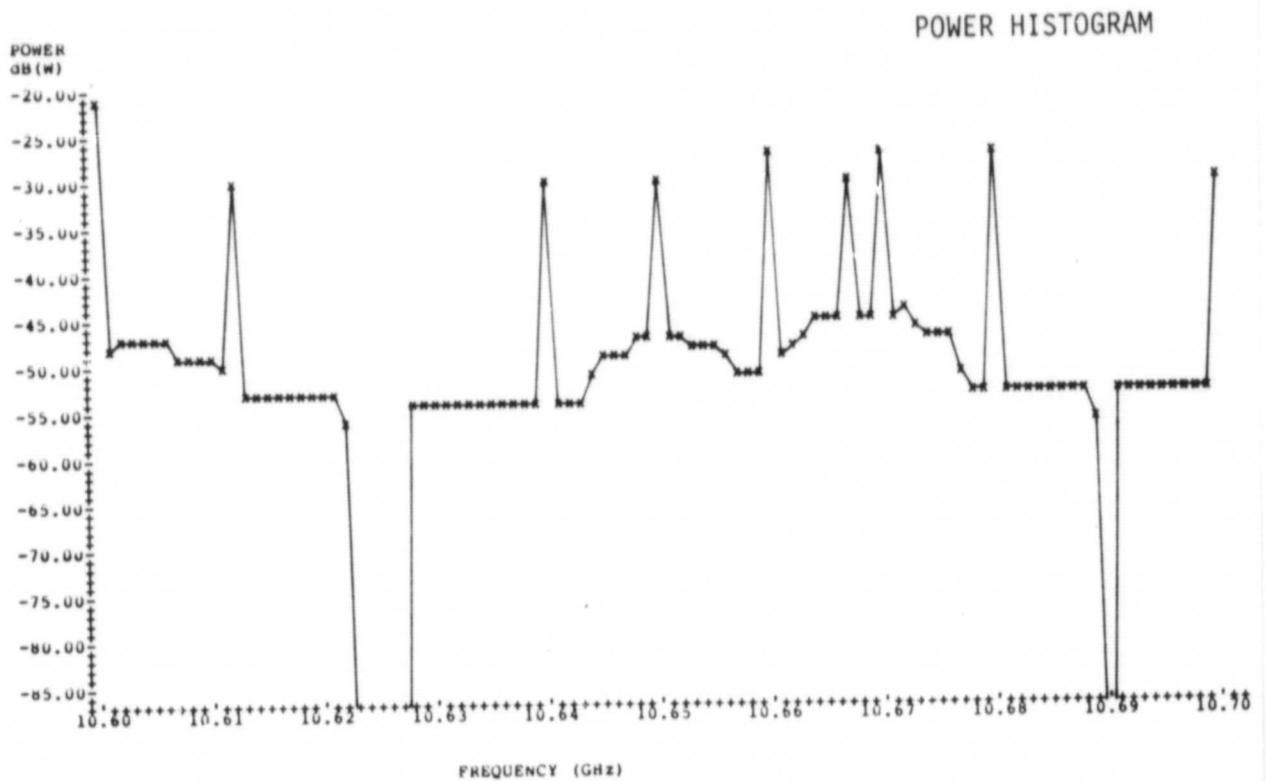
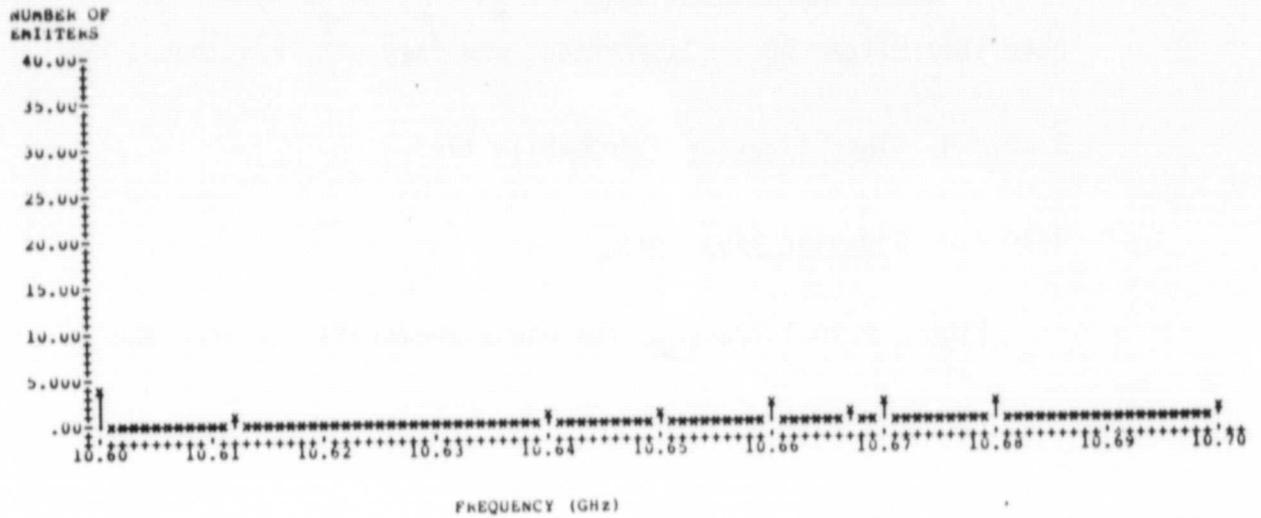


Figure 3.20.1 Non-Experimental Emitter and Power Histograms for the 10.6-10.7 GHz Band

### 3.21 10.95-11.2 GHz Band

#### 3.21.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
10-95 - 11-2 FIXED FIXED-SATELLITE (Space-to-Earth) (Earth-to-space) MOBILE	10-95 - 11-2 FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE	

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
10.95-11.2		FIXED FIXED-SATELLITE (Space-to-Earth) NG41 NG104	Non-Government fixed-satellite, limited to international operations.

NG41 Frequencies in the bands 3700-4200 MHz, 5925-6425 MHz, and 10.7-11.7 GHz may also be assigned to stations in the international fixed public and international control services located in U.S. Possessions in the Caribbean area.

NG104 The use of the bands 10.95-11.2 and 11.45-11.7 GHz in the fixed-satellite service is limited to international systems, i.e., other than domestic systems.

#### 3.21.2 Present Assignments

##### 3.21.2.1 Government Master File

- Assignment Class - There is only one assignment in this band; an experimental assignment located in New Mexico.
- Operating Agency - Air Force.
- Emission - This assignment is frequency modulated, with an emission bandwidth of 40 MHz.

- Transmitter Power - 2.5 Watts.
- Antenna - This assignment specifies a parabolic antenna with a gain of 46 dB(i).

### 3.21.2.2 Federal Communications Commission Data File

- Assignment Class - There are some experimental assignments in this band, although the majority of assignments are common carrier.

The approximately 1500 assignments are located throughout the U.S., with a large concentration of stations in California.

- Emission - All the assignments are frequency modulated, with typical emission bandwidths of 28 MHz.

- Transmitter Power - The majority of assignments specify transmitter powers of 500 milliwatts. However, there are a few assignments which list powers from 160 to 500 Watts.

### 3.21.2.3 International Frequency List

- High Power Examination - The majority of the 89 assignments in this band have transmitter powers of less than .01 kW. There are a few assignments with powers of 160 kW.

### 3.21.2.4 Classification - Probabilistic

- 3.21.2.5 Computer Histograms - Due to the large number of emitters in this band, no histograms have been generated.

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- Transmitter Power - 2.5 Watts.

- Antenna - This assignment specifies a parabolic antenna with a gain of 46 dB(i).

### 3.21.2.2 Federal Communications Commission Data File

- Assignment Class - There are some experimental assignments in this band, although the majority of assignments are common carrier.

The approximately 1500 assignments are located throughout the U.S., with a large concentration of stations in California.

- Emission - All the assignments are frequency modulated, with typical emission bandwidths of 28 MHz.

- Transmitter Power - The majority of assignments specify transmitter powers of 500 milliwatts. However, there are a few assignments which list powers from 160 to 500 Watts.

### 3.21.2.3 International Frequency List

- High Power Examination - The majority of the 89 assignments in this band have transmitter powers of less than .01 kW. There are a few assignments with powers of 160 kW.

### 3.21.2.4 Classification - Probabilistic

### 3.21.2.5 Computer Histograms - Due to the large number of emitters in this band, no histograms have been generated.

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### 3.22 12.5-12.75 GHz Band

#### 3.22.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
12.5 - 12.75 FIXED-SATELLITE (Space-to-Earth) (Earth-to-space)	12.5 - 12.75 FIXED FIXED-SATELLITE (Earth-to-space)	12.5 - 12.75 FIXED FIXED-SATELLITE (Space-to-Earth)
405BD 405BE	MOBILE except aeronautical mobile	MOBILE except aeronautical mobile

**405BD** In Bulgaria, Cameroon, Congo (Brazzaville), the Ivory Coast, Gabon, Ghana, Hungary, Iraq, Israel, Jordan, Kuwait, Libya, Mali, Niger, Poland, Syria, the United Arab Republic, Roumania, Senegal, Czechoslovakia, Togo and the U.S.S.R., the band 12.5-12.75 GHz is also allocated to the fixed service and the mobile, except aeronautical mobile, service.

**405BE** In Algeria, Belgium, Denmark, Spain, Ethiopia, Finland, France, Greece, Kenya, Liechtenstein, Luxembourg, Monaco, Norway, Uganda, the Netherlands, Portugal, the F.R. of Germany, Sweden, Switzerland, Tanzania and Tunisia, the band 12.5-12.75 GHz is also allocated, on a secondary basis, to the fixed service and the mobile, except aeronautical mobile, service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
12.5-12.7		FIXED FIXED-SATELLITE (Earth-to-space) NG8 NG52
12.7-12.75		FIXED FIXED-SATELLITE (Earth-to-space) MOBILE NG53

**NG8** Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocation.

**NG52** Stations used for transmission of program material to cable television (CATV) systems, which are authorized to operate in the band 12.2-12.7 GHz on November 22, 1965, may continue to be authorized to so operate until August 1, 1980, under the conditions specified in that license.

**[NG52 amended eff. 1-1-76; II(72)-8]**

**NG53** In the band 12.7-12.95 GHz, television pickup stations shall not cause harmful interference to community antenna relay, television intercity relay and television STL stations.

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### 3.22 12.5-12.75 GHz Band

#### 3.22.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
12.5-12.75	12.5-12.75	12.5-12.75
FIXED-SATELLITE (Space-to-Earth) (Earth-to-space)	FIXED FIXED-SATELLITE (Earth-to-space)	FIXED FIXED-SATELLITE (Space-to-Earth)
405BD-405BE	MOBILE except aeronautical mobile	MOBILE except aeronautical mobile

**405BD** In Bulgaria, Cameroon, Congo (Brazzaville), the Ivory Coast, Gabon, Ghana, Hungary, Iraq, Israel, Jordan, Kuwait, Libya, Mali, Niger, Poland, Syria, the United Arab Republic, Romania, Senegal, Czechoslovakia, Togo and the U.S.S.R., the band 12.5-12.75 GHz is also allocated to the fixed service and the mobile, except aeronautical mobile, service.

**405BE** In Algeria, Belgium, Denmark, Spain, Ethiopia, Finland, France, Greece, Kenya, Liechtenstein, Luxembourg, Monaco, Norway, Uganda, the Netherlands, Portugal, the F.R.G. of Germany, Sweden, Switzerland, Tanzania and Tunisia, the band 12.5-12.75 GHz is also allocated, on a secondary basis, to the fixed service and the mobile, except aeronautical mobile, service.

#### DOMESTIC

Band MHz	Government Allocation	Non-Government Allocation
12.5-12.7		FIXED FIXED-SATELLITE (Earth-to-space) NG8-NG52
12.7-12.75		FIXED FIXED-SATELLITE (Earth-to-space) MOBILE NG53

**NG8** Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocation.

**NG52** Stations used for transmission of program material to cable television (CATV) systems, which are authorized to operate in the band 12.2-12.7 GHz on November 22, 1965, may continue to be authorized to so operate until August 1, 1980, under the conditions specified in that license.

**[NG52 amended eff. 1-1-76, II(72)-8]**

**NG53** In the band 12.7-12.95 GHz, television pickup stations shall not cause harmful interference to community antenna relay, television intercity relay and television STL stations.

### 3.22.2 Present Assignments

#### 3.22.2.1 Government Master File

- Assignment Class - There are two assignments in this band. One is a fixed service assignment located in California, and the other is a fixed service in the American Samoa.

- Operating Agencies - ERDA and the Department of Interior have control over these assignments.

- Emission - One assignment is frequency modulated, with an emission bandwidth of 25 MHz, and the other is amplitude modulated, with a bandwidth of 13.3 MHz.

- Transmitter Power - The transmitter powers specified are .1 and 1 Watt.

- Antenna - The assignments use parabolic antennas with a gain of 35 and 45 db(i)

#### 3.22.2.2 Federal Communications Commission Data File

- Assignment Class - The first portion of the band, 12.5 to 12.69 GHz, is used by a number of services, mainly industrial and public safety. The remainder of the band, 12.7 to 12.75 GHz, is used by the auxiliary broadcast service almost exclusively. There are six experimental mobile assignments in this portion of the band. The 1000 assignments in the 12.5 to 12.75 GHz band are located throughout the U.S., with a large number in California and Texas.

- Emission - In the 12.5 to 12.69 GHz band, the majority of assignments are frequency modulated, with emission bandwidths of 20 MHz. Approximately 25 assignments are amplitude modulated, with bandwidths from 9 to 13 MHz. The remaining assignments are frequency modulated, with the majority having emission bandwidths of 25 MHz.

- Transmitter Power - The majority of assignments in the first portion of the band, 12.5 to 12.69 GHz, specify transmitter powers of 1 Watt or less. In the 12.7 to 12.75 GHz band, the transmitter power varies from 10 milliwatts to 12 Watts, with the majority having a power of 1 Watt or less.

#### 3.22.2.3 International Frequency List

- High Power Examination - All of the 59 assignments in this band have transmitter powers of less than .08 kW, except for two with powers of 20 kW.

#### 3.22.2.4 Classification - Probabilistic

#### 3.22.2.5 Computer Histograms

Due to the large number of emitters in this band, no histograms have been generated.

