NAVAL POSTGRADUATE SCHOOL
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THESIS

A Procedure for Accessing
Digital Satellites Containing Amateur Payloads

by

Stephanie L. O'Neal

September, 1994

Thesis Advisor: I. M. Ross

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The Space Systems Academic Group's (SSAG's) Amateur Radio Station User's Guide and an embedded user-friendly menu interaction system comprise the scope and purpose of this thesis. The User's Guide was developed in an effort to identify the best procedures to use when accessing amateur radio frequencies. Although the Amateur Radio Station is capable of voice and continuous wave (CW) communications, these areas are not addressed within the context of this manual. This manual is dedicated to the processes involved in accessing digital satellites containing amateur payloads.

Most of the information found in this user's manual was obtained from existing sources. This manual attempts to organize that information, and demonstrate how it applies specifically to the SSAG Amateur Radio Station.

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A Procedure for Accessing Digital Satellites Containing Amateur Payloads

by

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Submitted in partial fulfillment
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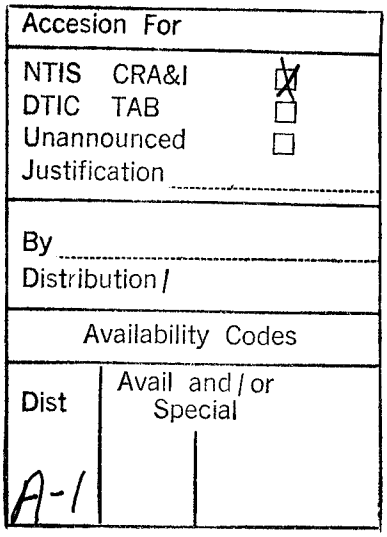
by



Stephanie O'Neal
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TABLE OF CONTENTS

The Amateur's Code

ONE

The Amateur is Considerate... He never knowingly uses the air in such a way as to lessen the pleasure of others.

TWO

The Amateur is Loyal... He offers his loyalty, encouragement and support to his fellow radio amateurs, his local club and to the American Radio Relay League, through which Amateur Radio is represented.

THREE

The Amateur is Progressive... He keeps his station abreast of science. It is well-built and efficient. His operating practice is beyond reproach.

FOUR

The Amateur is Friendly... Slow and patient sending when requested, friendly advice and counsel to the beginner, kindly assistance, cooperation and consideration for the interests of others; these are marks of the amateur spirit.

FIVE

The Amateur is Balanced... Radio is his hobby. He never allows it to interfere with any of the duties he owes to his home, his job, his school, or his community.

SIX

The Amateur is Patriotic... His knowledge and his station are always ready for the service of his country and his community.

- PAUL M. SEGAL
ex-W3EEA, W9EEA

Chapter 1

HAM STATION INTRODUCTION

1.0 Ham Station Description

The Naval Postgraduate School's Amateur Radio Station (ham station), is an educational tool originally developed to provide both the Engineers at the Space Systems Academic Group (SSAG) and students in the Space Systems Curricula as a means for future operation of the Petite Amateur Navy Satellite (PANSAT). PANSAT is the first operational satellite to be developed by the Naval Postgraduate School (NPS). PANSAT's mission will be to provide digital, store-and-forward communication utilizing direct sequence spread spectrum modulation via the amateur frequency radio band. As such, ground operation of PANSAT will be similar to operation of an amateur radio station. However, access to PANSAT will require ham operators to configure their systems with the capability of modulating and demodulating a spread spectrum multiple access (SSMA) signal.

The Ham Station is available to faculty, staff, and students who possess a valid United States of America amateur radio operator's license and are pursuing course work or thesis research. The Ham Station is a stand-alone unit. It is currently located in Bullard 106, but will eventually be moved to Bullard 124. Appendix A shows a schematic of the physical layout of the SSAG Spaces and the present location of the Ham Station.

1.1 Amateur Radio History

Every minute of every hour of every day, amateur radio operators, or hams, communicate with each other. Some hams communicate via signals reflected off the earth's ionosphere or relayed long distance from mountaintop radio repeaters. Still others bounce their signals off the moon! Other methods of communication range from international Morse code and voice, to accessing orbiting satellites that have digital

store-and-forward capabilities. Ham radio has logged a commendable record of technical achievement, as well as community and national service. In the case of national emergencies (including war) and natural disasters, the radio amateur has provided essential communications facilities. On occasion, a ham operator has been known to be the only link between disaster and the outside world.

Amateur radio began with Marconi, when in 1901, he transmitted the letter 'S' across the Atlantic Ocean. The miracle of "wireless" stimulated many researchers; subsequent electronic breakthroughs were rapid and numerous. The next phase of amateur radio came with the development of the relay method, which enabled communication with people beyond the range of individual equipment. An amateur, wishing to contact someone at a considerable distance, made contact with a second person within range of his equipment, and asked the intermediary to relay the message. An outgrowth of this common bond all radio amateurs shared - the relaying of radio messages - was the development and foundation of The American Radio Relay League (ARRL), the national body of radio amateurs in this country still in existence today.

Amateur radio communication has grown by leaps and bounds since the days of relaying messages, but the desire to maintain and operate experimental radio equipment continues. Today, a popular method of ham communication is via digital store and forward satellite systems. The Amateur Radio Satellite (AMSAT) Corporation, a non-profit, tax-exempt organization staffed solely by volunteers, is dedicated to keeping amateur radio in space.

AMSAT is responsible for the development and launching of many satellites now known as "PACSAT's." A PACSAT is a satellite capable of performing something akin to normal packet radio functions, much as a digipeater or packet bulletin board service (PBBS). The real advantage is that now this digipeater/PBBS is in space and moves continuously so its antenna pattern, or footprint, covers all the surface area of the earth several times daily. The Orbiting Satellites Carrying Amateur Radio (OSCARs) are just some of the AMSAT built and launched satellites available to hams for amateur communication. With the proper software package, any

satellite containing an amateur radio payload can be accessed by anyone with the proper amateur license.

1.2 The Licensing Process

The ham operator is a citizen who has been licensed by his or her government to operate his or her own experimental radio station, without profit, and in the public good. In order to qualify for this license privilege, an individual must demonstrate electronic knowledge and abide by rules governing acceptable frequency usage, quality and mode of radiation, and radiated power, to list a few. In the United States, the Federal Communications Commission (FCC) governs amateur radio operation. Part 97 of the FCC rules, the portion dealing specifically with amateur radio, describes five levels of amateur license. Each license has a more difficult examination, but also grants greater operating privileges. Table 1.1 briefly describes each license level and corresponding operating privileges.

There are several methods one might pursue to obtain an amateur license: personalized-instruction, self-study, or class attendance. If one chooses the personal-instruction method, the ARRL can help match an individual with a registered amateur instructor in your local area. Personal-instruction, as well as class sessions, are also available here at NPS through the Amateur Radio Club. If one chooses the self-study method, *Tune in the World With Ham Radio*, published by ARRL, is an excellent package that teaches everything one needs to know to pass the Novice examination. Whatever method you decide to choose, don't delay! The world of amateur communication is awaiting your QSL (receipt acknowledged).

Table 1.1
Licensing Levels and Privileges

CLASS	*CODE TEST*	*WRITTEN EXAMINATION*	*PRIVILEGES*
Novice	5 WPM (Element 1A)	Elementary theory and regulations (Element 2)	Telegraphy in 3700-3750, 7100-7150, and 21, 100-21, 200 KHz with 200 W PEP output maximum; telegraphy and TRRY on 28, 100-28, 300 KHz and telegraphy add SSB voice on 28, 200-28, 500 KHz with 200 W PEP max; all amateur modes authorized on 222.1-223.91 MHz, 25 W PEP max; all amateur modes authorized on 1270-1295 MHz, 5 W PEP max.
Technician	5 WPM (Element 1A)	Elementary theory and regulations; general-level theory and regulations. (Elements 2 and 3A)	All amateur privileges above 50.0 MHz plus Novice privileges.
General	13 WPM (Element 1B)	Elementary theory and regulations; general theory and regulations. (Element 2, 3A and 3B)	All amateur privileges except those reserved for Advanced and Amateur Extra class.
Advanced	13 WPM (Element 1B)	General theory and regulations, plus intermediate theory. (Elements 2, 3A, 3B and 4A)	All amateur privileges except those reserved for Amateur Extra class.
Amateur Extra	20 WPM (Element 1C)	General theory and regulations,	All amateur privileges.

1.3 Establishing An Account

Anyone wishing to use the Ham Station should obtain a "SSAG Ham Station User Account Request" form from the Network Manager. The form can also be found in a bin located near the Ham Station itself (Bullard 106). An account will be created upon ascertaining that the user possesses a valid amateur license. The burden of proof of licensing lies solely with the requestor. Upon receipt, an account will be created within three working days. Upon initial log-in, you should immediately change your password to one that is easily remembered. Password secrecy is paramount! An account log will be kept, and should your password become known by another user, you will be responsible for any illegal transmissions made via your account. A short, but true story may better illustrate this point.

> About one year ago, a student began making illegal transmissions from a transmitter he was constructing for a class project. Although the transmissions were innocently initiated, they were using an excessive amount of power and causing voice and packet interruptions area wide. The FCC, with the assistance of very irritated, licensed ham operators, was able to pinpoint the individual within an incredibly short timeframe. Although the student could have faced charges and been prosecuted, thanks to the assistance of the class instructor, the student was pardoned and given a verbal reprimand. Moral: A similar situation could happen to you - DON'T GIVE OUT YOUR PASSWORD!

