STUDY OF FEASIBILITY OF ACCESS TO A PORTION OF THE RADIO FREQUENCY SPECTRUM 406.1 TO 410 MHz FOR THE MOBILE-SATELLITE SERVICE.

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TABLE OF CONTENTS

1.0 INTRODUCTION

2.0 INTERFERENCE CALCULATION PROCEDURE

3.0 SPECIFICATION SYSTEM MODEL

3.1 MOBILE-SATELLITE SERVICE

3.2 FIXED AND MOBILE SERVICES

4.0 INTERFERENCE CRITERIA

5.0 FREQUENCY PLAN FOR 406.1-410 MHz BAND

6.0 INTERFERENCE TO MOBILE-SATELLITE SERVICE FROM FIXED AND MOBILE SERVICES

7.0 CONCLUSION

8.0 REFERENCES

APPENDICES

A. INTERFERER TO SATELLITE POINTING ANGLE

B. SATELLITE TO INTERFERER POINTING ANGLE

# 1.0 INTRODUCTION

The objective of this project according to the statement of work has been to investigate the possibility of access in North America to the 406.1 to 410 MHz band by the Mobile-Satellite service given existing and proposed operations by the Fixed and Mobile terrestrial services. A proposal for an allocation to the Mobile-Satellite service in the band 406.1 to 410 MHz has been included in the First Draft WARC-1979 Proposals by Canada. The project objective has been pursued according to the following task breakdown.

1) Definition of specification system models for the Mobile-Satellite service and the Fixed and Mobile Services.

2) Development of an interference calculation procedure to determine the level of Fixed and Mobile service transmissions at a Mobile-Satellite uplink frequency.

3) Assessment of the interference levels according to a developed criterion of interference permitting co-channel sharing by the Mobile-Satellite, Fixed and Mobile services.

The extent of access to the 406.1 to 410 MHz band has been determined for a Mobile-Satellite service with Canadian coverage. This study is restricted to uplink interference to a satellite in grostationary orbit. For a single beam Mobile-Satellite model, however, the actual coverage is essentially global so as to include all of North America and thus allow these results to be applied to a similar U.S. satellite system. A much more restricted spotbeam, Canadian coverage was also examined in a multibeam satellite system model. This model provides increased interference immunity for a Canadian Mobile-Satellite service.

The existing and proposed operations of the Fixed and Mobile services were taken from a radio catalogue of U.S. transmission in the band 403-410 MHz. Proposed operations are postulated to grow at an annual rate of 15%.

Provisions for co-channel sharing by the Mobile-Satellite, Fixed and Mobile services of the 406.1 to 410 MHz band may enable private sector use of the mobile satellite communications service of a single beam system. This proposed service excludes private sector requirements relating to aeronautical mobile and those originating with Radio Astonomy coordination contours.

## 2.0 INTERFERENCE CALCULATION PROCEDURE

The calculation of interference to a mobile-satellite service from fixed and mobile services in the 406.1 to 410 MHz frequency band is accomplished according to the steps below. In this calculation, the interference level in the mobile-satellite system channel bandwidth (BW) is determined. Since this calculation includes both co-channel and adjacent channel interference contributions, the interferer TX and satellite uplink frequencies are not necessarily the same.

Only uplink interference is examined in this analysis as other forms of intersystem interference are considered negligible.

The information inputs to this calculation procedure are obtained from specification system models for the mobile-satellite service and the fixed and mobile services. These specification system models are given in Section 3.0. The diagram in Figure 2-1 illustrates the interference geometry. The geometry formulations are included in Appendix 1.

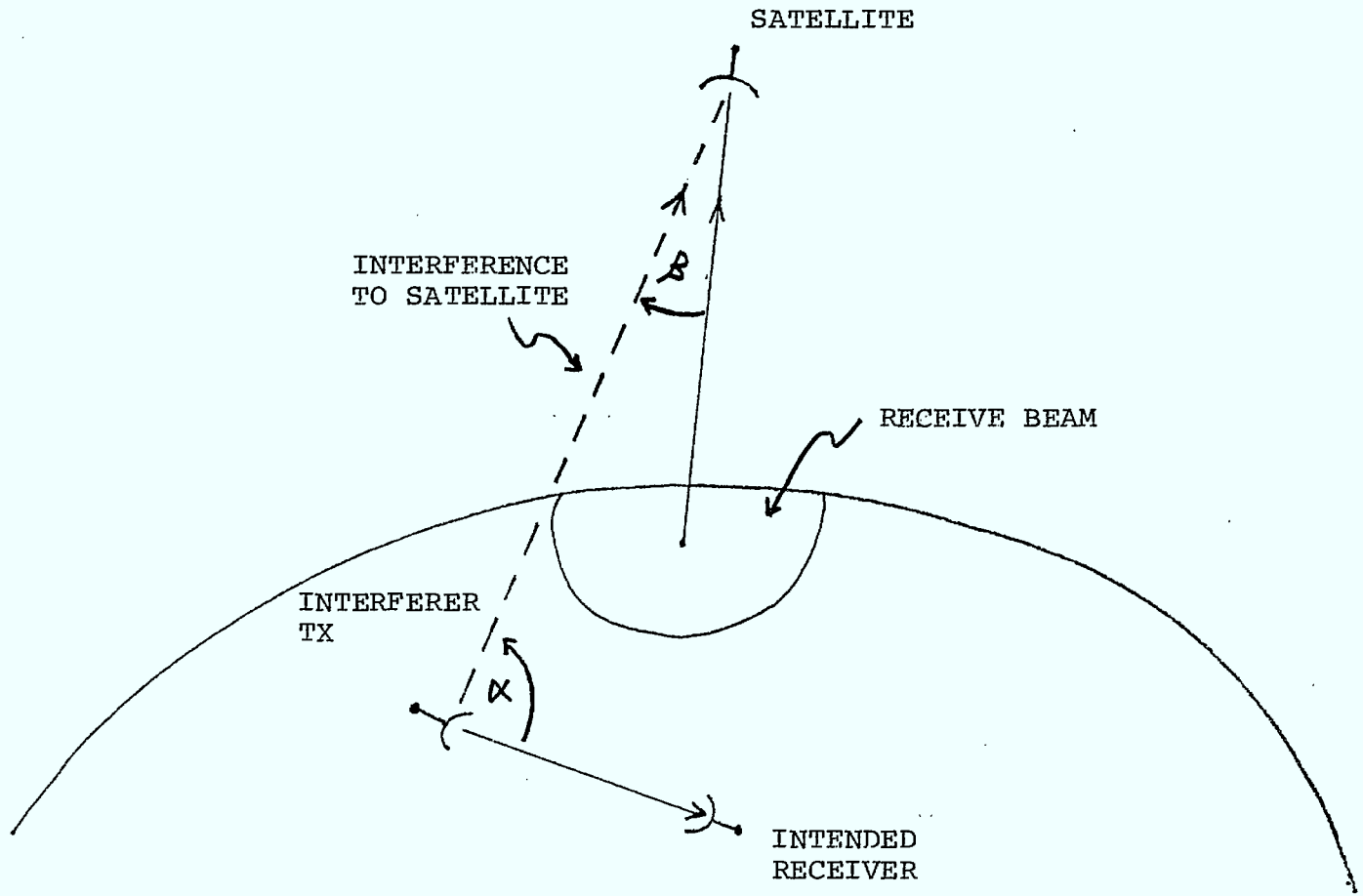
| STEP | CALCULATION |
|---|---|
| 1) | Determine the interferer transmitter (TX) effective radiated power in the direction of the intended receiver for the specified emission bandwidth |

$$ERP = P + G$$

ERP = Interferer TX effective radiated power

P = Interferer TX transmitted power for emission bandwidth B

G = Gain of interferer TX antenna




INTERFERENCE GEOMETRY

FIGURE 2-1

| STEP | CALCULATION |
|---|---|
| 2) | Determine the interferer emission spectrum for the licensed interferer emission bandwidth and calculate the portion of the Interferer TX effective radiated power falling in the satellite channel bandwidth centered at the uplink frequency. Since the majority of interferers have an FM emission, an FM emission spectrum was computed. A few narrowband (6 KHz), low power (5 watts) AM emissions are present, mainly at 408.825 MHz and are reasonably approximated by an FM spectrum. It is expected that all F3 and F9 emissions (voice and FDM) can be modelled as a gausian random process. Based on this assumption, and an interferer emission bandwidth defined for 98% power transmission the power spectrum corresponding to a bandwidth B is shown in Figure 2-2. The gausian power spectral density function is expressed as (Ref. 1). |

$$G(f) = \frac{ERP}{\Delta f_{rms}\sqrt{2\pi}} \exp(-(f-f_c)^2/2\Delta f_{rms}^2)$$

and $B = 4.6\ \Delta f_{rms}$

$G(f)$ = Power spectral density function

ERP = Interferer TX effective radiated power (Step 1)

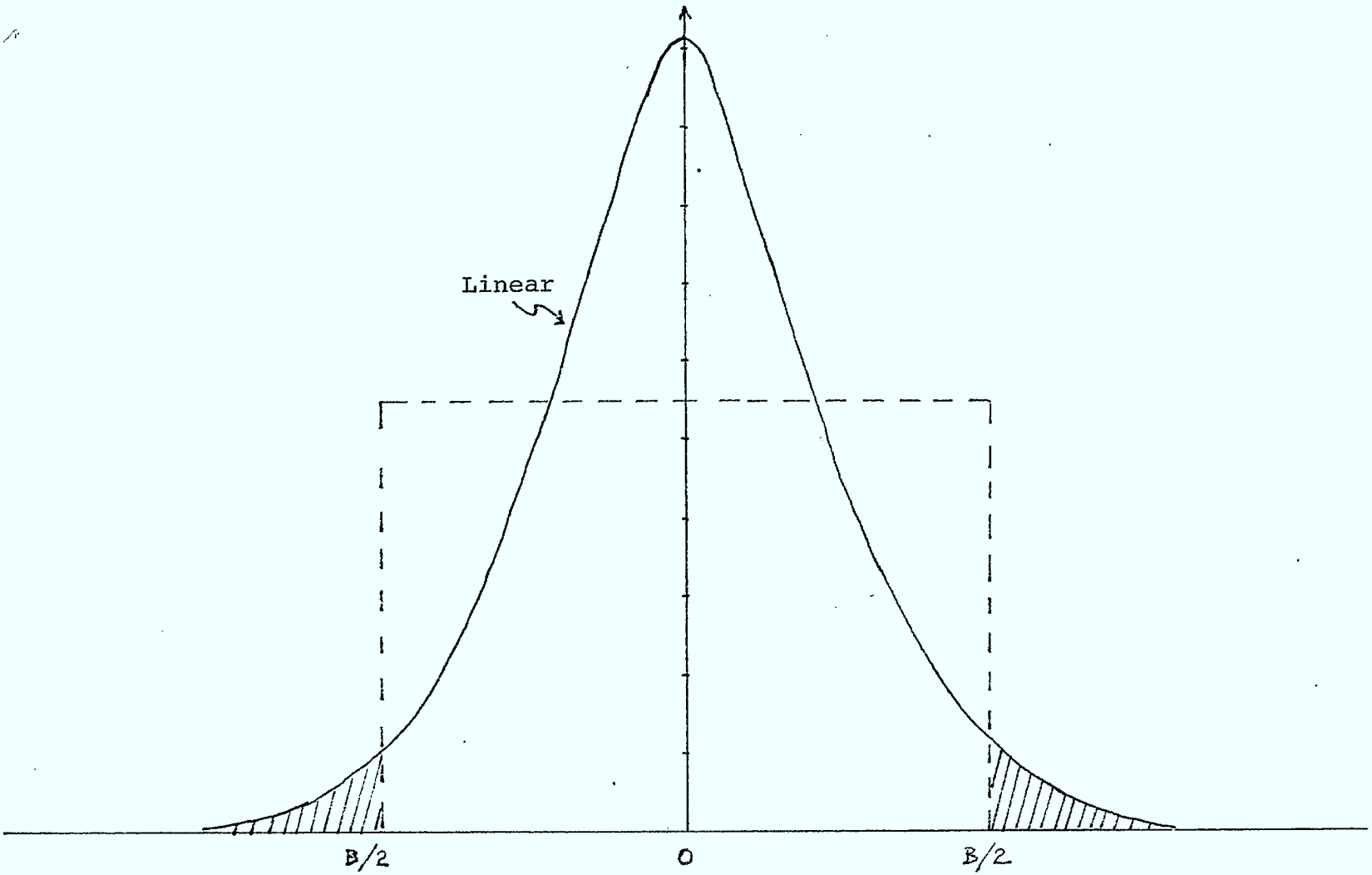
$\Delta f_{rms}$ = r.m.s. peak frequency deviation

$f$ = frequency

$f_c$ = interfering carrier frequency

$B$ = interfering emission bandwidth

The power falling in the satellite channel bandwidth BW at the uplink frequency $f_s$ is determined by integrating the power spectral density function as follows:




GAUSIAN EMISSION SPECTRUM

FIGURE 2-2

$$IP = \int_{f_s - \frac{BW}{2}}^{f_s + \frac{BW}{2}} G(f)\,df$$

IP = Portion of the interferer TX effective radiated power in bandwidth BW

BW = Satellite system channel bandwidth

$f_s$ = Satellite uplink frequency

3) Determine the interferer TX antenna pattern isolation in the direction of the satellite. This isolation is the amount of antenna gain reduction at the difference angle $\alpha$ between the interferer intended direction of transmission and the angle to the satellite. This angle includes both the elevation and azimuth components The patterns used are typical for each type of antenna as shown in Figure 2-3 (Ref. 2).

$$ITX = G - G(\alpha)$$

ITX = Interferer TX antenna pattern isolation

G = On-axis interferer TX antenna gain

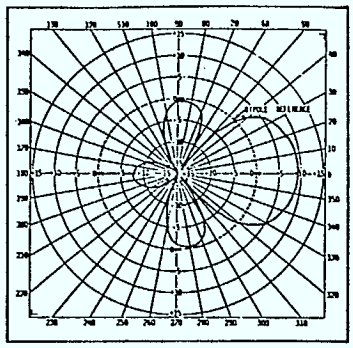
$G(\alpha)$ = Interferer TX antenna gain at angle $\alpha$ from main beam

$\alpha$ = Satellite - intended RX difference angle

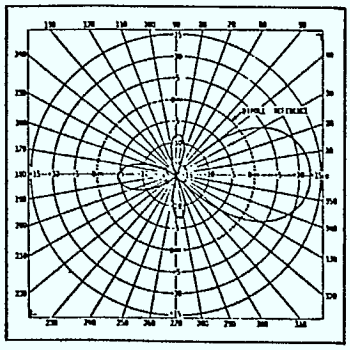
4) Determine the satellite receive antenna pattern isolation in the direction of the interferer TX. This isolation is the amount of antenna gain reduction at the difference angle $\beta$ between the satellite beam pointing direction and the direction to the interferer TX.

# TYPICAL HORIZONTAL COVERAGE PATTERNS

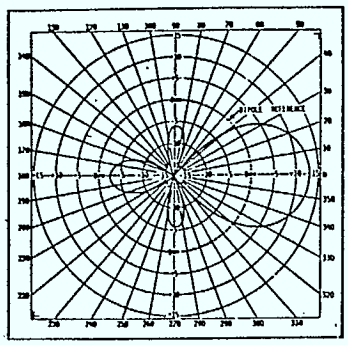
307 =^Yagi
360 = Parabolic Cylinder Reflector
227 = Corner Reflector
224 = Dipole



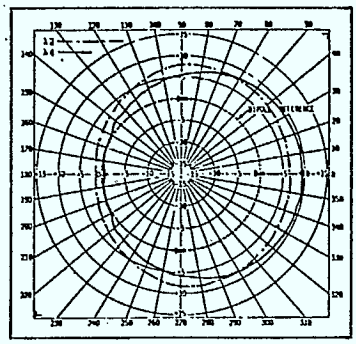
206 and 307



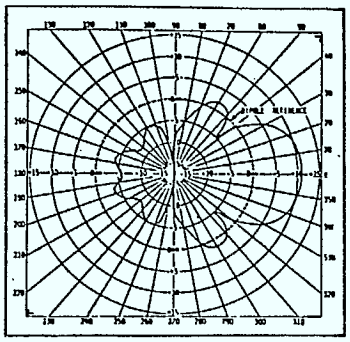
206-2 and 307-2



206-4 and 307-4



210-4 and 310-4



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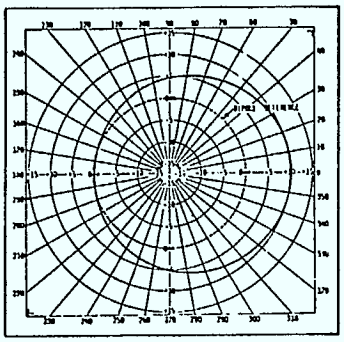

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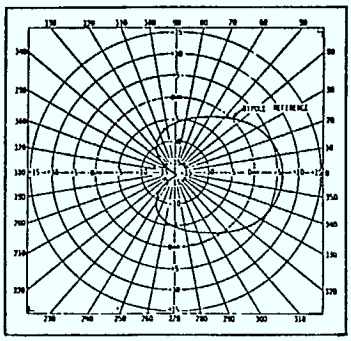

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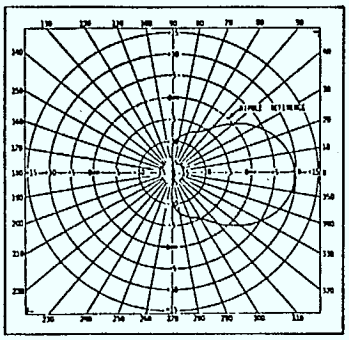

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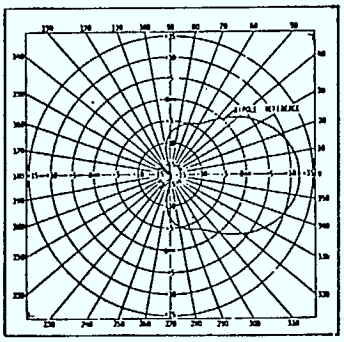
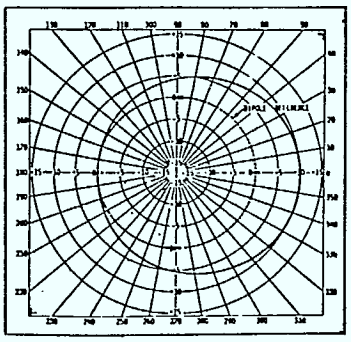
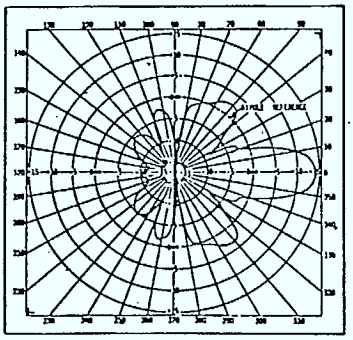


228-2



237



260 and 360

ANTENNA PATTERNS FIGURE 2-3

$$ISAT = GS - GS(\beta)$$

ISAT = Satellite receive antenna pattern isolation

GS = On-axis gain of satellite receive antenna

GS(β) = Satellite receive antenna gain at angle β from main beam

β = Interferer TX - beam pointing difference angle

5) Determine the effective interfering power by including the antenna isolations of the satellite and interferer TX in the calculation of Step 2.

$$EIP = IP - (ITX + ISAT)$$

EIP = Effective interfering power

IP = Interfering power (step 2)

ITX = Interferer TX antenna isolation (step 3)

ISAT = Satellite receive antenna isolation (step 4)

Since the satellite antenna will receive both wanted and interfering signals, only the pattern isolation ISAT is included in this calculation.

6) Determine the earth-station effective radiated power in the satellite channel bandwidth BW

$$CM = PM + GM$$

CM = Earth-station effective radiated power

PM = Earth-station transmitter power in the system channel bandwidth BW

GM = Mobile antenna gain

7) Calculate the ratio of the earth-station effective radiated power to the effective interfering power

$$C/I = \frac{EM}{EIP}$$

C/I = Carrier to interference ratio in the satellite channel bandwidth BW

CM = Mobile-satellite effective radiated power (step 6)

EIP = Effective interfering power (step 5)

8) Determine the mobile-satellite system degraded overall carrier to noise ratio taking the minimum overall design carrier to noise ratio of the satellite system and including the interference

$$C/(N+I) = \frac{1}{\frac{1}{C/N} + \frac{1}{C/I}}$$

C/(N+I) = Degraded C/N ratio

C/I = Carrier to interference ratio (step 7)

C/N = Satellite system overall carrier to noise ratio in channel bandwidth BW

9) The degradation of the minimum overall C/N ratio due to the interference I is thus

$$DEG = C/N - C/(N+I)$$

DEG = Degradation level

C/N = Satellite System overall carrier to noise ratio in channel bandwidth BW

C/(N+I) = Degraded C/N ratio

The degradation level calculated above is applicable for signal to noise ratios related linearly to the received carrier to noise ratio, as is the case for above threshold operation.

The total interference energy at the mobile-satellite uplink frequency is computed by repeating Steps 1 to 5 for all potential interferers and summing the individual interference energies. The degradation to the mobile-satellite overall $C/N_o$ caused by the total interference energy is computed in Steps 6 to 9.

In this calculation, the interferer RF emission spectrum was determined theoretically given the RF emission bandwidth. This represents a worst case since inclusion of transmitter filtering may provide a faster spectrum roll-off outside the emission bandwidth. Filtering at the transmit output port is normally included to suppress carrier harmonics and spurious, and thus may be wider than the emission bandwidth.

## 3.0 SPECIFICATION SYSTEM MODELS

### 3.1 Mobile-Satellite Service

Two system models for the mobile-satellite service have been considered in this study. The first model corresponds to a single beam satellite system. The parameter values for this system, used for the interference calculations are shown in Figure 3-1 (Ref. 3). The choice of 53 dB-Hz minimum overall $C/N_o$ for the mobile to fixed operation represents a worst case condition. This operation has a nominal $C/N_o$ of approximately 66 dB-Hz. For a given interference level the overall degraded C/N under nominal conditions will be greater than that determined at the minimum overall $C/N_o$. Thus a greater interference level can be tolerated under nominal conditions before a degraded C/N approaching threshold is reached. For example, a 3 dB degradation level at the minimum $C/N_o$ is equivalent to a 5 dB degradation level at the nominal $C/N_o$. A 3 dB degradation level represents the condition at which the interference level is equal to the otherwise received noise level, thus resulting in a doubling of the noise power. A satellite channel bandwidth of 20 KHz has been selected for a 16 Kbps 2-phase coherent PSK signal.