### 3.23 13.1-15.7 GHz Band

#### 3.23.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
12.75 - 13.25	FIXED MOBILE	
13.25 - 13.4	AERONAUTICAL RADIONAVIGATION 406 407 407A	
13.4 - 14	RADIOLOCATION 407 407A 408 409	
14 - 14.3	FIXED-SATELLITE (Earth-to-space) RADIONAVIGATION 408A 407 407A	
14.3 - 14.4	FIXED-SATELLITE (Earth-to-space) RADIONAVIGATION-SATELLITE 408A	
14.4 - 14.5	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 408B 408C	
14.5 - 15.35	FIXED MOBILE 408B 408C	
15.35 - 15.4	RADIO ASTRONOMY  409C	
15.4 - 15.7	AERONAUTICAL RADIONAVIGATION  352A 352B 407	

**352A** The bands 1 558.5 - 1 636.5 MHz, 4 200 - 4 400 MHz, 5 000 - 5 250 MHz and 15.4 - 15.7 GHz are reserved on a world-wide basis for the use and development of airborne electronic aids to air navigation and any directly associated ground-based or satellite-borne facilities.

**352B** The bands 1 558.5 - 1 636.5 MHz, 5 000 - 5 250 MHz and 15.4 - 15.7 GHz are also allocated to the aeronautical mobile (R) service for the use and development of systems using space radiocommunication techniques. Such use and development is subject to agreement and co-ordination between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

- 406** Limited to Doppler navigation aids.
- 407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa2** U.S.S.R., the bands 13.25 - 13.5 GHz, 14.175 - 14.3 GHz, 15.4 - 17.7 GHz, 23.6 - 24 GHz, 24.05 - 24.25 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.
- 407A** The band 13.25 - 14.2 GHz may also be used, on a secondary basis, for Earth-  
**Spa2** to-space transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.
- 408** In Sweden, the bands 13.4 - 14 GHz, 15.7 - 17.7 GHz and 33.4 - 36 GHz  
**Spa2** are also allocated to the fixed and mobile services.
- 408A** The use of the bands 14 - 14.3 GHz and 14.3 - 14.4 GHz by the radionavigation  
**Spa2** service and radionavigation-satellite service respectively, shall be such as to provide sufficient protection to space stations of the fixed-satellite service (see Recommendation No. Spa2 - 15, paragraph 2.14).
- 408B** The band 14.4 - 15.35 GHz may also be used, on a secondary basis, for space-  
**Spa2** to-Earth transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.
- 408C** Radio astronomy observations on the formaldehyde line (rest frequency  
**Spa2** 14.489 GHz) are being carried out in a number of countries under national arrangements. In making assignments to stations in the fixed and mobile services, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference in the band 14.485 - 14.515 GHz.
- 409** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
 U.S.S.R., the band 13.5-14 GHz is also allocated to the radionavigation service.
- 409C** In Algeria, Bulgaria, Cuba, Hungary, Kuwait, Lebanon, Morocco, Pakistan,  
**Spa** Poland, the United Arab Republic, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 15.35-15.4 GHz is also allocated to the fixed and mobile services.

- 406** Limited to Doppler navigation aids.
- 407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa2** U.S.S.R., the bands 13.25 - 13.5 GHz, 14.175 - 14.3 GHz, 15.4 - 17.7 GHz, 23.6 - 24 GHz, 24.05 - 24.25 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.
- 407A** The band 13.25 - 14.2 GHz may also be used, on a secondary basis, for Earth-  
**Spa2** to-space transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.
- 408** In Sweden, the bands 14 - 14 GHz, 15.7 - 17.7 GHz and 33.4 - 36 GHz  
**Spa2** are also allocated to the fixed and mobile services.
- 408A** The use of the bands 14 - 14.3 GHz and 14.3 - 14.4 GHz by the radionavigation  
**Spa2** service and radionavigation-satellite service respectively, shall be such as to provide sufficient protection to space stations of the fixed-satellite service (see Recommendation No. Spa2 - 15, paragraph 2.14).
- 408B** The band 14.4 - 15.35 GHz may also be used, on a secondary basis, for space-  
**Spa2** to-Earth transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.
- 408C** Radio astronomy observations on the formaldehyde line (rest frequency  
**Spa2** 14.489 GHz) are being carried out in a number of countries under national arrangements. In making assignments to stations in the fixed and mobile services, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference in the band 14.485 - 14.515 GHz.
- 409** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa2** U.S.S.R., the band 13.5-14 GHz is also allocated to the radionavigation service.
- 409C** In Algeria, Bulgaria, Cuba, Hungary, Kuwait, Lebanon, Morocco, Pakistan,  
**Spa2** Poland, the United Arab Republic, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 15.35-15.4 GHz is also allocated to the fixed and mobile services.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
12.75-13.25	AERONAUTICAL	FIXED MOBILE NG11 NG53
13.25-13.4	AERONAUTICAL RADIONAVIGATION Space Research (Earth-to-space)	AERONAUTICAL RADIONAVIGATION Space Research (Earth-to-space)
13.4-14.0	RADIOLOCATION Space Research (Earth-to-space) G59	Radiolocation Space Research (Earth-to-space)
14.0-14.2	RADIONAVIGATION Space Research (Earth-to-space)	FIXED-SATELLITE (Earth-to-space) RADIONAVIGATION Space Research (Earth-to-space)
14.2-14.3	RADIONAVIGATION	FIXED-SATELLITE (Earth-to-space) RADIONAVIGATION
14.3-14.4	RADIONAVIGATION- SATELLITE	FIXED-SATELLITE (Earth-to-space) RADIONAVIGATION- SATELLITE
14.4-14.5	FIXED MOBILE Space Research (Space-to-Earth)	FIXED-SATELLITE (Earth-to-space) Space Research (Space-to-Earth)
14.5-15.35	FIXED MOBILE Space Research (Space-to-Earth)	
15.35-15.4	RADIO ASTRONOMY G45	RADIO ASTRONOMY
15.4-15.7	AERONAUTICAL RADIONAVIGATION G54	AERONAUTICAL RADIONAVIGATION

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

G54 Aeronautical mobile communications which are an integral part of aeronautical radionavigation systems may be satisfied in the band 1558.5-1636.6 MHz, 5000-5250 MHz and 15.4-15.7 GHz.

G59 In the bands 902-928 MHz, 3100-3700 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz and 24.05-24.25 GHz, all Government non-military radiolocation shall be secondary to military radiolocation.

NG11 Television inter-city relay stations may be authorized to use frequencies in this band on the condition that harmful interference will not be caused to stations operating in accordance with the Table of Frequency Allocations.

### 3.23.2 Present Assignments

#### 3.23.2.1 Government Master File

- Assignment Class - The assignments in the 13.1 to 14.4 GHz portion of the band are mainly used for experimental purposes, except for a few radionavigation mobile stations and two space research earth stations. The band 14.4 to 15.3 GHz is used by mobile telemetering land stations and the fixed service, as well as the experimental service. The 15.35-15.4 GHz region is an exclusive radioastronomy allocation. The band 15.4 to 15.7 GHz is used for the radionavigation and experimental services.

The approximately 300 assignments in the band 13.1 to 15.7 GHz are located throughout the U.S., with a higher concentration in California, Nevada, and New Hampshire. There are a few space transmitters in the lower portion of the band. Most of these transmissions are space-to-space.

- Operating Agencies - This band is used primarily by the Air Force, Army, HEW and NASA, although many other government agencies have scattered use throughout the band.

- Emission - The emission characteristics in the 13.1 to 15.7 GHz band can be separated into two groups. The band 13.1 to 15.4 GHz is made up mainly of frequency modulated systems, with a few pulsed systems and unmodulated signals. The emission bandwidths vary according to the service. The fixed service specifies emission bandwidths from 15 to 40 MHz. The space research earth stations have bandwidths of 85 MHz, and the mobile stations specify bandwidths of 32 MHz. The radionavigation mobile stations have bandwidths of 10 MHz. The experimental systems vary over a wide range of bandwidths,

including some as large as 200 MHz (pulse modulated). The space transmitters specify emission bandwidths up to 360 MHz for a pulse modulated system. The portion of the band 15.4 to 15.7 GHz is made up mainly of pulse modulated systems which have emission bandwidths up to 50 MHz, although the majority are 2 to 4 MHz.

- Transmitter Power - The transmitter powers used throughout the band are usually less than 2 kW, with a few assignments noting powers of up to 10 kW. Additionally, there are 4 experimental assignments specifying transmitter powers of 250, 110, 30 and 100 kW at 14.55, 14.8, 15.492 and 15.7 GHz respectively.

- Antenna - There are a variety of antennas used in this band, with a number of them being parabolic. The parabolic antenna specify gains as high as 57 dB(i).

#### 3.23.2.2 Federal Communications Commission Data File

- Assignment Class - The assignments in the band up to 13.2 GHz are for the auxiliary broadcast service. There are 80 mobile units in this part of the band. The latter portion of the band is used for experimental and industrial purposes, with a few common carrier and marine assignments. The more than 600 assignments are located throughout the U.S.

- Emission - The emission characteristics are the same for all the auxiliary broadcast systems. These systems are frequency modulated, with bandwidths of 25 MHz. There are fixed experimental systems at 13.195 MHz, which are unmodulated. There are eight amplitude modulated mobile units, with bandwidths of 4.75 MHz, and eighty frequency modulated systems with

bandwidths of 250 kHz. The majority of the remaining assignments are frequency modulated, with emission bandwidths from 20 kHz to 32 MHz. The pulse modulated systems specify bandwidths from 3 to 10 MHz, and the amplitude modulated systems vary from 2 kHz to 12 MHz.

- Transmitter Power - The transmitter power for the auxiliary broadcast assignments is 2 Watts or less. The assignments above 13.192 GHz specify transmitter powers up to 50 kW. There are two experimental assignments with specified powers of 100 and 144 kW.

#### 3.23.2.3 International Frequency List

- High Power Examination - This frequency band can be divided into two portions. The band from 14490.25 MHz to 15375 MHz does not specify transmitter powers, except in three cases where the powers are 50, 60 and 250 kW. The remaining allocations in the band have specified powers of 4 kW or less.

#### 3.23.2.4 Classification - Probabilistic

#### 3.23.2.5 Computer Histograms

Figure 3.23-1 presents the non-experimental emitter and power histograms. Figure 3.23-2 presents the same including experimental assignments.

FREQUENCY BAND : 13.0-15.7(GHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM

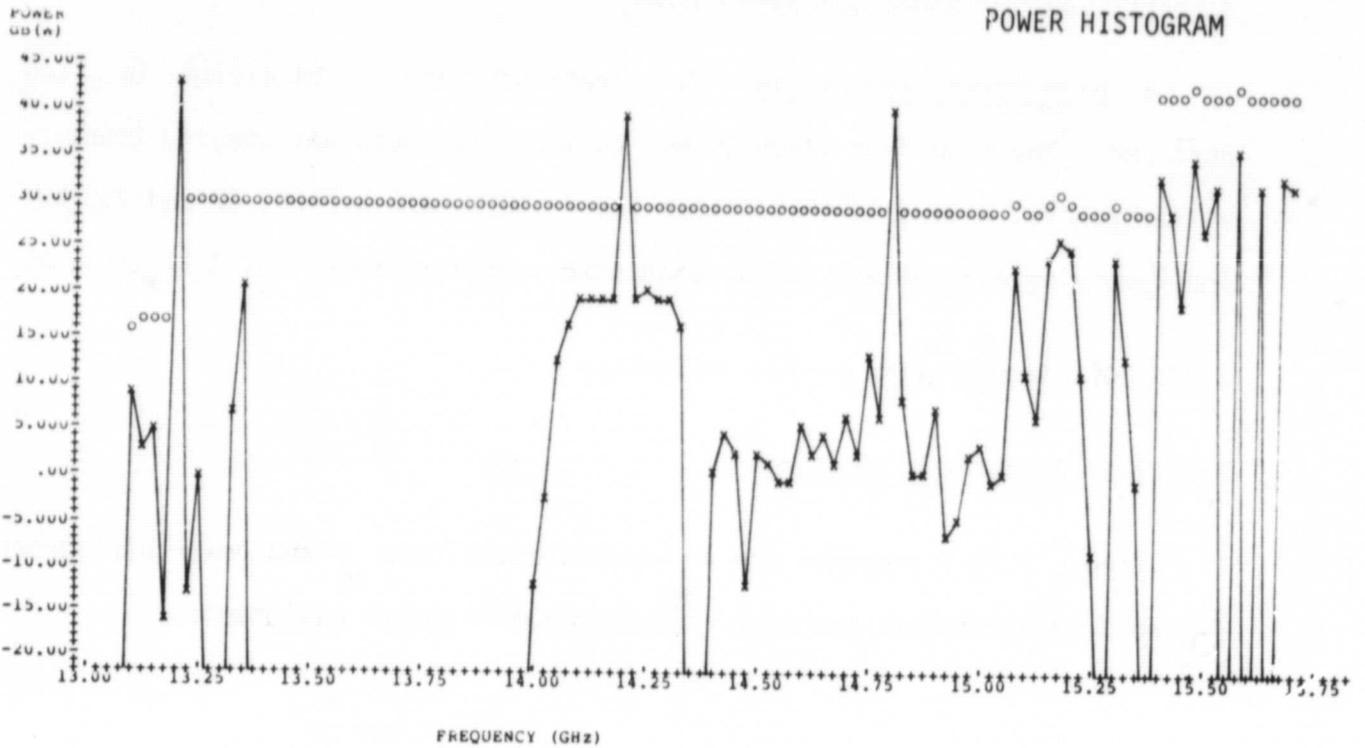
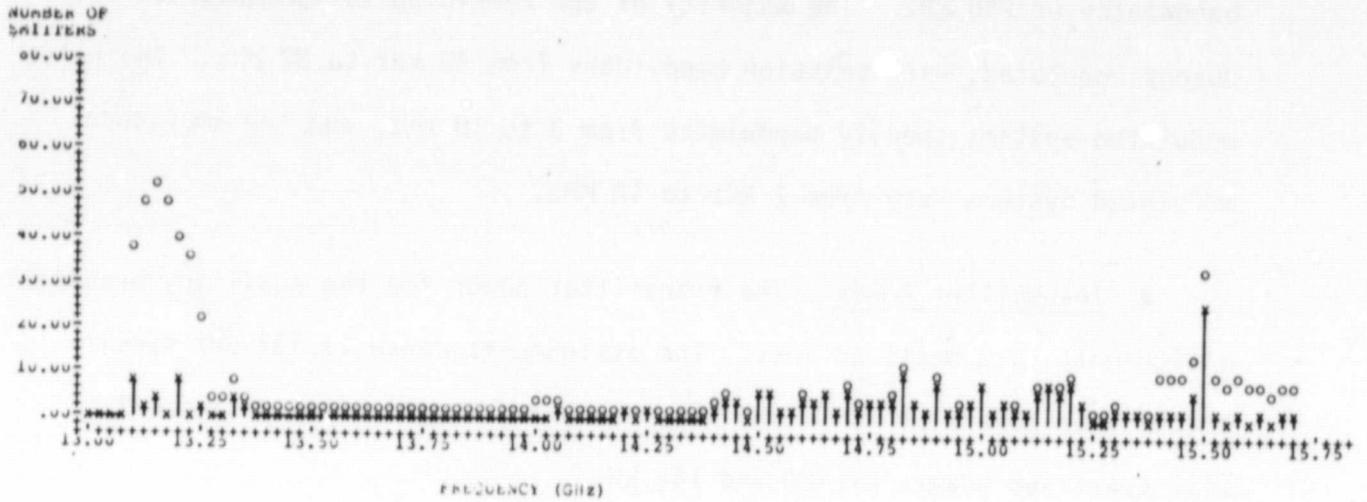
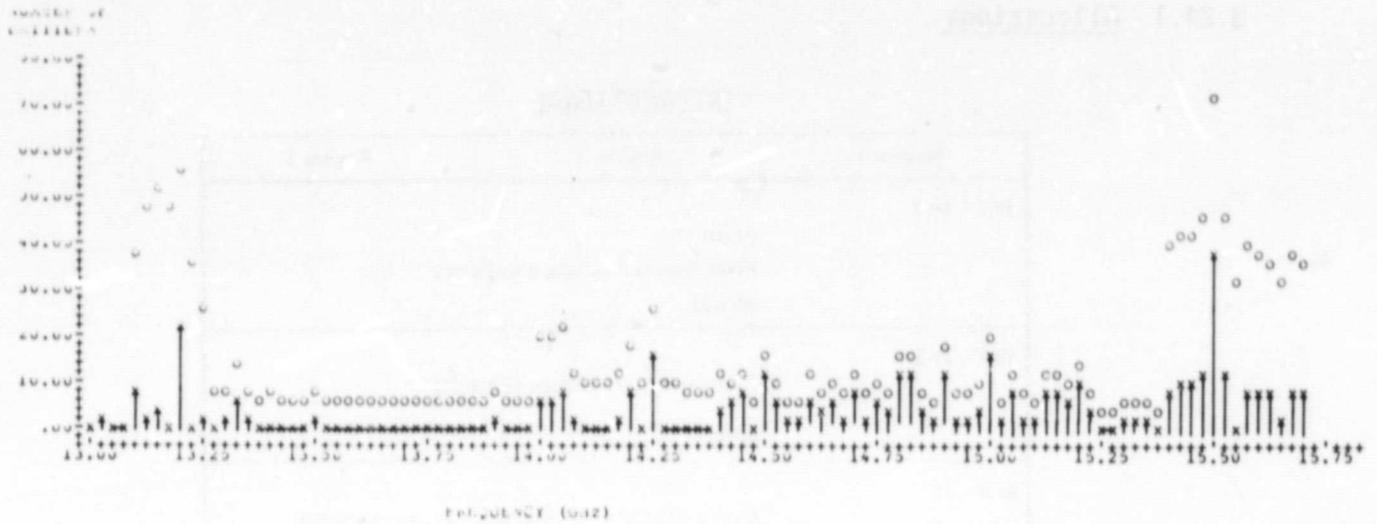