1.4 Computer Disk Storage Policies

The Ham Station operates within an unclassified environment and all transmission and receptions should also be unclassified. Storage of your personal diskettes should be within your own working area and in accordance with SECNAVINST 5510 and OPNAVINST 5239 series publications.

1.5 Support Policies (Getting HELP)

The Ham Station Manager and other SSAG engineers are available to answer specific questions. However, the staff is small so users must employ a self-help philosophy. There are many sources of help available which should be utilized before a staff member is sought out. These include:

On-line help and documentation - The operating system and most related application programs provide excellent on-line help and documentation in order for you to find what you need with minimal effort.

Hard-copy manuals (including this one) - When the information needed is more obscure, or perhaps equipment specific, technical manuals and guides are located near the Ham Station to assist you. Appendix C provides a listing of all pertinent manuals.

Fellow students - Experience is the best help. It is most probable that a fellow student may have already encountered a similar problem and can provide you with the guidance you need.

Self research - Trail-n-Error type experimentation will make you much more productive and proficient at using the Ham Station. Should you encounter a problem which can only be attributed to a lack of direction provided in this user manual, please provide a written change request to the Ham Station Manager. With your help, this manual can become a truly functional document.

Chapter 2

HAM STATION PREPARATION

2.0 Ham Station Configuration

Figure 2.1 shows a schematic of the location and configuration of the equipment comprising the Ham Station. Unless otherwise posted, all pieces of equipment depicted should be present at all times.

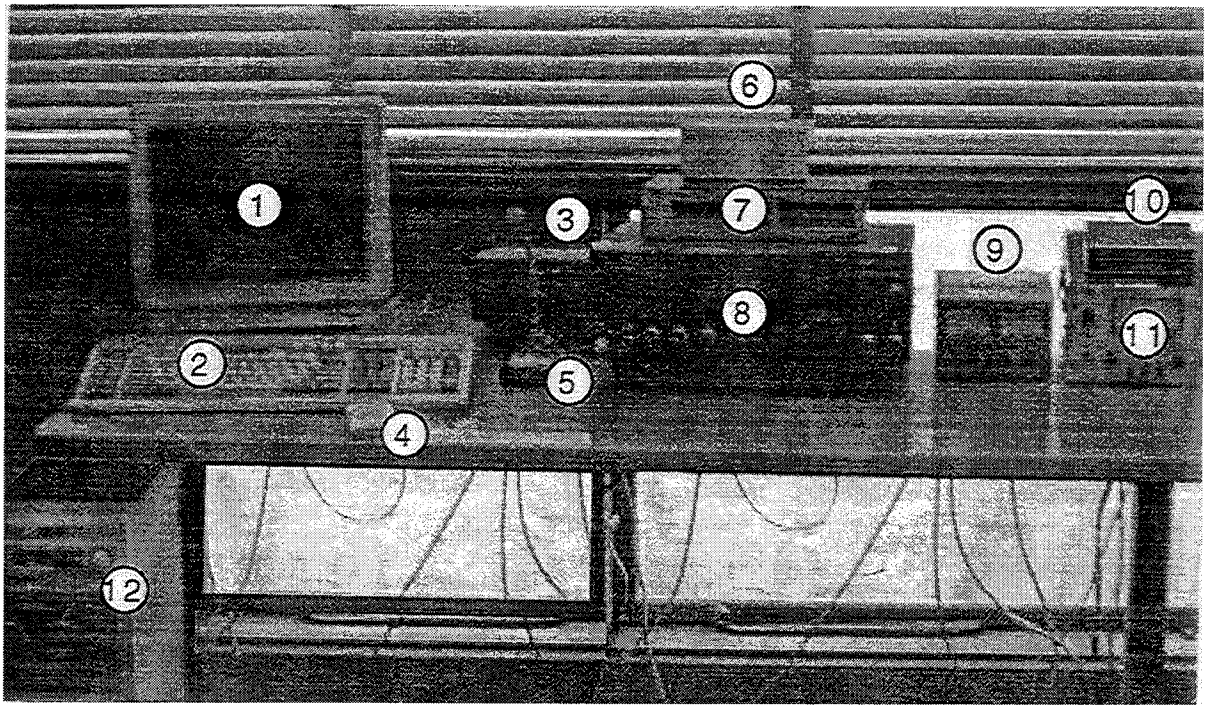


Fig.2.1. *Ham Station Layout*

Legend:

1 - Computer Monitor
2 - Computer Keyboard
3 - ICOM Power Supply (for Microphone)
4 - Computer Mouse
5 - ICOM Desk Microphone
6 - Satellite/Terrestrial Port Controller
7 - DSP-2232 Multi-Mode Data Controller
8 - ICOM Multiband Transceiver
9 - Yaesu Elevation-Azimuth Dual Controller
10 - PacCOMM PSK-1 Modem (no longer used)
11 - Hewlett Packard Power Supply (for DSP)
12 - Computer CPU

2.1 Ham Station Settings

Most of the equipment has variable settings, dependent solely upon which satellite or ground station you anticipate accessing. Appendix D and Appendix E contain frequently accessed satellites, modes and frequencies. Appendix F contains a quick access guide which indicates appropriate equipment settings for those satellites.

2.2 Equipment Familiarization

While it may be tempting to jump ahead to the Reception and Transmission Chapters, it is of utmost importance to gain a basic understanding about what the Ham Station equipment is actually used for and doing during these operations.

This section will address basic operation and functionality of the DSP-2232 Multi-Mode Data Controller, the Satellite/Terrestrial Port Controller, the ICOM Multiband Transceiver, and the Yaesu Elevation-Azimuth Dual Controller. Further information may be found in the technical reference manuals listed in Appendix C. Operation of computer equipment and related peripheral devices will also be discussed briefly. Extensive knowledge of computer operation is not necessary because most functions have been automated and will be presented to the user as menu options. Operation of the ICOM Desk Microphone is not discussed in this user's guide.

2.2.1 Computer Equipment

The term "computer equipment" includes the CPU (central processing unit), monitor, keyboard and mouse. In order to power on the CPU, depress the button located on the top right corner of the unit. This button contains the digits 1 (on) and 0 (off). In order to power on the monitor, depress the button located in the front of the unit, on the bottom right-hand side. There are no power on buttons for the mouse and keyboard.

As of this writing, the computer network software is being upgraded. Consequently, instructions containing specific logon requirements for accessing your account have not yet been finalized. The Network Manager will provide you with

specific instructions for logging onto the system once you have established an account.

Once logged on, you will be presented with a main menu which will give you several options to choose from. Manipulating the menu system is discussed in applicable chapters within this user's guide. All commands and menu entries required are not case sensitive. The case chosen to display these entries within this text is for illustrative purposes only.

2.2.2 DSP-2232 Multi-Mode Data Controller

The DSP-2232 was designed to provide the amateur with the complete digital operating position when coupled with a computer. The DSP-2232 can operate HF or VHF packet, on Radio Port 2, and operate any other digital mode on Radio Port 1 at the same time.

2.2.2.1 Front Panel Indicators

Figure 2.2 shows the front panel indicators on the DSP-2232 unit.

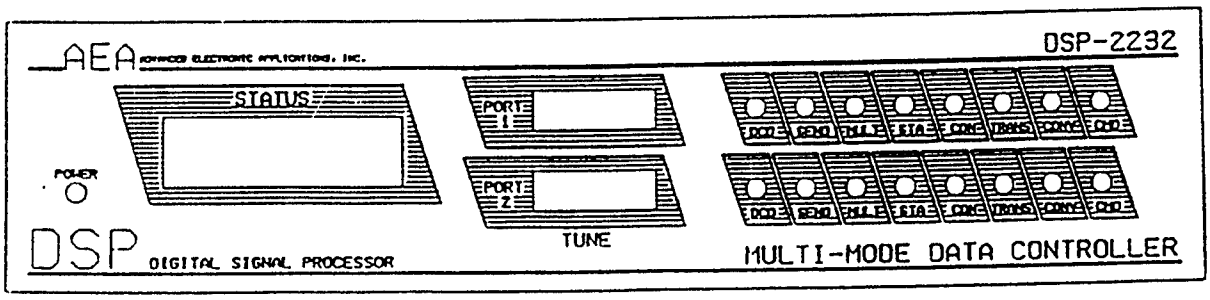


Fig.2.2.DSP-2232 Front Panel Controls and Indicators

On the left is the LCD Status indicator, which displays the status of Radio Port 1 on the top line, and Radio Port 2 on the second line.

In the middle of the front panel are two LED Tune Bar-Graph tuning indicators. The top indicator aids in tuning signals on Radio Port 1, and the bottom bar-graph is a tuning aid for Radio Port 2.

On the right are LED Status Indicators for both Radio Ports. The top row of eight LEDs indicates the status of Radio Port 1 and the bottom row indicates the status for Radio Port 2.

Each Radio Port LED Status Indicator is marked with an abbreviated name. Table 2.1 lists and describes the function of each of the LEDs.