For the second system model a multibeam satellite has been adopted to introduce greater satellite receive antenna isolation and thus increased immunity to interference. For this satellite system, Canadian coverage is envisioned with the use of four spot beams, each of $2^o$ beamwidth. Since such systems are usually bandwidth or downlink power limited, the increased gain of the satellite receive antenna will have little effect on the overall $C/N_o$. As a result of the increased satellite receive antenna gain, the earth station transmit eirp may be reduced accordingly while still maintaining the same overall link performance (omitting interference) as in the single beam system. A reduction of earth station eirp,

however, will result in an increased susceptibility to interference from the fixed and mobile services. That this should be the case is evident by examining Steps 4 to 7 of the interference calculation procedure. An increased receive antenna directivity and gain will result in an increased antenna pattern isolation determined in Step 4. This in turn reduces the effective interfering power calculated in Step 5. However, since the earth station effective radiated power is also reduced it is expected that the C/I ratio in Step 7 will remain largely unchanged from the single beam case. The advantage of the multibeam system over the single beam system, as far as interference susceptibility is concerned is the increase in the main lobe (on-axis) satellite receive gain relative to the sidelobe levels. This advantage is negated by reducing the earth station eirp. For this reason all other parameters of the multibeam system are the same as those adopted for the single beam system.

| | | |
|---|---|---|
| 1) | Ground transmit power | 25 watts (14 dBW) |
| 2) | Ground antenna gain (helix) | 13 dBi |
| 3) | Channel bandwidth | 20 KHz |
| 4) | Minimum overall $C/N_o$ required (Mobile to fixed) | 53 dB-Hz |
| 5) | Satellite antenna pattern 3 dB beamwidth | |
| | 1) Single beam (19.5 dBi) | $17^o$ |
| | 2) Multibeam | $2^o$ |
| 6) | Satellite Coordinates | |
| | 1) Latitude (N) | $0^o$ |
| | 2) Longitude (W) | $95^o$ - $115^o$ |
| 7) | Satellite Orbit Radius (geostationary) | 42,166 km |

MOBILE-SATELLITE SERVICE MODEL

FIGURE 3-1

## 3.1 Fixed and Mobile Services

The system specification model required by the interference calculation for the fixed and mobile interferers must incorporate the following parameters

1) Frequency
2) Transmitted power
3) Antenna gain and type
4) Emission bandwidth and type
5) Transmission azimuth (if fixed)
6) Site coordinates
7) Station Class (fixed or mobile)

The corresponding parameter values are obtained from a cataglogue of U.S. based transmitters operating in the 406.1-410 MHz frequency band (Ref. 4). Given the antenna type, a typical pattern can be used. Classification of interferer transmitters is difficult due to the number of different types and the data base was used without classification. Thus the resulting interference levels are determined for the actual catalogued U.S. transmitters except as noted as follows. A postulated 15% annual growth rate was applied for data base by increasing the interfering energy levels by that amount. High power wideband missile command destruct transmissions at 406.5000 and 409.000 MHz were removed from the data base due to their temporary nature. For some interferers no entries appear for antenna type, gain and site coordinates. In these cases, an omnidirectional pattern of zero gain was assumed at a selected northern U.S. coordinate.

## 4.0 INTERFERENCE CRITERIA

The maximum level of degradation to the minimum overall $C/N_o$ is determined by the margin above the threshold point required by the receiver demodulator and by the effect the interference will have on the intelligibility of the desired signal. The latter factor is very difficult to ascertain requiring experimental analysis due to the somewhat subjective aspects involved. At high degradation levels crosstalk and breakthrough may be more of a problem than noise-like degradation. The first factor, however, can be accurately estimated and may well limit the allowable interference before intelligibility becomes a problem. Throughout it is assumed that all interferers are active all the time. For the minimum overall satellite $C/N_o$ of 53 dB-Hz and a 20 KHz channel bandwidth (43 dB), a non-degraded overall C/N of 10 dB is obtained. It is expected that a PSK demodulator for voice (using a phase-lock loop) will have an actual threshold of about 7 dB including losses in the loop. Thus a margin of at least 3 dB exists, depending on the exact nature of the demodulator. Operating to threshold, an interference degradation level of about 3 dB is permissible at the minimum overall $C/N_o$ of 53 dB-Hz. At a degradation level of 3 dB the interference level represents half of the total noise power present. This in itself may be considered a maximum degradation level as regards the quality of communication, since the interference is comparable to the otherwise present noise level. So in the worst case for the minimum overall $C/N_o$ of 53 dB-Hz and a mobile-satellite uplink power of 27 dBW, the transmitted interference in a 20 KHz bandwidth for a 3 dB degradation is 17 dBW. Expressed as an emission regulation this becomes

> The total radio emission towards the geostationary orbital region from 95° to 115° (at selected frequencies in the 406.1-410 MHz band), shall not exceed 17 dBW in a 20 KHz bandwidth

Total radio emission includes emissions distributed over a number of interferer transmitters at co-channel, adjacent and at distant frequencies (for wideband emissions). In fact the total radio emission is determined by the following factors:

1) Interferer EIRP
2) Location of interferer relative to the satellite
3) Direction of interferer transmitter
4) Emission bandwidth of interferer transmitter
5) Number of interferers
6) Adjacent and distant channel contributions

An emission regulation expressed directly in terms of these factors would be unsuitable since the above factors vary for each interfering transmission and the number of such transmissions at a given frequency is variable. The interference level at a given frequency is also dependant on its position in the channeling plan with regard to adjacent and distant channel interference contributions.

The demodulation threshold criterion of interference is dependent on the type of demodulator used and the satellite channel bandwidth required. The smaller the bandwidth the lower the threshold $C/N_o$ can be and thus more interference can be tolerated. A smaller bandwidth would also mean less received interference power, since a smaller portion of a wideband interfering emission spectrum is included. More generally the maximum allowable level of interference can be determined for other values of overall operating $C/N_o$, threshold $C/N_o$, and transmitted ground station EIRP, by use of the following equation

$$I = (C)(BW)\left[\frac{1}{(C/N_o)_{TH}} - \frac{1}{C/N_o}\right]$$

where C = Uplink EIRP

BW = Satellite channel bandwidth

$(C/N_o)_{TH}$ = Threshold overall $C/N_o$ ratio

$C/N_o$ = operating overall carrier to noise density ratio

For example, with an overall operating $C/N_o$ of 66 dB-Hz instead of 53 dB-Hz, and using the same values, as before, for the other parameters, the maximum allowable interference level in 20 KHz becomes 19.9 dBW.

## 5.0 FREQUENCY BAND FOR 406.1-410 MHZ BAND

The channeling plan for U.S. assignments in the 406.1-410 MHz frequency band is shown in Figure 5-1 (Ref. 5). The proposed satellite system (MUSAT) channels fall within the 25 KHz narrowband channel designation. It is noted that splinter channel usage at 406.9375, 407.2375, 407.5625, 406.6375, and 406.6875 by the U.S. mobile and fixed transmitters have an emission bandwidth of 50 KHz, exceeding the maximum splinter channel bandwidth of 12.5 KHz that is recommended in the channeling plan. Despite this restriction, splinter channel usage for the single beam satellite system was examined, as discussed in Section 6.0.

### 4.3.9 Channeling Plan for Assignments in the Band 406.1 - 410 MHz

This plan designates the frequencies in the band 406.1 - 410 MHz available for assignments a) with a bandwidth of emission that can be contained wholly within 25 kHz (narrowband channels), b) with a bandwidth of emission that can be contained wholly within 12.5 kHz (splinter channels), and c) those with other than F3 emission that cannot be contained wholly within 25 kHz (wideband channels).

Wide band 406.4875 - 407.1125 MHz

| | | | | | | |
|---|---|---|---|---|---|---|
| 406.125 | 406.675 | 407.225 | 407.775 | 408.325 | 408.875 | 409.425 |
| 406.150 | 406.700 | 407.250 | 407.800 | 408.350 | 408.900 | 409.450 |
| 406.175 | 406.725 | 407.275 | 407.825 | 408.375 | 408.925 | 409.475 |
| 406.200 | 406.750 | 407.300 | 407.850 | 408.400 | 408.950 | 409.500 |
| 406.225 | 406.775 | 407.325 | 407.875 | 408.425 | 408.975 | 409.525 |
| 406.250 | 406.800 | 407.350 | 407.900 | 408.450 | 409.000 | 409.550 |
| 406.275 | 406.825 | 407.375 | 407.925 | 408.475 | 409.025 | 409.575 |
| 406.300 | 406.850 | 407.400 | 407.950 | 408.500 | 409.050 | 409.600 |
| 406.325 | 406.875 | 407.425 | 407.975 | 408.525 | 409.075 | 409.625 |
| 406.350 | 406.900 | 407.450 | 408.000 | 408.550 | 409.100 | 409.650 |
| 406.375 | 406.925 | 407.475 | 408.025 | 408.575 | 409.125 | 409.675 |
| 406.400 | 406.950 | 407.500 | 408.050 | 408.600 | 409.150 | 409.700 |
| 406.425 | 406.975 | 407.525 | 408.075 | 408.625 | 409.175 | 409.725 |
| 406.450 | 407.000 | 407.550 | 408.100 | 408.650 | 409.200 | 409.750 |
| 406.475 | 407.025 | 407.575 | 408.125 | 408.675 | 409.225 | 409.775 |
| 406.500 | 407.050 | 407.600 | 408.150 | 408.700 | 409.250 | 409.800 |
| 406.525 | 407.075 | 407.625 | 408.175 | 408.725 | 409.275 | 409.825 |
| 406.550 | 407.100 | 407.650 | 408.200 | 408.750 | 409.300 | 409.850 |
| 406.575 | 407.125 | 407.675 | 408.225 | 408.775 | 409.325 | 409.875 |
| 406.600 | 407.150 | 407.700 | 408.250 | 408.800 | 409.350 | 409.900 |
| 406.625 | 407.175 | 407.725 | 408.275 | 408.825 | 409.375 | 409.925 |
| 406.650 | 407.200 | 407.750 | 408.300 | 408.850 | 409.400 | 409.950 |
| | | | | | | 409.975 |

### 4.3.10 Channeling Plan for Splinter Channel Assignments in the Band 406.1 - 410 MHz

The frequencies designated for splinter channel use in Section 4.3.9 are available for assignment to all Government agencies in accordance with allocation footnote G5 and as specified in this Section.

#### Conditions for Use

1. Normally the assigned frequency shall be in the center of a half (12.5 kHz) or quarter (6.25 kHz) channel.
2. Any type of emission may be authorized.
3. The technical standards applicable to the use of splinter channels are in paragraph 4 of section 5.4.6.
4. Directional antennas shall be used where practicable on point-to-point circuits.
5. Prior to filling an application for a splinter channel, coordination shall be effected with any agency with adjacent channel assignments in the list of Frequency Assignments to Government Radio Stations.

406.1-410 FREQUENCY PLAN

FIGURE 5-1

## 6.0 INTERFERENCE TO MOBILE-SATELLITE SERVICES FROM FIXED AND MOBILE SERVICES

The interference to the mobile-satellite service from fixed and mobile transmitters was examined for various system models of each service. A growth factor of 15% per year was applied to the fixed and mobile service system model. It is expected that this growth rate will be reflected in a corresponding increase in the interfering energy. An interference spectrum was computed using the interference calculation procedure for the following inter system configurations.

(a) Mobile-Satellite: Single beam satellite at ($0^{\circ}$, $105^{\circ}$)
Fixed and Mobile: 15% annual growth for 1 year

(b) Mobile-Satellite: Single beam satellite at ($0^{\circ}$, ~~$105^{\circ}$~~ $95^{\circ}$)
Fixed and Mobile: 15% annual growth for 1 year

(c) Mobile-Satellite: Multibeam, satellite at ($0^{\circ}$, $105^{\circ}$)
Fixed and Mobile: 15% annual growth for 1 year

(d) Mobile-Satellite: Single beam satellite at ($0^{\circ}$, $105^{\circ}$)
Splinter channeling plan
Fixed and Mobile: 15% annual growth for 1 year

(e) Mobile-Satellite: Single beam satellite at ($0^{\circ}$, $105^{\circ}$)
Fixed and Mobile: 15% annual growth for 1 year
: Removal of strong wideband emissions

The results for each run are included in Figures 6-1 to 6-5. The interference spectrum consists of the degradation level at the minimum overall $C/N_o$ of 53 dB-Hz plotted versus the 406.1-410 MHz channeling plan. Accompanying each spectrum is the actual numerical output of the computer. This output consists of the actual interference level (independent of the satellite system $C/N_o$) in dBW at each mobile-satellite frequency,

the carrier to interference ratio (in a 20 KHz bandwidth), the degradation level for the actual data base and the degradation level including a 15% increase in the interference level. From this output it is possible to assess the degradation level for any satellite system $C/N_o$ according to the interference calculation procedure Steps 8 and 9. Alternatively, the degradation level for any operating overall $C/N_o$ can be determined from a knowledge of the degradation level at 53 dB-Hz by use of the following equation.

$$DEG\left(C/N_o\right) = \frac{C}{N_o} - 10\log\left[\frac{1}{\left(10^{\frac{(C/N_o)}{10}}\right) + \left(10^{\frac{(53-DEG(53))}{10}}\right) - \left(10^{\frac{1}{5.3}}\right)}\right]$$

where $DEG\left(C/N_o\right)$ Degradation for an overall $C/N_o$ ratio

$DEG(53)$ Degradation at overall $C/N_o$ ratio of 53 dB-Hz

This result, however, does not permit a direct reference to the interference spectrums of Figures 6-1 to 6-5. This is accomplished by determining the degradation level for an overall $C/N_o$ ratio, according to the following method.

As stated previously at higher overall $C/N_o$ ratios a greater level of interference can be tolerated before a set degraded level is reached. Thus the allowable degradation level calculated at any reference overall $C/N_o$, will be greater for a system with a higher overall $C/N_o$. For example a degradation level of 3.0 dB for the worst case single beam system $C/N_o$ 53 dB-Hz is equivalent to (approximately) a 5.0 dB degradation level at an overall $C/N_o$ of 66 dB-Hz calculated at a reference $C/N_o$ of 53 dB-Hz. This result is illustrated in the table below.

| $C/I_o$ (dB-Hz) | $C/N_o$ (db-Hz) | $(C/N_o)_D$ (dB-Hz) | DEG (dB) |
|---|---|---|---|
| 53 | 53 | 50 | 3 |
| 50.1 | 66 | 50 | 16 |
| 50.1 | 53 (ref.) | 48.2 | 4.7 |

The minimum degraded $(C/N_o)_D$ is the demodulator threshold. The degradation for any operating overall $C/N_o$, given the degradation at 53 dB-Hz, calculated at a reference $C/N_o$ of 53 dB-Hz is given by the following equation

$$DEG_{REF(53)} = 53 - 10\log\left[\frac{1}{\frac{1}{\left(10^{5.3}\right)} + \frac{1}{\left(10^{(53-DEG_{53})/10}\right)} - \frac{1}{\left(10^{(C/N_o)/10}\right)}}\right]$$

where

$DEG_{REF(53)}$ Degradation level at an overall $C/N_o$ ratio calculated at a reference $C/N_o$ of 53 dB-Hz

$DEG_{53}$ Degradation level at the overall $C/N_o$ ratio of 53 dB-Hz

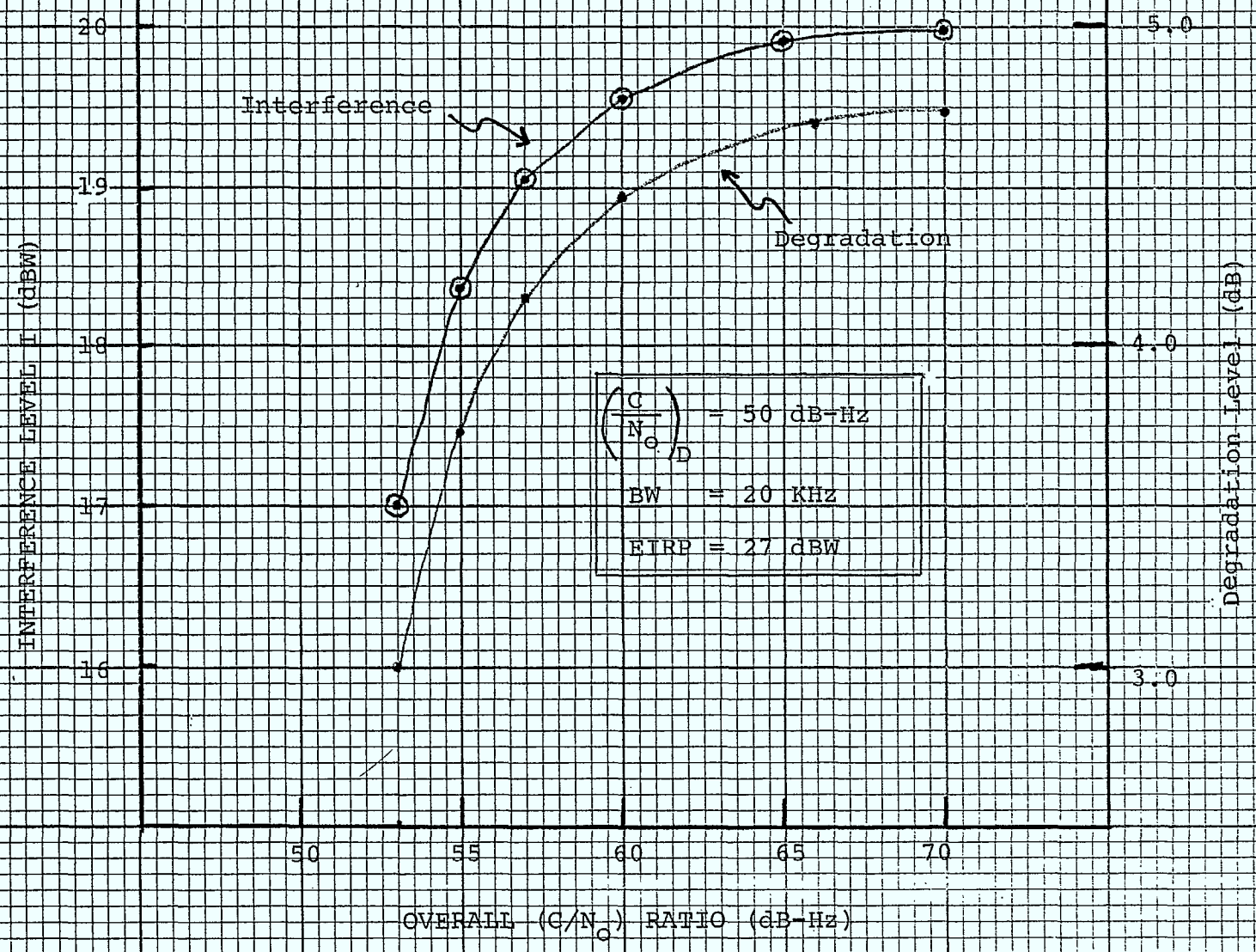
By calculating the degradation level at the reference $C/N_o$ of 53 dB-Hz, the interference spectrums can be used for any overall $C/N_o$ ratio and degraded $C/N_o$ ratio. The maximum allowable interference and degradation levels correspond to a degraded $C/N_o$ ratio equal to the demodulator threshold. The graph in Figure 6-8 shows the variation of the maximum allowable interference and degradation level as the overall operating $C/N_o$ is changed. The frequencies for which the degradation level does not exceed 5.0 dB were examined for characteristics accounting for the low interference level. These frequencies and selected characteristics are listed in Figure 6-6 and shown in Figure 6-7 for the interference spectrum of Figure 6-1.

It is evident from the above results that for the single beam system most of the frequencies have interference levels exceeding "acceptable levels". The salient characteristic of the 32 frequencies having a degradation level not exceeding 5 dB, is the absence of a fixed or mobile assignment or just one assignment in most cases. In fact, the unused frequencies account for 20 of these 32 frequencies. All the unused frequencies in the

406.1-410 MHz band, as shown in Figure 6-7 however, are not available due to adjacent channel and distant channel interference. Thus of the 36 unused channels, only 20 are potentially usable. Some caution must be exercised in interpreting the characteristics of the frequencies for which only one assignment exists. These assignments are designated as USA, USP, and NTS. The USA and USP designations refer to Atlantic and Pacific maritime transmissions. These operations may involve more than one transmission at a time and this must be considered in assessing the potential use of these particular frequencies included in the list of Figure 6-6. It is also noted that since the growth factor has been applied on a percentage basis, the unused frequencies are still considered to be free of assignments in the future.

A comparative analysis of the results serves to reveal the effect of various parameters on the interference levels. Use of a splinter channeling plan instead of the regular channeling plan results in a "smoothing" of the interference spectrum due to the reduction of high interference levels and an increase in otherwise low interference levels. Since there are actually only five splinter channel assignments in the Fixed and Mobile service, the above interference spectrum arises from adjacent channel interference. This arrangement may be advantageous since the number of available channels with interfering levels not exceeding 5.0 dB increases to 37 from 32. The number of low interference level channels however is decreased.

Three means by which the interference susceptibility of the satellite system can be reduced are (a) increasing the uplink eirp, (b) decreasing the minimum overall $C/N_o$ or (c) increasing the satellite receive antenna discrimination to interferers. The last method is considered in the multibeam satellite system model in which a $2^o$ spot beam is used instead of a single beam $17^o$beamwidth receive pattern. This change results




MAXIMUM ALLOWABLE INTERFERENCE AND DEGRADATION LEVEL

FIGURE 6-8

in a greatly reduced interference spectrum with 118 frequencies of interfering levels not exceeding 5.0 dB. The spectrum shown in Figure 6-3 is for one $2^{o}$ spot beam positioned in central Canada; latitude $55^{o}$N, longitude $95^{o}$W.

As verified by a comparison of interference spectrums in Figures 6-1 and 6-2, a change of satellite orbital longitude from $105^{o}$ to $95^{o}$W does not significantly alter the interference levels.

For the final interference computation of Figure 6-5, the effects of altering the fixed and mobile service data base was examined. The data base was altered by the removal of strong wideband emissions at 407.0, 408.0 and 409.0 MHz. These emissions extend over 600 KHz at a transmit power of 1 Kw. In particular, removing the emissions at 407.0 MHz results in a reduction to low interference levels at the unused frequencies of 407.075 and 407.100 MHz. Similarly, removal of emissions at 408.0 and 409.0 MHz substantially reduces the interference levels at nearby unused frequencies. This effect is expected since interference at unused frequencies consists entirely of adjacent and distant channel contributions. Reassignment of narrowband emissions results in a reduction of cochannel interference levels. This action is effective if the adjacent and distant channel interference levels do not dominate. Frequencies at which a single narrowband reassignment may sufficiently reduce the interference level are 406.700, 408.175, 409.425 and 409.250 MHz (excepting frequencies with USA, USP and NTS designations).