Figure 3.23-1. Non-Experimental Emitter and Power Histograms for the 13.0-15.7 GHz Band

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FREQUENCY BAND : 13.0-15.7(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

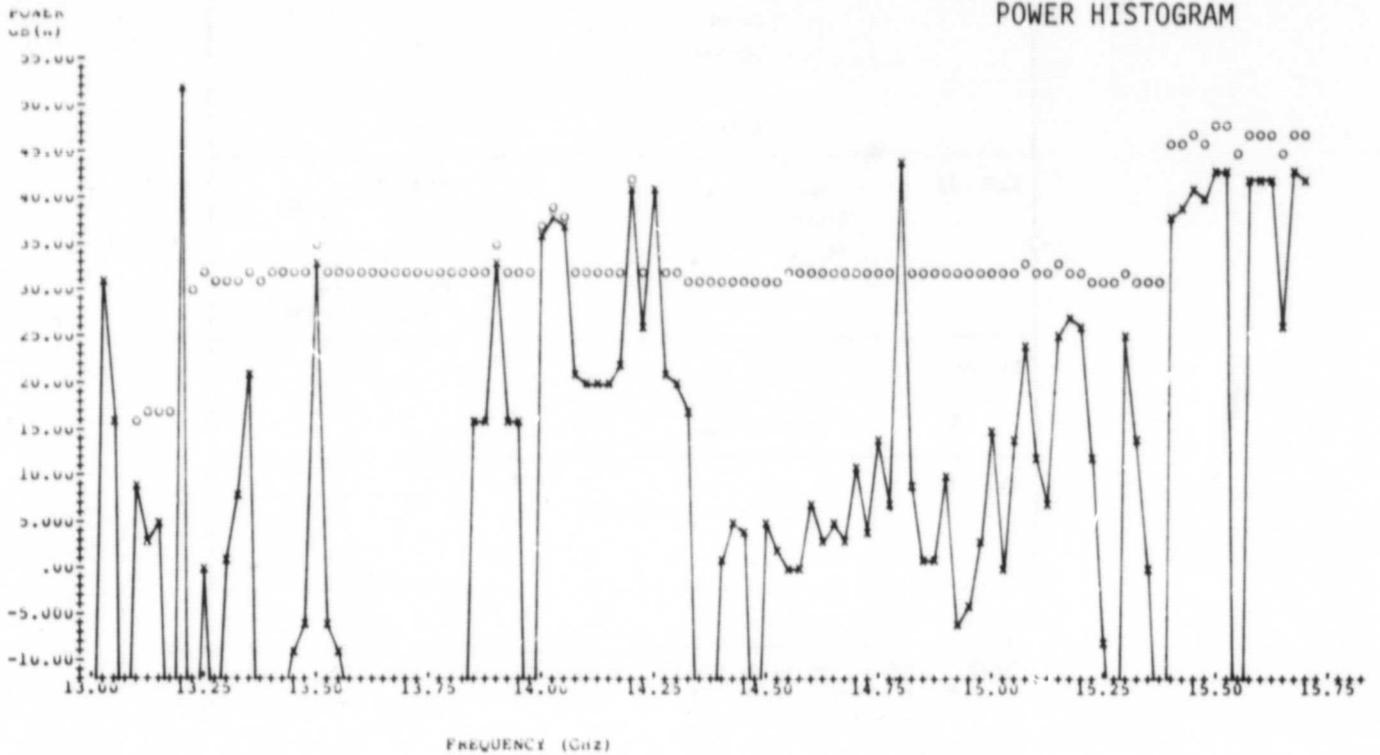


Figure 3.23-2. Emitter and Power Histograms for the 13.0-15.7 GHz Band Including Experimental

FREQUENCY BAND : 13.0-15.7(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM

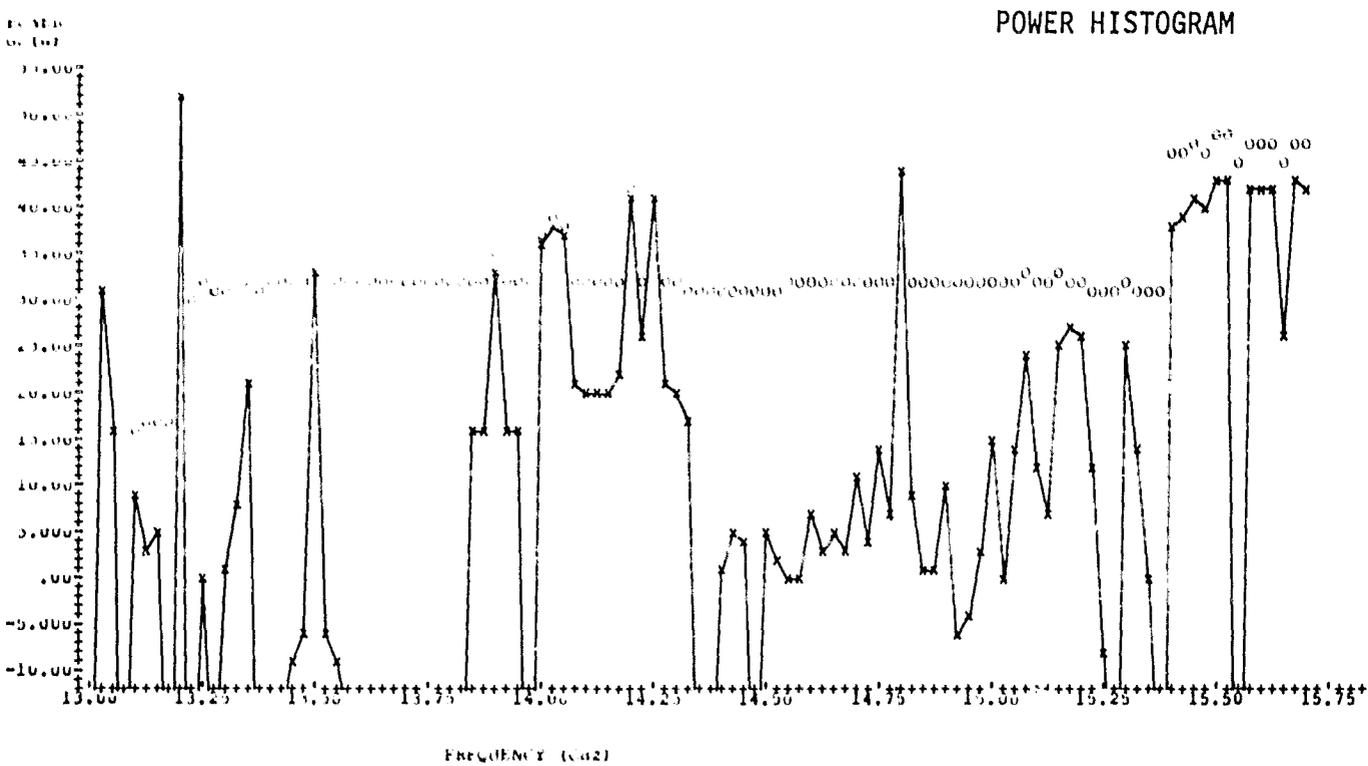
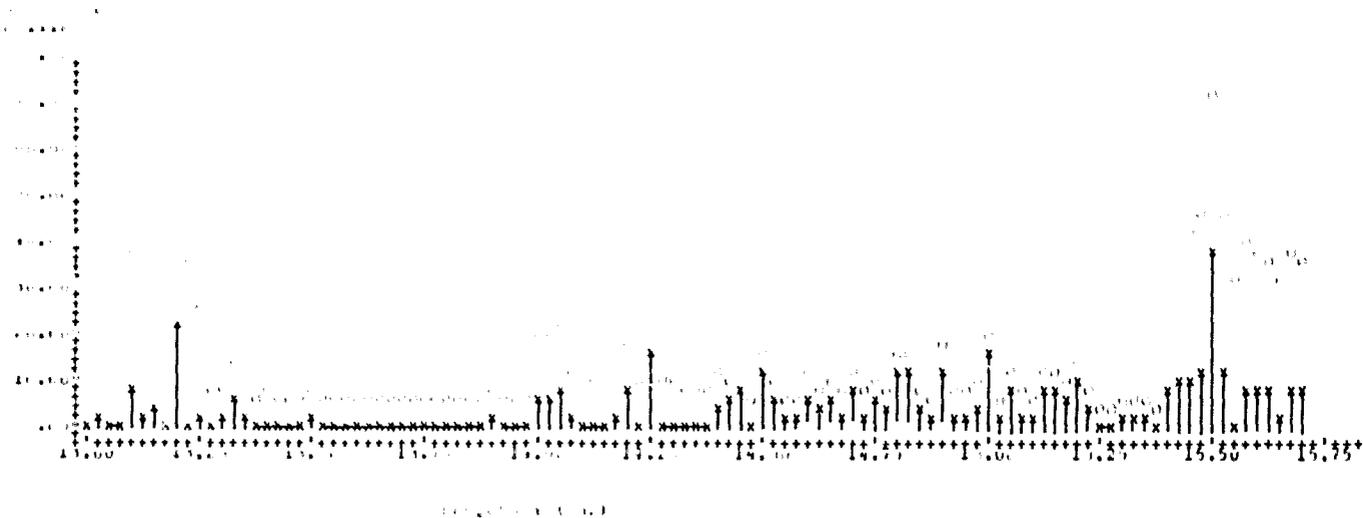


Figure 3.23-2. Emitter and Power Histograms for the 13.0-15.7 GHz Band Including Experimental

### 3.24 17.7-24.0 GHz Band

#### 3.24.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
17.7 - 19.7	FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE	
19.7 - 21.2	FIXED-SATELLITE (Space-to-Earth) 409E	
21.2 - 22	EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED MOBILE	
22 - 22.5	FIXED MOBILE 410A	
22.5 - 23	FIXED MOBILE	22.5 - 23 FIXED MOBILE BROADCASTING-SATELLITE 410B
23 - 23.6	FIXED MOBILE	
23.6 - 24	RADIO ASTRONOMY 407	

**407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 13.25 - 13.5 GHz, 14.175 - 14.3 GHz, 15.4 - 17.7 GHz, 23.6 - 24 GHz, 24.05 - 24.25 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.

**409E** In Japan, the bands 19.7 - 21.2 GHz and 29.5 - 31 GHz are also allocated to the fixed and mobile services. This additional use shall not impose any limitation on the power flux density of space stations in the fixed-satellite service.

**410A** The band 22.21 - 22.26 GHz is also allocated to the radio astronomy service for observations of a spectral line due to water vapour (rest frequency 22.235 GHz). Administrations are urged to give all practicable protection in this band for future research in radio astronomy.