Table 2.1
LED Status Indicator Displays

NAME	DESCRIPTION	LED FUNCTION
DCD	Data Carrier Detect	Lit when data signals are received
SEND	Send	Lit when Push-to-Talk (PTT) line is active
MULT	Multiple	Lit when multiple connections exist Blinks when receive buffer is full
STA	Status	Lit when a packet has been sent, but not yet acknowledged Blinks when MailDrop messages exist
TRANS	Transparent	Lit when in Transparent Mode
CONV	Converse	Lit when in Converse Mode
CON	Connected	Lit when packet connection exists
CMD	Command	Lit when in Command Mode

2.2.2.2 Selecting and Loading Modems

The various modems programmed in the DSP-2232 can be seen with the execution of the directory command, while accessing PROCOMM - a software application program accessible through the menu system. Simply enter the DIR command at the Command Mode prompt as shown.

cmd: **DIR** <Enter>

Figure 2.3 contains the DSP-2232 response.

```
(920723)
  1: RTTY/TOR 170: 2125/2295            2: RTTY/TOR 170: 1445/1275
  3: RTTY/TOR 425: 2125/2550            4: RTTY/TOR 850:2125/2975
 10: p1 Packet 300 bps HF 2110/2310    11: p1 Packet 300 bps HF 1460/1260
 12: p1 Packet 1200 bps VHF            13: p1 Packet 1200 bps PACSAT
 14: p1 Packet 1200 bps PSK            15: p1 Packet 2400 bps V.26B
 16: p1 Packet 4800 bps PACSAT         17: p1 Packet 4800 bps PSK
 18: p1 Packet 9600 bps FSK K9NG/G3RUH
 20: p2 Packet 300 bps HF 2110/2310
 22: p2 Packet 1200 bps VHF            23: p2 Packet 1200 bps PACSAT
 25: p2 Packet 2400 bps V.26B
 28: p2 Packet 9600 bps FSK K9NG/G3RUH
 30: RTTY/TOR 170: 2125/2295; p2 Packet 300 bps HF 2110/2310
 31: RTTY/TOR 170: 2125/2295; p2 Packet 1200 bps VHF
 33: p1 Packet 300 bps HF 2110/2310; p2 Packet 1200 bps VHF
 35: p1 Packet 1200 bps VHF; p2 Packet 1200 bps VHF
 40: Morse 750 Hz                      41: Analog FAX HF
 42: Analog FAX APT                    43: Analog SSTV
 44: DSP data 400 bps OSCAR-13         45: RTTY/TOR 1200 ASCII OSCAR-11
 46: DSP data Spectrum                 50: p1 Packet 1200 bps MSK
 51: p1 Packet 2400 bps MSK            52: p1 Packet 9600 G3RUH UO22 eq
 60: p2 Packet 1200 bps MSK            61: p2 Packet 2400 bps MSK
```

Fig.2.3. *DSP-2232 Pre-programmed Modems*

Any modem from this list may be loaded, while in PROCOMM, with the modem command. All modem commands have been automatically entered for corresponding satellites; therefore, the modems listed in Figure 2.3 are provided only for your information. However, when a bulletin board system (BBS) is being accessed, you must configure the DSP-2232 with the appropriate modem. For example, say you wanted to operate only at 1200 bits per second (bps) very high frequency (VHF) on Radio Port 2. This would indicate that Modem 22 would be the ideal choice.

Simply enter the MOD command at the Command Mode prompt as shown.

cmd: **MOD 22** <Enter>

The DSP-2232 will respond with the following:

```
MODem was 18
MODem now 22
cmd:**HBaud now 1200
```

When a Radio Port 2 only modem is loaded, Radio Port 1 is effectively disabled. Thus, you will not see any LED activity on Radio Port 1. When a dual port modem, such as Modem 33 is loaded, LED activity should be seen on both radio ports.

The DSP-2232 normally displays monitored packets by prefacing each packet with a port designator "p1" for Radio Port 1 and "p2" for Radio Port 2. However, because the inclusion of a port designator presents a problem for the satellite upload and download software programs, this display has been disabled.

2.2.2.3 Satellite Operation

This section will cover displays you should be aware of while using specific modems during satellite operation.

2.2.2.3.1 Using Modem 23

The most widely used satellite modem is Modem 23. This enables the DSP-2232 to receive a 1200 bps Binary Phase Shift Key (BPSK) PACSAT signal from a single side band (SSB) receiver. Tuning in BPSK satellite stations properly is critical to successful operation. For best results follow the procedure below.

Make certain your satellite transceiver is in the SSB mode. That is, verify that Appendix E listed frequencies match the pre-programmed frequencies that appear in the LCD Display of the transceiver.

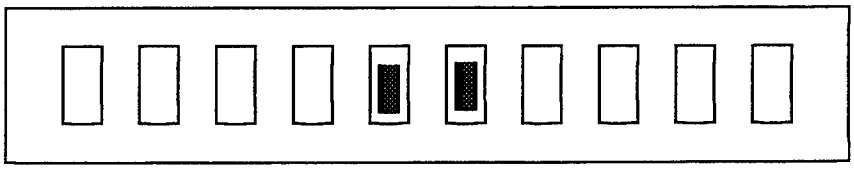
Turn any IF-Shift and Passband-Tuning controls to

the center or OFF position. (This is not necessary on the ICOM Multiband Transceiver.)

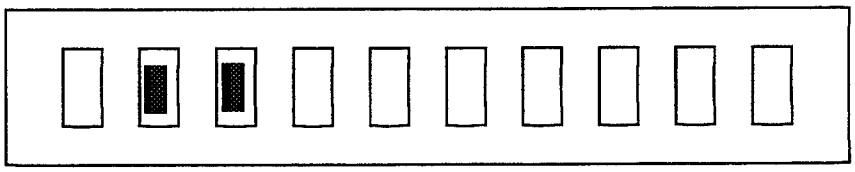
Verify that the transceiver is properly tuned to the BPSK satellite downlink frequency. Do not forget that the signal may be a few kilo-hertz (KHz) away from the exact downlink frequency due to doppler shifting. As a general rule, tune up about 5 KHz, from base frequency, upon satellite approach and down about 5 KHz, from base frequency, as the satellite descends.

Adjust the volume of the received signal so that the DCD LED lights when a properly tuned BPSK signal is being received.

When you find a station, slowly vary the variable frequency oscillator (VFO) on your transceiver and look at the Tuning Bar-Graph display on the DSP-2232. If the display appears as below, the signal is tuned-in.

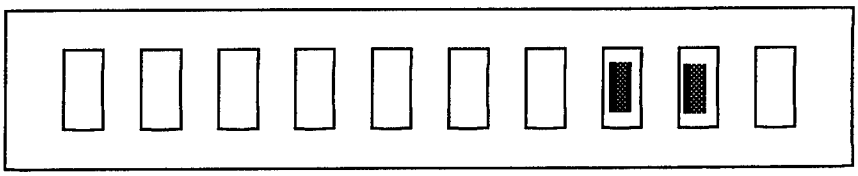


If the tuning indicator looks like the one below, the frequency from your speaker is too low to copy the signal. Slowly tune the VFO and make the frequency higher.



If the tuning indicator looks like the one below, the frequency from your speaker is too high to copy

the signal. Slowly tune the VFO and make the frequency lower.



2.2.2.3.2 Using Modems 18 and 52

Another satellite modem gaining in popularity is Modem 18. This modem will configure the DSP-2232 for 9600 bps Frequency Shift Key (FSK) operation. Modem 52, specifically designed for operation of UoSAT-22, also requires the same tuning instructions. For best results, follow the procedures below.

Make certain your satellite transceiver is in the FM mode. That is, verify that Appendix E listed frequencies match the pre-programmed frequencies that appear in the LCD Display of the transceiver.

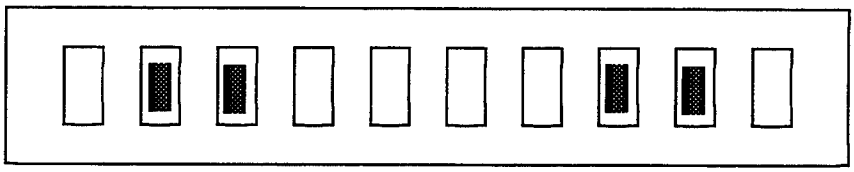
Turn any IF-Shift and Passband-Tuning controls to the center or OFF position. (This is not necessary on the ICOM Multiband Transceiver.)

Verify that the transceiver is properly tuned to the 9600 FSK satellite downlink frequency. Do not forget that the signal may be a few KHz away from the exact downlink frequency due to doppler shifting. As a general rule, tune up about 5 KHz, from base frequency, upon satellite approach and down about 5 KHz, from base frequency, as the satellite descends.

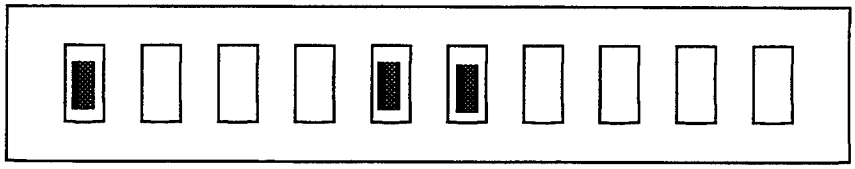
Adjust the volume of the received signal so that the DCD LED lights when a properly tuned signal is being received.

When you find a station, slowly vary the VFO on your transceiver and look at the Tune Bar-Graph

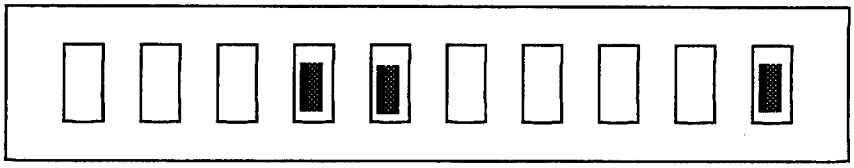
display on the DSP-2232. If the tuning indicator appears as below, the signal is tuned-in.



If the tuning indicator looks like the one below, adjust the frequency of your transceiver to achieve tuned-in display.



If the tuning indicator looks like the one below, adjust the frequency of your transceiver to achieve the tuned-in display.