## MOBILE-SATELLITE SYSTEM

| | |
|---|---|
| GROUND TRANSMIT EIRP | 27 dBW |
| EMISSION BANDWIDTH | 20 KHz |
| OVERALL $C/N_o$ | 53 dB-Hz |
| SATELLITE ANTENNA BEAMWIDTH | $17^o$ |
| SATELLITE COORDINATES | |
| 1) LATITUDE | $0^o$ |
| 2) LONGITUDE | $105^o$ |
| BEAM POINTING COORDINATES | |
| 1) LATITUDE | $60^o$ |
| 2) LONGITUDE | $95^o$ |
| SATELLITE ORBIT RADIUS | ∿42,166 Km |

## FIXED AND MOBILE SYSTEM

U.S. Catalogue of transmitters in 406.1-410 MHz band, omitting high power (command destruct) transmissions at 406.5 and 409.0 MHz

15% annual growth rate for one year

FIGURE 6-1

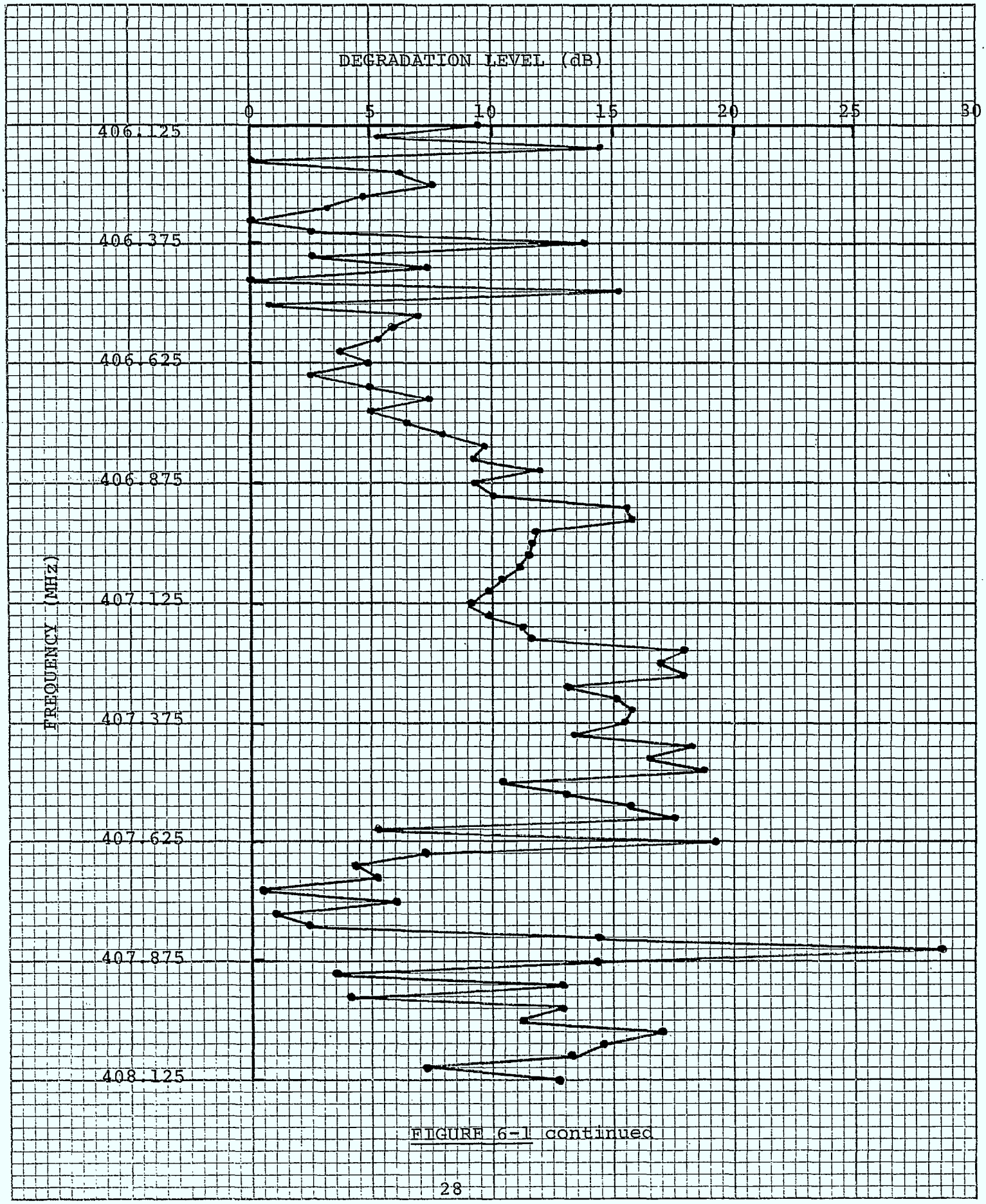



FIGURE 6-1 continued

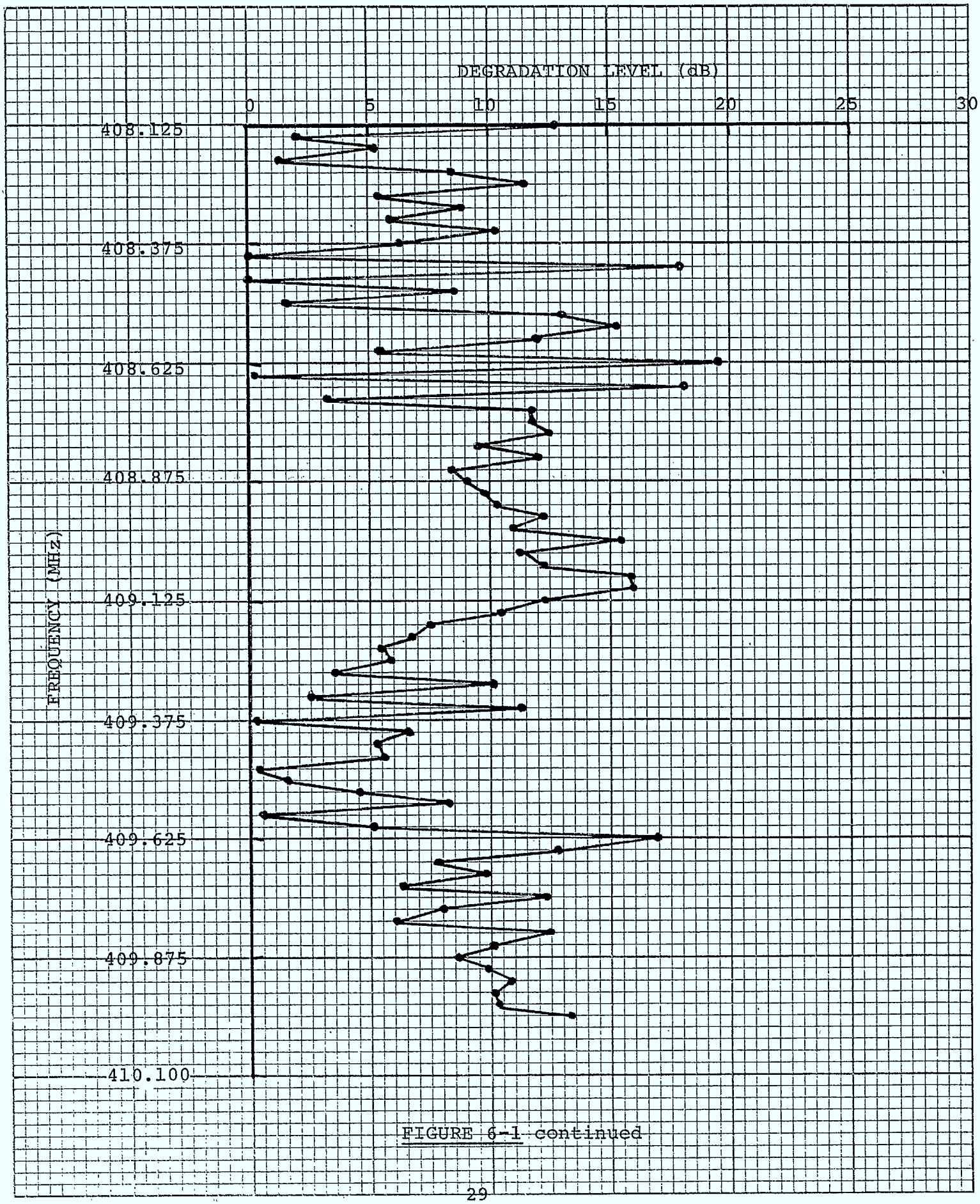



FIGURE 6-1 continued

FIGURE 6-1 continued

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

13,14,20,53,1,1,18,60,95,0,105

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 406.125 | 25.4 | 1.6 | 8.9 | 9.5 |
| 406.150 | 20.1 | 6.9 | 4.8 | 5.3 |
| 406.175 | 30.8 | -3.8 | 13.9 | 14.5 |
| 406.200 | -22.1 | 49.1 | .0 | .0 |
| 406.225 | 21.4 | 5.6 | 5.7 | 6.2 |
| 406.250 | 23.2 | 3.8 | 7.1 | 7.6 |
| 406.275 | 19.5 | 7.5 | 4.4 | 4.8 |
| 406.300 | 16.8 | 10.2 | 2.9 | 3.2 |
| 406.325 | -34.2 | 61.2 | .0 | .0 |
| 406.350 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.375 | 30.1 | -3.1 | 13.3 | 13.9 |
| 406.400 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.425 | 23.0 | 4.0 | 6.9 | 7.4 |
| 406.450 | -4.6 | 31.6 | .0 | .0 |
| 406.475 | 31.5 | -4.5 | 14.6 | 15.2 |
| 406.500 | 9.4 | 17.6 | .7 | .8 |
| 406.525 | 22.4 | 4.6 | 6.5 | 7.0 |
| 406.550 | 21.1 | 5.9 | 5.5 | 6.0 |
| 406.575 | 20.3 | 6.7 | 5.0 | 5.4 |
| 406.600 | 17.9 | 9.1 | 3.5 | 3.8 |
| 406.625 | 19.6 | 7.4 | 4.5 | 4.9 |
| 406.650 | 15.4 | 11.6 | 2.3 | 2.5 |
| 406.675 | 19.8 | 7.2 | 4.6 | 5.0 |
| 406.700 | 22.9 | 4.1 | 6.9 | 7.4 |
| 406.725 | 19.7 | 7.3 | 4.6 | 5.0 |
| 406.750 | 21.8 | 5.2 | 6.0 | 6.5 |
| 406.775 | 23.6 | 3.4 | 7.5 | 8.0 |
| 406.800 | 25.6 | 1.4 | 9.2 | 9.7 |
| 406.825 | 25.1 | 1.9 | 8.7 | 9.3 |
| 406.850 | 28.1 | -1.1 | 11.4 | 12.0 |
| 406.875 | 25.2 | 1.8 | 8.8 | 9.3 |
| 406.900 | 26.0 | 1.0 | 9.5 | 10.1 |
| 406.925 | 31.9 | -4.9 | 15.0 | 15.6 |
| 406.950 | 32.1 | -5.1 | 15.2 | 15.8 |
| 406.975 | 27.9 | -.9 | 11.2 | 11.8 |

| | | | | |
|---|---|---|---|---|
| 406.675 | 19.8 | 7.2 | 4.6 | 5.0 |
| 406.700 | 22.9 | 4.1 | 6.9 | 7.4 |
| 406.725 | 19.7 | 7.3 | 4.6 | 5.0 |
| 406.750 | 21.8 | 5.2 | 6.0 | 6.5 |
| 406.775 | 23.6 | 3.4 | 7.5 | 8.0 |
| 406.800 | 25.6 | 1.4 | 9.2 | 9.7 |
| 406.825 | 25.1 | 1.9 | 8.7 | 9.3 |
| 406.850 | 28.1 | -1.1 | 11.4 | 12.0 |
| 406.875 | 25.2 | 1.8 | 8.8 | 9.3 |
| 406.900 | 26.0 | 1.0 | 9.5 | 10.1 |
| 406.925 | 31.9 | -4.9 | 15.0 | 15.6 |
| 406.950 | 32.1 | -5.1 | 15.2 | 15.8 |
| 406.975 | 27.9 | -.9 | 11.2 | 11.8 |
| 407.000 | 27.8 | -.8 | 11.1 | 11.7 |
| 407.025 | 27.6 | -.6 | 11.0 | 11.5 |
| 407.050 | 27.2 | -.2 | 10.6 | 11.1 |
| 407.075 | 26.4 | .6 | 9.9 | 10.4 |
| 407.100 | 25.7 | 1.3 | 9.2 | 9.8 |
| 407.125 | 25.0 | 2.0 | 8.6 | 9.1 |
| 407.150 | 25.8 | 1.2 | 9.3 | 9.9 |
| 407.175 | 27.4 | -.4 | 10.8 | 11.3 |
| 407.200 | 27.7 | -.7 | 11.1 | 11.6 |
| 407.225 | 34.4 | -7.4 | 17.4 | 18.0 |
| 407.250 | 33.2 | -6.2 | 16.3 | 16.9 |
| 407.275 | 34.2 | -7.2 | 17.3 | 17.9 |
| 407.300 | 29.3 | -2.3 | 12.5 | 13.1 |
| 407.325 | 31.4 | -4.4 | 14.5 | 15.1 |
| 407.350 | 32.1 | -5.1 | 15.2 | 15.8 |
| 407.375 | 31.8 | -4.8 | 14.9 | 15.5 |
| 407.400 | 29.6 | -2.6 | 12.8 | 13.4 |
| 407.425 | 34.6 | -7.6 | 17.6 | 18.2 |
| 407.450 | 32.8 | -5.8 | 15.9 | 16.5 |
| 407.475 | 35.1 | -8.1 | 18.2 | 18.8 |
| 407.500 | 26.3 | .7 | 9.8 | 10.4 |
| 407.525 | 29.3 | -2.3 | 12.5 | 13.1 |
| 407.550 | 32.0 | -5.0 | 15.1 | 15.7 |
| 407.575 | 34.0 | -7.0 | 17.0 | 17.6 |
| 407.600 | 20.2 | 6.8 | 4.9 | 5.3 |
| 407.625 | 35.6 | -8.6 | 18.6 | 19.2 |
| 407.650 | 22.9 | 4.1 | 6.8 | 7.3 |
| 407.675 | 18.8 | 8.2 | 4.0 | 4.4 |
| 407.700 | 20.0 | 7.0 | 4.8 | 5.2 |
| 407.725 | 7.4 | 19.6 | .4 | .5 |
| 407.750 | 21.3 | 5.7 | 5.7 | 6.1 |

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07>OF,INUHF,1

07>
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FIGURE 6-1 continued

FIGURE 6-1 continued

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RU,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1    DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 17,14,20,53,1,1,10,60,95,0,105 | | | | |
| 407.775 | 10.5 | 16.5 | .9 | 1.0 |
| 407.800 | 15.1 | 11.9 | 2.1 | 2.4 |
| 407.825 | 30.6 | -3.6 | 13.0 | 14.4 |
| 407.850 | 44.9 | -17.9 | 27.9 | 28.5 |
| 407.875 | 30.5 | -3.5 | 13.7 | 14.3 |
| 407.900 | 17.3 | 9.7 | 3.2 | 3.5 |
| 407.925 | 29.1 | -2.1 | 12.4 | 12.9 |
| 407.950 | 18.3 | 8.7 | 3.7 | 4.1 |
| 407.975 | 29.0 | -2.0 | 12.3 | 12.9 |
| 408.000 | 27.3 | -.3 | 10.6 | 11.2 |
| 408.025 | 33.3 | -6.3 | 16.4 | 17.0 |
| 408.050 | 30.8 | -3.8 | 14.0 | 14.6 |
| 408.075 | 29.4 | -2.4 | 12.7 | 13.2 |
| 408.100 | 22.7 | 4.3 | 6.8 | 7.2 |
| 408.125 | 29.0 | -2.0 | 12.2 | 12.8 |
| 408.150 | 14.2 | 12.8 | 1.8 | 2.0 |
| 408.175 | 20.1 | 6.9 | 4.8 | 5.2 |
| 408.200 | 11.9 | 15.1 | 1.2 | 1.3 |
| 408.225 | 24.3 | 2.7 | 8.0 | 8.5 |
| 408.250 | 27.6 | -.6 | 11.0 | 11.5 |
| 408.275 | 20.3 | 6.7 | 5.0 | 5.4 |
| 408.300 | 24.7 | 2.3 | 6.4 | 6.9 |
| 408.325 | 21.0 | 6.0 | 5.5 | 5.9 |
| 408.350 | 26.1 | .9 | 7.6 | 10.2 |
| 408.375 | 21.5 | 5.5 | 5.8 | 6.7 |
| 408.400 | -16.2 | 43.2 | .0 | .0 |
| 408.425 | 34.3 | -7.3 | 17.4 | 18.0 |
| 408.450 | -16.3 | 43.3 | .0 | .0 |
| 408.475 | 24.4 | 2.6 | 8.1 | 8.6 |
| 408.500 | 12.9 | 14.1 | 1.4 | 1.6 |
| 408.525 | 29.3 | -2.3 | 12.5 | 13.1 |
| 408.550 | 31.6 | -4.6 | 14.7 | 15.3 |
| 408.575 | 28.1 | -1.1 | 11.4 | 12.0 |
| 408.600 | 20.4 | 6.6 | 5.0 | 5.5 |
| 408.625 | 36.0 | -9.0 | 19.0 | 19.6 |

| | | | | |
|---|---|---|---|---|
| 400.600 | 20.4 | 6.6 | 5.0 | 5.5 |
| 400.625 | 36.0 | -9.0 | 19.0 | 19.6 |
| 400.650 | 2.2 | 24.0 | .1 | .2 |
| 400.675 | 34.4 | -7.4 | 17.5 | 18.1 |
| 400.700 | 16.8 | 10.2 | 2.9 | 3.2 |
| 400.725 | 27.9 | -.9 | 11.2 | 11.8 |
| 400.750 | 27.9 | -.9 | 11.3 | 11.8 |
| 400.775 | 28.6 | -1.6 | 11.9 | 12.5 |
| 400.800 | 25.4 | 1.6 | 9.0 | 9.5 |
| 400.825 | 28.1 | -1.1 | 11.4 | 12.0 |
| 400.850 | 24.1 | 2.9 | 7.9 | 8.4 |

07>OF,INUHF,1

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

FIGURE 6-1
continued

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

13,14,20,53,1,1,10,60,95,0,105

| | | | | |
|---|---|---|---|---|
| 400.850 | 24.1 | 2.9 | 7.9 | 8.4 |
| 400.875 | 25.0 | 2.0 | 8.6 | 9.1 |
| 400.900 | 25.7 | 1.3 | 9.2 | 9.8 |
| 400.925 | 26.3 | .7 | 9.7 | 10.3 |
| 400.950 | 28.4 | -1.4 | 11.7 | 12.2 |
| 400.975 | 27.1 | -.1 | 10.5 | 11.0 |
| 407.000 | 31.8 | -4.8 | 15.0 | 15.5 |
| 407.025 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.050 | 28.4 | -1.4 | 11.7 | 12.3 |
| 409.075 | 32.2 | -5.2 | 15.3 | 15.9 |
| 409.100 | 32.3 | -5.3 | 15.5 | 16.0 |
| 409.125 | 28.4 | 1.4 | 11.7 | 12.3 |
| 409.150 | 26.5 | .5 | 9.9 | 10.5 |
| 409.175 | 23.1 | 3.9 | 7.0 | 7.5 |
| 409.200 | 22.1 | 4.9 | 6.3 | 6.7 |
| 409.225 | 20.5 | 6.5 | 5.1 | 5.5 |
| 409.250 | 21.0 | 6.0 | 5.4 | 5.9 |
| 409.275 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.300 | 26.1 | .7 | 9.6 | 10.1 |
| 407.325 | 15.3 | 11.7 | 2.2 | 2.5 |
| 409.350 | 22.3 | -.3 | 10.7 | 11.3 |

13,14,20,53,1,1,10,60,95,0,105

| | | | | |
|---|---|---|---|---|
| 408.850 | 24.1 | 2.9 | 7.9 | 8.4 |
| 408.875 | 25.0 | 2.0 | 8.6 | 9.1 |
| 408.900 | 25.7 | 1.3 | 9.2 | 9.8 |
| 408.925 | 26.3 | .7 | 9.7 | 10.3 |
| 408.950 | 28.4 | -1.4 | 11.7 | 12.2 |
| 408.975 | 27.1 | -.1 | 10.5 | 11.0 |
| 409.000 | 31.8 | -4.8 | 15.0 | 15.5 |
| 409.025 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.050 | 28.4 | -1.4 | 11.7 | 12.3 |
| 409.075 | 32.2 | -5.2 | 15.3 | 15.9 |
| 409.100 | 32.3 | -5.3 | 15.5 | 16.0 |
| 409.125 | 28.4 | -1.4 | 11.7 | 12.3 |
| 409.150 | 26.5 | .5 | 9.9 | 10.5 |
| 409.175 | 23.1 | 3.9 | 7.0 | 7.5 |
| 409.200 | 22.1 | 4.9 | 6.3 | 6.7 |
| 409.225 | 20.5 | 6.5 | 5.1 | 5.5 |
| 409.250 | 21.0 | 6.0 | 5.4 | 5.9 |
| 409.275 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.300 | 26.1 | .9 | 9.6 | 10.1 |
| 409.325 | 15.3 | 11.7 | 2.2 | 2.5 |
| 409.350 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.375 | -1.0 | 28.0 | .1 | .1 |
| 409.400 | 22.0 | 5.0 | 6.2 | 6.6 |
| 409.425 | 20.0 | 7.0 | 4.8 | 5.2 |
| 409.450 | 20.6 | 6.4 | 5.2 | 5.6 |
| 409.475 | 5.2 | 21.8 | .3 | .3 |
| 409.500 | 12.7 | 14.3 | 1.4 | 1.5 |
| 409.525 | 19.0 | 8.0 | 4.1 | 4.5 |
| 409.550 | 23.9 | 3.1 | 7.7 | 8.2 |
| 409.575 | 7.6 | 19.4 | .5 | .5 |
| 409.600 | 19.9 | 7.1 | 4.7 | 5.1 |
| 409.625 | 33.2 | -6.2 | 16.3 | 16.9 |
| 409.650 | 28.8 | -1.8 | 12.1 | 12.7 |
| 409.675 | 23.3 | 3.7 | 7.2 | 7.7 |
| 409.700 | 25.7 | 1.3 | 9.2 | 9.8 |
| 409.725 | 21.6 | 5.4 | 5.9 | 6.4 |
| 409.750 | 28.4 | -1.4 | 11.7 | 12.3 |
| 409.775 | 23.7 | 3.3 | 7.5 | 8.0 |
| 409.800 | 21.3 | 5.7 | 5.7 | 6.1 |
| 409.825 | 28.7 | -1.7 | 11.9 | 12.5 |
| 409.850 | 26.1 | .9 | 9.6 | 10.1 |
| 409.875 | 24.4 | 2.6 | 8.1 | 8.6 |
| 409.900 | 25.8 | 1.2 | 9.4 | 9.9 |
| 409.925 | 26.8 | .2 | 10.2 | 10.8 |
| 409.950 | 26.1 | .9 | 9.6 | 10.1 |
| 409.975 | 26.3 | .7 | 9.8 | 10.3 |
| 410.000 | 29.6 | -2.6 | 12.0 | 13.4 |

47 26.5

FIGURE 6-1 continued

## MOBILE-SATELLITE SYSTEM

| | |
|---|---|
| GROUND TRANSMIT EIRP | 27 dBW |
| EMISSION BANDWIDTH | 20 KHz |
| OVERALL $C/N_o$ | 53 dB-Hz |
| SATELLITE ANTENNA BEAMWIDTH | $17^o$ |
| SATELLITE COORDINATES | |
| 1) LATITUDE | $0^o$ |
| 2) LONGITUDE | $95^o$ |
| BEAM POINTING COORDINATES | |
| 1) LATITUDE | $60^o$ |
| 2) LONGITUDE | $95^o$ |
| SATELLITE ORBIT RADIUS | ∿42,166 Km |

## FIXED AND MOBILE SYSTEM

U.S. Catalogue of transmitters in 406.1-410 MHz band, omitting high power (command destruct) transmissions at 406.5 and 409.0 MHz