**410B** In Region 3, the broadcasting-satellite service is authorized in the band 22.5 - 23.0 GHz, subject to power flux density limits for the protection of the terrestrial services in this band.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
17.7-19.7		FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE NG106
19.7-20.2		FIXED-SATELLITE (Space-to-Earth)
20.2-21.2	FIXED-SATELLITE (Space-to-Earth) G107	
21.2-22	EARTH EXPLORATION- SATELLITE (Space- to-Earth) FIXED MOBILE	EARTH EXPLORA- TION SATELLITE (Space-to-Earth) FIXED MOBILE NG107
22-23.6	FIXED MOBILE	FIXED MOBILE NG107
23.6-24	RADIO ASTRONOMY G45	RADIO ASTRONOMY

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

G107 Military earth stations in the band 7250-7750 and 7900-8400 MHz and 20.2-21.2, 30-31, 92-93, 102-103, 140-141 and 150-151 GHz may be fixed, transportable or located on board a ship or aircraft.

NG106 In the band 18.36-19.04 GHz, frequencies in the band segments 18.36-18.58 GHz and 18.82-19.04 GHz may be assigned for use by operational fixed stations, only on condition that suitable alternative frequencies in the band segment 18.58-18.82 GHz are not available for assignment to such stations.

NG107 In the band 21.2-23.6 GHz, frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz may be assigned to domestic fixed public stations, only on condition that suitable alternative frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz are not available for assignment to such stations. Similarly, frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz may be assigned to operational fixed stations, only on condition that suitable alternative frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz are not available for assignment to such stations.

DOMESTIC		
Band MHz	Government Allocation	Non-government Allocation
17.7-19.2		FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE NG106
19.2-20.2		FIXED-SATELLITE (Space-to-Earth)
20.2-21.2	FIXED-SATELLITE (Space-to-Earth) G107	
21.2-22	EARTH EXPLORATION- SATELLITE (Space- to-Earth) FIXED MOBILE	EARTH EXPLORA- TION SATELLITE (Space-to-Earth) FIXED MOBILE NG107
22-23.6	FIXED MOBILE	FIXED MOBILE NG107
23.6-24	RADIO ASTRONOMY G45	RADIO ASTRONOMY

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

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NG106 In the band 18.36-19.04 GHz, frequencies in the band segments 18.36-18.58 GHz and 18.82-19.04 GHz may be assigned for use by operational fixed stations, only on condition that suitable alternative frequencies in the band segment 18.58-18.82 GHz are not available for assignment to such stations.

NG107 In the band 21.2-23.6 GHz, frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz may be assigned to domestic fixed public stations, only on condition that suitable alternative frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz are not available for assignment to such stations. Similarly, frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz may be assigned to operational fixed stations, only on condition that suitable alternative frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz are not available for assignment to such stations.

### 3.24.2 Present Assignments

#### 3.24.2.1 Government Master File

- Assignment Class - Half of the 29 assignments are experimental. The remaining assignments are in the radiolocation service. The assignments are located throughout the U.S.

- Operating Agencies - The majority of assignments are under the Federal Aviation Administration. NASA and the Air Force operate the remaining assignments.

- Emission - Most of the assignments employ pulse modulation, with bandwidths varying from 50 kHz to 250 MHz. The amplitude modulated signals have emission bandwidths which vary from 2 kHz to 6 kHz. The frequency modulated assignments have bandwidths of 3.6 MHz and 10 MHz.

- Transmitter Power - The transmitter powers vary from .8 to 64 kW.

- Antenna - The assignments in this band use horn antennas, with gains of 20 dB(i), or parabolic antennas with 40 to 45 dB(i) gain.

#### 3.24.2.2 Federal Communications Commission Data File

- Assignment Class - The assignments in this band are almost exclusively for the mobile experimental service. The approximately 1300 assignments are distributed throughout the U.S.

- Emission - Fifty-five percent of the assignments are frequency modulated, with bandwidths varying from 1.3 to 220 MHz. Forty-three percent of the assignments are unmodulated. The few amplitude and pulse modulated systems show bandwidths of 2 to 3 kHz and 10 to 12 MHz respectively.

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- Transmitter Power - The transmitter power varies from 50 milliwatts to 630 kW.

#### 3.24.2.3 International Frequency List

- High Power Examination - Of the 13 assignments listed in the IFL, 7 have transmitter powers of 1.6 kW and the remaining are less than .5 kW.

#### 3.24.2.4 Classification - Probabilistic

#### 3.24.2.5 Computer Histograms

Due to the large number of emitters in the band, histograms have not been generated.

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Due to the large number of emitters in the band, histograms have not been generated.

### 3.25 27.5-35.2 GHz Band

#### 3.25.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
27.5 - 29.5	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	
29.5 - 31	FIXED-SATELLITE (Earth-to-space) 409E	
31 - 31.3	FIXED MOBILE <i>Space Research</i> 412H 412I	
31.3-31.5	RADIO ASTRONOMY 412A	
31.5-31.8 SPACE RESEARCH <i>Fixed</i> <i>Mobile</i>	31.5-31.8 SPACE RESEARCH  405C	31.5-31.8 SPACE RESEARCH <i>Fixed</i> <i>Mobile</i>
31.8-32.3	RADIONAVIGATION  <i>Space Research</i> 412B	
32.3-33	RADIONAVIGATION	
33-33.4 RADIO ASTRONOMY RADIONAVIGATION	33-33.4	RADIONAVIGATION  412F
33.4-34.2	RADIOLOCATION  407 408 412 412G	
34.2-35.2	RADIOLOCATION  <i>Space Research</i> 407 408 412 412C 412D	

**405C** In Cuba, the band 31.5-31.8 GHz is also allocated, on a secondary basis, to the fixed and mobile services.

**407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 13.25 - 13.5 GHz, 14.175 - 14.3 GHz, 15.4 - 17.7 GHz, 23.6 - 24 GHz, 24.05 - 24.25 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.

### 3.25 27.5-35.2 GHz Band

#### 3.25.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
27.5 - 29.5	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	
29.5 - 31	FIXED-SATELLITE (Earth-to-space) 409E	
31 - 31.3	FIXED MOBILE <i>Space Research</i> 412H 412I	
31.3-31.5	RADIO ASTRONOMY 412A	
31.5-31.8 SPACE RESEARCH <i>Fixed</i> <i>Mobile</i>	31.5-31.8 SPACE RESEARCH  405C	31.5-31.8 SPACE RESEARCH <i>Fixed</i> <i>Mobile</i>
31.8-32.3	RADIONAVIGATION <i>Space Research</i> 412B	
32.3-33	RADIONAVIGATION	
33-33.4 RADIO ASTRONOMY RADIONAVIGATION	33-33.4	RADIONAVIGATION  412F
33.4-34.2	RADIOLOCATION  407 408 412 412G	
34.2-35.2	RADIOLOCATION <i>Space Research</i> 407 408 412 412C 412D	

405C In Cuba, the band 31.5-31.8 GHz is also allocated, on a secondary basis, to the fixed and mobile services.

407 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 13.25 - 13.5 GHz, 14.175 - 14.3 GHz, 15.4 - 17.7 GHz, 23.6 - 24 GHz, 24.05 - 24.25 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.

- 408 Spa2** In Sweden, the bands 13.4 - 14 GHz, 15.7 - 17.7 GHz and 33.4 - 36 GHz are also allocated to the fixed and mobile services.
- 409E Spa2** In Japan, the bands 19.7 - 21.2 GHz and 29.5 - 31 GHz are also allocated to the fixed and mobile services. This additional use shall not impose any limitation on the power flux density of space stations in the fixed-satellite service.
- 412** In Japan, the bands 24.25-25.25 GHz and 33.4-36 GHz, are also allocated to the meteorological aids service.
- 412A Spa** In Bulgaria, Cuba, Hungary, Poland, the United Arab Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 31.3-31.5 GHz is also allocated to the fixed and mobile services.
- 412B Spa** In Bulgaria, Cuba, Hungary, Poland, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the space research service is a primary service in the band 31.8-32.3 GHz.
- 412C Spa** In Bulgaria, Cuba, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the space research service is a primary service in the band 34.2-35.2 GHz.
- 412D Spa** The band 34.4-34.5 GHz may be used by weather radar devices on meteorological-satellite for the detection of cloud.
- 412F Spa** In Cuba and India, the band 33-33.4 GHz is also allocated to the radio astronomy service.
- 412G Spa** In Bulgaria, Cuba, Hungary, Poland, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 33.4-34 GHz is also allocated to the radio astronomy service.
- 412H Spa** In Bulgaria, Cuba, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the space research service is a primary service in the band 31-31.3 GHz.
- 412I Spa2** Radio astronomy observations in the band 31.2 - 31.3 GHz are carried out in a number of countries under national arrangements. Administrations are urged to take all practicable steps to protect radio astronomy observations in this band from harmful interference.

DOMESTIC			
Band MHz	Government Allocation	Non-Government Allocation	Remarks
27.5-29.5		FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	
29.5-30		FIXED-SATELLITE (Earth-to-space)	
30-31	FIXED-SATELLITE (Earth-to-space) G107		
31-31.2		FIXED MOBILE	
31.2-31.5	RADIO ASTRONOMY G45	RADIO ASTRONOMY	
31.5-31.8	SPACE RESEARCH G35	SPACE RESEARCH	
31.8-33.4	RADIONAVIGATION	RADIONAVIGATION	

33.4-36.0	RADIOLOCATION	Radiolocation	Although the band 10000-10500 MHz presently seems most suitable as a common frequency band for such survey operations in different countries, future development, if required, should be directed to the band 34.0-35.6 GHz, within the overall band 33.4-36.0 GHz, with no new development below 10000 MHz.
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G35 In the bands 136-137 MHz and 31.5-31.8 GHz, no assignments are to be made except those that are in accordance with the Government Table of Frequency Allocations and those for experimentation that is consistent with the use for which the band is allocated.

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.60-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 172-185 GHz and 230-240 GHz.

G107 Military earth stations in the band 7250-7750 and 7900-8400 MHz and 20.2-21.2, 30-31, 92-93, 102-103, 140-141 and 150-151 GHz may be fixed, transportable or located on board a ship or aircraft.

### 3.25.2 Present Assignments

#### 3.25.2.1 Government Master File

- Assignment Class - The assignments in this band are used for radio-location land, radiolocation mobile, radionavigation land, and experimental. There is one flight telemetering mobile station. There are four transmitters in space, and the remainder of the 75 assignments are located throughout the U.S.

- Operating Agencies - The Army, Air Force, ERDA, Navy and N/SA are the agencies using this band.

- Emission - The assignments are mainly pulse modulated, with emission bandwidths varying from 50 kHz to 50 MHz. One spaceborne assignment has an emission bandwidth of 240 MHz, with a transmitter power of .1585 kW. The frequency modulated assignments have an emission bandwidth of 500 kHz, except for two experimental assignments with emission bandwidths of 1.06 GHz and 2 GHz, and transmitter powers of .8 and 1 Watt respectively.

- Transmitter Power - The assignments in this band have transmitter powers from .2 Watts to 125 kW.

- Antenna - The antennas specified in this band are parabolic, for the most part, with gains up to 53 dB(i).

#### 3.25.2.2 Federal Communications Commission Data File

- Assignment Class - Eighty-three percent of the assignments are experimental, with more than half of these being for mobile systems. Fourteen percent are mobile public safety assignments. The remaining assignments are industrial. The approximately 500 assignments are concentrated in New York, New Jersey and Maryland.

- Emission - Half of the assignments are unmodulated. One third are frequency modulated, with emission bandwidths of 25 MHz. There are a few assignments with bandwidths of 250 MHz, one with a bandwidth of 600 MHz and the remainder having bandwidths less than 30 kHz. There are a few pulse modulated assignments, with emission bandwidths of 10 to 120 MHz, and a few amplitude modulated systems, with bandwidths from 2 kHz to 8 MHz.

- Transmitter Power - The majority of assignments have a power of 20 Watts. The remaining assignments vary from 100 milliwatts to 100 kW. There are 6 assignments with transmitter powers of 630 kW.

#### 3.25.2.3 International Frequency List

- High Power Examination - In this band there are seven assignments listed. The transmitter powers specified vary from 18 to 40 kW.

#### 3.25.2.4 Classification - Probabilistic

#### 3.25.2.5 Computer Histograms

Figure 3.25-1 presents the non-experimental emitter and power histograms.  
Figure 3.25-2 presents the same including experimental assignments.

#### 3.25.2.4 Classification - Probabilistic

#### 3.25.2.5 Computer Histograms

Figure 3.25-1 presents the non-experimental emitter and power histograms.  
Figure 3.25-2 presents the same including experimental assignments.