2.2.2.3.3 Using Modem 45

Modem 45 is most frequently used with UoSAT-11, which can transmit 1200 bps FM Alternate FSK (AFSK) ASCII signals. Proper tuning is critical to successful operation. For best results, follow the procedure below.

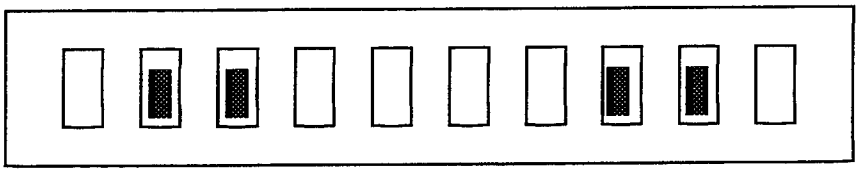
Make certain your satellite transceiver is in the FM mode. That is, verify that Appendix E listed frequencies match the pre-programmed frequencies that appear in the LCD Display of the transceiver.

Turn any IF-Shift and Passband-Tuning controls to the center or OFF position. (This is not necessary on the ICOM Multiband Transceiver.)

Verify that the transceiver is properly tuned to the 1200 or 4800 bps satellite downlink frequency. Do not forget that the signal may be a few KHz away from the exact downlink frequency due to doppler shifting. As a general rule, tune up about 5 KHz, from base frequency, upon satellite approach and down about 5 KHz, from base frequency, as the satellite descends.

Adjust the volume of the received signal so that the DCD LED lights when a properly tuned signal is being received.

When you find a station, slowly vary the VFO on your transceiver and look at the Tune Bar-Graph display on the DSP-2232. If the tuning indicator appears as below, the signal is tuned-in.



If the tuning indicator does not appear as indicated above, adjust the frequency of your transceiver to achieve the proper display.

2.2.2.3.4 Using Modem 22

Finally, Modem 22 is used by satellites that can transmit 1200 bps FM AFSK AX.25 (software protocol used by amateur satellites) standard VHF packet signals. For best results, follow the procedure below.

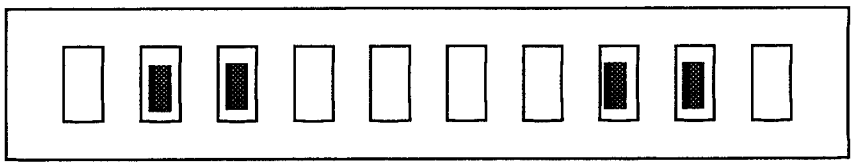
Make certain your satellite transceiver is in the FM mode. That is, verify that Appendix E listed frequencies match the pre-programmed frequencies that appear in the LCD Display of the transceiver.

Turn any IF-Shift and Passband-Tuning controls to the center or OFF position. (This is not necessary on the ICOM Multiband Transceiver.)

Verify that the transceiver is properly tuned to the 1200 bps satellite downlink frequency. Do not forget that the signal may be a few KHz away from the exact downlink frequency due to doppler shifting. As a general rule, tune up about 5 KHz, from base frequency, upon satellite approach and down about 5 KHz, from base frequency, as the satellite descends.

Adjust the volume of the received signal so that the DCD LED lights when a properly tuned signal is being received.

When you find a station, slowly vary the VFO on your transceiver and look at the Tune Bar-Graph display on the DSP-2232. If the tuning indicator appears as below, the signal is tuned-in.



If the tuning indicator does not appear as indicated above, adjust the frequency of your transceiver to achieve the proper display.

2.2.3 Satellite/Terrestrial Port Controller

Appendix F provides a listing of the appropriate Satellite/Terrestrial Port Controller Settings. Figure 2.4 illustrates the front panel of this unit.

Notice that the right switch is labeled Port 1 on top and 9600 on the bottom. Similarly, the left switch is labeled Port 2 on top and AFSK on the bottom. These switches are external switches that work together with the DSP-2232 to establish

appropriate radio port settings. A connection cannot be made, unless this unit is properly configured.

Merely push the switch to the top or bottom of each side as indicated to achieve the desired setting.

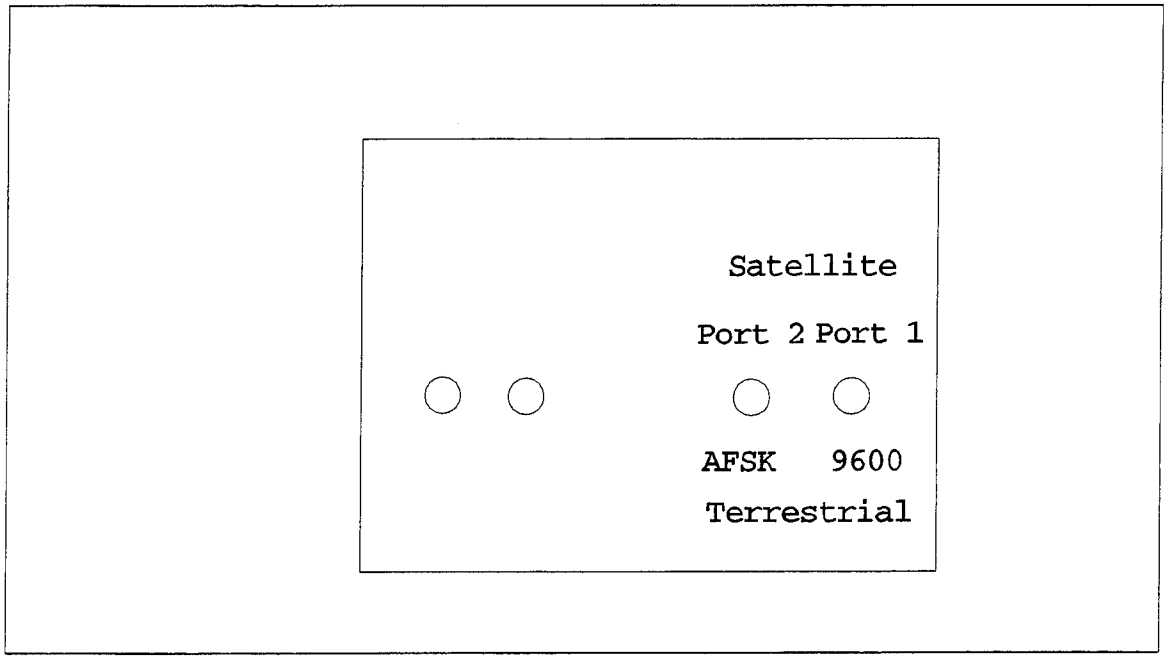


Fig.2.4. *Satellite/Terrestrial Port Controller*

2.2.4 ICOM Multiband Transceiver

The ICOM Multiband Transceiver, as its title indicates, has the ability to both receive and transmit signals. Proper knowledge of operating this particular piece of equipment is a must.

2.2.4.1 Control Functions

Appendix B is an extract from the ICOM Multiband Transceiver Instruction Manual which contains a list of all the control functions found on this unit.

2.2.4.2 Basic Receiving

The following procedures should be followed to optimize reception.

Push POWER in to turn on the unit.

Rotate the SATELLITE Switch to SATL, to access a satellite, or OFF to access a ground station.

Ensure TRANSMIT/RECEIVE Switch is in the RECEIVE position.

Referring to Appendix F, rotate the MEMORY CHANNEL SELECTOR to the appropriate channel. If you wish to use a frequency other than that which has been pre-programmed, refer to the transceiver's instruction manual for tuning directions.

Push SUB to select the upper control band. Push the Khz button. If you see an inverted triangle over the right digits, push this button again. Adjust the frequency as necessary with the MAIN Dial.

Ensure the PREAMP Switch is pushed in. This will allow the S-meter display to be visible.

When actually receiving a signal (1) squelch opens and received audio is heard; (2) the RX indicator lights up; and (3) the S-meter shows relative signal strength.

2.2.4.3 Basic Transmitting

The procedures for transmitting are exactly the same as those outlined for reception. The transceiver will automatically go into transmission mode while attempting to send a packet. You will notice that the TX indicator light will be illuminated when it is in send mode. Otherwise, the unit will be in receive mode - "listening before it transmits."

2.2.5 Yaesu Elevation-Azimuth Dual Controller

The Yaesu Elevation-Azimuth Dual Controller provides 360° azimuth and 180° elevation control of medium and large size unidirectional satellite antenna arrays under remote control from the station operating position. The Controller may be

2.2.5.1 Controller Operation

Upon executing the following procedures, you will have verified that the Controller is functioning properly. Figure 2.5 shows the front panel of the Controller.

Turn on the POWER switch. The meter lamps should light and the meters should indicate the approximate position of the antenna.

Press the UP switch. The ELEVATION rotator should turn as the meter indication moves to the right.