15% annual growth rate for one year

FIGURE 6-2

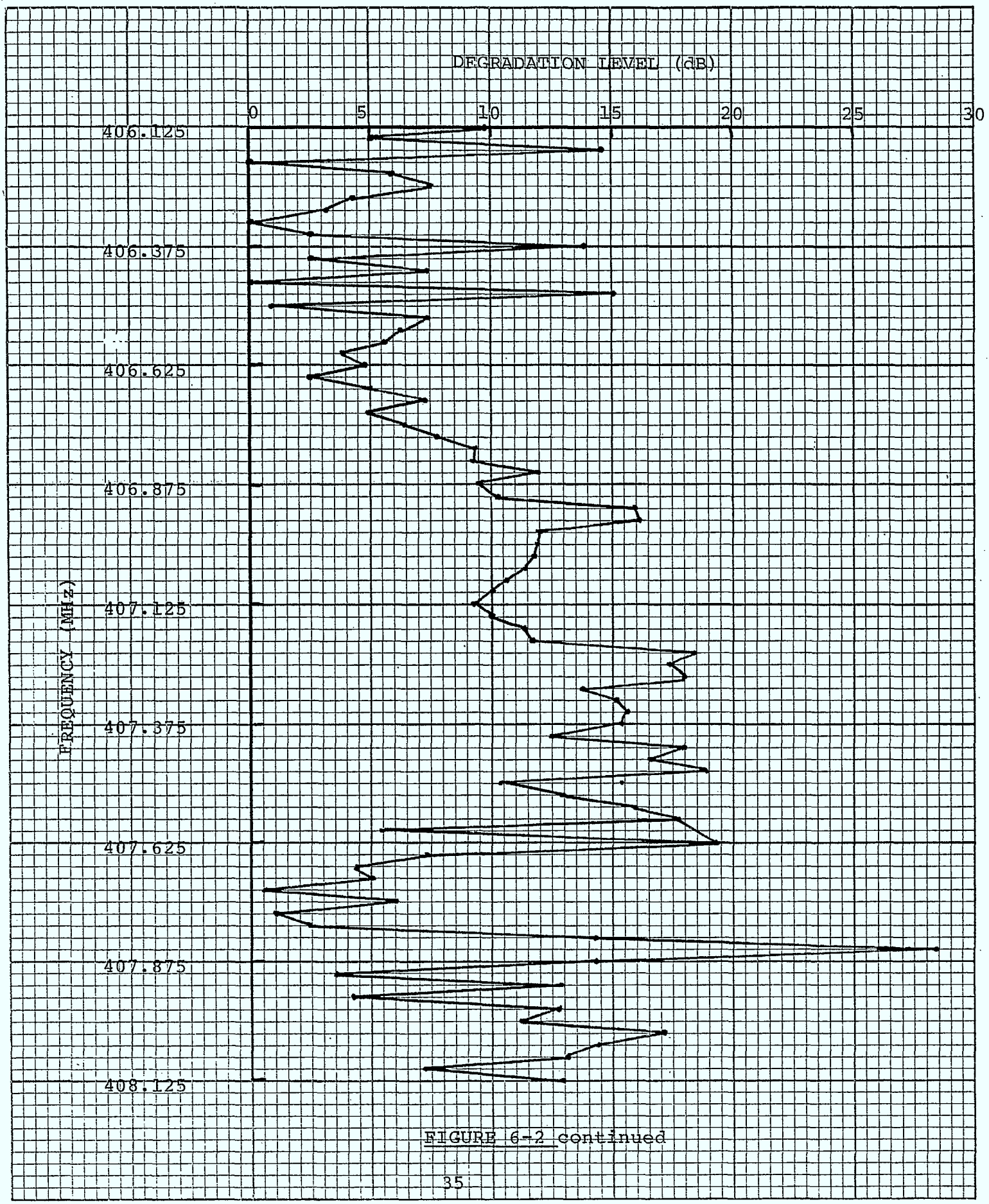


FIGURE 6-2 continued

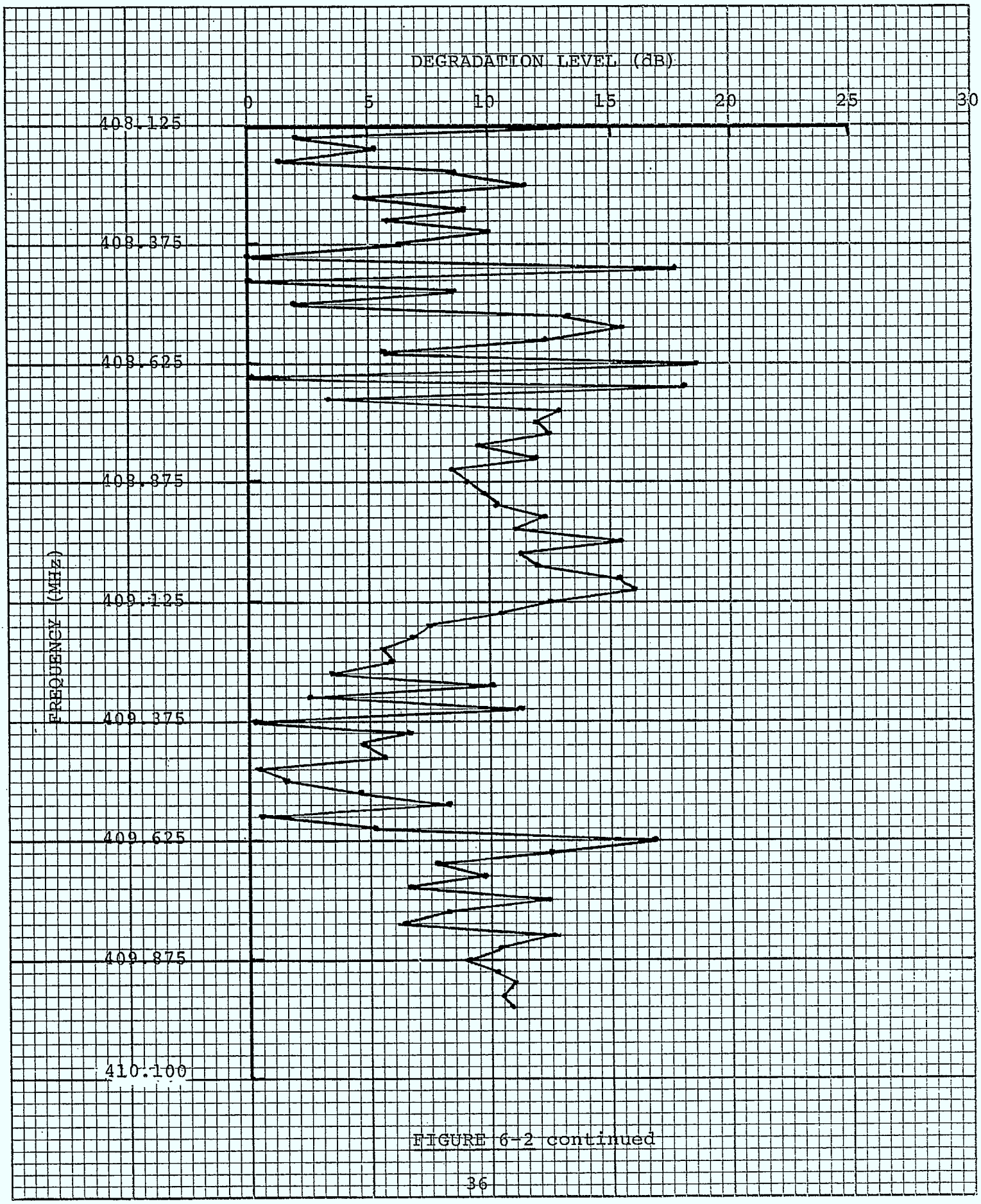


FIGURE 6-2 continued

FIGURE 6-2 continued

```
07>URU,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,60,95,0,95 | | | | |
| 406.1250 | 25.7 | 1.3 | 9.2 | 9.8 |
| 406.1500 | 20.0 | 7.0 | 4.7 | 5.1 |
| 406.1750 | 30.9 | -3.9 | 14.0 | 14.6 |
| 406.2000 | -22.3 | 49.3 | .0 | .0 |
| 406.2250 | 21.1 | 5.9 | 5.5 | 6.0 |
| 406.2500 | 23.2 | 3.8 | 7.1 | 7.6 |
| 406.2750 | 18.7 | 8.3 | 3.9 | 4.3 |
| 406.3000 | 16.8 | 10.2 | 2.9 | 3.2 |
| 406.3250 | -34.2 | 61.2 | .0 | .0 |
| 406.3500 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.3750 | 30.1 | -3.1 | 13.3 | 13.9 |
| 406.4000 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.4250 | 23.0 | 4.0 | 6.9 | 7.4 |
| 406.4500 | -4.1 | 31.1 | .0 | .0 |
| 406.4250 | 31.3 | -4.3 | 14.5 | 15.1 |
| 406.5000 | 9.9 | 17.1 | .8 | .9 |
| 406.5250 | 22.9 | 4.1 | 6.9 | 7.4 |
| 406.5500 | 21.5 | 5.5 | 5.8 | 6.3 |
| 406.5750 | 20.5 | 6.5 | 5.1 | 5.6 |
| 406.6000 | 18.0 | 9.0 | 3.5 | 3.9 |
| 406.6250 | 19.4 | 7.6 | 4.4 | 4.8 |
| 406.6500 | 15.4 | 11.6 | 2.3 | 2.5 |
| 406.6750 | 19.7 | 7.3 | 4.6 | 5.0 |
| 406.7000 | 22.8 | 4.2 | 6.8 | 7.3 |
| 406.7250 | 19.8 | 7.2 | 4.6 | 5.0 |
| 406.7500 | 21.8 | 5.2 | 6.0 | 6.5 |
| 406.7250 | 23.4 | 3.6 | 7.3 | 7.8 |
| 406.8000 | 25.3 | 1.7 | 8.9 | 9.4 |
| 406.8250 | 25.0 | 2.0 | 8.6 | 9.2 |
| 406.8500 | 28.1 | -1.1 | 11.4 | 12.0 |
| 406.8750 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.9000 | 26.2 | .8 | 9.7 | 10.3 |
| 406.9250 | 32.3 | -5.7 | 15.4 | 16.0 |

| | | | | |
|---|---|---|---|---|
| 406.0000 | 25.3 | 1.7 | 8.9 | 9.4 |
| 406.0250 | 25.0 | 2.0 | 8.6 | 9.2 |
| 406.0500 | 28.1 | -1.1 | 11.4 | 12.0 |
| 406.0750 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.9000 | 26.2 | .8 | 9.7 | 10.3 |
| 406.9250 | 32.3 | -5.3 | 15.4 | 16.0 |
| 406.9500 | 32.5 | -5.5 | 15.6 | 16.2 |
| 406.9750 | 28.1 | -1.1 | 11.4 | 12.0 |
| 407.0000 | 28.0 | -1.0 | 11.4 | 11.9 |
| 407.0250 | 27.9 | -.9 | 11.3 | 11.8 |
| 407.0500 | 27.4 | -.4 | 10.8 | 11.4 |
| 407.0750 | 26.6 | .4 | 10.1 | 10.6 |
| 407.1000 | 25.9 | 1.1 | 9.4 | 10.0 |
| 407.1250 | 25.2 | 1.8 | 8.8 | 9.3 |
| 407.1500 | 25.9 | 1.1 | 9.4 | 10.0 |
| 407.1750 | 27.5 | -.5 | 10.8 | 11.4 |
| 407.2000 | 27.8 | -.8 | 11.1 | 11.7 |
| 407.2250 | 34.8 | -7.8 | 17.8 | 18.4 |
| 407.2500 | 33.7 | -6.7 | 16.8 | 17.4 |
| 407.2750 | 34.3 | -7.3 | 17.4 | 18.0 |
| 407.3000 | 30.0 | -3.0 | 13.2 | 13.7 |
| 407.3250 | 31.4 | -4.4 | 14.5 | 15.1 |
| 407.3500 | 31.9 | -4.9 | 15.0 | 15.6 |
| 407.3750 | 31.7 | -4.7 | 14.9 | 15.4 |
| 407.4000 | 28.7 | -1.7 | 11.9 | 12.5 |
| 407.4250 | 34.3 | -7.3 | 17.4 | 18.0 |
| 407.4500 | 32.9 | -5.9 | 16.0 | 16.6 |
| 407.4750 | 35.2 | -8.2 | 18.3 | 18.9 |
| 407.5000 | 26.4 | .6 | 9.9 | 10.4 |
| 407.5250 | 29.0 | -2.0 | 12.3 | 12.9 |
| 407.5500 | 32.2 | -5.2 | 15.3 | 15.9 |
| 407.5750 | 34.1 | -7.1 | 17.2 | 17.7 |
| 407.6000 | 20.3 | 6.7 | 5.0 | 5.4 |
| 407.6250 | 35.6 | -8.6 | 18.7 | 19.3 |
| 407.6500 | 22.9 | 4.1 | 6.8 | 7.3 |
| 407.6750 | 18.8 | 8.2 | 4.0 | 4.4 |
| 407.7000 | 20.0 | 7.0 | 4.7 | 5.1 |
| 407.7250 | 7.4 | 19.6 | .4 | .5 |
| 407.7500 | 21.3 | 5.7 | 5.7 | 6.1 |
| 407.7750 | 10.5 | 16.5 | .9 | 1.0 |
| 407.8000 | 15.1 | 11.9 | 2.1 | 2.4 |
| 407.8250 | 30.5 | -3.5 | 13.7 | 14.3 |
| 407.8500 | 44.8 | -17.8 | 27.8 | 28.4 |
| 407.8750 | 30.5 | -3.5 | 13.7 | 14.2 |
| 407.9000 | 17.3 | 9.7 | 3.2 | 3.5 |

07>OF,INUHF,1

INTERFERENCE PROGRAM

FIGURE 6-2 continued

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS



GROUND TRANSMIT POWER,DBW

FIGURE 6-2 continued

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

13,14,20,53,1,1,18,60,95,0,95

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG. + 15% (dB) |
|---|---|---|---|---|
| 407.7750 | 10.5 | 16.5 | .9 | 1.0 |
| 407.8000 | 15.1 | 11.9 | 2.1 | 2.4 |
| 407.8250 | 30.5 | -3.5 | 13.7 | 14.3 |
| 407.8500 | 44.8 | -17.8 | 27.8 | 28.4 |
| 407.8750 | 30.5 | -3.5 | 13.6 | 14.2 |
| 407.9000 | 17.3 | 9.7 | 3.2 | 3.5 |
| 407.9250 | 29.1 | -2.1 | 12.4 | 12.9 |
| 407.9500 | 18.5 | 8.5 | 3.8 | 4.2 |
| 407.9750 | 28.8 | -1.8 | 12.1 | 12.7 |
| 408.0000 | 27.3 | -.3 | 10.7 | 11.2 |
| 408.0250 | 33.4 | -6.4 | 16.5 | 17.1 |
| 408.0500 | 30.6 | -3.6 | 13.8 | 14.4 |
| 408.0750 | 29.3 | -2.3 | 12.5 | 13.1 |
| 408.1000 | 22.7 | 4.3 | 6.8 | 7.2 |
| 408.1250 | 29.2 | -2.2 | 12.5 | 13.0 |
| 408.1500 | 14.2 | 12.8 | 1.8 | 2.0 |
| 408.1750 | 20.1 | 6.9 | 4.8 | 5.2 |
| 408.2000 | 11.9 | 15.1 | 1.2 | 1.3 |
| 408.2250 | 24.4 | 2.6 | 8.1 | 8.6 |
| 408.2500 | 27.5 | -.5 | 10.9 | 11.5 |
| 408.2750 | 19.0 | 8.0 | 4.1 | 4.5 |
| 408.3000 | 24.8 | 2.2 | 8.5 | 9.0 |
| 408.3250 | 20.8 | 6.2 | 5.3 | 5.7 |
| 408.3500 | 25.9 | 1.1 | 9.4 | 10.0 |
| 408.3750 | 21.7 | 5.3 | 6.0 | 6.4 |
| 408.4000 | -16.3 | 43.3 | .0 | .0 |
| 408.4250 | 34.2 | -7.2 | 17.2 | 17.8 |
| 408.4500 | -16.5 | 43.5 | .0 | .0 |
| 408.4750 | 24.3 | 2.7 | 8.0 | 8.5 |
| 408.5000 | 13.7 | 13.3 | 1.7 | 1.9 |
| 408.5250 | 29.5 | -2.5 | 12.7 | 13.3 |
| 408.5500 | 31.8 | -4.8 | 14.9 | 15.5 |
| 408.5750 | 28.4 | -1.4 | 11.7 | 12.3 |
| 408.6000 | 20.5 | 6.5 | 5.1 | 5.6 |
| 408.6250 | 34.9 | -7.9 | 18.0 | 18.6 |
| 408.6500 | 1.8 | 25.2 | .1 | .1 |
| 408.6750 | 34.4 | -7.4 | 17.5 | 18.1 |
| 408.7000 | 16.9 | 10.1 | 2.9 | 3.3 |
| 408.7250 | 29.0 | -2.0 | 12.3 | 12.9 |

```
        408.5500                    31.8     -4.8     14.9     15.5
        408.5750                    28.4     -1.4     11.7     12.3
        408.6000                    20.5      6.5      5.1      5.6
        408.6250                    34.9     -7.9     18.0     18.6
        408.6500                     1.8     25.2       .1       .1
        408.6750                    34.4     -7.4     17.5     18.1
        408.7000                    16.9     10.1      2.9      3.3
        408.7250                    29.0     -2.0     12.3     12.9
        408.7500                    28.1     -1.1     11.4     12.0
        408.7750                    28.6     -1.6     11.9     12.5
        408.8000                    25.4      1.6      9.0      9.5
        408.8250                    28.1     -1.1     11.4     12.0
        408.8500                    24.1      2.9      7.9      8.4
        408.8750                    25.0      2.0      8.6      9.1

07>OF,INUHF,1

07>RU,INUHDF,7,7
                    INTERFERENCE  PROGRAM


INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

    GROUND TRANSMIT POWER,DBW
    GROUND ANTENNA GAIN
    EMMISION BANDWIDTH,HZ
    OVERALL SYSTEM C/NO,DB-HZ
    PROGRAM RUN TYPE
       1 - DISC FILE INPUT
       2 - TERMINAL INPUT
    SATELLITE PATTERN TYPE
       1 - MUSAT
       2 - MULTIBEAM
    FREQUENCY SEPERATION LIMIT
    BEAM POINTING COORDINATES,LAT,LONG DEGREES
    SATELLITE COORDINATES,LAT,LONG  DEGREES