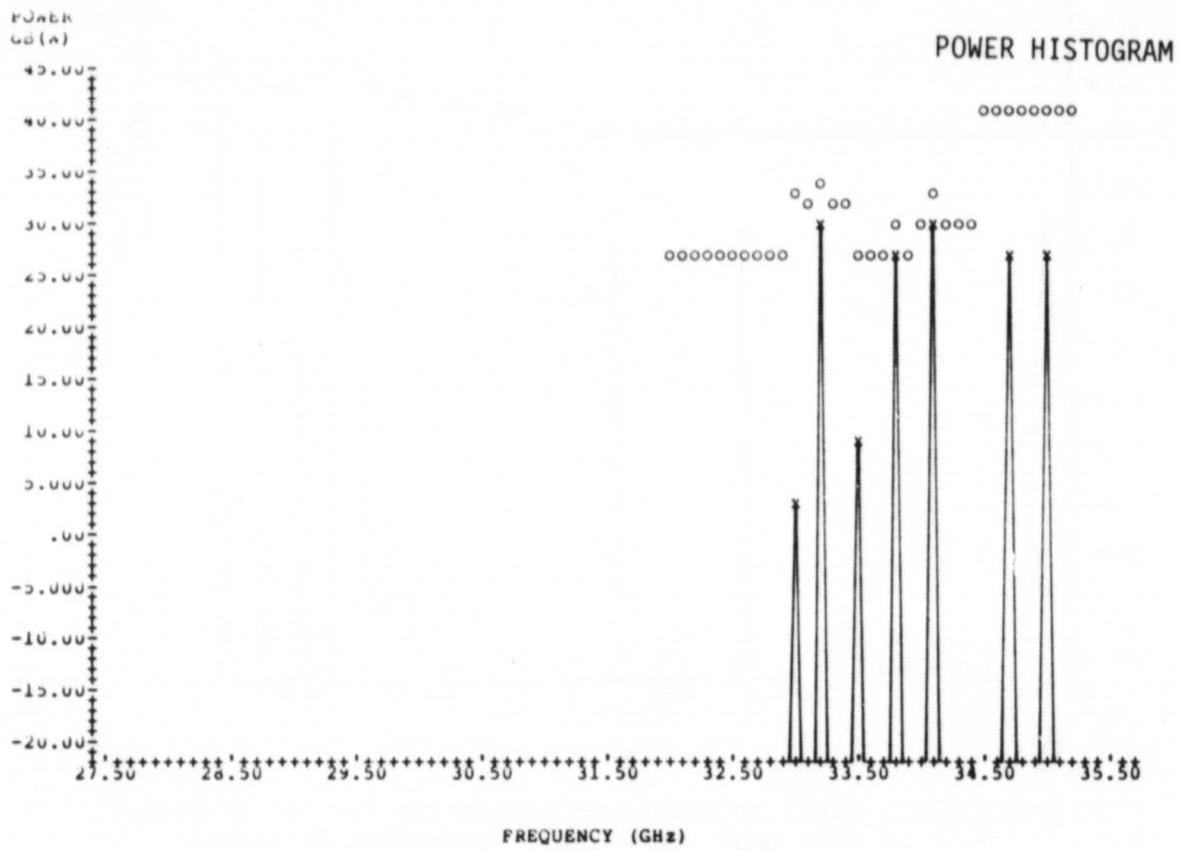
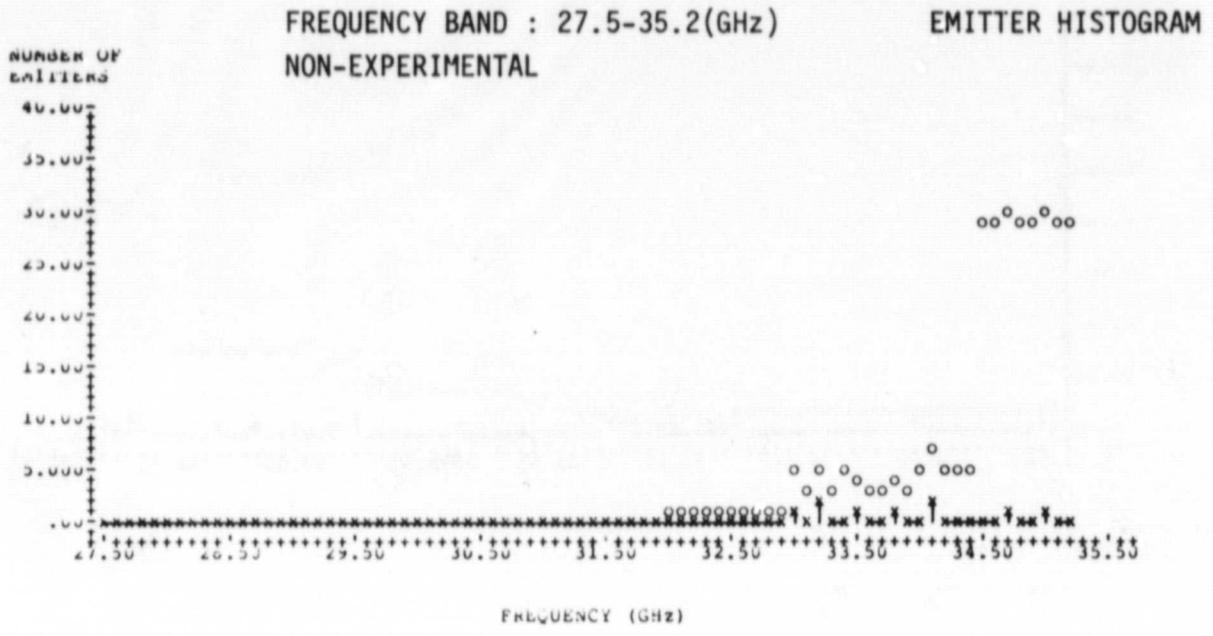


Figure 3.25-1. Non-Experimental Emitter and Power Histograms for the 27.5-35.2 GHz Band

FREQUENCY BAND : 27.5-35.2(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM

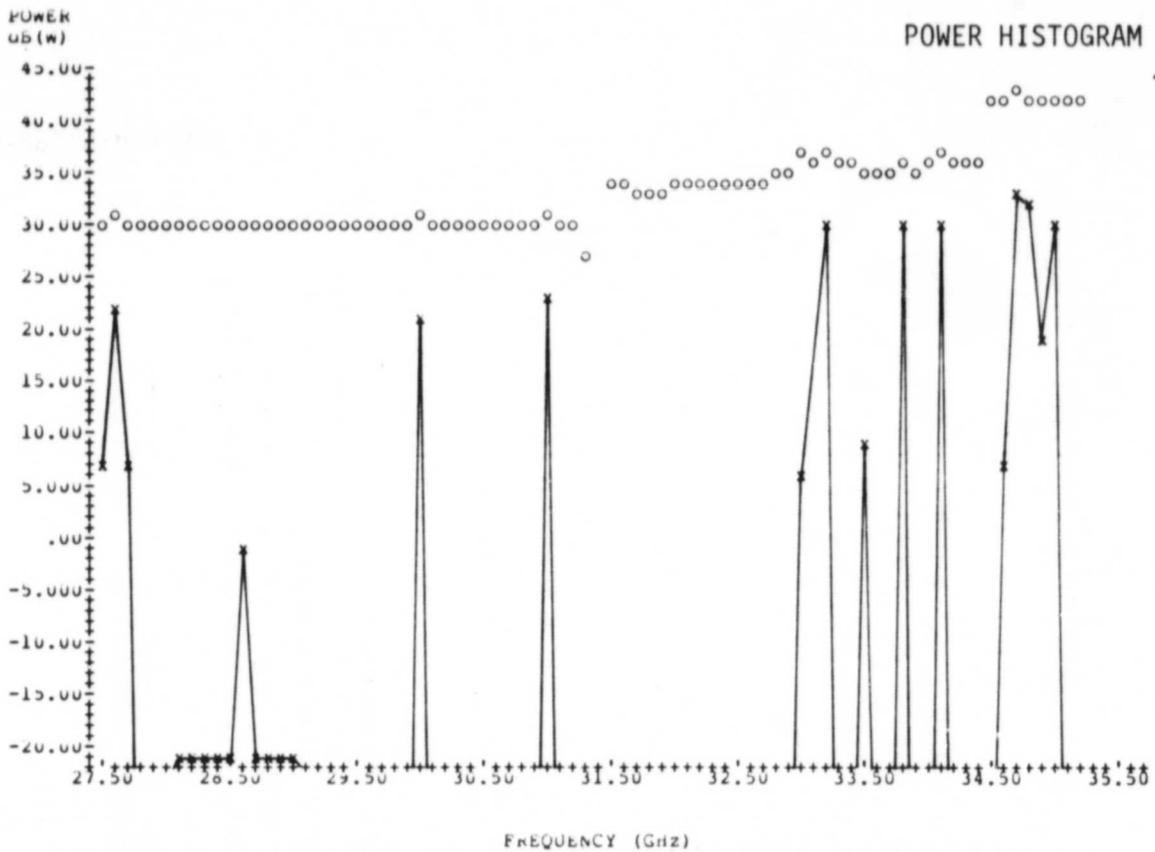
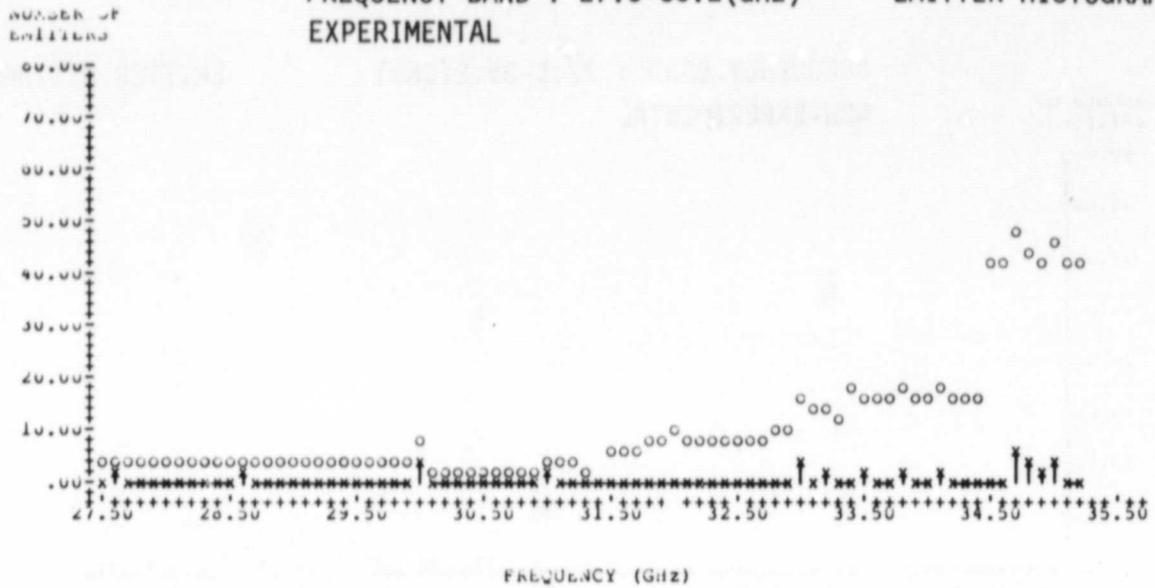


Figure 3.25-2. Emitter and Power Histograms for the 27.5-35.2 GHz Band Including Experimental Assignments

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### 3.26 35.5-43.0 GHz Band

#### 3.26.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
35.2-36	<b>RADIOLOCATION</b> 407 408 412	
36-40	<b>FIXED</b> <b>MOBILE</b> 391A 412E	
40-41	<b>FIXED-SATELLITE (Space-to-Earth)</b>	
41-43	<b>BROADCASTING-SATELLITE</b>	

**391A** Radio astronomy observations are being carried out in the bands 5 750 -  
**Spa2** 5 770 MHz and 36 458 - 36 488 GHz in a number of countries under national arrangements. Administrations are urged to take all practicable steps to protect radio astronomy observations in these bands from harmful interference.

**407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa2** U.S.S.R., the bands 13 25 - 13 5 GHz, 14 175 - 14 3 GHz, 15 4 - 17 7 GHz, 23 6 - 24 GHz, 24 05 - 24 25 GHz and 33 4 - 36 GHz are also allocated to the fixed and mobile services.

**408** In Sweden, the bands 13 4 - 14 GHz, 15 7 - 17 7 GHz and 33 4 - 36 GHz  
**Spa2** are also allocated to the fixed and mobile services.

**412** In Japan, the bands 24 25-25 25 GHz, and 33 4-36 GHz, are also allocated to the  
 meteorological aids service.

**412E** In Bulgaria, Cuba, Hungary, Poland, Yugoslavia, Roumania, Czechoslovakia  
**Spa** and the U.S.S.R., the band 36 5-37 5 GHz is also allocated to the radio astronomy service.

### 3.26 35.5-43.0 GHz Band

#### 3.26.1 Allocations

#### INTERNATIONAL

Region 1	Region 2	Region 3
35.2-36	RADIOLOCATION 407 408 412	
36-40	FIXED MOBILE 391A 412E	
40-41	FIXED-SATELLITE (Space-to-Earth)	
41-43	BROADCASTING-SATELLITE	

**391A** Radio astronomy observations are being carried out in the bands 5 750 -  
**Spa2** 5 770 MHz and 36 458 - 36 488 GHz in a number of countries under national  
 arrangements. Administrations are urged to take all practicable steps to protect  
 radio astronomy observations in these bands from harmful interference.

**407** In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the  
**Spa2** U.S.S.R., the bands 13 25 - 13 5 GHz, 14 175 - 14 3 GHz, 15 4 - 17 7 GHz,  
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**412E** In Bulgaria, Cuba, Hungary, Poland, Yugoslavia, Roumania, Czechoslovakia  
**Spa** and the U.S.S.R., the band 36 5-37 5 GHz is also allocated to the radio astronomy  
 service.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
33.4-36.0	RADIOLOCATION G34	Radiolocation
36.0-38.6	FIXED MOBILE	
38.6-40.0		FIXED MOBILE
40-41	FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE	FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE
41-43	FIXED MOBILE	FIXED BROADCASTING- SATELLITE MOBILE

G34 In the band 34.4-34.5 GHz, weather radars on board meteorological satellites for cloud detection are authorized to operate on the basis of equality with military radiolocation devices. All other non-military radiolocation in the band 33.4-36.0 GHz shall be secondary to the military services.

### 3.26.2 Present Assignments

#### 3.26.2.1 Government Master File

- Assignment Class - This band is mainly used for experimental purposes with some radiolocation service assignments. Twenty of the assignments are distributed throughout the U.S. The remaining 9 assignments are spaceborne, geostationary and non-geostationary.

- Operating Agencies - The Air Force operates the majority of assignments in this band.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
33.4-36.0	RADIOLOCATION G34	Radiolocation
36.0-38.6	FIXED MOBILE	
38.6-40.0		FIXED MOBILE
40-41	FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE	FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE
41-43	FIXED MOBILE	FIXED BROADCASTING- SATELLITE MOBILE

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- Operating Agencies - The Air Force operates the majority of assignments in this band.

- Emission - Half of the assignments are frequency modulated, with emission bandwidths of 500 kHz, 40 MHz and 500 MHz. A third of the assignments are pulse modulated, with emission bandwidths of 50 kHz, 12 MHz and 360 MHz. There is no information given on the remaining assignments.

- Transmitter Power - The majority of assignments vary in their transmitter power from 2 Watts to 10 kW, except for 6 assignments with a specified power of 125 kW.

- Antenna - The earth station antennas described have gains up to 51 dB(i).

#### 3.26.2.2 Federal Communications Commission Data File

- Assignment Class - The majority of assignments in this band are experimental (most of which are mobile). The remaining assignments are in the common carrier service. Most of the approximately 255 assignments are located in New York and New Jersey.

- Emission - Fifty percent of the assignments are unmodulated. The remaining half are frequency modulated, with the majority having emission bandwidths of 25 MHz.

- Transmitter Power - Most of the assignments specify powers of 20 Watts. There are five experimental assignments with powers of 630 kW.

#### 3.26.2.3 International Frequency List

- High Power Examination - There are only ten assignments in this range, with transmitter powers ranging from 1.6 kW to 6.4 kW.

- Emission - Half of the assignments are frequency modulated, with emission bandwidths of 500 kHz, 40 MHz and 500 MHz. A third of the assignments are pulse modulated, with emission bandwidths of 50 kHz, 12 MHz and 360 MHz. There is no information given on the remaining assignments.

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- High Power Examination - There are only ten assignments in this range, with transmitter powers ranging from 1.6 kW to 6.4 kW.