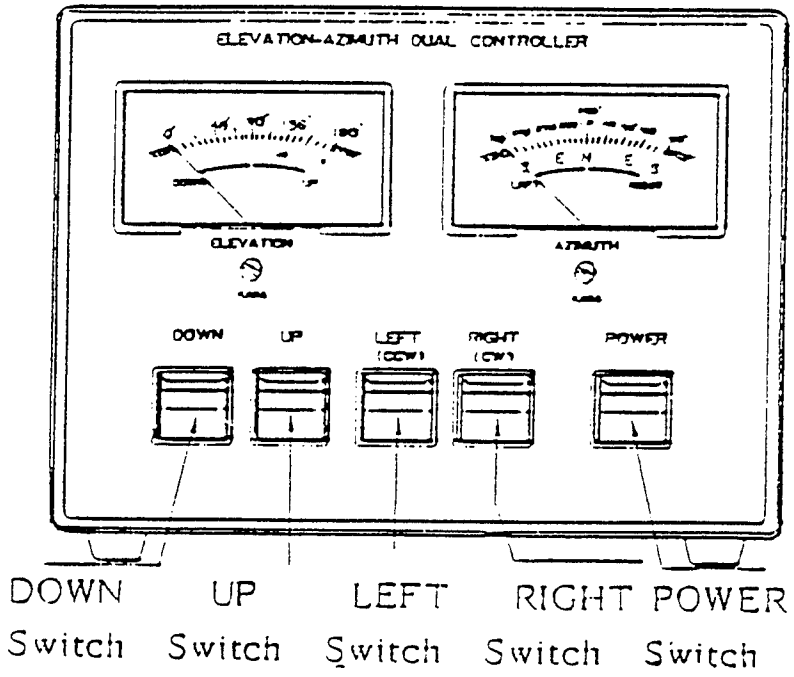


Fig.2.5.Elevation-Azimuth Dual Controller: Front Display

Release the UP switch and confirm that the rotator slowly stops.

Press the DOWN switch. The ELEVATION rotator should turn in the opposite direction as the meter indication moves to the left. Release the DOWN switch and confirm that the rotator slowly stops.

Press the LEFT switch. The AZIMUTH rotator should turn counter-clockwise as the meter indication

moves to the left. Release the LEFT switch and confirm that the rotator slowly stops.

Press the RIGHT switch. The AZIMUTH rotator should turn clockwise as the meter indication moves to the right. Release the RIGHT switch and confirm that the rotator slowly stops.

If operation does not occur as listed above, do not operate the Controller and advise the Ham Station Manager immediately.

2.2.5.2 Operational Notes

If both UP and DOWN switches or RIGHT and LEFT switches are pressed at the same time, the corresponding rotator should always turn up or right (clockwise). (This type of operation is not recommended.)

Release the switch when the meter indicates in the end zones (the rotator will also stop).

Remember to turn the POWER switch off when the rotators are not in use.

Chapter 3

CHOOSING/TRACKING A SATELLITE

3.0 Manipulating The Menu System

Once you have logged onto the system, you should be presented with the Main Menu which appears in Figure 3.1.

```
        WELCOME TO NPS SSAG'S AMATEUR RADIO GROUND STATION

Select one of the following menu options:

       1  -  Procomm

       2  -  INSTANTTRACK

       3  -  Access a Specific Satellite

       4  -  Return to DOS   (Type MENU to return)

Type the number and press ENTER:
```

Fig.3.1. *Main Menu Display*

In order to choose a satellite for transmission or reception purposes, you must first establish exactly where the satellite is and when the satellite's footprint will be within your area of operation (AOR). INSTANT*TRACK* is the name of the application software package that will provide this type of tracking information for you. At the Main Menu prompt, select INSTANT*TRACK* as shown.

Type the number and press Enter: **2** <Enter>

3.1 Accessing INSTANT*TRACK*

After you have chosen Menu Option 2, the INSTANT*TRACK* program will be activated. INSTANT*TRACK* is also menu driven. Should

you need help at any time while in this program, depress the "H" or "?" (help) keys. Figure 3.2 is a display of the menu you will see upon program initiation. At the prompt, select Menu Option 2.

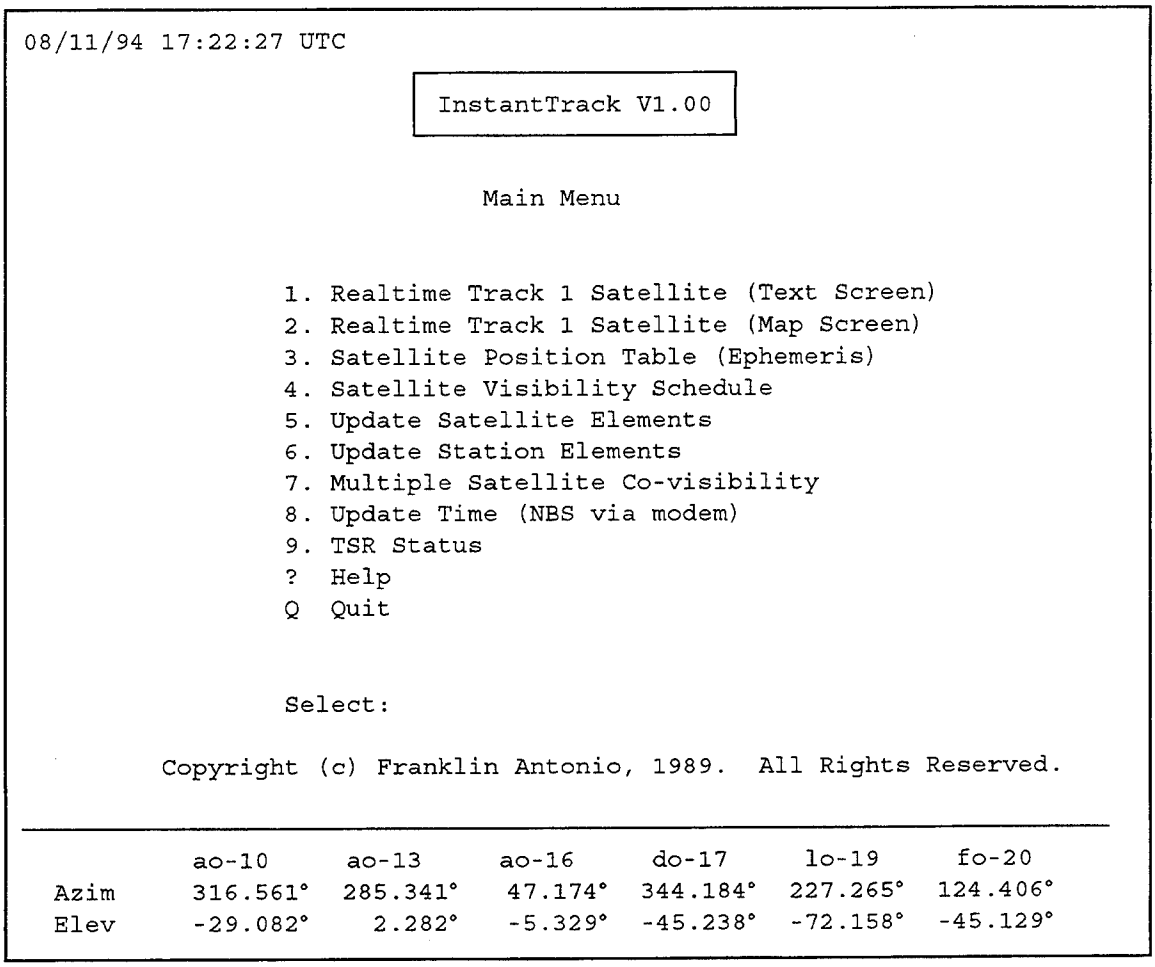


Fig.3.2. *INSTANTTRACK Main Menu*

3.2 Satellite Availability

Selecting Menu Option 2 from this menu will produce a screen that has a listing of all the satellites that have previously been loaded into the system via updating the orbital elements. Figure 3.3 illustrates a typical Realtime Track display. Although many satellites are listed, some of them may no longer be functional for amateur purposes. However, AMSAT or NASA may still be tracking them; thus, their orbital elements are still being calculated.

```
09/11/94 17:22:35 UTC      Satellite Selection Menu          Page 1 of 3

1. Sun              19. mir             37. met-3/4         55.
2. Moon             20. rs-10/11        38. noaa-12         56.
3. ao-10            21. rs-12/13        39. met-3/5         57.
4. uo-11            22. hubble          40. met-2/21        58.
5. ao-13            23. arsene          41. 22828           59.
6. uo-14            24. STS-65          42.                 60.
7. ao-16            25. gro             43.                 61.
8. do-17            26. uars            44.                 62.
9. wo-18            27. noaa-9          45.                 63.
10. lo-19           28. noaa-10         46.                 64.
11. fo-20           29. met-2/17        47.                 65.
12. ao-21           30. met-3/2         48.                 66.
13. uo-22           31. noaa-11         49.                 67.
14. ko-23           32. met-2/18        50.                 68.
15. ko-25           33. met-3/3         51.                 69.
16. io-26           34. met-2/19        52.                 70.
17. ao-27           35. fy-1/2          53.                 71.
18. posat           36. met-2/20        54.                 72.

 Enter satellite number, or type PgUp or PgDn for previous or next page,
 or G{groupname} to select a subset, or Enter to abort.
 Select:
```

Fig.3.3. *INSTANTTRACK's Satellite Selection Menu*

If the screen contains satellite names that are highlighted, these are the ones that are presently within your field of view. You may decide to attempt to access one of these satellites, or choose another which is not yet in view. In order to decide whether or not to access a specific satellite, merely enter the corresponding satellite's item number at the prompt. For example, if you wanted to work with UoSAT-22, you would enter Menu Option 13 at the prompt shown in Figure 3.3.

3.3 Satellite Tracking

Upon entering the satellite's item number, this action will invoke a Mercator projection of the globe, as shown in Figure 3.4. The display will also have, among other things, the satellite's current location, its footprint, elevation angle, time remaining in view, and ground track relative to your position.