13,14,20,53,1,1,18,60,95,0,95
        408.8750                    25.0      2.0      8.6      9.1
        408.9000                    25.7      1.3      9.2      9.8
        408.9250                    26.3       .7      9.7     10.3
        408.9500                    28.4     -1.4     11.7     12.3
        408.9750                    27.1      -.1     10.5     11.1
        409.0000                    31.8     -4.8     14.9     15.5
        409.0250                    27.3      -.3     10.7     11.3
        409.0500                    28.2     -1.2     11.5     12.0
        409.0750                    31.6     -4.6     14.8     15.4
        409.1000                    32.2     -5.2     15.4     16.0
        409.1250                    28.6     -1.6     11.9     12.5
        409.1500                    26.5       .5     10.0     10.5
        409.1750                    23.1      3.9      7.0      7.5
        409.2000                    22.1      4.9      6.3      6.7
        409.2250                    20.5      6.5      5.1      5.6
        409.2500                    21.0      6.0      5.5      5.9
        409.2750                    17.4      9.6      3.2      3.5
        409.3000                    26.1       .9      9.6     10.1
        409.3250                    15.3     11.7      2.2      2.5
        409.3500                    27.3      -.3     10.7     11.3
        409.3750                    -1.0     28.0       .1       .1
        409.4000                    22.0      5.0      6.2      6.6
        409.4250                    19.5      7.5      4.4      4.8
        409.4500                    20.4      6.4      5.2      5.6
```

FIGURE 6-2
continued

13,14,20,53,1,1,18,60,95,0,95

| | | | | |
|---|---|---|---|---|
| 408.8750 | 25.0 | 2.0 | 8.6 | 9.1 |
| 408.9000 | 25.7 | 1.3 | 9.2 | 9.8 |
| 408.9250 | 26.3 | .7 | 9.7 | 10.3 |
| 408.9500 | 28.4 | -1.4 | 11.7 | 12.3 |
| 408.9750 | 27.1 | -.1 | 10.5 | 11.1 |
| 409.0000 | 31.8 | -4.8 | 14.9 | 15.5 |
| 409.0250 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.0500 | 28.2 | -1.2 | 11.5 | 12.0 |
| 409.0750 | 31.6 | -4.6 | 14.8 | 15.4 |
| 409.1000 | 32.2 | -5.2 | 15.4 | 16.0 |
| 409.1250 | 28.6 | -1.6 | 11.9 | 12.5 |
| 409.1500 | 26.5 | .5 | 10.0 | 10.5 |
| 409.1750 | 23.1 | 3.9 | 7.0 | 7.5 |
| 409.2000 | 22.1 | 4.9 | 6.3 | 6.7 |
| 409.2250 | 20.5 | 6.5 | 5.1 | 5.6 |
| 409.2500 | 21.0 | 6.0 | 5.5 | 5.9 |
| 409.2750 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.3000 | 26.1 | .9 | 9.6 | 10.1 |
| 409.3250 | 15.3 | 11.7 | 2.2 | 2.5 |
| 409.3500 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.3750 | -1.0 | 28.0 | .1 | .1 |
| 409.4000 | 22.0 | 5.0 | 6.2 | 6.6 |
| 409.4250 | 19.5 | 7.5 | 4.4 | 4.8 |
| 409.4500 | 20.6 | 6.4 | 5.2 | 5.6 |
| 409.4750 | 5.2 | 21.8 | .3 | .3 |
| 409.5000 | 12.7 | 14.3 | 1.4 | 1.5 |
| 409.5250 | 19.1 | 7.9 | 4.2 | 4.6 |
| 409.5500 | 23.9 | 3.1 | 7.7 | 8.2 |
| 409.5750 | 7.4 | 19.6 | .5 | .5 |
| 409.6000 | 20.0 | 7.0 | 4.7 | 5.2 |
| 409.6250 | 33.1 | -6.1 | 16.2 | 16.8 |
| 409.6500 | 28.7 | -1.7 | 11.9 | 12.5 |
| 409.6750 | 23.3 | 3.7 | 7.2 | 7.7 |
| 409.7000 | 25.7 | 1.3 | 9.3 | 9.8 |
| 409.7250 | 22.0 | 5.0 | 6.2 | 6.6 |
| 409.7500 | 28.5 | -1.5 | 11.8 | 12.4 |
| 409.7750 | 23.9 | 3.1 | 7.7 | 8.2 |
| 409.8000 | 21.7 | 5.3 | 5.9 | 6.4 |
| 409.8250 | 28.8 | -1.8 | 12.0 | 12.6 |
| 409.8500 | 26.3 | .7 | 9.7 | 10.3 |
| 409.8750 | 24.8 | 2.2 | 8.4 | 9.0 |
| 409.9000 | 26.2 | .8 | 9.7 | 10.2 |
| 409.9250 | 27.1 | -.1 | 10.5 | 11.0 |
| 409.9500 | 26.4 | .6 | 9.9 | 10.5 |
| 409.9750 | 26.7 | .3 | 10.1 | 10.7 |

45 26.4

FIGURE 6-2 continued

## MOBILE-SATELLITE SYSTEM

| | |
|---|---|
| GROUND TRANSMIT EIRP | 27 dBW |
| EMISSION BANDWIDTH | 20 KHz |
| OVERALL $C/N_o$ | 53 dB-Hz |
| SATELLITE ANTENNA BEAMWIDTH | $2^o$ |
| SATELLITE COORDINATES | |
| 1) LATITUDE | $0^o$ |
| 2) LONGITUDE | $105^o$ |
| BEAM POINTING COORDINATES | |
| 1) LATITUDE | $60^o$ |
| 2) LONGITUDE | $95^o$ |
| SATELLITE ORBIT RADIUS | ∿42,166 Km |

## FIXED AND MOBILE SYSTEM

U.S. Catalogue of transmitters in 406.1-410 MHz band, omitting high power (command destruct) transmissions at 406.5 and 409.0 MHz

15% annual growth rate for one year

FIGURE 6-3

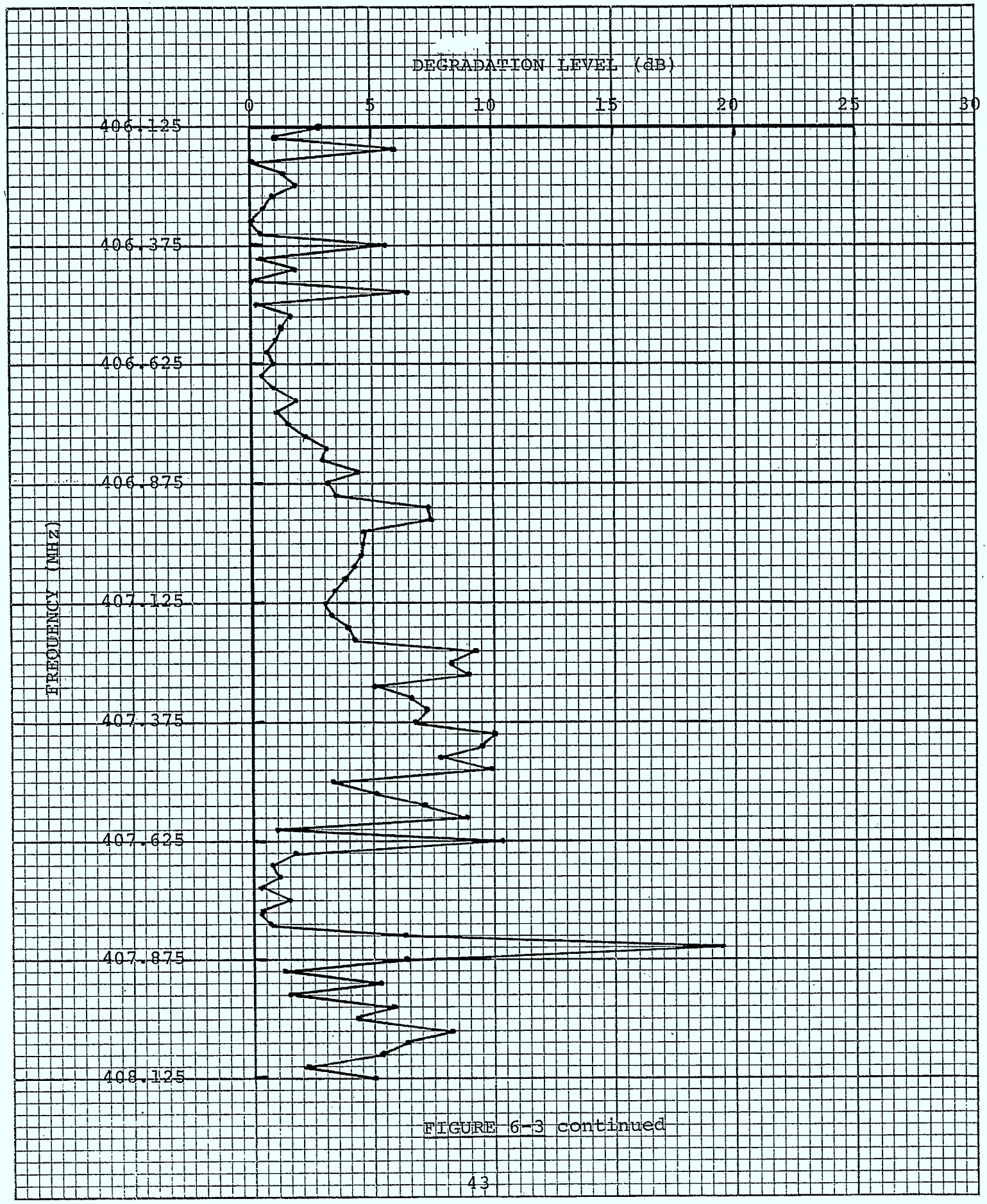


FIGURE 6-3 continued

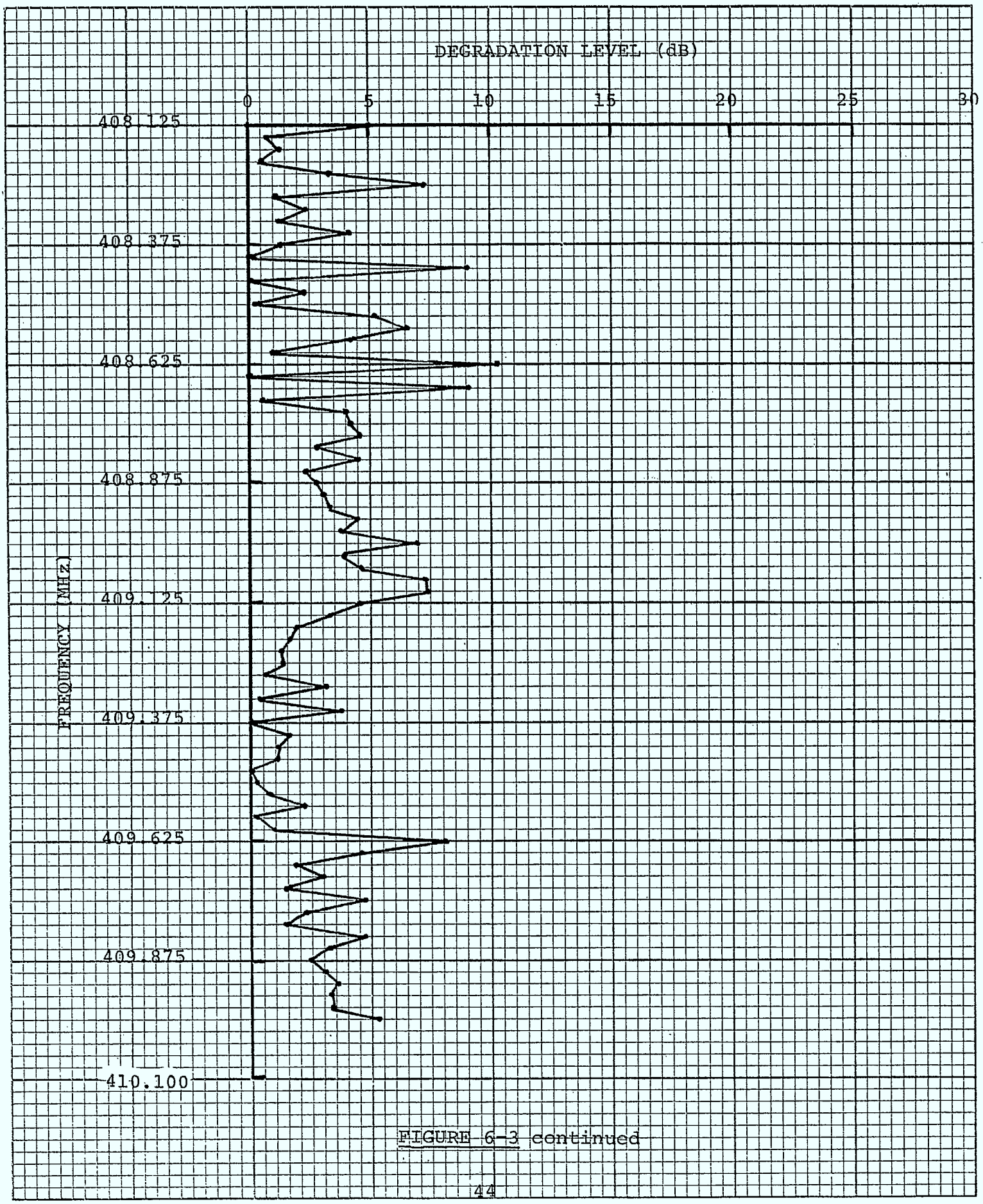


FIGURE 6-3 continued

FIGURE 6-3 continued

```
RUN,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (db) | DEG. + 15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,2,18,55,95,0,105 | | | | |
| 406.1250 | 15.8 | 11.2 | 2.4 | 2.7 |
| 406.1500 | 10.6 | 16.4 | .9 | 1.0 |
| 406.1750 | 21.1 | 5.9 | 5.5 | 6.0 |
| 406.2000 | -31.6 | 58.6 | .0 | .0 |
| 406.2250 | 11.9 | 15.1 | 1.2 | 1.3 |
| 406.2500 | 12.4 | 13.6 | 1.6 | 1.8 |
| 406.2750 | 2.8 | 17.2 | .8 | .9 |
| 406.3000 | 7.0 | 20.0 | .4 | .5 |
| 406.3250 | -44.0 | 71.0 | .0 | .0 |
| 406.3500 | 6.2 | 20.5 | .3 | .4 |
| 406.3750 | 20.7 | [illegible] | 5.2 | 5.6 |
| 406.4000 | 6.2 | 20.8 | .3 | .4 |
| 406.4250 | 13.5 | 17.5 | 1.6 | 1.8 |
| 406.4500 | -14.0 | 41.0 | .0 | .0 |
| 406.4750 | 21.8 | 5.2 | 6.1 | 6.5 |
| 406.5000 | -.2 | 27.2 | .1 | .1 |
| 406.5250 | 13.0 | 14.0 | 1.4 | 1.6 |
| 406.5500 | 11.5 | 15.5 | 1.1 | 1.2 |
| 406.5750 | 10.6 | 16.4 | .9 | 1.0 |
| 406.6000 | 8.2 | 18.8 | .5 | [illegible] |
| 406.6250 | 10.2 | 16.8 | .8 | .9 |
| 406.6500 | 5.8 | 21.2 | .3 | .4 |
| 406.6750 | 10.3 | [illegible] | .3 | .3 |
| 406.7000 | 17.4 | 17.6 | 1.6 | 1.8 |
| 406.7250 | 16.4 | 16.6 | .9 | 1.0 |
| 406.7500 | 12.6 | [illegible] | 1.3 | 1.5 |
| 406.7750 | 14.5 | 12.5 | 1.7 | 2.0 |
| 406.8000 | 16.5 | 10.5 | 2.8 | 3.1 |
| 406.8250 | 16.1 | 10.9 | 2.6 | [illegible] |
| 406.8500 | [illegible] | 9.2 | 4.0 | 4.4 |
| 406.8750 | [illegible] | 10.5 | 2.8 | [illegible] |
| 406.9000 | 17.4 | 9.6 | 3.7 | [illegible] |
| 406.9250 | 22.7 | 4.3 | 6.8 | 7.5 |

| | | | | |
|---|---|---|---|---|
| 406.8500 | 18.8 | 8.2 | 4.0 | 4.4 |
| 406.8750 | 16.5 | 10.5 | 2.8 | 3.1 |
| 406.9000 | 17.4 | 9.6 | 3.2 | 3.5 |
| 406.9250 | 22.7 | 4.3 | 6.8 | 7.3 |
| 406.9500 | 23.0 | 4.0 | 7.0 | 7.5 |
| 406.9750 | 19.2 | 7.8 | 4.2 | 4.6 |
| 407.0000 | 19.1 | 7.9 | 4.2 | 4.6 |
| 407.0250 | 18.9 | 8.1 | 4.1 | 4.5 |
| 407.0500 | 18.5 | 8.5 | 3.8 | 4.2 |
| 407.0750 | 17.8 | 9.2 | 3.4 | 3.8 |
| 407.1000 | 17.1 | 9.9 | 3.0 | 3.4 |
| 407.1250 | 16.3 | 10.7 | 2.7 | 3.0 |
| 407.1500 | 16.8 | 10.2 | 2.9 | 3.2 |
| 407.1750 | 18.2 | 8.8 | 3.7 | 4.0 |
| 407.2000 | 18.5 | 8.5 | 3.8 | 4.2 |
| 407.2250 | 25.0 | 2.0 | 8.6 | 9.2 |
| 407.2500 | 23.9 | 3.1 | 7.7 | 8.2 |
| 407.2750 | 24.8 | 2.2 | 8.5 | 9.0 |
| 407.3000 | 19.7 | 7.3 | 4.6 | 5.0 |
| 407.3250 | 21.9 | 5.1 | 6.1 | 6.6 |
| 407.3500 | 22.7 | 4.3 | 6.7 | 7.2 |
| 407.3750 | 22.2 | 4.8 | 6.3 | 6.8 |
| 407.4000 | 25.9 | 1.1 | 9.4 | 10.0 |
| 407.4250 | 25.4 | 1.6 | 9.0 | 9.5 |
| 407.4500 | 23.4 | 3.6 | 7.3 | 7.8 |
| 407.4750 | 25.9 | 1.1 | 9.4 | 9.9 |
| 407.5000 | 16.7 | 10.3 | 2.9 | 3.2 |
| 407.5250 | 20.0 | 7.0 | 4.7 | 5.1 |
| 407.5500 | 22.6 | 4.4 | 6.6 | 7.1 |
| 407.5750 | 24.7 | 2.3 | 8.4 | 8.9 |
| 407.6000 | 10.5 | 16.5 | .9 | 1.0 |
| 407.6250 | 26.3 | .7 | 9.7 | 10.3 |
| 407.6500 | 13.1 | 13.9 | 1.5 | 1.7 |
| 407.6750 | 9.0 | 18.0 | .6 | .7 |
| 407.7000 | 10.9 | 16.1 | .9 | 1.1 |
| 407.7250 | 2.4 | 24.6 | .1 | .2 |
| 407.7500 | 12.4 | 14.6 | 1.3 | 1.5 |

```
07>OF,INUHF,1
```

```
07>RU,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
```

FIGURE 6-3 continued

FIGURE 6-3 continued

```
>?>RU,TNUMF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG. + 15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,55,95,0,105 | | | | |
| 407.7500 | 12.4 | 14.6 | 1.3 | 1.5 |
| 407.7750 | 5.5 | 21.5 | .3 | .3 |
| 407.8000 | 8.2 | 18.8 | .5 | .6 |
| 407.8250 | 21.6 | 5.4 | 5.9 | 6.3 |
| 407.8500 | 35.8 | -8.8 | 18.9 | 19.5 |
| 407.8750 | 21.6 | 5.4 | 5.9 | 6.4 |
| 407.9000 | 11.3 | 15.7 | 1.0 | 1.2 |
| 407.9250 | 20.1 | 6.9 | 4.8 | 5.2 |
| 407.9500 | 12.4 | 14.6 | 1.3 | 1.5 |
| 407.9750 | 20.9 | 6.1 | 5.4 | 5.8 |
| 408.0000 | 18.7 | 8.3 | 3.9 | 4.3 |
| 408.0250 | 23.9 | 3.1 | 7.7 | 8.2 |
| 408.0500 | 21.6 | 5.4 | 5.9 | 6.4 |
| 408.0750 | 20.1 | 6.9 | 4.8 | 5.3 |
| 408.1000 | 14.6 | 12.4 | 2.0 | 2.2 |
| 408.1250 | 19.8 | 7.2 | 4.6 | 5.0 |
| 408.1500 | 9.1 | 17.9 | .7 | .7 |
| 408.1750 | 12.0 | 15.0 | 1.2 | 1.3 |
| 408.2000 | 6.9 | 20.1 | .4 | .5 |
| 408.2250 | 17.1 | 9.9 | 3.1 | 3.4 |
| 408.2500 | 22.8 | 4.2 | 6.8 | 7.3 |
| 408.2750 | 11.0 | 16.0 | 1.0 | 1.1 |
| 408.3000 | 15.2 | 11.8 | 2.2 | 2.4 |
| 408.3250 | 11.4 | 15.6 | 1.1 | 1.2 |
| 408.3500 | 18.5 | 8.5 | 3.8 | 4.2 |
| 408.3750 | 11.9 | 15.1 | 1.2 | 1.3 |
| 408.4000 | -25.8 | 52.8 | .0 | .0 |
| 408.4250 | 24.8 | 2.2 | 8.5 | 9.0 |
| 408.4500 | -25.7 | 52.7 | .0 | .0 |
| 408.4750 | 14.8 | 12.2 | 2.0 | 2.3 |
| 408.5000 | 3.4 | 23.6 | .2 | .2 |
| 408.5250 | 20.0 | 7.0 | 4.0 | 5.2 |
| 408.5500 | 22.0 | 5.0 | 6.2 | 6.6 |
| 408.5750 | 18.6 | 8.4 | 3.9 | 4.2 |
| 408.6000 | 10.7 | 16.3 | .9 | 1.0 |
| 408.6250 | 26.3 | .7 | 9.0 | 10.3 |

| | | | | |
|---|---|---|---|---|
| [illegible] | 9.7 | 26.6 | .2 | .2 |
| 408.5250 | 20.0 | 7.0 | 4.0 | 5.2 |
| 408.5500 | 22.0 | 5.0 | 6.2 | 6.6 |
| 408.5750 | 18.6 | 8.4 | 3.9 | 4.2 |
| 408.6000 | 10.7 | 16.3 | .9 | 1.0 |
| 408.6250 | -26.3 | .7 | 9.0 | 10.3 |
| 408.6500 | -7.5 | 34.5 | .0 | .0 |
| 408.6750 | 25.0 | 2.0 | 8.6 | 9.1 |
| 408.7000 | 7.5 | 19.5 | .5 | .5 |
| 408.7250 | 18.2 | 8.8 | 3.7 | 4.0 |
| 408.7500 | 18.5 | 8.5 | 3.8 | 4.2 |
| 408.7750 | 19.1 | 7.9 | 4.2 | 4.6 |
| 408.8000 | 16.0 | 11.0 | 2.5 | 2.8 |
| 408.8250 | 19.0 | 8.0 | 4.1 | 4.5 |
| 408.8500 | 14.8 | 12.2 | 2.0 | 2.3 |
| 408.8750 | 15.7 | 11.3 | 2.4 | 2.7 |

07>OF,INUHF,8

07>RU,INUHF,7,7

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ

FIGURE 6-3 continued

PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM

FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

13,14,20,53,1,12,18,55,95,0,105

| | | | | |
|---|---|---|---|---|
| 408.8500 | 14.8 | 12.2 | 2.0 | 2.3 |
| 408.8750 | 15.7 | 11.3 | 2.4 | 2.7 |
| 408.9000 | 16.4 | 10.6 | 2.7 | 3.0 |
| 408.9250 | 17.0 | 10.0 | 3.0 | 3.3 |
| 408.9500 | 19.0 | 8.0 | 4.1 | 4.5 |
| 408.9750 | 17.8 | 9.2 | 3.4 | 3.8 |
| 409.0000 | 22.5 | 4.5 | 6.6 | 7.0 |
| 409.0250 | 18.1 | 8.9 | 3.6 | 3.9 |
| 409.0500 | 19.1 | 7.9 | 4.2 | 4.6 |
| 409.0750 | 22.8 | 4.2 | 6.8 | 7.3 |
| 409.1000 | 23.0 | 4.0 | 6.9 | 7.4 |
| 409.1250 | 19.1 | 7.9 | 4.2 | 4.5 |
| 409.1500 | 17.0 | 10.0 | 3.0 | 3.3 |
| 409.1750 | 13.8 | 13.2 | 1.7 | 1.9 |
| 409.2000 | 12.8 | 14.2 | 1.4 | 1.6 |
| 409.2250 | 11.2 | 15.8 | 1.0 | 1.2 |
| 409.2500 | 11.7 | 15.3 | 1.1 | 1.3 |
| 409.2750 | 8.1 | 18.9 | .5 | .6 |
| 409.3000 | 16.6 | 10.4 | 2.8 | 3.1 |
| 409.3250 | 5.5 | 21.5 | .3 | .3 |
| 409.3500 | 17.9 | 9.1 | 3.5 | 3.8 |
| 409.3750 | -10.0 | 37.0 | .0 | .0 |

17,11,23,53,1,12,18,55,95,0,105

| | | | | |
|---|---|---|---|---|
| 408.0500 | 14.8 | 12.2 | 2.0 | 2.3 |
| 408.0750 | 15.7 | 11.3 | 2.4 | 2.7 |
| 408.9000 | 16.4 | 10.6 | 2.7 | 3.0 |
| 408.9250 | 17.0 | 10.0 | 3.0 | 3.3 |
| 408.9500 | 19.0 | 8.0 | 4.1 | 4.5 |
| 408.9750 | 17.8 | 9.2 | 3.4 | 3.8 |
| 409.0000 | 22.5 | 4.5 | 6.6 | 7.0 |
| 409.0250 | 18.1 | 8.9 | 3.6 | 3.9 |
| 409.0500 | 19.1 | 7.9 | 4.2 | 4.6 |
| 409.0750 | 22.8 | 4.2 | 6.8 | 7.3 |
| 409.1000 | 23.0 | 4.0 | 6.9 | 7.4 |
| 409.1250 | 19.1 | 7.9 | 4.2 | 4.5 |
| 409.1500 | 17.0 | 10.0 | 3.0 | 3.3 |
| 409.1750 | 13.8 | 13.2 | 1.7 | 1.9 |
| 409.2000 | 12.8 | 14.2 | 1.4 | 1.6 |
| 409.2250 | 11.2 | 15.8 | 1.0 | 1.2 |
| 409.2500 | 11.7 | 15.3 | 1.1 | 1.3 |
| 409.2750 | 8.1 | 18.9 | .5 | .6 |
| 409.3000 | 16.6 | 10.4 | 2.8 | 3.1 |
| 409.3250 | 5.5 | 21.5 | .3 | .3 |
| 409.3500 | 17.9 | 9.1 | 3.5 | 3.8 |
| 409.3750 | -10.0 | 37.0 | .0 | .0 |
| 409.4000 | 12.9 | 14.1 | 1.4 | 1.6 |
| 409.4250 | 11.0 | 16.0 | 1.0 | 1.1 |
| 409.4500 | 10.8 | 16.2 | .9 | 1.1 |
| 409.4750 | -4.5 | 31.5 | .0 | .0 |
| 409.5000 | 2.9 | 24.1 | .2 | .2 |
| 409.5250 | 9.4 | 17.6 | .7 | .8 |
| 409.5500 | 14.6 | 12.4 | 2.0 | 2.2 |
| 409.5750 | -1.9 | 28.9 | .1 | .1 |
| 409.6000 | 10.5 | 16.5 | .9 | 1.0 |
| 409.6250 | 23.8 | 3.2 | 7.6 | 8.1 |
| 409.6500 | 19.2 | 7.8 | 4.2 | 4.6 |
| 409.6750 | 13.5 | 13.5 | 1.6 | 1.8 |
| 409.7000 | 16.3 | 10.7 | 2.7 | 3.0 |
| 409.7250 | 12.3 | 14.7 | 1.3 | 1.4 |
| 409.7500 | 19.3 | 7.7 | 4.3 | 4.7 |
| 409.7750 | 14.6 | 12.4 | 2.0 | 2.2 |
| 409.8000 | 12.1 | 14.9 | 1.2 | 1.4 |
| 409.8250 | 19.3 | 7.7 | 4.3 | 4.7 |
| 409.8500 | 16.8 | 10.2 | 2.9 | 3.2 |
| 409.8750 | 15.2 | 11.8 | 2.2 | 2.5 |
| 409.9000 | 16.6 | 10.4 | 2.8 | 3.1 |
| 409.9250 | 17.6 | 9.4 | 3.3 | 3.6 |
| 409.9500 | 16.9 | 10.1 | 2.9 | 3.3 |
| 409.9750 | 17.1 | 9.9 | 3.1 | 3.4 |
| 410.0000 | 20.1 | 6.9 | 4.8 | 5.2 |

17 17.1

FIGURE 6-3 continued

## MOBILE-SATELLITE SYSTEM

| | |
|---|---|
| GROUND TRANSMIT EIRP | 27 dBW |
| EMISSION BANDWIDTH | 20 KHz |
| OVERALL $C/N_o$ | 53 dB-Hz |
| SATELLITE ANTENNA BEAMWIDTH | $17^o$ |
| SATELLITE COORDINATES | |
| 1) LATITUDE | $0^o$ |
| 2) LONGITUDE | $105^o$ |
| BEAM POINTING COORDINATES | |
| 1) LATITUDE | $60^o$ |
| 2) LONGITUDE | $95^o$ |
| SATELLITE ORBIT RADIUS | ∿42,166 Km |
| FREQUENCY PLAN | SPLINTER CHANNELS |

## FIXED AND MOBILE SYSTEM

U.S. Catalogue of transmitters in 406.1-410 MHz band, omitting high power (command destruct) transmissions at 406.5 and 409.0 MHz

15% annual growth rate for one year

FIGURE 6-4

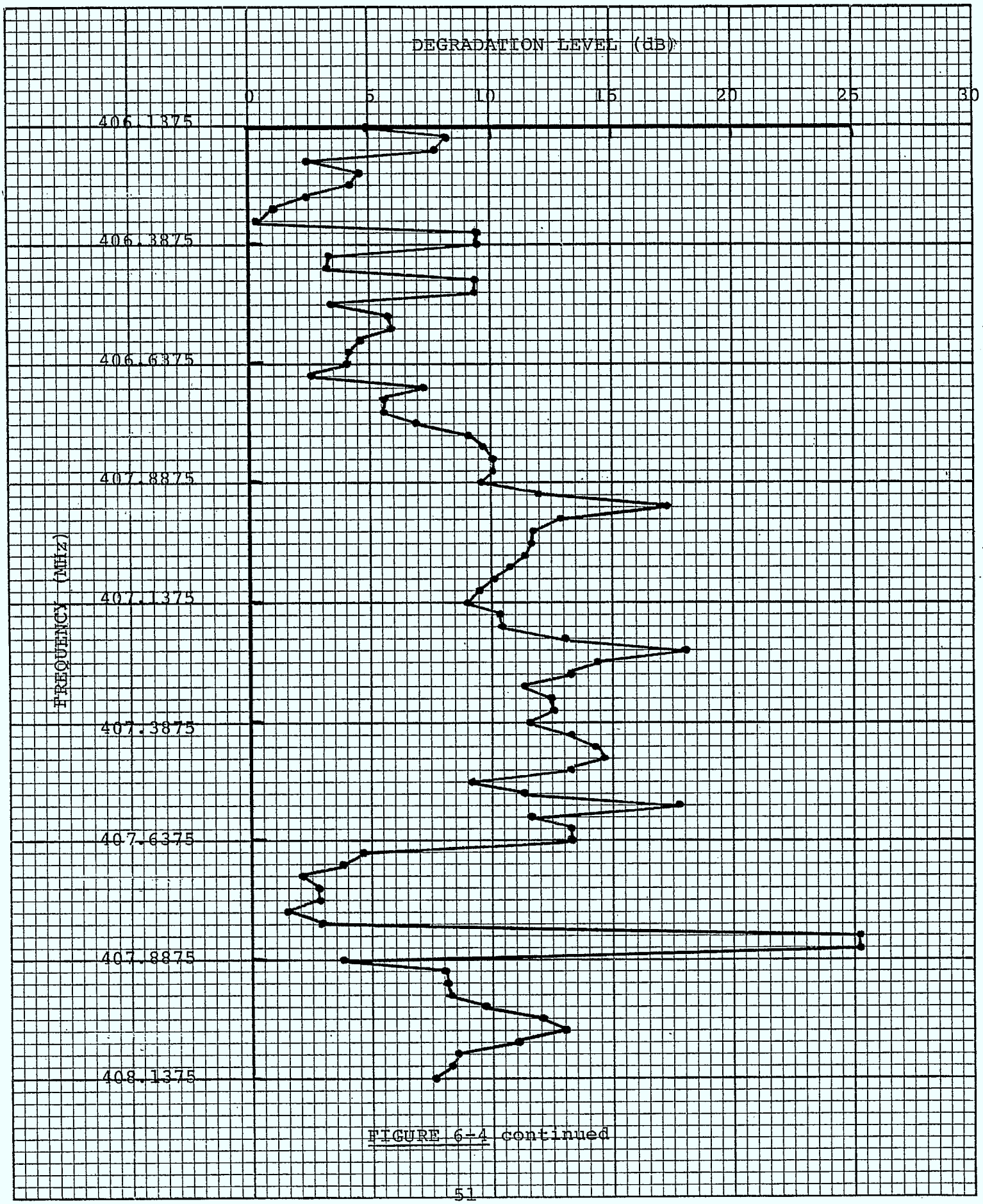


FIGURE 6-4 continued

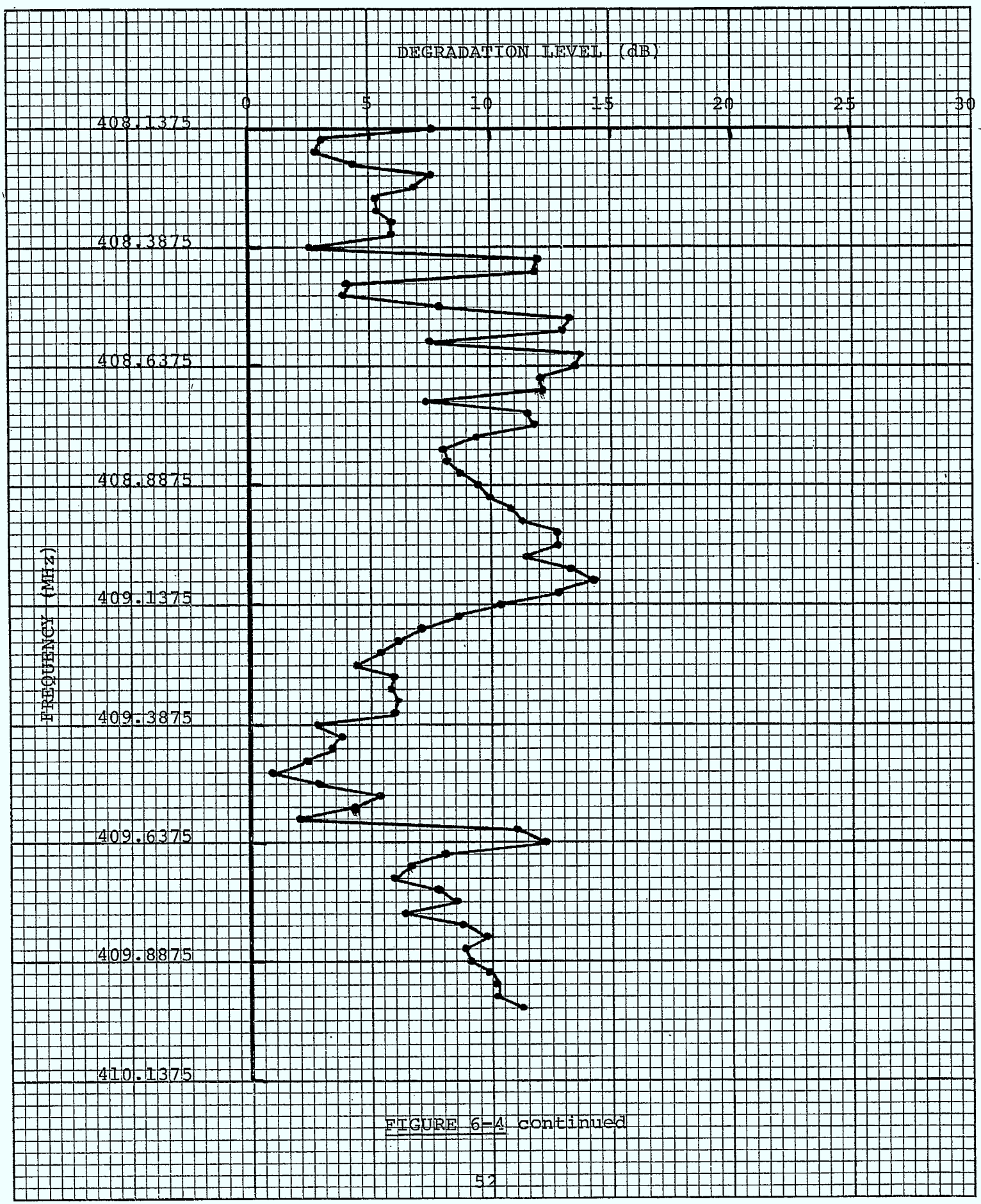


FIGURE 6-4 continued

FIGURE 6-4 continued