3.26.2.4 Classification - Probabilistic or indeterminate.

3.26.2.5 Computer Histograms

Figure 3.26-1 presents the non-experimental emitter and power histograms.

Figure 3.26-2 presents the same including experimental assignments.

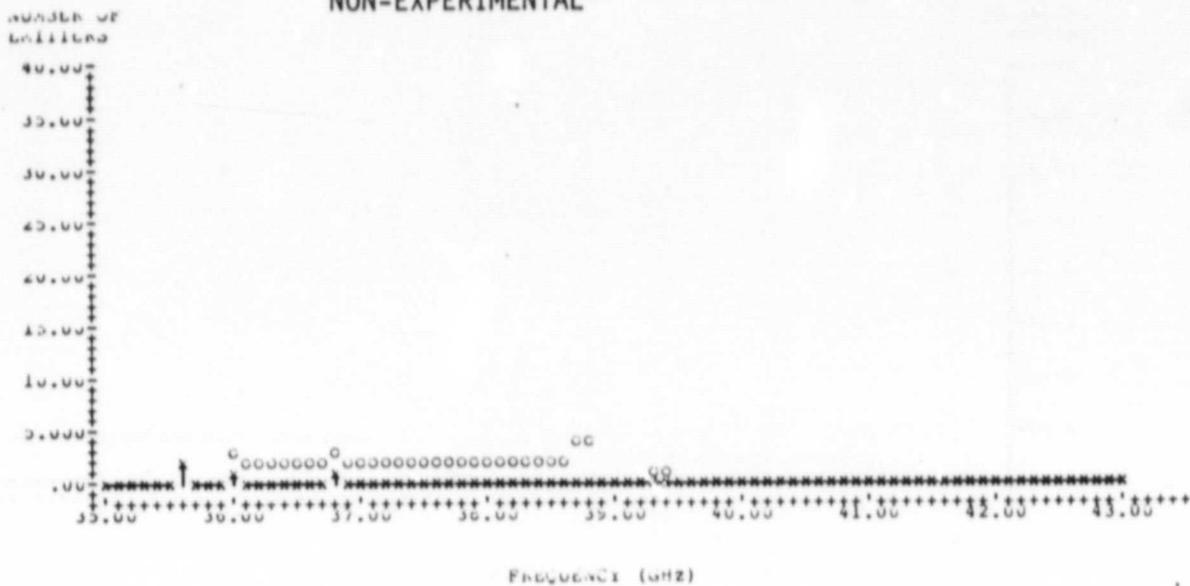
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Figure 3.26-1 presents the non-experimental emitter and power histograms.  
Figure 3.26-2 presents the same including experimental assignments.

FREQUENCY BAND : 35.0-43.0(GHz)  
NON-EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

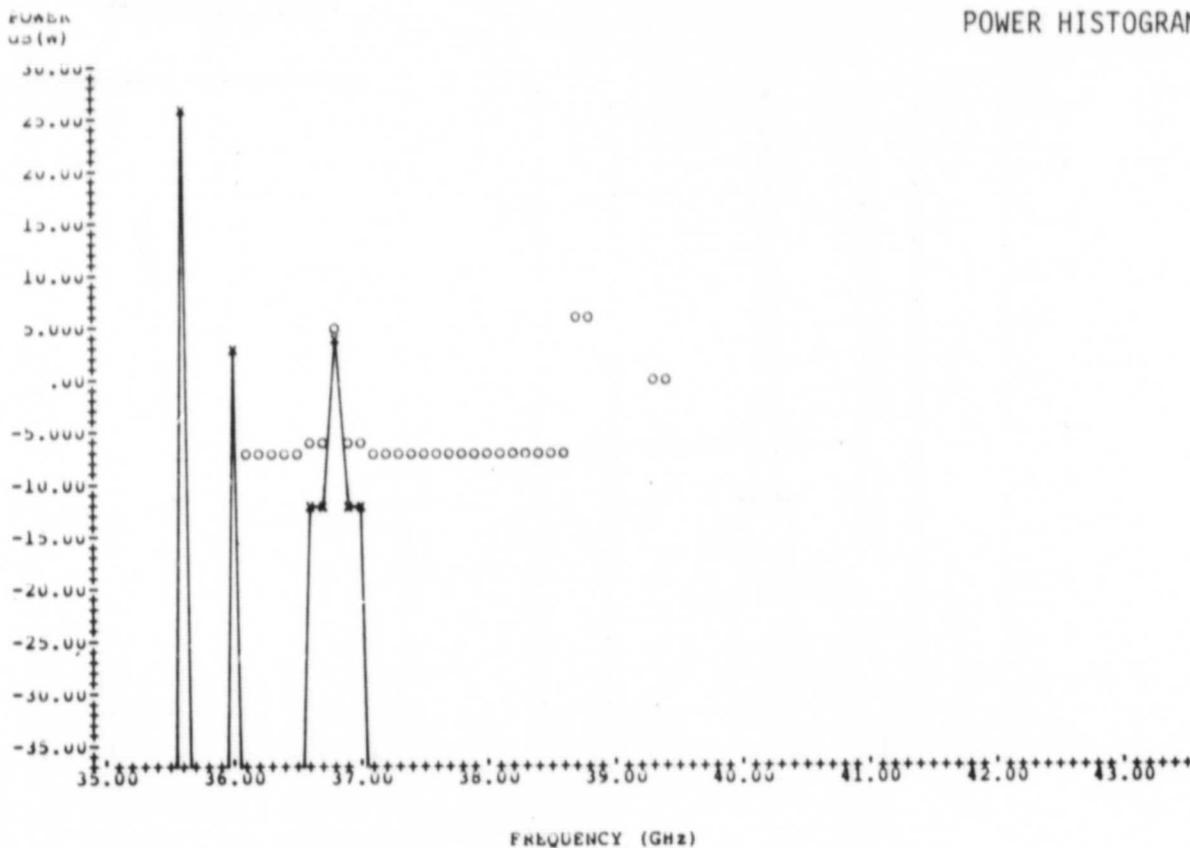


Figure 3.26-1. Non-Experimental Emitter and Power Histograms for the 35-43 GHz Band

FREQUENCY BAND : 35.0-43.0(GHz)  
 NON-EXPERIMENTAL

EMITTER HISTOGRAM

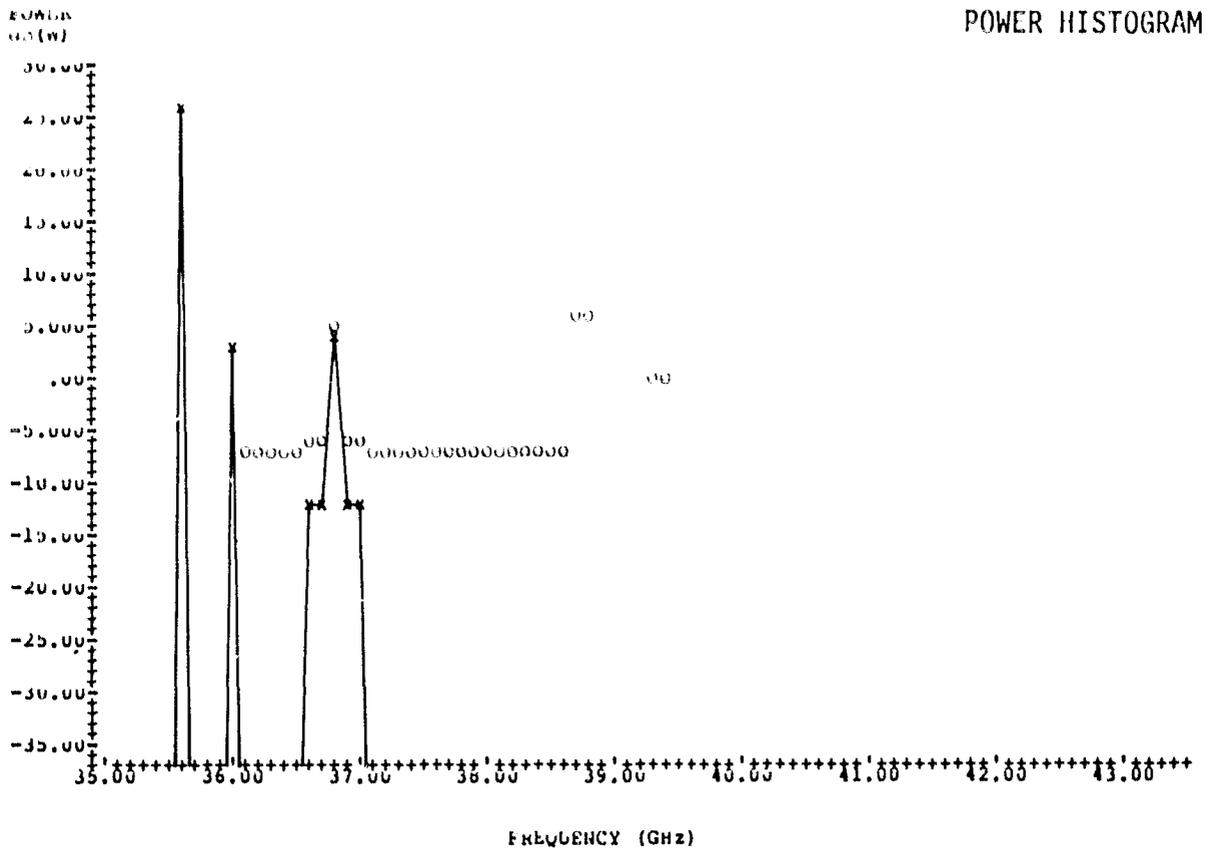
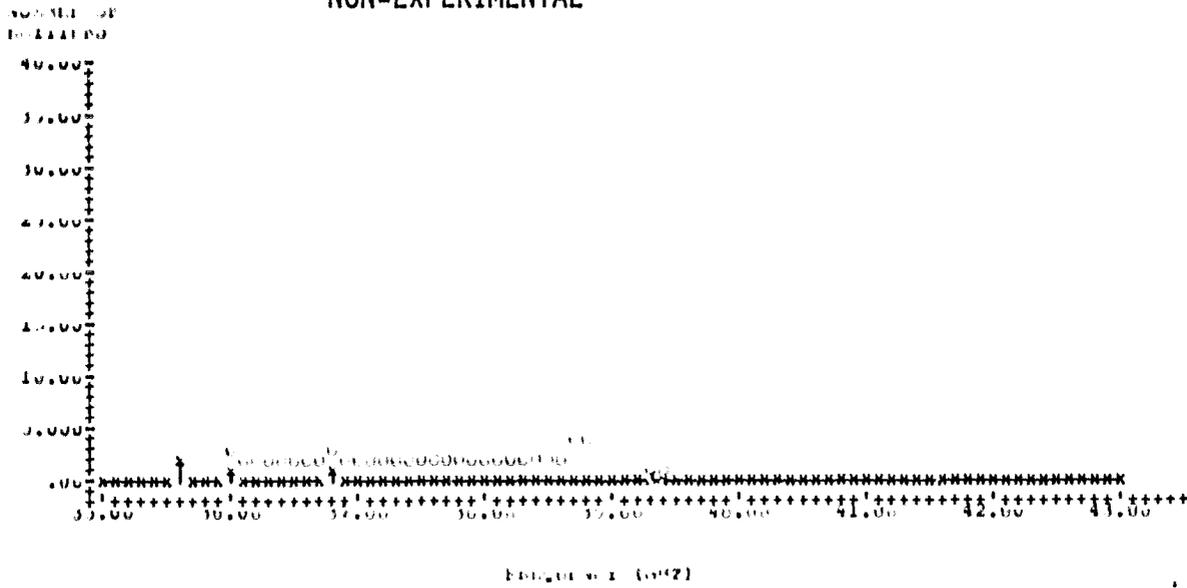


Figure 3.26-1. Non-Experimental Emitter and Power Histograms for the 35-43 GHz Band

FREQUENCY BAND : 35.0-43.0(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM