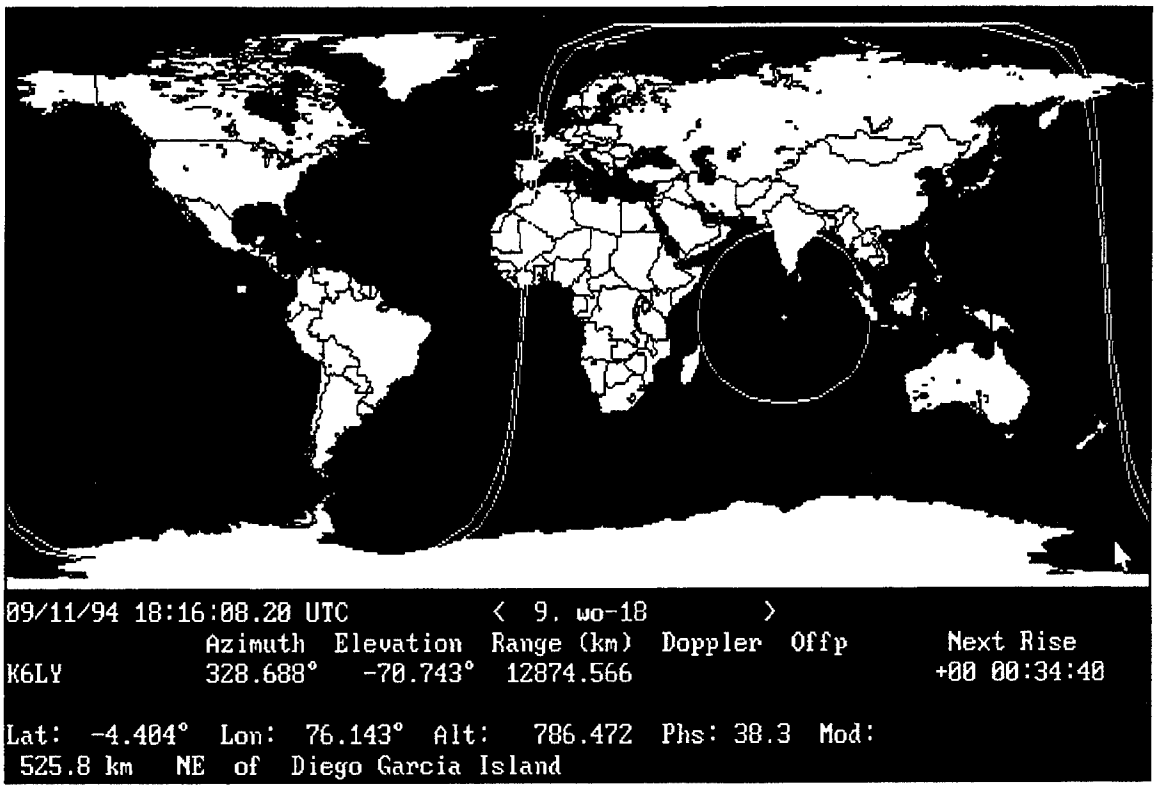


Fig.3.4. *Mercator Projection Tracking*

The satellite footprint is identifiable by a bright white, normally circular pattern on the projection; the satellite itself is shown as the bright white dot within the footprint; your position is denoted as an X; the time remaining in view (as well as time to next set) may be seen by depressing the "W" key while viewing this screen.

The satellite's elevation angle is of utmost importance. Because of the present location of the antenna (between four buildings), it is almost impossible to access any satellite that is below 25° elevation. Therefore, you only want to attempt to work satellite passes that stay above this elevation angle.

You may watch a satellite's entire pass by depressing the "F" key, which acts as a fast forward button, while viewing this screen. To toggle the pass on and off, depress the Space Bar on the keyboard. To return the satellite to its actual position, depress the "F" key again.

Once you have determined which satellite you would like to try to access, depress the "R" key - which will enable the rotor. This action will result in automatic antenna tracking of the satellite's pass once the footprint enters your AOR. (The antenna will not begin to move until the satellite's footprint enters your AOR, so be patient.)

3.4 Exiting INSTANT*TRACK*

After you have enabled the rotor, you may now exit INSTANT*TRACK* by depressing the "Q" (quit) key two times. The first "Q" will result in exiting the Mercator projection. The second "Q" will be at the main INSTANT*TRACK* menu prompt which will cause you to exit the program. Once you have exited the program, you will be returned to the Main Menu as depicted in Figure 3.1.

3.5 Other INSTANT*TRACK* Commands

Table 3.1, located on the next page, contains a listing of all INSTANT*TRACK* commands which may be used while in the Mercator projection screen. Becoming familiar with these commands will make tracking a satellite much easier and quicker.

Table 3.1
INSTANT*TRACK* Commands

KEY-COMMAND	ACTION
B	Enable/Disable the bottom row display
C	Enable/Disable nearest city display
E	Look at orbital elements for this satellite
F	Start/Stop fast-forward mode
I	Enable/Disable display of XYZ coordinates
O	Add/Delete station observer
Space Bar	Freeze/Unfreeze the display
P 1P 2P 3P 4P	Change the map projection Change to cylindrical equidistant view Change to orthographic view Change to orbit-view Change to sky-view
R	Enable/Disable antenna rotor control
S	Toggle scroll mode (cylindrical map) Enable/Disable RA/Dec/Tsky display
T	Set a specific time, or return to real-time
U	Force an update of map now
W	Enable/Disable next rise/set time calculation display
Q	Quit tracking. Return to Main Menu.
Left <-	Go back to previous satellite
Right ->	Advance to next satellite

Chapter 4

RECEIVING FILES FROM A SATELLITE

4.0 Configuring the Satellite/Terrestrial Port Controller

Having determined which satellite you anticipate accessing, you must first refer to Appendix F to determine the appropriate Satellite/Terrestrial Port Controller Settings. A connection cannot be made, unless this unit is properly configured. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

4.1 Configuring the ICOM Multiband Transceiver

Appendix F lists the Memory Channel assignments which have been pre-programmed for each satellite's access. Ensure that the LCD Display shows the proper frequency assignments listed in Appendix E. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.) If you want to try an alternate frequency, refer to the transceiver's instruction manual for tuning directions.

While awaiting the satellite's ascent, recall that it is common practice to adjust the Main Dial up about 5 KHz to account for doppler shifting. As the satellite is passing, you may try adjusting the frequency down to as low as about 5 KHz below base frequency. You will know how effective this manipulation is by watching the signal strength display (S-meter). The key is to try and maintain as strong a signal strength as possible during the satellite's pass.

4.2 Manipulating the Menu System

In order to receive files from a satellite, you must enter Menu Option 3 at the Main Menu prompt. This action will result in the presentation of Frequently Used Satellites Menu,

as shown in Figure 4.1, which contains all of the satellites currently accessed by this station.

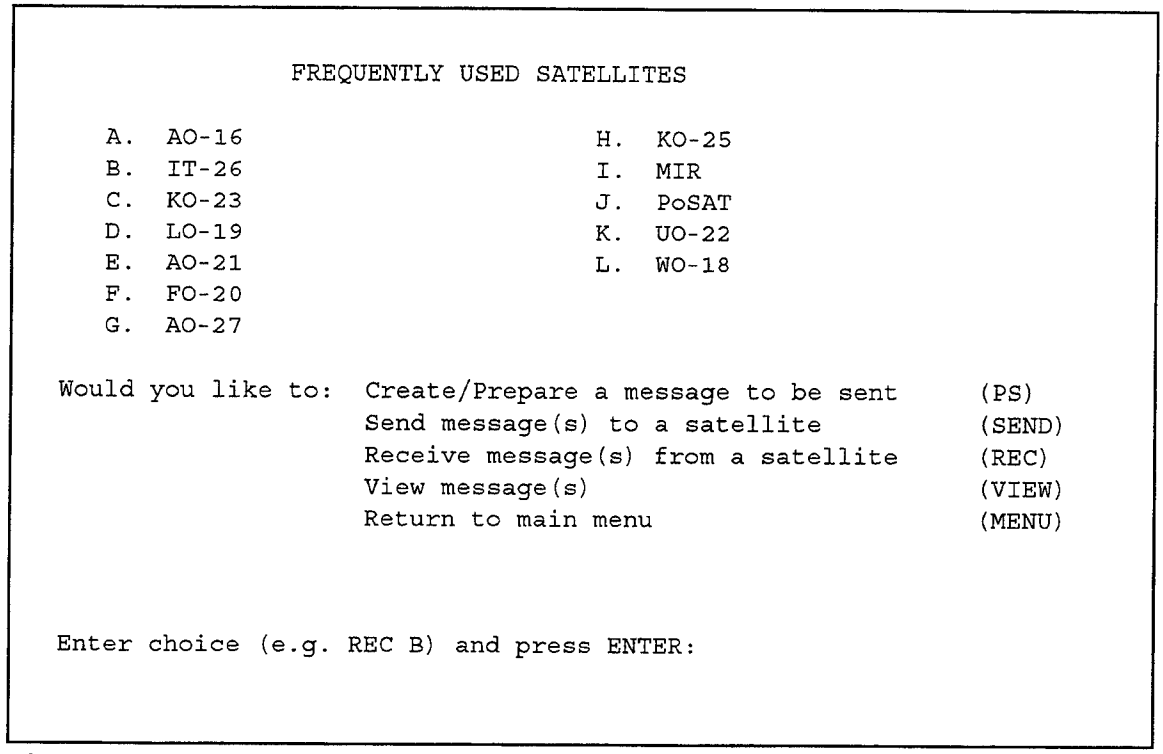


Fig.4.1. *Frequently Used Satellites Menu*

Although the system is set up to receive from all satellites listed, not all satellites possess this functionality at all times. Be sure to check Appendix D and Appendix E to see if any changes have occurred prior to attempting to access a satellite in this manner.