```
RU,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,60,95,0,105 | | | | |
| 406.1375 | 19.8 | 7.2 | 4.6 | 5.0 |
| 406.1625 | 23.9 | 3.1 | 7.7 | 8.2 |
| 406.1875 | 23.4 | 3.6 | 7.3 | 7.8 |
| 406.2125 | 15.2 | 11.0 | 2.2 | 2.4 |
| 406.2375 | 19.1 | 7.9 | 4.2 | 4.6 |
| 406.2625 | 18.5 | 8.5 | 3.8 | 4.2 |
| 406.2875 | 15.1 | 11.9 | 2.2 | 2.4 |
| 406.3125 | 10.5 | 16.5 | .9 | 1.0 |
| 406.3375 | 4.0 | 23.0 | .2 | .2 |
| 406.3625 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.3875 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.4125 | 17.0 | 10.0 | 3.0 | 3.3 |
| 406.4375 | 16.7 | 10.3 | 2.9 | 3.2 |
| 406.4625 | 25.3 | 1.7 | 8.9 | 9.4 |
| 406.4875 | 25.2 | 1.8 | 8.8 | 9.4 |
| 406.5125 | 17.1 | 9.9 | 3.1 | 3.4 |
| 406.5375 | 20.9 | 6.1 | 5.3 | 5.8 |
| 406.5625 | 21.1 | 5.9 | 5.5 | 5.9 |
| 406.5875 | 19.2 | 7.8 | 4.2 | 4.6 |
| 406.6125 | 18.3 | 8.7 | 3.7 | 4.1 |
| 406.6375 | 18.3 | 8.7 | 3.7 | 4.0 |
| 406.6625 | 15.5 | 11.5 | 2.3 | 2.6 |
| 406.6875 | 22.7 | 4.3 | 6.7 | 7.2 |
| 406.7125 | 20.4 | 6.6 | 5.0 | 5.4 |
| 406.7375 | 20.6 | 6.4 | 5.2 | 5.6 |
| 406.7625 | 22.3 | 4.7 | 6.4 | 6.9 |
| 406.7875 | 24.9 | 2.1 | 8.6 | 9.1 |
| 406.8125 | 25.6 | 1.4 | 9.1 | 9.7 |
| 406.8375 | 26.0 | 1.0 | 9.5 | 10.1 |
| 406.8625 | 26.1 | .9 | 9.6 | 10.1 |
| 406.8875 | 25.5 | 1.5 | 9.1 | 9.6 |
| 406.9125 | 28.1 | -1.1 | 11.4 | 12.0 |

| | | | | |
|---|---|---|---|---|
| 406.3125 | 10.5 | 16.5 | .9 | 1.0 |
| 406.3375 | 4.0 | 23.0 | .2 | .2 |
| 406.3625 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.3875 | 25.4 | 1.6 | 9.0 | 9.5 |
| 406.4125 | 17.0 | 10.0 | 3.0 | 3.3 |
| 406.4375 | 16.7 | 10.3 | 2.9 | 3.2 |
| 406.4625 | 25.3 | 1.7 | 8.9 | 9.4 |
| 406.4875 | 25.2 | 1.8 | 8.8 | 9.4 |
| 406.5125 | 17.1 | 9.9 | 3.1 | 3.4 |
| 406.5375 | 20.9 | 6.1 | 5.3 | 5.8 |
| 406.5625 | 21.1 | 5.9 | 5.5 | 5.9 |
| 406.5875 | 19.2 | 7.8 | 4.2 | 4.6 |
| 406.6125 | 18.3 | 8.7 | 3.7 | 4.1 |
| 406.6375 | 18.3 | 8.7 | 3.7 | 4.0 |
| 406.6625 | 15.5 | 11.5 | 2.3 | 2.6 |
| 406.6875 | 22.7 | 4.3 | 6.7 | 7.2 |
| 406.7125 | 20.4 | 6.6 | 5.0 | 5.4 |
| 406.7375 | 20.6 | 6.4 | 5.2 | 5.6 |
| 406.7625 | 22.3 | 4.7 | 6.4 | 6.9 |
| 406.7875 | 24.9 | 2.1 | 8.6 | 9.1 |
| 406.8125 | 25.6 | 1.4 | 9.1 | 9.7 |
| 406.8375 | 26.0 | 1.0 | 9.5 | 10.1 |
| 406.8625 | 26.1 | .9 | 9.6 | 10.1 |
| 406.8875 | 25.5 | 1.5 | 9.1 | 9.6 |
| 406.9125 | 28.1 | -1.1 | 11.4 | 12.0 |
| 406.9375 | 33.6 | -6.6 | 16.7 | 17.3 |
| 406.9625 | 29.1 | -2.1 | 12.3 | 12.9 |
| 406.9875 | 27.8 | -.8 | 11.2 | 11.7 |
| 407.0125 | 27.7 | -.7 | 11.0 | 11.6 |
| 407.0375 | 27.5 | -.5 | 10.8 | 11.4 |
| 407.0625 | 26.8 | .2 | 10.2 | 10.8 |
| 407.0875 | 26.1 | .9 | 9.6 | 10.1 |
| 407.1125 | 25.4 | 1.6 | 8.9 | 9.5 |
| 407.1375 | 24.9 | 2.1 | 8.5 | 9.0 |
| 407.1625 | 26.3 | .7 | 9.8 | 10.4 |
| 407.1875 | 26.5 | .5 | 10.0 | 10.5 |
| 407.2125 | 29.3 | -2.3 | 12.5 | 13.1 |
| 407.2375 | 34.4 | -7.4 | 17.5 | 18.1 |
| 407.2625 | 30.6 | -3.6 | 13.8 | 14.4 |
| 407.2875 | 29.4 | -2.4 | 12.7 | 13.2 |
| 407.3125 | 27.5 | -.5 | 10.8 | 11.4 |
| 407.3375 | 28.7 | -1.7 | 11.9 | 12.5 |
| 407.3625 | 28.8 | -1.8 | 12.1 | 12.6 |
| 407.3875 | 27.7 | -.7 | 11.0 | 11.6 |
| 407.4125 | 29.5 | -2.5 | 12.8 | 13.3 |
| 407.4375 | 30.6 | -3.6 | 13.7 | 14.3 |
| 407.4625 | 31.0 | -4.0 | 14.1 | 14.7 |
| 407.4875 | 29.4 | -2.4 | 12.6 | 13.2 |
| 407.5125 | 24.9 | 2.1 | 8.6 | 9.1 |
| 407.5375 | 27.5 | -.5 | 10.9 | 11.4 |
| 407.5625 | 34.0 | -7.0 | 17.1 | 17.7 |
| 407.5875 | 27.7 | -.7 | 11.0 | 11.6 |
| 407.6125 | 29.4 | -2.4 | 12.7 | 13.2 |
| 407.6375 | 29.5 | -2.5 | 12.7 | 13.3 |
| 407.6625 | 19.1 | 7.9 | 4.2 | 4.6 |
| 407.6875 | 17.8 | 9.2 | 3.4 | 3.8 |
| 407.7125 | 14.3 | 12.7 | 1.9 | 2.1 |
| 407.7375 | 15.7 | 11.3 | 2.4 | 2.7 |
| 407.7625 | 16.0 | 11.0 | 2.5 | 2.8 |

FIGURE 6-4 continued

FIGURE 6-4 continued

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

| FREQ.(MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG+15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,60,95,0,105 | | | | |
| 407.7625 | 16.0 | 11.0 | 2.5 | 2.8 |
| 407.7875 | 12.4 | 14.6 | 1.3 | 1.5 |
| 407.8125 | 16.2 | 10.8 | 2.6 | 2.9 |
| 407.8375 | 41.6 | -14.6 | 24.6 | 25.2 |
| 407.8625 | 41.6 | -14.6 | 24.6 | 25.2 |
| 407.8875 | 17.6 | 9.4 | 3.3 | 3.7 |
| 407.9125 | 23.6 | 3.4 | 7.4 | 8.0 |
| 407.9375 | 23.7 | 3.3 | 7.5 | 8.1 |
| 407.9625 | 24.0 | 3.0 | 7.8 | 8.3 |
| 407.9875 | 25.6 | 1.4 | 9.1 | 9.7 |
| 408.0125 | 28.2 | -1.2 | 11.5 | 12.1 |
| 408.0375 | 29.2 | -2.2 | 12.4 | 13.0 |
| 408.0625 | 27.1 | -.1 | 10.5 | 11.1 |
| 408.0875 | 24.4 | 2.6 | 8.1 | 8.6 |
| 408.1125 | 24.0 | 3.0 | 7.8 | 8.3 |
| 408.1375 | 23.2 | 3.8 | 7.1 | 7.6 |
| 408.1625 | 16.3 | 10.7 | 2.7 | 3.0 |
| 408.1875 | 15.7 | 11.3 | 2.4 | 2.7 |
| 408.2125 | 18.7 | 8.3 | 4.0 | 4.3 |
| 408.2375 | 23.2 | 3.8 | 7.1 | 7.6 |
| 408.2625 | 22.3 | 4.7 | 6.4 | 6.9 |
| 408.2875 | 20.1 | 6.9 | 4.8 | 5.2 |
| 408.3125 | 20.2 | 6.8 | 4.9 | 5.3 |
| 408.3375 | 21.1 | 5.9 | 5.5 | 6.0 |
| 408.3625 | 21.1 | 5.9 | 5.5 | 6.0 |
| 408.3875 | 15.2 | 11.8 | 2.2 | 2.5 |
| 408.4125 | 28.1 | -1.1 | 11.4 | 12.0 |
| 408.4375 | 28.0 | -1.0 | 11.3 | 11.9 |
| 408.4625 | 18.2 | 8.8 | 3.6 | 4.0 |
| 408.4875 | 18.1 | 8.9 | 3.6 | 3.9 |
| 408.5125 | 23.5 | 3.5 | 7.4 | 7.9 |
| 408.5375 | 29.5 | -2.5 | 12.7 | 13.3 |
| 408.5625 | 29.2 | -2.2 | 12.5 | 13.0 |
| 408.5875 | 23.0 | 4.0 | 7.0 | 7.5 |
| 408.6125 | 29.9 | -2.9 | 13.1 | 13.7 |
| 408.6375 | 29.7 | -2.7 | 13.0 | 13.5 |
| 408.6625 | 28.2 | -1.2 | 11.5 | 12.1 |

| | | | | |
|---|---|---|---|---|
| 408.5125 | 23.5 | 3.5 | 7.4 | 7.9 |
| 408.5375 | 29.5 | -2.5 | 12.7 | 13.3 |
| 408.5625 | 29.2 | -2.2 | 12.5 | 13.0 |
| 408.5875 | 23.0 | 4.0 | 7.0 | 7.5 |
| 408.6125 | 29.9 | -2.9 | 13.1 | 13.7 |
| 408.6375 | 29.7 | -2.7 | 13.0 | 13.5 |
| 408.6625 | 28.2 | -1.2 | 11.5 | 12.1 |
| 408.6875 | 28.3 | -1.3 | 11.6 | 12.2 |
| 408.7125 | 22.9 | 4.1 | 6.8 | 7.3 |
| 408.7375 | 27.5 | -.5 | 10.9 | 11.5 |
| 408.7625 | 27.9 | -.9 | 11.2 | 11.8 |
| 408.7875 | 25.3 | 1.7 | 8.9 | 9.4 |
| 408.8125 | 23.7 | 3.3 | 7.5 | 8.0 |
| 408.8375 | 23.8 | 3.2 | 7.6 | 8.2 |
| 408.8625 | 24.5 | 2.5 | 8.2 | 8.8 |

07>OF,INUHF,1

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

**FIGURE 6-4** continued

13,14,20,53,1,1,18,60,95,0,105

| | | | | |
|---|---|---|---|---|
| 408.8625 | 24.5 | 2.5 | 8.2 | 8.8 |
| 408.8875 | 25.3 | 1.7 | 8.9 | 9.5 |
| 408.9125 | 26.0 | 1.0 | 9.5 | 10.0 |
| 408.9375 | 27.0 | .0 | 10.4 | 10.9 |
| 408.9625 | 27.3 | -.3 | 10.7 | 11.3 |
| 408.9875 | 28.8 | -1.8 | 12.1 | 12.7 |
| 409.0125 | 28.9 | -1.9 | 12.1 | 12.7 |
| 409.0375 | 27.5 | -.5 | 10.9 | 11.5 |
| 409.0625 | 29.4 | -2.4 | 12.7 | 13.2 |
| 409.0875 | 30.4 | -3.4 | 13.6 | 14.2 |
| 409.1125 | 28.9 | -1.9 | 12.1 | 12.7 |
| 409.1375 | 26.2 | .8 | 9.7 | 10.3 |
| 409.1625 | 24.4 | 2.6 | 8.1 | 8.6 |
| 409.1875 | 22.5 | 4.5 | 6.6 | 7.1 |
| 409.2125 | 21.3 | 5.7 | 5.6 | 6.1 |
| 409.2375 | 20.3 | 6.7 | 4.9 | 5.4 |
| 409.2625 | 18.9 | 8.1 | 4.0 | 4.4 |

13,14,20,53,1,1,18,60,95,0,105

| | | | | |
|---|---|---|---|---|
| 408.8625 | 24.5 | 2.5 | 8.2 | 8.8 |
| 408.8875 | 25.3 | 1.7 | 8.9 | 9.5 |
| 408.9125 | 26.0 | 1.0 | 9.5 | 10.0 |
| 408.9375 | 27.0 | .0 | 10.4 | 10.9 |
| 408.9625 | 27.3 | -.3 | 10.7 | 11.3 |
| 408.9875 | 28.8 | -1.8 | 12.1 | 12.7 |
| 409.0125 | 28.9 | -1.9 | 12.1 | 12.7 |
| 409.0375 | 27.5 | -.5 | 10.9 | 11.5 |
| 409.0625 | 29.4 | -2.4 | 12.7 | 13.2 |
| 409.0875 | 30.4 | -3.4 | 13.6 | 14.2 |
| 409.1125 | 28.9 | -1.9 | 12.1 | 12.7 |
| 409.1375 | 26.2 | .8 | 9.7 | 10.3 |
| 409.1625 | 24.4 | 2.6 | 8.1 | 8.6 |
| 409.1875 | 22.5 | 4.5 | 6.6 | 7.1 |
| 409.2125 | 21.3 | 5.7 | 5.6 | 6.1 |
| 409.2375 | 20.3 | 6.7 | 4.9 | 5.4 |
| 409.2625 | 18.9 | 8.1 | 4.0 | 4.4 |
| 409.2875 | 21.2 | 5.8 | 5.6 | 6.0 |
| 409.3125 | 20.9 | 6.1 | 5.4 | 5.8 |
| 409.3375 | 21.4 | 5.6 | 5.7 | 6.2 |
| 409.3625 | 21.1 | 5.9 | 5.5 | 6.0 |
| 409.3875 | 15.7 | 11.3 | 2.4 | 2.7 |
| 409.4125 | 17.9 | 9.1 | 3.5 | 3.8 |
| 409.4375 | 17.1 | 9.9 | 3.0 | 3.4 |
| 409.4625 | 14.6 | 12.4 | 2.0 | 2.2 |
| 409.4875 | 9.5 | 17.5 | .7 | .8 |
| 409.5125 | 16.0 | 11.0 | 2.5 | 2.8 |
| 409.5375 | 20.2 | 6.8 | 4.9 | 5.3 |
| 409.5625 | 18.7 | 8.3 | 4.0 | 4.3 |
| 409.5875 | 14.0 | 13.0 | 1.8 | 2.0 |
| 409.6125 | 27.1 | -.1 | 10.5 | 11.1 |
| 409.6375 | 28.3 | -1.3 | 11.6 | 12.2 |
| 409.6625 | 23.7 | 3.3 | 7.5 | 8.0 |
| 409.6875 | 21.9 | 5.1 | 6.1 | 6.6 |
| 409.7125 | 21.2 | 5.8 | 5.6 | 6.0 |
| 409.7375 | 23.4 | 3.6 | 7.3 | 7.8 |
| 409.7625 | 24.2 | 2.8 | 8.0 | 8.5 |
| 409.7875 | 21.7 | 5.3 | 6.0 | 6.4 |
| 409.8125 | 24.6 | 2.4 | 8.2 | 8.8 |
| 409.8375 | 25.7 | 1.3 | 9.3 | 9.8 |
| 409.8625 | 24.7 | 2.3 | 8.3 | 8.9 |
| 409.8875 | 25.0 | 2.0 | 8.6 | 9.1 |
| 409.9125 | 25.9 | 1.1 | 9.4 | 9.9 |
| 409.9375 | 26.2 | .8 | 9.7 | 10.2 |
| 409.9625 | 26.2 | .8 | 9.7 | 10.2 |
| 409.9875 | 27.4 | -.4 | 10.7 | 11.3 |