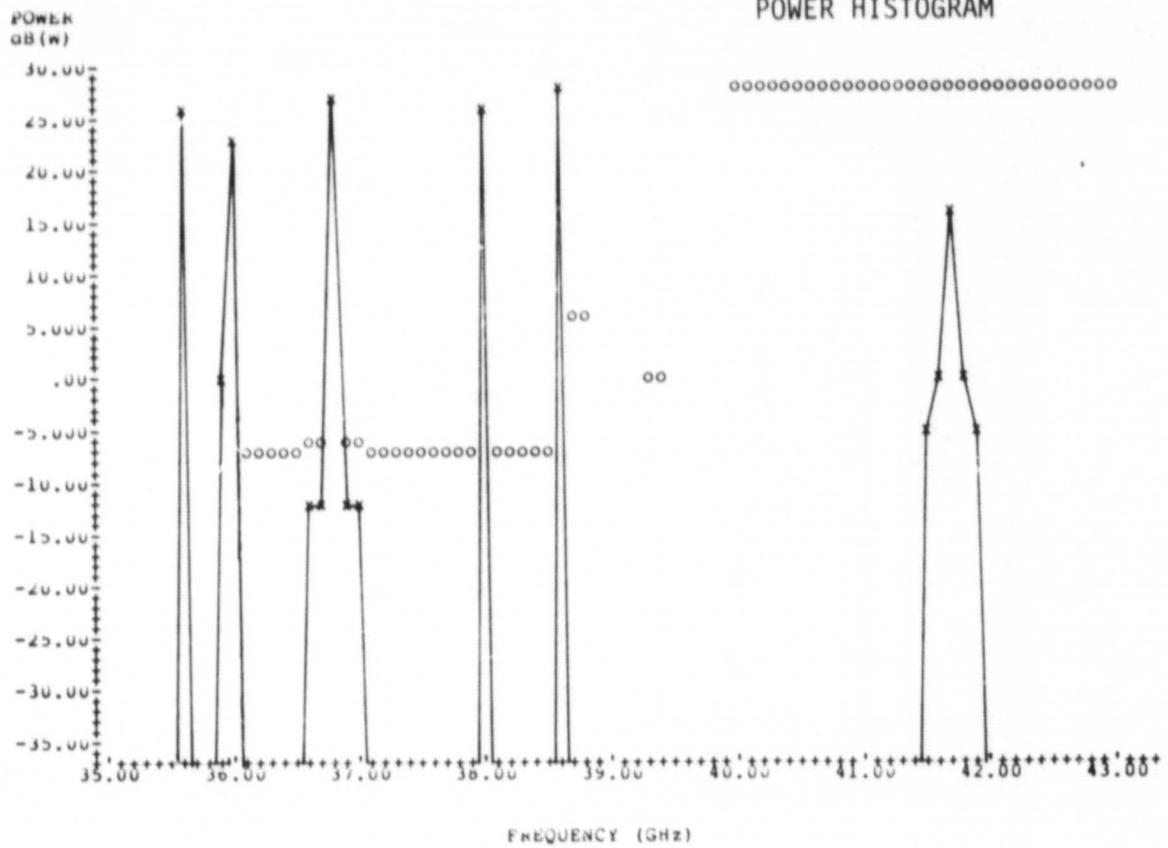
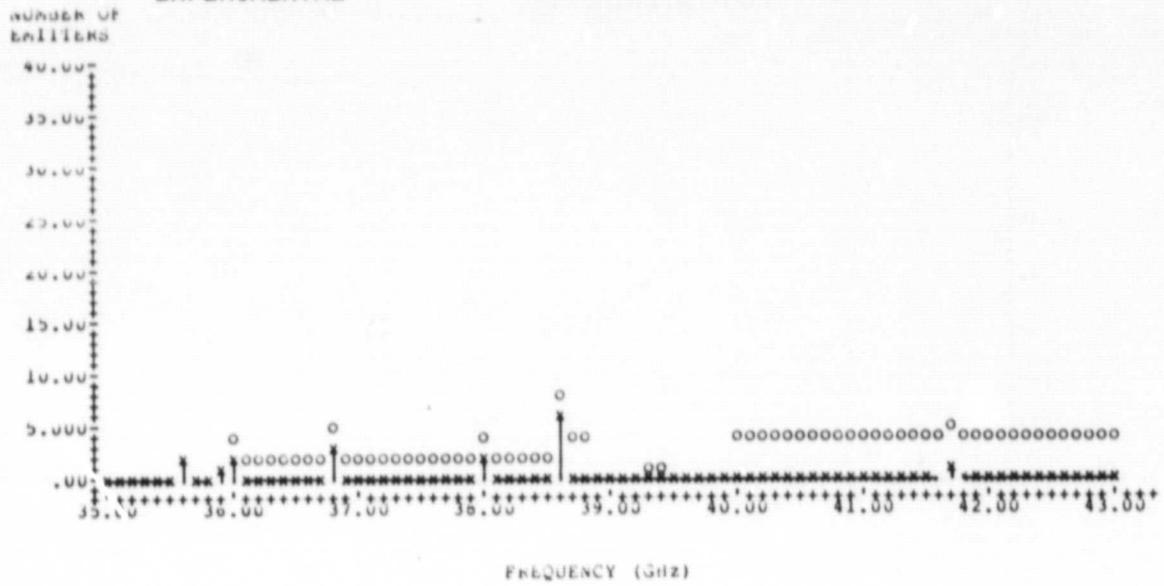
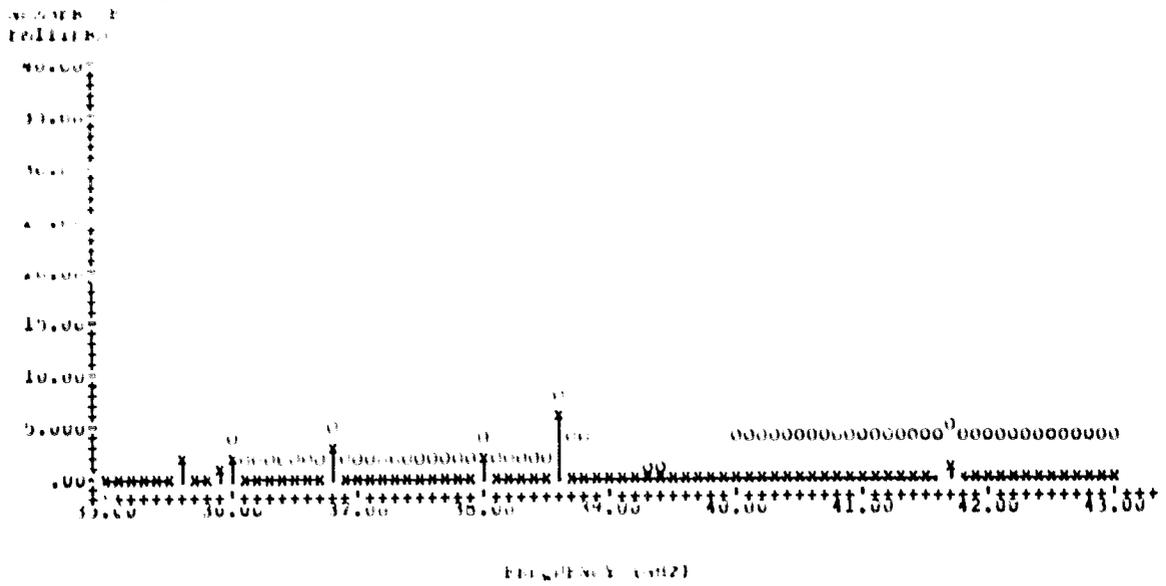


Figure 3.26-2. Emitter and Power Histograms for the 35-43 GHz Band Including Experimental Assignments

FREQUENCY BAND : 35.0-43.0(GHz)  
 EXPERIMENTAL

EMITTER HISTOGRAM



POWER HISTOGRAM

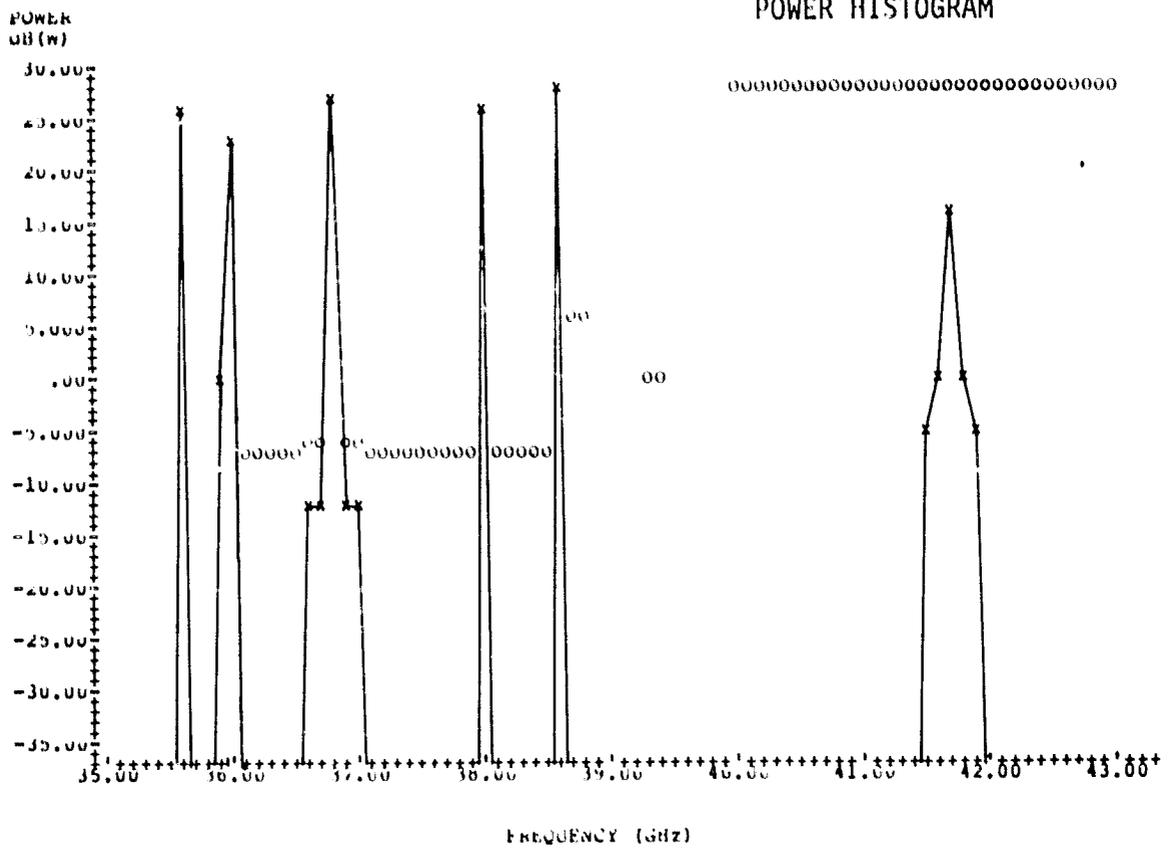


Figure 3.26-2. Emitter and Power Histograms for the 35-43 GHz Band Including Experimental Assignments

### 3.27 50-65 GHz Band

#### 3.27.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
50 - 51	FIXED-SATELLITE (Earth-to-space)	
51 - 52	EARTH EXPLORATION-SATELLITE SPACE RESEARCH	
52 - 54.25	SPACE RESEARCH (Passive) 412J	
54.25 - 58.2	INTER-SATELLITE	
58.2 - 59	SPACE RESEARCH (Passive) 412J	
59 - 64	INTER-SATELLITE	
64 - 65	SPACE RESEARCH (Passive) 412J	

**412J** All emissions in the bands 52-54.25 GHz, 58.2-59 GHz, 64-65 GHz, **Spa2** 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz are prohibited. The use of passive sensors by other services is also authorized.

### 3.27 50-65 GHz Band

#### 3.27.1 Allocations

INTERNATIONAL		
Region 1	Region 2	Region 3
50 - 51	FIXED SATELLITE (Earth-to-space)	
51 - 52	EARTH EXPLORATION-SATELLITE SPACE RESEARCH	
52 - 54.25	SPACE RESEARCH (Passive) 412J	
54.25 - 59.2	INTER-SATELLITE	
58.2 - 59	SPACE RESEARCH (Passive) 412J	
59 - 64	INTER-SATELLITE	
64 - 65	SPACE RESEARCH (Passive) 412J	

412J All emissions in the bands 52-54.25 GHz, 58.2-59 GHz, 64-65 GHz,  
Spa2 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz  
are prohibited. The use of passive sensors by other services is also authorized.

DOMESTIC		
Band MHz	Government Allocation	Non-Government Allocation
50-51	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE
51-52	EARTH EXPLORATION- SATELLITE SPACE RESEARCH	EARTH EXPLORATION- SATELLITE SPACE RESEARCH
52-54.25	SPACE RESEARCH (Passive) G45	SPACE RESEARCH (Passive)
54.25-58.2	FIXED INTER-SATELLITE MOBILE	FIXED MOBILE except aeronautical mobile
58.2-59	SPACE RESEARCH (Passive) G45	SPACE RESEARCH (Passive)
59-64	FIXED INTER-SATELLITE MOBILE	FIXED MOBILE except aeronautical mobile
64-65	SPACE RESEARCH (Passive) G45	SPACE RESEARCH (Passive)

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

### 3.27.2 Present Assignments

#### 3.27.2.1 Government Master File

- Assignment Class - There are only two assignments listed in this band. Both of the assignments are for experimental research. The assignment located in New Mexico operates over a frequency range of 50 to 55 GHz. There is one assignment in Colorado at 57.63 GHz.

- Operating Agencies - The Air Force uses the assignment at 50 GHz and the Department of Commerce operates at 57 GHz.

- Emission - The Air Force assignment is pulse modulated with an emission bandwidth of 10 MHz. The frequency modulated assignment has an emission bandwidth of 5 MHz.

- Transmitter Power - The Air Force assignment has a transmitter power of 10 kW, and the other has a power of .1 Watt.

- Antenna - Both assignments use parabolic antennas with gains of 41 and 46 dB(i) respectively.

#### 3.27.2.2 Federal Communications Commission Data File

- Assignment Class - This band is used exclusively for experimental research. The approximately 250 assignments are located throughout the United States and possessions.

- Emission - The experimental stations are unmodulated or frequency modulated, with emission bandwidths of 25 MHz. The industrial user specifies its emission bandwidth as 20 kHz frequency modulated.

- Transmitter Power - The transmitter power is 20 Watts for the experimental assignments and 30 Watts for the industrial user.

#### 3.27.2.3 International Frequency List

- High Power Examination - There are no listings internationally in this band.

3.27.2.4 Classification - Non-determinant

3.27.2.5 Computer Histograms

Figure 3.27-1 presents the experimental emitter and power histograms.