Once you have verified that in fact the satellite you desire is functioning, and the antenna has begun tracking that satellite, you may now enter the appropriate menu option to receive files. For example, if you wanted to receive files from AO-16 you would enter the following at the prompt, as shown below.

Enter Choice (e.g. REC B) and press Enter: **REC A** <Enter>

4.3 Accessing the Satellite Reception Software (PB)

The satellite reception software, most commonly called "PB" is activated upon entering the REC command at the prompt. Upon

entering this command, you will see a number of lines quickly scroll by on your screen. These lines contain pre-programmed configuration commands which are setting up the DSP-2232 for appropriate reception.

The scrolling will end with the presentation of the screen shown in Figure 4.2.

4.3.1 PB Screen Displays

The PB Screen is subdivided into three separate parts; the top half of the screen is divided vertically. The upper left section contains File Status information. The upper right section contains Download information and the lower section contains General information. At the very top of the screen is the Command Line and at the very bottom is the Status Line.

4.3.1.1 Command Line

As shown in Figure 4.2, the Command Line contains the following options:

Download: Priority Auto Grab Never Fill Dir Info Viewdir Quit! Help

"Priority" allows you to place some messages before others in the automatic downloading system. All Priority messages will have their "holes" filled before any messages with Auto status. Unless you already have a message number in mind, it is best to use this option in the Viewdir screen. If used in the main PB display window, you will be prompted to enter a message number before this action will be executed. The same applies for the Auto, Grab and Never commands.

"Auto" indicates that the message will be completely downloaded and filled automatically by PB, without your intervention. When the message is completely filled, the status indicator will have a square white block in it.

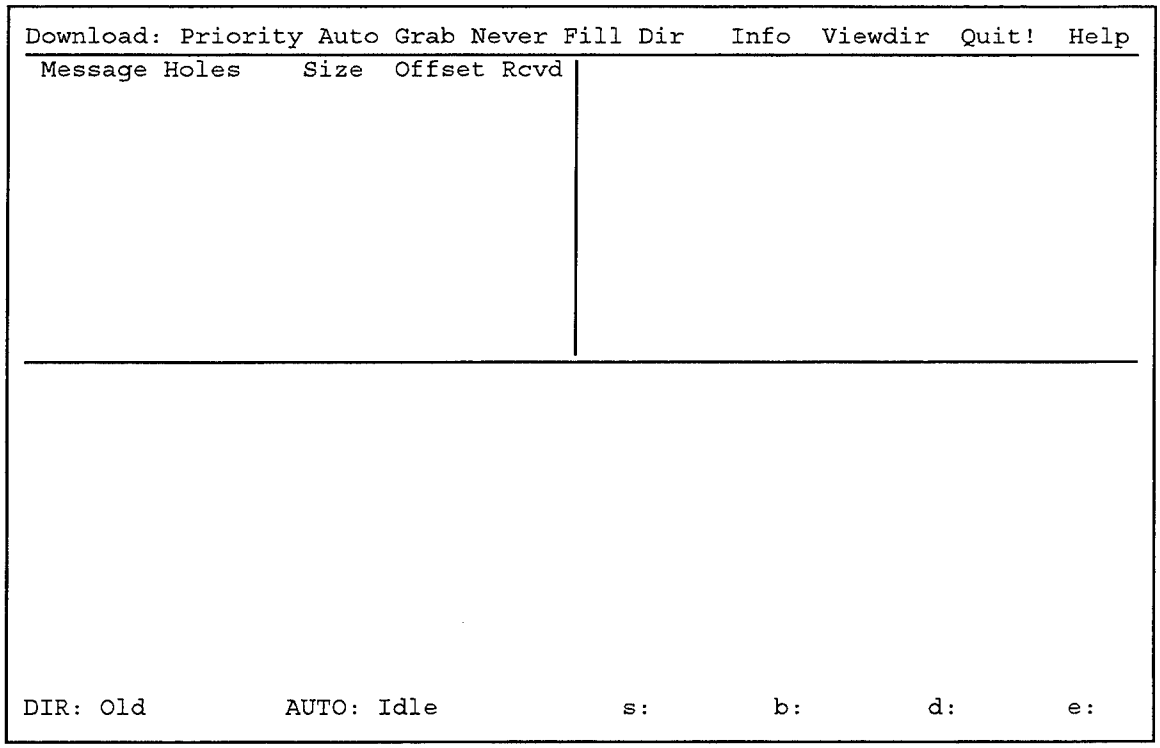


Fig.4.2. *PB's (Main) Display*

"Grab" indicates that the message will be saved if it is overheard when another station is downloading it. Normally, messages marked Grab are those messages not specifically addressed to you. PB will not automatically try to fill all holes in the message.

"Never" indicates a message will not be automatically downloaded and filled, nor will it be saved if it is overheard while another station is downloading it.

"Fill" is a broadcast command which tells the satellite to transmit an entire message, if you have not yet received any part of it. If you have already received part of the message, Fill will request only the missing portions or "holes." Fill does not alter the message status, and the message will not automatically be completely filled unless it is already marked by the A or P command.

"Dir" is a broadcast command which sends a request to the satellite to update your directory. Generally, the directory will be updated when you run PB, and after PB has downloaded

any messages with Auto or Priority status. It is best to let PB automatically update your directory after Auto and Priority operations are complete.

"Info" will display all of your system specific parameters, such as callsign, operating baud rate, operating version of PB, etc., in the Download Window.

"Viewdir" will produce the satellite's directory listing which can be made selective through the use of function (F) keys. The F-keys will extract selected files from the satellite's directory and display them for you. Table 4.1 shows the available F-keys and corresponding displays.

Table 4.1
Viewdir Function Keys

KEY	DISPLAY
F1	ALL THE MAIL FILES
F2	YOUR PERSONAL MAIL
F3	ALL BULLETINS
F4	SATELLITE LOGS
F5	FILES DOWNLOADED
F6	FILES REQUESTED
F7	KEPLERIAN ELEMENTS
F8	IMAGE FILES
F9	NEWS FILES
F10	PB/PG FILES
F11	BBS GATEWAY FILES
F12	URGENT PRIORITY FILES

Figure 4.3 shows a typical satellite directory - notice the file markings to the left of the file numbers. While in the Viewdir screen, you may use the left, right, up, and down arrow keys. Advancing left will provide you with more information about the file(s) being considered for download.

```
D/L: Priority Auto Grab Never      Quit! Main Help
Message S     Subject               To    From  Posted at  Size

2460b   g   WA1515T1.IN           WB5EKW N7RSN 02/15 18:52   979
24609   g   WA1513T1.IN           GB7LAN N7RSN 02/15 18:52 10271
24608   g   WA1512T1.IN           EA3RAC N7RSN 02/15 18:52  1727
24607   g   WA1511T1.IN           ZL2AMD N7RSN 02/15 18:51  2250
24606   g   WA1510T1.IN           NU9H   N7RSN 02/15 18:51  1327
24605   g   WA1509T1.IN           W9HGI  N7RSN 02/15 18:51  5693
24604   g   WA1508T1.IN           W1YRM  N7RSN 02/15 18:51   970
24603   g   WA1507T1.IN           SV8RV  N7RSN 02/15 18:51  1146
24602   g   WA1506T1.IN           F6CDD  N7RSN 02/15 18:51   827
24601   g   WA1505T1.IN           OH6SAT N7RSN 02/15 18:51   846
24600   g   WA1504T1.IN           W0SL   N7RSN 02/15 18:51   688
245ff   g   WA1503T1.IN           N0GIB  N7RSN 02/15 18:50   827
245fe   g   WA1502T1.IN           ON4KVI N7RSN 02/15 18:50  3580
245fd   g   WA1501T1.IN           NL7NC  N7RSN 02/15 18:50  4265
2451f   g   BL940215                            02/15 18:41  4126
245fc   g   ON1424T1.ZIP          VK5SPG ON4KVI02/15 18:40   572
245fb   g   ON1423T1.ZIP          ZS1ABM ON4KVI02/15 18:39  1619
245fa   g   ON1422T1.ZIP          LU8DYF ON4KVI02/15 18:39  1140
245f9   g   ON1421T1.ZIP          W0SL   ON4KVI02/15 18:39   875
245f8   g   ON1420T1.ZIP          AB4RB  ON4KVI02/15 18:38  1113

DIR: Old          AUTO: Idle        s:         b:         d:        e:
```

Fig.4.3. *Typical PB Viewdir Display*

4.3.1.2 File Status Window

The File Status Window displays information about files currently being requested for broadcast and the progress of the operation. As displayed in Figure 4.2, the following headings appear in this window:

Message Holes Size Offset Rcvd

"Message" indicates the filename of the file being accessed. The filename is represented as a four digit hexadecimal number which is assigned by the satellite upon message upload.

"Holes" indicate the number of holes remaining to be filled before the download is complete.

"Size" relates to the decimal length of the file.

"Offset" indicates the address of where the next broadcast packet will begin. (Offset is not used by the general user.)

"Rcvd" indicates the percentage of the total file you have already received.

4.3.1.3 Download Window

The Download Window provides a caption of all operations currently taking place. Most of the messages displayed will be similar to "Message 3d22 heard" or "Message 3d22 downloaded." Occasionally, there will be other messages displayed such as "Stat Blocked," and "Stat Done," to list a few.

4.3.1.4 General Information Window

In the General Information Window you will see messages pertaining to the broadcast queue, the BB Status (BBSTAT) and satellite responses.