66 25.0

FIGURE 6-4 continued

## MOBILE-SATELLITE SYSTEM

| | |
|---|---|
| GROUND TRANSMIT EIRP | 27 dBW |
| EMISSION BANDWIDTH | 20 KHz |
| OVERALL $C/N_o$ | 53 dB-Hz |
| SATELLITE ANTENNA BEAMWIDTH | $17^o$ |
| SATELLITE COORDINATES | |
| 1) LATITUDE | $0^o$ |
| 2) LONGITUDE | $105^o$ |
| BEAM POINTING COORDINATES | |
| 1) LATITUDE | $60^o$ |
| 2) LONGITUDE | $95^o$ |
| SATELLITE ORBIT RADIUS | ∿42,166 Km |

## FIXED AND MOBILE SYSTEM

U.S. Catalogue of transmitters in 406.1-410 MHz band, omitting high power (command destruct) transmissions at 406.5 and 409.0 MHz

Removal of strong wideband emissions at 407.0, 408.0 and 409.0 MHz

15% annual growth rate for one year

FIGURE 6-5

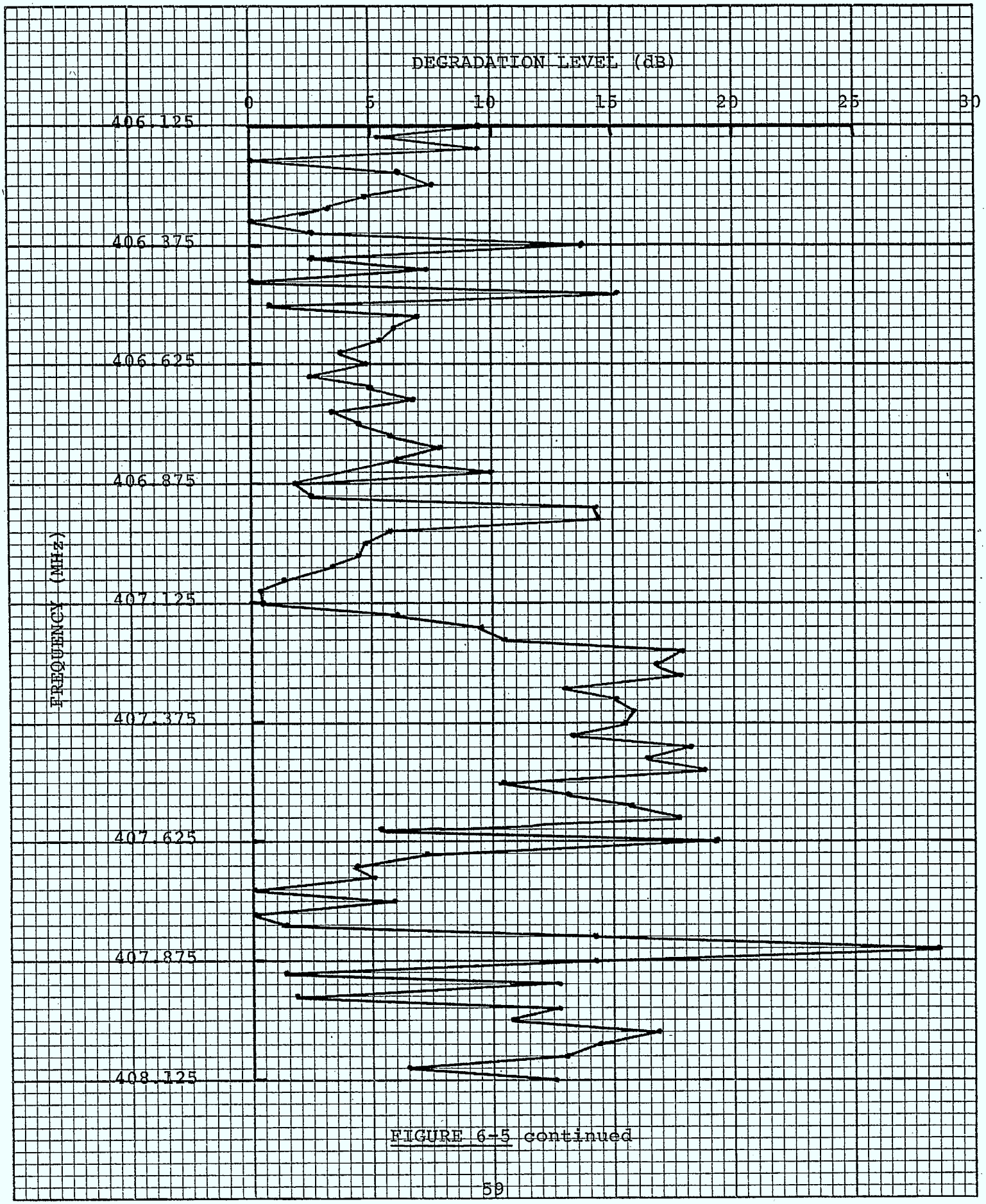


FIGURE 6-5 continued

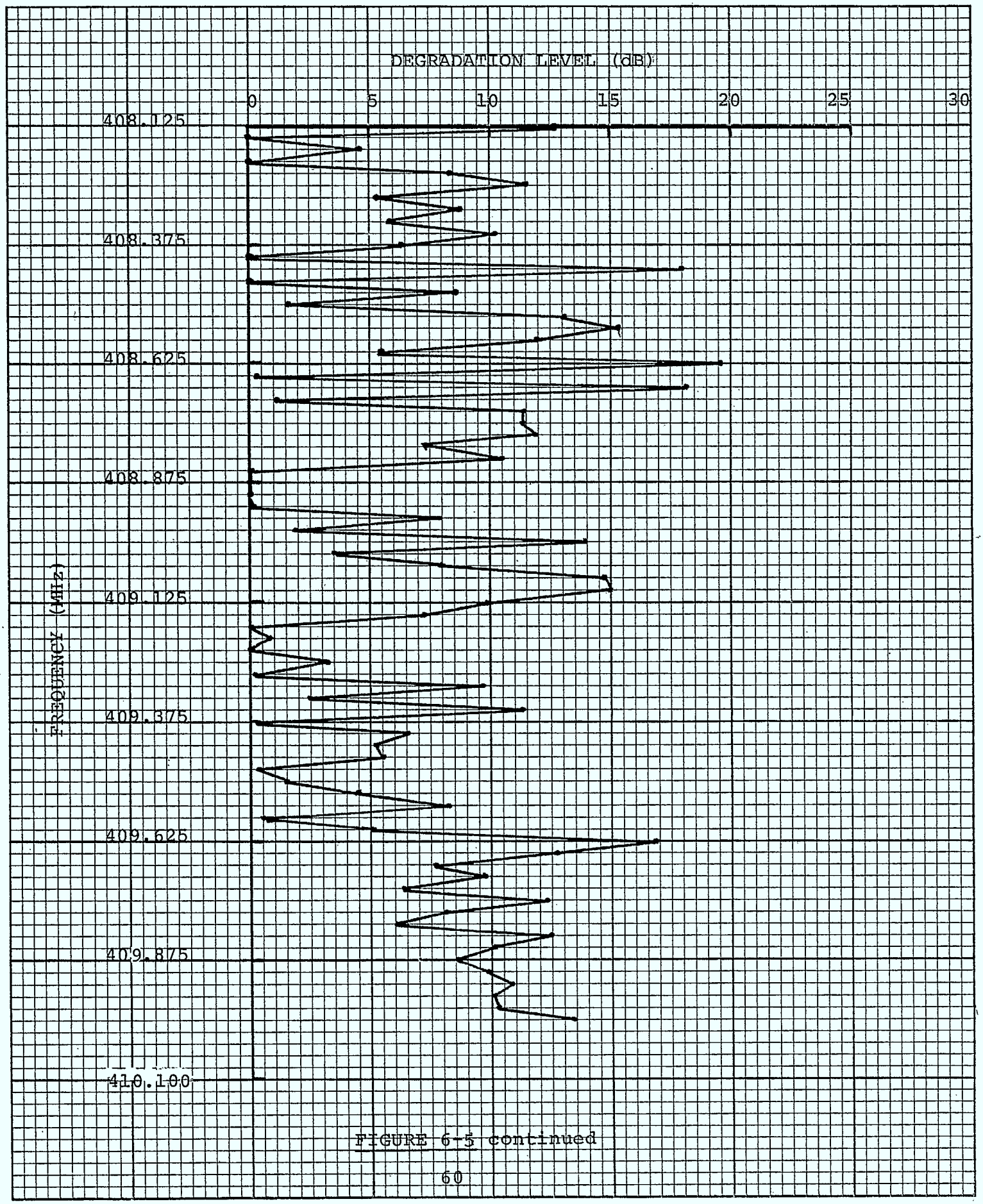


FIGURE 6-5 continued

FIGURE 6-5 continued

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R
07>URU,INUHF,7,7
                    INTERFERENCE  PROGRAM


INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

     GROUND TRANSMIT POWER,DBW
     GROUND ANTENNA GAIN
     EMMISION BANDWIDTH,HZ
     OVERALL SYSTEM C/NO,DB-HZ
     PROGRAM RUN TYPE
        1 - DISC FILE INPUT
        2 - TERMINAL INPUT
     SATELLITE PATTERN TYPE
        1 - MUSAT
        2 - MULTIBEAM
     FREQUENCY SEPERATION LIMIT
     BEAM POINTING COORDINATES,LAT,LONG DEGREES
     SATELLITE COORDINATES,LAT,LONG  DEGREES
```

| FREQ(MHz) | EIRP (dB) | C/I (dB) | DEG. (db) | DEG. +15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,60,95,0,105 | | | | |
| 406.1250 | 25.4 | 1.6 | 8.9 | 9.5 |
| 406.1500 | 20.1 | 6.9 | 4.8 | 5.3 |
| 406.1750 | 30.8 | -3.8 | 13.9 | 14.5 |
| 406.2000 | -22.1 | 49.1 | .0 | .0 |
| 406.2250 | 21.4 | 5.6 | 5.7 | 6.2 |
| 406.2500 | 23.2 | 3.8 | 7.1 | 7.6 |
| 406.2750 | 19.5 | 7.5 | 4.4 | 4.8 |
| 406.3000 | 16.8 | 10.2 | 2.9 | 3.2 |
| 406.3250 | -34.2 | 61.2 | .0 | .0 |
| 406.3500 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.3750 | 30.1 | -3.1 | 13.3 | 13.9 |
| 406.4000 | 15.6 | 11.4 | 2.4 | 2.6 |
| 406.4250 | 23.0 | 4.0 | 6.9 | 7.4 |
| 406.4500 | -4.6 | 31.6 | .0 | .0 |
| 406.4750 | 31.5 | -4.5 | 14.6 | 15.2 |
| 406.5000 | 9.4 | 17.6 | .7 | .8 |
| 406.5250 | 22.[illegible] | 4.6 | 6.5 | 7.0 |
| 406.5500 | 21.1 | 5.9 | 5.5 | 6.0 |
| 406.5750 | 20.3 | 6.7 | 5.0 | 5.4 |
| 406.6000 | 17.9 | 9.1 | 3.5 | 3.8 |
| 406.6250 | 19.6 | 7.4 | 4.5 | 4.9 |
| 406.6500 | 15.4 | 11.6 | 2.3 | 2.5 |
| 406.6750 | 19.8 | 7.2 | 4.6 | 5.0 |
| 406.7000 | 22.2 | 4.8 | 6.4 | 6.8 |
| 406.7250 | 17.1 | 9.9 | 3.1 | 3.4 |
| 406.7500 | 19.0 | 8.0 | 4.1 | 4.5 |
| 406.7750 | 21.1 | 5.9 | 5.5 | 5.9 |
| 406.8000 | 23.5 | 3.5 | 7.4 | 7.9 |
| 406.8250 | 21.3 | 5.7 | 5.6 | 6.1 |
| 406.8500 | 26.0 | 1.0 | 9.5 | 10.0 |
| 406.8750 | 13.6 | 13.4 | 1.6 | 1.8 |
| 406.9000 | 15.2 | 11.8 | 2.2 | 2.5 |
| 406.9250 | 30.5 | -3.5 | 13.7 | 14.3 |
| 406.9500 | 30.7 | -3.7 | 13.8 | 14.4 |
| 406.9750 | 20.7 | 6.3 | 5.3 | 5.7 |
| 407.0000 | 19.4 | 7.6 | 4.4 | 4.8 |
| 407.0250 | 19.0 | 8.0 | 4.1 | 4.5 |

| | | | | |
|---|---|---|---|---|
| 406.0250 | 21.3 | 5.7 | 5.6 | 6.1 |
| 406.0500 | 26.0 | 1.0 | 9.5 | 10.0 |
| 406.0750 | 13.6 | 13.4 | 1.6 | 1.8 |
| 406.9000 | 15.2 | 11.8 | 2.2 | 2.5 |
| 406.9250 | 30.5 | -3.5 | 13.7 | 14.3 |
| 406.9500 | 30.7 | -3.7 | 13.8 | 14.4 |
| 406.9750 | 20.7 | 6.3 | 5.3 | 5.7 |
| 407.0000 | 19.4 | 7.6 | 4.4 | 4.8 |
| 407.0250 | 19.0 | 8.0 | 4.1 | 4.5 |
| 407.0500 | 17.1 | 9.9 | 3.1 | 3.4 |
| 407.0750 | 11.9 | 15.1 | 1.2 | 1.3 |
| 407.1000 | 4.5 | 22.5 | .2 | .3 |
| 407.1250 | -7.6 | 19.4 | .5 | .5 |
| 407.1500 | 21.2 | 5.8 | 5.6 | 6.1 |
| 407.1750 | 25.6 | 1.4 | 9.1 | 9.6 |
| 407.2000 | 26.6 | .4 | 10.0 | 10.5 |
| 407.2250 | 34.2 | -7.2 | 17.3 | 17.9 |
| 407.2500 | 33.1 | -6.1 | 16.2 | 16.8 |
| 407.2750 | 34.2 | -7.2 | 17.2 | 17.8 |
| 407.3000 | 29.2 | -2.2 | 12.4 | 13.0 |
| 407.3250 | 31.4 | -4.4 | 14.5 | 15.1 |
| 407.3500 | 32.1 | -5.1 | 15.2 | 15.8 |
| 407.3750 | 31.8 | -4.8 | 14.9 | 15.5 |
| 407.4000 | 29.6 | -2.6 | 12.8 | 13.4 |
| 407.4250 | 34.6 | -7.6 | 17.6 | 18.2 |
| 407.4500 | 32.8 | -5.8 | 15.9 | 16.5 |
| 407.4750 | 35.1 | -8.1 | 18.2 | 18.8 |
| 407.5000 | 26.3 | .7 | 9.8 | 10.4 |
| 407.5250 | 29.3 | -2.3 | 12.6 | 13.1 |
| 407.5500 | 32.0 | -5.0 | 15.1 | 15.7 |
| 407.5750 | 34.0 | -7.0 | 17.1 | 17.7 |
| 407.6000 | 20.2 | 6.8 | 4.9 | 5.3 |
| 407.6250 | 35.6 | -8.6 | 18.6 | 19.2 |
| 407.6500 | 22.9 | 4.1 | 6.8 | 7.3 |
| 407.6750 | 18.8 | 8.2 | 4.0 | 4.4 |
| 407.7000 | 19.8 | 7.2 | 4.7 | 5.1 |
| 407.7250 | -27.4 | 54.4 | .0 | .0 |
| 407.7500 | 21.0 | 6.0 | 5.5 | 5.9 |
| 407.7750 | -29.5 | 56.5 | .0 | .0 |

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>>OF.INUHF.1

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```

```
RU.INUHF.7.7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

    GROUND TRANSMIT POWER.DBW
    GROUND ANTENNA GAIN
    EMMISION BANDWIDTH.HZ
    OVERALL SYSTEM C/NO.DB-HZ
    PROGRAM RUN TYPE
       1   DISC FILE INPUT
       2   TERMINAL INPUT
    SATELLITE PATTERN TYPE
```

FIGURE 6-5 continued

FIGURE 6-5 continued

RU,INUHF,7,7

INTERFERENCE PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS

GROUND TRANSMIT POWER,DBW
GROUND ANTENNA GAIN
EMMISION BANDWIDTH,HZ
OVERALL SYSTEM C/NO,DB-HZ
PROGRAM RUN TYPE
1 - DISC FILE INPUT
2 - TERMINAL INPUT
SATELLITE PATTERN TYPE
1 - MUSAT
2 - MULTIBEAM
FREQUENCY SEPERATION LIMIT
BEAM POINTING COORDINATES,LAT,LONG DEGREES
SATELLITE COORDINATES,LAT,LONG DEGREES

13,14,20,53,1,1,18,60,95,0,105

| FREQ(MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 407.7500 | 21.0 | 6.0 | 5.5 | 5.9 |
| 407.7750 | -29.5 | 56.5 | .0 | .0 |
| 407.8000 | 12.2 | 14.8 | 1.2 | 1.4 |
| 407.8250 | 30.5 | -3.5 | 13.7 | 14.2 |
| 407.8500 | 44.9 | -17.9 | 27.9 | 28.5 |
| 407.8750 | 30.4 | -3.4 | 13.6 | 14.2 |
| 407.9000 | 12.2 | 14.8 | 1.2 | 1.4 |
| 407.9250 | 28.9 | -1.9 | 12.1 | 12.7 |
| 407.9500 | 13.4 | 13.6 | 1.6 | 1.8 |
| 407.9750 | 28.8 | -1.8 | 12.1 | 12.7 |
| 408.0000 | 26.8 | .2 | 10.3 | 10.8 |
| 408.0250 | 33.2 | -6.2 | 16.3 | 16.9 |
| 408.0500 | 30.6 | -3.6 | 13.8 | 14.4 |
| 408.0750 | 29.2 | -2.2 | 12.5 | 13.0 |
| 408.1000 | 21.8 | 5.2 | 6.0 | 6.5 |
| 408.1250 | 28.8 | -1.8 | 12.1 | 12.6 |
| 408.1500 | -3.6 | 30.6 | .0 | .0 |
| 408.1750 | 19.2 | 7.8 | 4.2 | 4.6 |
| 408.2000 | -25.5 | 52.5 | .0 | .0 |
| 408.2250 | 24.1 | 2.9 | 7.9 | 8.4 |
| 408.2500 | 27.6 | -.6 | 10.9 | 11.5 |
| 408.2750 | 20.1 | 6.9 | 4.8 | 5.2 |
| 408.3000 | 24.6 | 2.4 | 8.3 | 8.8 |
| 408.3250 | 21.0 | 6.0 | 5.5 | 5.9 |
| 408.3500 | 26.1 | .9 | 9.6 | 10.2 |
| 408.3750 | 21.5 | 5.5 | 5.8 | 6.3 |
| 408.4000 | -16.3 | 43.3 | .0 | .0 |
| 408.4250 | 34.3 | -7.3 | 17.4 | 18.0 |
| 408.4500 | -16.2 | 43.2 | .0 | .0 |
| 408.4750 | 24.4 | 2.6 | 8.1 | 8.6 |
| 408.5000 | 12.9 | 14.1 | 1.4 | 1.6 |
| 408.5250 | 29.3 | -2.3 | 12.5 | 13.1 |
| 408.5500 | 31.6 | -4.6 | 14.7 | 15.3 |
| 408.5750 | 28.1 | -1.1 | 11.4 | 12.0 |
| 408.6000 | 20.4 | 6.6 | 5.0 | 5.5 |
| 408.6250 | 36.0 | -9.0 | 19.0 | 19.6 |
| 408.6500 | .2 | 24.8 | .1 | .2 |

| | | | | |
|---|---|---|---|---|
| 408.6000 | 20.4 | 6.6 | 5.0 | 5.5 |
| 408.6250 | 36.0 | -9.0 | 19.0 | 19.6 |
| 408.6500 | 2.2 | 24.8 | .1 | .2 |
| 408.6750 | 34.4 | -7.4 | 17.5 | 18.1 |
| 408.7000 | 11.0 | 16.0 | 1.0 | 1.1 |
| 408.7250 | 27.5 | -.5 | 10.8 | 11.4 |
| 408.7500 | 27.3 | -.3 | 10.7 | 11.3 |
| 408.7750 | 27.9 | -.9 | 11.2 | 11.8 |
| 408.8000 | 22.9 | 4.1 | 6.8 | 7.3 |
| 408.8250 | 26.5 | .5 | 10.0 | 10.5 |
| 408.8500 | -42.6 | 69.6 | .0 | .0 |
| 408.875 | *** NO INTERFERENCE *** | | | |
| 408.9000 | -33.9 | 60.9 | .0 | .0 |
| 408.9250 | 2.0 | 25.0 | .1 | .2 |
| 408.9500 | 23.6 | 3.4 | 7.4 | 7.9 |
| 408.9750 | 13.8 | 13.2 | 1.7 | 1.9 |
| 409.0000 | 30.1 | -3.1 | 13.3 | 13.9 |
| 409.0250 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.0500 | 23.6 | 3.4 | 7.5 | 8.0 |