FREQUENCY BAND : 50.0-65.0(GHz)  
EXPERIMENTAL

EMITTER HISTOGRAM

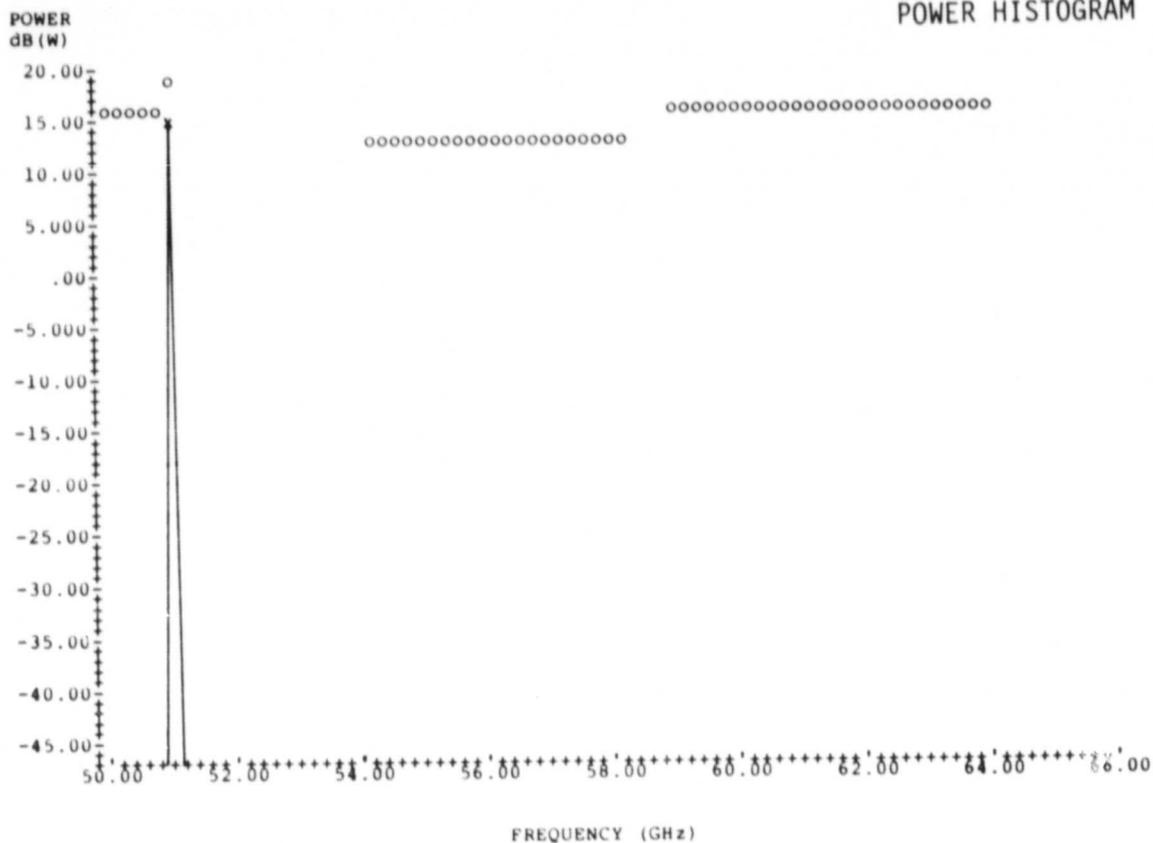
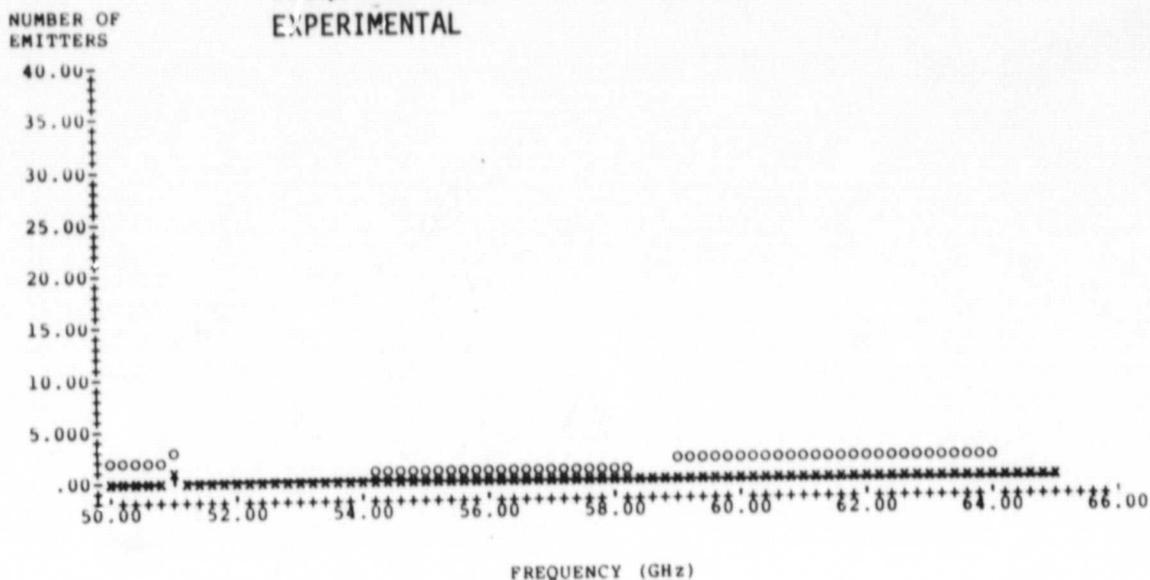


Figure 3.27-1 Emitter and Power Histograms for the 50-65 GHz Band Including Experimental Assignments

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## ANNEX A

### CALCULATION OF RF POWER LEVEL AT ORBITAL ALTITUDE IN THE 668-674 MHz FREQUENCY BAND

The 668-674 MHz band (UHF-TV Channel 47) was chosen for an example analysis because the operational characteristics of TV stations in the band are fairly well documented.

The detailed analysis was carried out by determining the location and emission characteristics of each transmitter in the band, placing the satellite at a given location on its orbital sphere, and calculating the power received by the EEE in each 20 kHz (and 1 MHz) sub-band within the 668 to 674 MHz frequency band. This calculation involved the following factors:

- Transmitter powers
- Transmitter emission spectra
- Gain of the transmitting antennas towards the satellite
- Gain of the satellite antenna towards the transmitting stations
- Distance between the satellite and transmitting stations
- Doppler shift of the transmitter emission spectras due to the relative motion of the satellite
- Feeder losses between the receiving antenna and the receiver

The 668 to 674 MHz frequency band is allocated to UHF television Channel 47 in the United States. Five stations are licensed and on the air in this band. They are:

<u>Call Letters</u>	<u>City</u>
KJEO	Fresno, California
WTVP	Peoria, Illinois
WNJU	New Brunswick, New Jersey
WSVN	Norton, Virginia
KYNE	Yakima, Washington

The locations of these five stations are shown in Figure A-1. The satellite is arbitrarily located over Chicago, Illinois (42° North latitude, 87° West longitude) at an altitude of 400 km. This location is also shown in Figure A-1 along with a curve representing the limits of visibility of the satellite when at this location. Points outside of this curve are over the horizon and not visible to the satellite. It can be seen from the figure that only three of the five television stations are visible to the satellite.

The emission spectrum for each station was assumed to be a nominal spectrum based on FCC regulations. The gain of the TV antennas toward the satellite was assumed to be 0 dB due to the difficulty of obtaining precise gain values at high elevation angles. The gain of the satellite antenna towards each television station was calculated using the following formula:

$$\text{Gain} = 40.6 - 25 \log \theta$$

Maximum gain is 5 dB

Minimum gain is -3 dB

where:  $\theta$  is the angle between the main beam of the satellite antenna and the television station

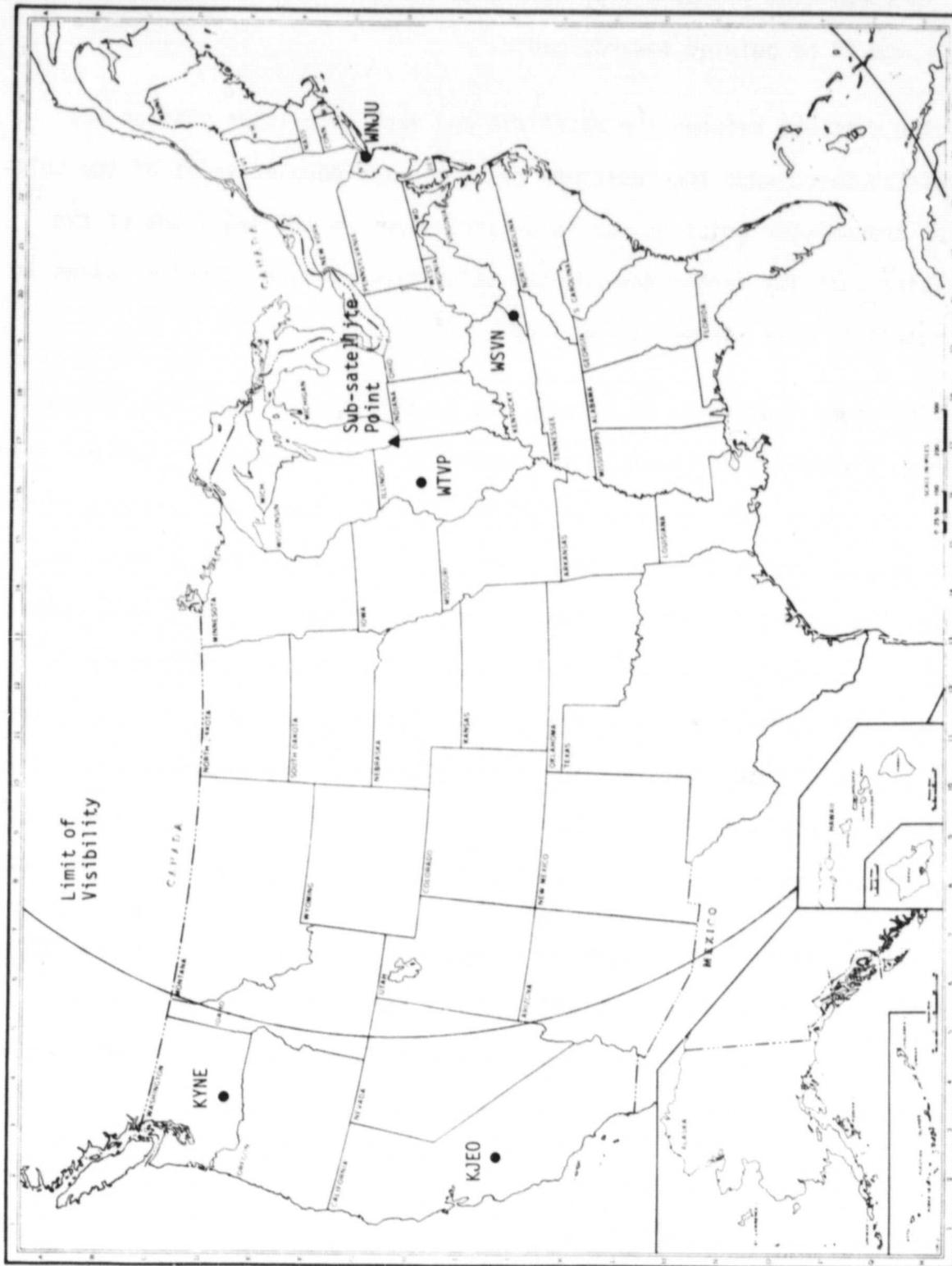


Figure A-1. UHF-TV Station Location and Limit of Satellite Visibility

This equation yields a 3 dB full beamwidth of  $70^\circ$ . The satellite antenna is assumed to be pointed towards nadir.

The distance between the satellite and each television station was calculated based upon the locations of each. The doppler shift of the television transmitter emission was calculated based on the magnitude of the satellite velocity vector towards the television station. Feeder losses in the satellite were assumed to be 3 dB.

The power that would be received by a satellite located over Chicago is shown in Figure A-2 for each 20 kHz bandwidth within the 668 to 674 MHz frequency band. The large peak at about 669.25 MHz contains the video carriers of the three visible stations. The three carriers are offset slightly from one another due to doppler shifts and FCC required offsets of the transmission spectra. Similarly, the peaks at 672.9 and 673.8 contain the chrominance sub-carriers and audio carriers of the three stations. The large flat area from about 670 to 672 MHz contains the video information being transmitted. The rms power levels are shown in the figure, but the actual levels observed at any specific instant will vary greatly due to the content of the TV picture.

In order to see the effect of changing the receiver passband from 20 kHz to 1 MHz, the figure indicates (with X's at 668.5, 669.5, 670.5, 671.5, 672.5 and 673.5 MHz) the power level which would be received in the 668-669, 669-670, 670-671, 671-672 and 673-674 MHz bands respectively.

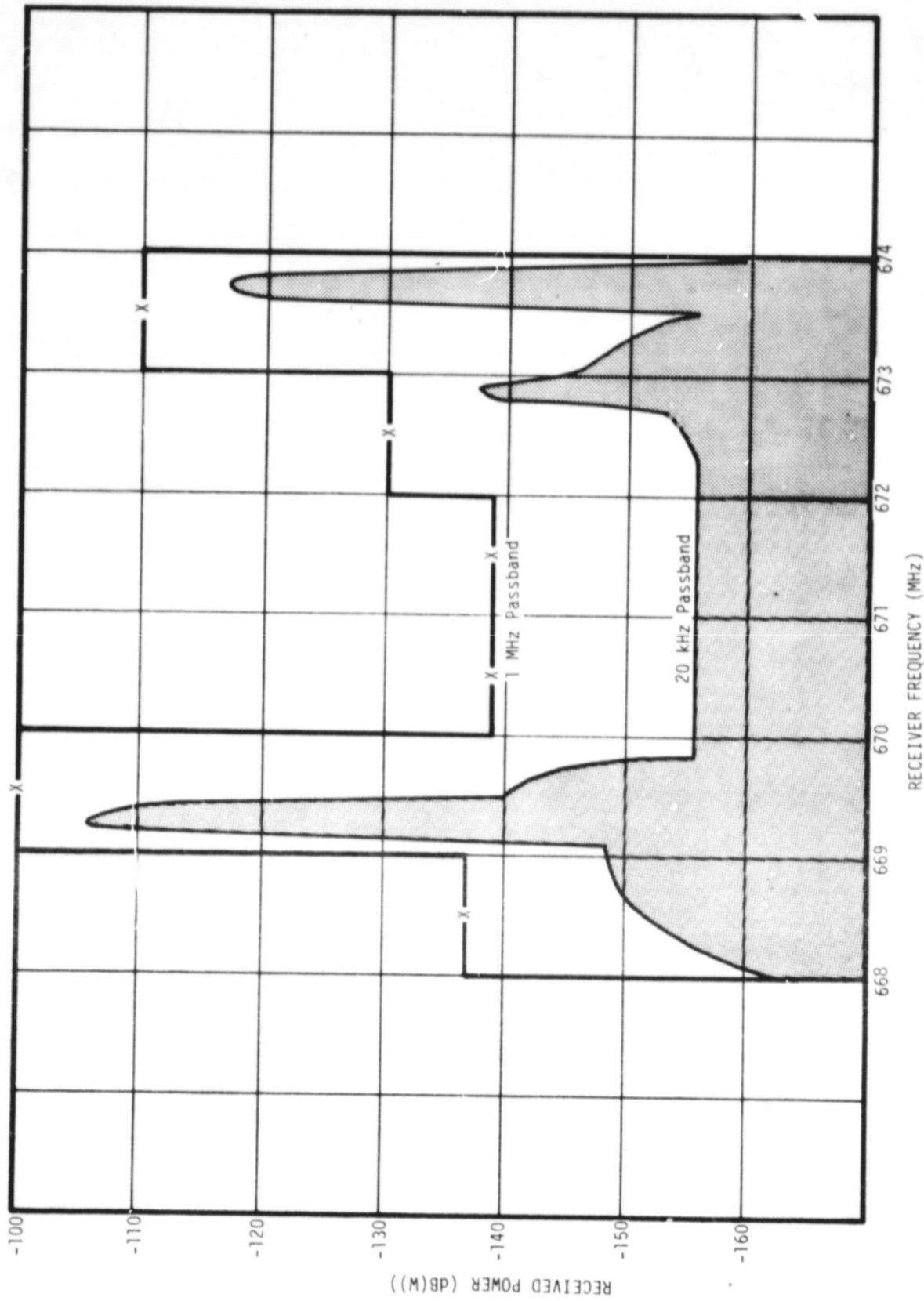


Figure A-2. Received Power vs. Frequency for 20 kHz and 1 MHz Receiver Passbands