```
07>OF,INUHF,8

07>RU,INUHF,7,7
                    INTERFERENCE  PROGRAM

INPUT THE FOLLOWING SATELLITE SYSTEM PARAMETERS
```

FIGURE 6-5 continued

```
    GROUND TRANSMIT POWER,DBW
    GROUND ANTENNA GAIN
    EMMISION BANDWIDTH,HZ
    OVERALL SYSTEM C/NO,DB-HZ
    PROGRAM RUN TYPE
       1 - DISC FILE INPUT
       2 - TERMINAL INPUT
    SATELLITE PATTERN TYPE
       1 - MUSAT
       2 - MULTIBEAM
    FREQUENCY SEPERATION LIMIT
    MEAN POINTING COORDINATES,LAT,LONG DEGRCES
    SATELLITE COORDINATES,LAT,LONG  DEGRCES
```

| FREQ. (MHz) | EIRP (dBW) | C/I (dB) | DEG. (dB) | DEG.+15% (dB) |
|---|---|---|---|---|
| 13,14,20,53,1,1,18,60,95,0,105 | | | | |
| 408.875 | *** NO INTERFERENCE *** | | | |
| 408.9000 | -33.9 | 60.9 | .0 | .0 |
| 408.9250 | 2.0 | 25.0 | .1 | .2 |
| 408.9500 | 23.6 | 3.4 | 7.4 | 7.9 |
| 408.9750 | 13.8 | 13.2 | 1.7 | 1.9 |
| 409.0000 | 30.1 | -3.1 | 13.3 | 13.9 |
| 409.0250 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.0500 | 23.6 | 3.4 | 7.5 | 8.0 |
| 409.0750 | 30.9 | -3.9 | 14.1 | 14.7 |
| 409.1000 | 31.3 | -4.3 | 14.4 | 15.0 |
| 409.1250 | 25.8 | 1.2 | 9.3 | 9.9 |
| 409.1500 | 22.7 | 4.3 | 6.8 | 7.2 |
| 409.1750 | -6.5 | 33.5 | .0 | .0 |
| 409.2000 | 9.5 | 17.5 | .7 | .8 |
| 409.2250 | -3.7 | 30.7 | .0 | .0 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | |
|---|---|---|---|---|
| 408.075 | *** NO INTERFERENCE *** | | | |
| 408.9000 | -33.9 | 60.9 | .0 | .0 |
| 408.9250 | 2.0 | 25.0 | .1 | .2 |
| 408.9500 | 23.6 | 3.4 | 7.4 | 7.9 |
| 408.9750 | 13.8 | 13.2 | 1.7 | 1.9 |
| 409.0000 | 30.1 | -3.1 | 13.3 | 13.9 |
| 409.0250 | 17.4 | 9.6 | 3.2 | 3.5 |
| 409.0500 | 23.6 | 3.4 | 7.5 | 8.0 |
| 409.0750 | 30.9 | -3.9 | 14.1 | 14.7 |
| 409.1000 | 31.3 | -4.3 | 14.4 | 15.0 |
| 409.1250 | 25.8 | 1.2 | 9.3 | 9.9 |
| 409.1500 | 22.7 | 4.3 | 6.8 | 7.2 |
| 409.1750 | -6.5 | 33.5 | .0 | .0 |
| 409.2000 | 9.5 | 17.5 | .7 | .8 |
| 409.2250 | -3.7 | 30.7 | .0 | .0 |
| 409.2500 | 16.7 | 10.3 | 2.8 | 3.2 |
| 409.2750 | -1.9 | 28.9 | .1 | .1 |
| 409.3000 | 25.7 | 1.3 | 9.2 | 9.7 |
| 409.3250 | 15.3 | 11.7 | 2.2 | 2.5 |
| 409.3500 | 27.3 | -.3 | 10.7 | 11.3 |
| 409.3750 | -1.0 | 28.0 | .1 | .1 |
| 409.4000 | 22.0 | 5.0 | 6.2 | 6.6 |
| 409.4250 | 20.0 | 7.0 | 4.8 | 5.2 |
| 409.4500 | 20.6 | 6.4 | 5.2 | 5.6 |
| 409.4750 | 5.2 | 21.8 | .3 | .3 |
| 409.5000 | 12.7 | 14.3 | 1.4 | 1.5 |
| 409.5250 | 19.0 | 8.0 | 4.1 | 4.5 |
| 409.5500 | 23.9 | 3.1 | 7.7 | 8.2 |
| 409.5750 | 7.6 | 19.4 | .5 | .5 |
| 409.6000 | 19.9 | 7.1 | 4.7 | 5.1 |
| 409.6250 | 33.2 | -6.2 | 16.3 | 16.9 |
| 409.6500 | 28.8 | -1.8 | 12.1 | 12.7 |
| 409.6750 | 23.3 | 3.7 | 7.2 | 7.7 |
| 409.7000 | 25.7 | 1.3 | 9.2 | 9.8 |
| 409.7250 | 21.6 | 5.4 | 5.9 | 6.4 |
| 409.7500 | 28.4 | -1.4 | 11.7 | 12.3 |
| 409.7750 | 23.7 | 3.3 | 7.5 | 8.1 |
| 409.8000 | 21.3 | 5.7 | 5.7 | 6.1 |
| 409.8250 | 28.7 | -1.7 | 11.9 | 12.5 |
| 409.8500 | 26.1 | .9 | 9.6 | 10.1 |
| 409.8750 | 24.4 | 2.6 | 8.1 | 8.6 |
| 409.9000 | 25.8 | 1.2 | 9.4 | 9.9 |
| 409.9250 | 26.8 | .2 | 10.2 | 10.8 |
| 409.9500 | 26.1 | .9 | 9.6 | 10.1 |
| 409.9750 | 26.3 | .7 | 9.8 | 10.3 |

45 25.0

FIGURE 6-5 continued

| FREQ. (MHz) | AVERAGE POWER/ 20 KHz (dBW) | AVERAGE ANTENNA GAIN (dB) | AVERAGE DIRECTION | NUMBER OF INTERFERERS |
|---|---|---|---|---|
| 406.200 | NO F-A | | | |
| 406.275 | 14.8 (USP) | 4.0 | N.D. | 2 |
| 406.300 | 17.0 (NTS) | 0.0 | N.D. | 1 |
| 406.325 | NO F-A | | | |
| 406.350 | NO F-A | | | |
| 406.400 | NO F-A | | | |
| 406.450 | NO F-A | | | |
| 406.500 | -1.6 (NTS) | 0.0 | N.D. | 1 |
| 406.600 | 3.8 | 5.0 | N.D. | 1 |
| 406.625 | 13.6 | 9.5 | N.D. | 4 |
| 406.650 | NO F-A | | | |
| 406.675 | NO F-A | | | |
| 406.725 | 4.8 | 16.0 | 106° | 3 |
| 407.675 | 17.4 (USP) | 0.0 | N.D. | 1 |
| 407.725 | NO F-A | | | |
| 407.775 | No F-A | | | |
| 407.800 | 10 (USP) | 0.0 | N.D. | 1 |
| 407.900 | 10 (USP) | 0.0 | N.D. | 1 |
| 407.950 | NO F-A | | | |
| 408.150 | NO F-A | | | |
| 408.200 | NO F-A | | | |
| 408.400 | NO F-A | | | |
| 408.450 | NO F-A | | | |
| 408.500 | 0.0 (USP) | 0.0 | N.D. | 1 |

CONTINUED ON NEXT PAGE

FIGURE 6-6

| FREQ. (MHz) | AVERAGE POWER/ 20 KHz (dBW) | AVERAGE ANTENNA GAIN (dB) | AVERAGE DIRECTION | NUMBER OF INTERFERERS |
|---|---|---|---|---|
| 408.650 | NO F-A | | | |
| 408.700 | NO F-A | | | |
| 409.275 | NO F-A | | | |
| 409.325 | 15.4 (USA) | 0.0 | N.D. | 1 |
| 409.375 | NO F-A | | | |
| 409.475 | NO F-A | | | |
| 409.500 | NO F-A | | | |
| 409.575 | NO F-A | | | |

NO F-A = NO FREQUENCY ASSIGNMENT
N.D. = NON-DIRECTIONAL
USA = U.S. ATLANTIC
USP = U.S. PACIFIC

FREQUENCIES WITH 5.0 dB OR LESS DEGRADATION

FIGURE 6-6

## 4.3.9 Channeling Plan for Assignments in the Band 406.1 - 410 MHz

This plan designates the frequencies in the band 406.1 - 410 MHz available for assignments a) with a bandwidth of emission that can be contained wholly within 25 kHz (narrowband channels), b) with a bandwidth of emission that can be contained wholly within 12.5 kHz (splinter channels), and c) those with other than F3 emission that cannot be contained wholly within 25 kHz (wideband channels).

Wide band 406.875 - 407.125 MHz

| | | | | | | |
|---|---|---|---|---|---|---|
| 406.125 | ● 406.675 | 407.225 | ● 407.775 | 408.325 | 408.875 | 409.425 |
| 406.150 | 406.700 | 407.250 | ● 407.800 | 408.350 | 408.900 | 409.450 |
| 406.175 | ● 406.725 | 407.275 | 407.825 | 408.375 | 408.925 | ● 409.475 |
| ● 406.200 | 406.750 | 407.300 | 407.850 | ● 408.400 | 408.950 | ● 409.500 |
| 406.225 | 406.775 | 407.325 | 407.875 | 408.425 | 408.975 | 409.525 |
| 406.250 | 406.800 | 407.350 | ● 407.900 | ● 408.450 | 409.000 | 409.550 |
| ● 406.275 | 406.825 | 407.375 | 407.925 | 408.475 | 409.025 | ● 409.575 |
| ● 406.300 | 406.850 | 407.400 | ● 407.950 | ● 408.500 | 409.050 | 409.600 |
| ● 406.325 | 406.875 | 407.425 | 407.975 | 408.525 | 409.075 | 409.625 |
| ● 406.350 | 406.900 | 407.450 | 408.000 | 408.550 | 409.100 | 409.650 |
| 406.375 | 406.925 | 407.475 | 408.025 | 408.575 | 409.125 | 409.675 |
| ● 406.400 | 406.950 | 407.500 | 408.050 | 408.600 | 409.150 | 409.700 |
| 406.425 | 406.975 | 407.525 | 408.075 | 408.625 | 409.175 | 409.725 |
| ● 406.450 | 407.000 | 407.550 | 408.100 | ● 408.650 | 409.200 | 409.750 |
| 406.475 | 407.025 | 407.575 | 408.125 | 408.675 | 409.225 | 409.775 |
| ● 406.500 | 407.050 | 407.600 | ● 408.150 | ● 408.700 | 409.250 | 409.800 |
| 406.525 | 407.075 | 407.625 | 408.175 | 408.725 | ● 409.275 | 409.825 |
| 406.550 | 407.100 | 407.650 | ● 408.200 | 408.750 | 409.300 | 409.850 |
| 406.575 | 407.125 | ● 407.675 | 408.225 | 408.775 | ● 409.325 | 409.875 |
| ● 406.600 | 407.150 | 407.700 | 408.250 | 408.800 | 409.350 | 409.900 |
| ● 406.625 | 407.175 | ● 407.725 | 408.275 | 408.825 | ● 409.375 | 409.925 |
| ● 406.650 | 407.200 | 407.750 | 408.300 | 408.850 | 409.400 | 409.950 |
| | | | | | | 409.975 |

## 4.3.10 Channeling Plan for Splinter Channel Assignments in the Band 406.1 - 410 MHz

[ ] unused

● ≤ 5.0 dB degradation

The frequencies designated for splinter channel use in Section 4.3.9 are available for assignment to all Government agencies in accordance with allocation footnote G5 and as specified in this Section.

### Conditions for Use

1. Normally the assigned frequency shall be in the center of a half (12.5 kHz) or quarter (6.25 kHz) channel.
2. Any type of emission may be authorized.
3. The technical standards applicable to the use of splinter channels are in paragraph 4 of section 5.4.6.
4. Directional antennas shall be used where practicable on point-to-point circuits.
5. Prior to filling an application for a splinter channel, coordination shall be effected with any agency with adjacent channel assignments in the list of Frequency Assignments to Government Radio Stations.

FREQUENCIES WITH 5.0 dB OR LESS DEGRADATION

FIGURE 6-7

## 7.0 CONCLUSION

The results presented in this report indicate that access in North America to the 406.1 to 410 MHz band by the Mobile-satellite service is feasible for both single beam and multibeam satellite system configurations. The extent of access for the single beam system, however, is largely limited to frequencies with no assignments. From the analysis it is not apparent why there is an absence of assignments at these frequencies. Some of these frequencies may be unsuitable for use or some may be reserved. These possibilities must be examined when considering single beam system operation at these frequencies.

From the analysis based on one $2^{o}$ spot beam, a multibeam arrangement promises a considerable increase in potential frequency selection in the 406.1-410 MHz band, assuming the same uplink eirp as for a single beam system.

The analysis in this report has been based on selected Mobile-satellite system parameters as given in the specification system models. These parameter values are considered typical of possible mobile-satellite system designs. Methods to generalize this analysis, particularly with regard to the interference criteria, have been included in this report. Further analysis regarding the interference criteria, to include degrading effects on the quality of communications, must involve specific system configurations.

The conclusions reached are largely insensitive to expected variations of most mobile-satellite system parameters. The actual number of accessible frequencies may vary, but access is still considered feasible. These results however are dependent upon the Mobile and Fixed operations in the 406.1 to 410 MHz band. Knowledge of the proposed operations in this area is required to accurately forecast the spectrum environment in which a Mobile-satellite system may have to operate in the future.

## 8.0 REFERENCES


1) Taub and Schilling, "Principles of Communication Systems", P.134, 1971.

2) Sinclair Radio Laboratories, "Sinclair Base Station Antennas 108-512 MHz", 1975

3) "Multi-purpose UHF Satellite Communications System Feasibility Study", Department of Communications, Government of Canada, December 1974.

4) "U.S. Radio Catalogue 403-410 MHz", Office of Telecommunications Policy,Interdepartment Radio Advisory Committee, Washington, D.C. 20005, 11 November 1976.

5) Manual of Regulations and Procedures for Radio Frequency Management, DOC, January 1976.

## APPENDIX A

### 1.0 Interferer to Satellite Pointing Angle

The interferer transmitter antenna isolation is determined from a knowledge of the antenna pattern and the pointing angle from interferer to satellite relative to the antenna on-axis direction. The calculation proceeds in two steps, given the satellite geostationary slot position, interferer coordinates and transmission azimuth. The first step is the calculation of the satellite elevation angle at the interferer and the second involves the calculation of the bearing to the satellite from the interferer. From these two angles the net pointing angle can be obtained.

### 1.1 Pointing Angle in Elevation

Satellite slot position:

1) Latitude, $X = 0^{\circ}$
2) Longitude, $Y = 95^{\circ}$ to $115^{\circ}$
3) Orbit altitude $h = 35{,}788$ km

Interferer Coordinates:

1) Latitude, S
2) Longitude, T

so let

$$\Delta L_a = (S-X) \text{ degrees}$$

$$\Delta L_o = (T-Y) \text{ degrees}$$

Now from spherical trigonometry it is determined that the angle $\omega$ substended by the interfer and satellite, at the centre of the earth is given by

$$\omega = \cos^{-1}\left[\cos\Delta L_a \cos\left|\Delta L_o\right|\right]$$

The corresponding distance from interferer to satellite is given by

$$r = \sqrt{R^2 + (R+h)^2 - 2(R)(R+h)\cos\omega}$$

where R is the radius of the earth
~ 6378 km
h is the geostationary orbit altitude
~ 35,788 km

The satellite elevation angle, $\theta$, at the interferer can now be calculated using the following equations

$$\frac{\sin\omega}{r} = \frac{\sin\phi}{R}$$

so $\phi = \sin^{-1}\left[\frac{R}{r}\sin\omega\right]$

and thus $\theta = (90-\omega)-\phi$

The relationship of these variables is shown in Figure 1.

## 1.2 Pointing Angle in Azimuth

The pointing angle in azimuth from interfer to satellite is the difference angle between the bearing to the satellite sub-orbital point and the interfer antenna on-axis direction. The satellite bearing is determined as follows:

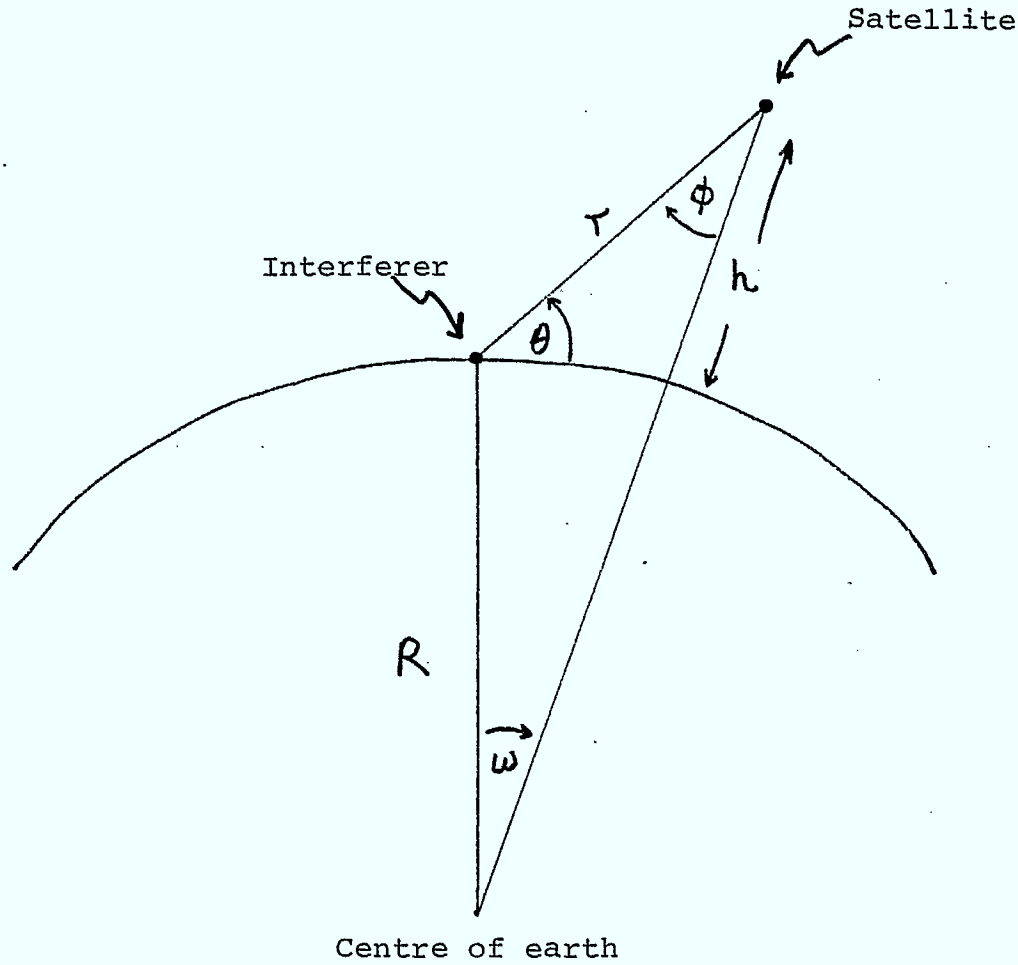
Let $C = R\omega$
$b = R\Delta L_a$
$a = R\Delta L_o$

From spherical trigonometry a right spherical triangle with sides a, b and C and angles $\gamma$ and $\Psi$, as shown in Figure 2 can be described by the following equation for $\gamma$

$$\gamma = \sin^{-1}\left[\frac{\sin a}{\sin C}\right]$$

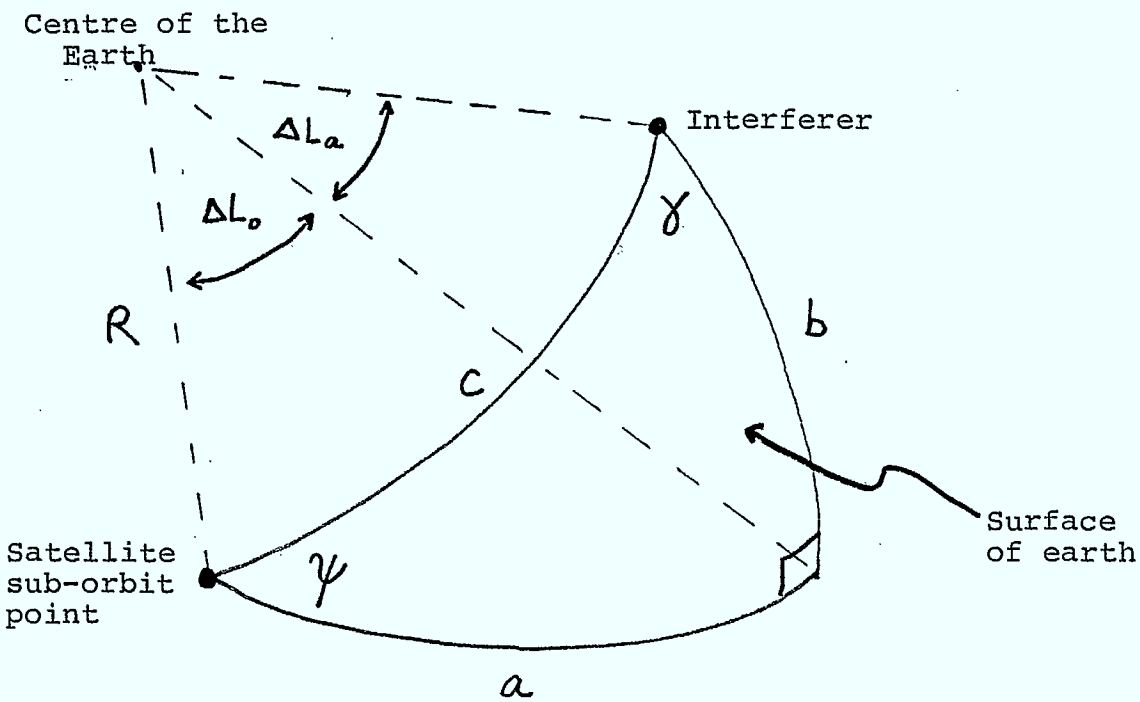
Now if $\Delta L_o$ is positive, the satellite bearing is

$180^o + \gamma$




POINTING ANGLE IN ELEVATION

FIGURE 1




POINTING ANGLE IN AZIMUTH

FIGURE 2

and if $\Delta L_o$ is negative, the satellite bearing is

$$180^o - \gamma$$

Given the interferer transmission azimuth A, the azimuth pointing angle $\lambda$ is thus

$$\lambda = \left| A - (180^o \pm \gamma) \right| \quad \text{degrees}$$

1.3 Net Pointing Angle

The net interferer to satellite pointing angle $\alpha$ is determined, using the following equation from sperical trigonometry

$$\alpha = \cos^{-1} \left[ \cos \theta \cos \lambda \right]$$

where $\theta$ Pointing angle in elevation

$\lambda$ Pointing angle in azimuth

$\alpha$ Net Pointing angle, degree

## APPENDIX B

### 1.0 Satellite to Interferer Pointing Angle ($\beta$)

The amount of discrimination to interferers provided by the satellite receive antenna is determined by the directivity of the satellite antenna and the difference angle between the satellite beam pointing direction and the direction to the interferer. This difference angle is computed using vectorial analysis. Given the interferer, beam pointing and satellite coordinates the corresponding Cartesian coordinates referenced to the centre of the earth are determined using the following transformation

$$X = R(\cos LAT)(\sin LONG)$$
$$Y = R(\cos LAT)(\cos LONG)$$
$$Z = R(\sin LAT)$$

where LAT Latitude
LONG Longitude
R Radial distance from centre of Earth

The vectors representing the satellite interferer and beam pointing locations in a Cartesian 3-D space are defined as follows

$$\overline{VS} = ix_1 + jy_1 + KZ_1$$
$$\overline{VI} = ix_2 + jy_2 + KZ_2$$
$$\overline{VB} = ix_3 + jy_3 + KZ_3$$

where
$\overline{VS}$ Satellite vector
$\overline{VI}$ Interferer vector
$\overline{VB}$ Beam pointing vector

The vectors representing the satellite beam pointing direction and the satellite to interferer pointing

direction are determined as follows

$$\overline{VSI} = \overline{VS} - \overline{VI}$$
$$= i(x_1-x_2) + j(y_1-y_2) + K(z_1-z_2)$$

$$\overline{VSB} = \overline{VS} - \overline{VB}$$
$$= i(x_1-x_3) + j(y_1-y_3) + K(z_1-z_3)$$

where $\overline{VSI}$ Satellite to interferer vector

$\overline{VSB}$ Satellite beam pointing direction vector

By using the Scalar product relation for two vectors, the difference angle $\beta$ between these two directions is given by

$$\beta = \cos^{-1}\left[\frac{\overline{VSI}\cdot\overline{VSB}}{|\overline{VSI}||\overline{VSB}|}\right]$$

and

$$\overline{VSI}\cdot\overline{VSB} = (x_1-x_2)(x_1-x_3) + (y_1-y_2)(y_1-y_3) + (z_1-z_2)(z_1-z_3)$$

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