4.3.1.4.1 Broadcast Queue

The broadcast queue is simply a list of those stations whose request for broadcast is being processed. For example, the appearance of K16QE/D means that a directory entry has been requested by an operator with the callsign K16QE. If you enter a broadcast request, you will see your call progress to the right and when it reaches the head of the queue, you will receive your directory updates. You can watch the progress of this transaction in the Download Window (top right of screen).

4.3.1.4.2 BBSTAT Messages

The BBSTAT messages are brief. They include "BBSTAT:Open," "BBSTAT:Full" and "BBSTAT:Shut." As implied, these messages indicate whether or not the satellite's BBS can currently be accessed.

4.3.1.4.3 Satellite Responses

You may see messages like "OK K16QE" and "NO -1 K16QE." These messages are satellite responses to user requests. "OK K16QE"

implies that the request from K16QE has been acknowledged. "NO -1 K16QE" implies that the queue is full (there is a maximum of 20 entries) and the request has not been entered. Still another message "NO -2 K16QE" implies that the file requested is no longer available. Files generally have a maximum lifetime of five days before they are auto-deleted. This maximum lifetime setting is entirely dependent upon the random access memory (RAM) available on the satellite, and the lifetime assigned in the PACSAT File Header designated upon message upload.

4.3.1.5 Status Line

On the very bottom of Figure 4.2, you will see the Status Line which looks something like this:

```
Dir:Old    Auto:Idle        s:      b:      d:      e:
```

"Dir" indicates the status of the PFHDIR.PFH file that is loaded in your satellite's download subdirectory. This file contains the last requested directory obtained from the satellite. The status line will either indicate Old or Up-to-date.

"Auto" indicates the status of your reception activity. It will either indicate Idle (I am asleep or passively receiving files), Auto (I am requesting broadcasts) or OFF (I am in manual mode).

"s:" indicates the speed, in bps, at which you are receiving data on the downlink. This is calculated about every five seconds.

"b:" indicates the number of bytes of message content you have received.

"d:" indicates the number of directory bytes received.

"e:" indicates the number of errors encountered. (This number should be small.)

4.3.2 PB Error Messages

Should there be any error messages, you will see them appear in the middle of your screen and prior to being presented the PB Display. The messages will overlay existing text. The most common error message is "TNC not active." This indicates you have not powered on your DSP-2232. If this happens, quit the screen by depressing "Q" (quit) and re-enter the REC command once the DSP-2232 has been powered-on.

If any other error messages appear, please consult your resources in an attempt to resolve its cause.

4.5 Exiting the Satellite Reception Software (PB)

Once you have noticed that all activity has stopped on your display screen, and you can no longer acquire a strong signal strength by manipulating the Main Dial on the transceiver, you should now exit the PB program. To exit, merely depress the "Q" key. This action will result in termination of the PB program and will begin post-processing all downloaded files. You will see the following message line on your screen:

Post-processing downloaded files.....

4.6 Post-Processing

Do not depress any buttons while this action is being performed. The post-processing time is directly dependent upon how many files were successfully downloaded and the size of each file.

4.7 Notes on File Displaying and Deletion

Post-processing involves accessing several executable and batch file programs which effectively strip the headers placed on the file at upload; decompress the downloaded file; and convert it to readable text. Should a file not be clearly displayed upon viewing, it may actually be an executable program which someone has loaded onto the satellite for individual amateur usage. Often times, hams are very willing to share programs they have found or developed.

Once post-processing is complete, you will see a display similar to Figure 4.4. You may then answer the menu options presented to you as desired.

If you choose to display all files to screen, you must toggle the PAUSE key usually located in the upper right-hand portion of your keyboard. Be sure to locate this key before answering "N" (no) to the prompt "Display all to printer (y/n)?"

Do not delete all files unless you are absolutely sure you no longer want to retain them. You may re-access these files at any time by entering the VIEW command at the Frequently Used Satellites Menu prompt. If space constraint within your account becomes a problem, it would be wise to send all output to the printer and then delete all the files. Again, prior to deleting, ensure all files have actually been printed by the printer.

```
The following files are available to be viewed:

9032.MSG

Would you like to view ALL (y/n)?y

Display output to Printer (y/n)?y

Delete all (y/n)?y
All messages have been deleted
```

Fig.4.4. *Example Post-processed Display with Responses*

Chapter 5

TRANSFERRING FILES TO A SATELLITE

5.0 Configuring the Satellite/Terrestrial Port Controller

Having determined which satellite you anticipate accessing, you must first refer to Appendix F to determine the appropriate Satellite/Terrestrial Port Controller Settings. A connection cannot be made, unless this unit is properly configured. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

5.1 Configuring the ICOM Multiband Transceiver

Appendix F lists the Memory Channel assignments which have been pre-programmed for each satellite's access. Ensure that the LCD Display shows the proper frequency assignments listed in Appendix E. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.) If you want to try an alternate frequency, refer to the transceiver's instruction manual for tuning directions.

While awaiting the satellite's ascent, recall that it is common practice to adjust the Main Dial up about 5 KHz to account for doppler shifting. As the satellite is passing, you may try adjusting the frequency down to as low as about 5 KHz below base frequency. You will know how effective this manipulation is by watching the S-meter. The key is to try and maintain as strong a signal strength as possible during the satellite's pass.

5.3 Manipulating the Menu System

In order to transfer files from a satellite, you must enter Menu Option 3 at the Main Menu prompt. This action will result in the presentation of the Frequently Used Satellites Menu.

Although the system is set up to transmit to all satellites listed, not all satellites possess this functionality at all times. Be sure to check Appendix D and Appendix E to see if any changes have occurred prior to attempting to access a satellite in this manner.

5.3.1 Creating/Preparing a File for Transmission

Once you have verified that in fact the satellite you wish to access is functioning, you must then create a file and/or prepare a file to be sent to that satellite. You want to be sure and execute this step well before the antenna begins tracking the satellite pass, because uplink connections are often difficult to obtain. Individual PACSAT uplink connections are limited and there are many other amateurs attempting to access the same satellite at the time you are.

The file that you will be creating or preparing for transmission is accessible by anyone; even if you address the packet to a specific user. Vulgar, pornographic, personal or any other sensitive information should not be transmitted via amateur frequencies.

To create a file, enter the following command at the prompt:

Enter Choice (e.g. REC B) and press Enter: **PS A** <Enter>

This action will produce Figure 5.1. As displayed on the screen, you may create a new file (or edit an existing text file) or prepare a file, you have already loaded under the satellite's subdirectory, for transmission.

```
Would you like to:  Create a file                        (CR)
                    Prepare file for transmission        (PT)
                    Return to menu                       (LV)

Choosing the CR option invokes the DOS editor to create the file and
will then automatically prepare that file for transmission upon exiting.
Type "CR <filename>" at prompt, NO EXTENSION. If no filename is
specified, you will edit an unnamed file and must remember to save it
with a filename upon exiting the DOS editor.

Choosing the PT option assumes you are preparing a file that you have
already loaded under this satellite's /uploads subdirectory and merely
need to prepare it for transmission. Omit giving the filename an
extension.  Type "PT <filename>" at prompt.

Both methods will involve automatic zipping of the file via PKZIP.

Enter choice and press ENTER:
```

Fig.5.1. *Create/Prepare a File Menu*

5.3.1.1 Creating a File

In order to create a new file (or edit an existing file), simply type CR and the filename as shown below. DO NOT USE AN EXTENSION when inputing the filename (e.g., filename.txt; the ".txt" is considered to be a filename extension).

Enter Choice and press ENTER: **CR TEMP** <Enter>

This action will invoke the DOS Editor where you may commence typing in the text of your file. Upon completion, depress the ALT key and then the "F" (file) key. Depress "Q" (quit). The DOS Editor will automatically ask you if you want to save the changes before exiting. Depress "Y" (yes) and press the ENTER key.

Please note, if the DOS Editor brought up a file you previously created with the same filename, or you purposely chose to edit a file previously created, you may still edit this file as described above. However, upon completion, instead of depressing "Q," you must first rename the file by depressing "A" (Save As). Type in the new filename and press

ENTER. Depress the ALT key and then the "F" key once again, and now depress "Q."

After you have terminated the DOS Editor, the file will automatically be compressed via PKZIP. After compression, the File Header information will be applied. This is performed automatically and is done using the file PFHADD.EXE.

5.3.1.2 Preparing a File for Transmission

In order to prepare a file (e.g., a program or image) for transmission, say one that is presently loaded on a floppy diskette, you must first load the file under a specific satellite's subdirectory. If the file contains text, it must be in ASCII; that is, no control codes can be within the body of the text file. Additionally, any file being loaded should not be compressed. Compression will be performed automatically. To prepare a file, you must first return to the Main Menu by entering MENU at the Frequently Used Satellites Menu prompt. Next, you must exit the menu system by entering Menu Option 4. You will then be at your root directory, with the root directory prompt.

Now, for example, if you wanted to place the file TEMP, which is on your diskette in Drive A, in AO-16's uploads subdirectory, enter the following at each prompt (this example assumes F:\ is your root directory):

F:\ **cd ao16\uploads** <Enter>
F:\AO16\UPLOADS\ **copy a: temp** <Enter>

The computer will respond with the following display:

1 file(s) copied

Next enter the following at each prompt:

F:\AO16\UPLOADS\ **cd** <Enter>
F:\ **menu** <Enter>

This will return you back to the Main Menu. Select Menu Option 3 to return to the Frequently Used Satellites Menu. Continuing our example, enter PS A at the menu prompt. This

will give you the screen previously presented in Figure 5.1. Enter the following at the prompt:

Enter Choice and press ENTER: **PT TEMP** <Enter>

The file will automatically be compressed via PKZIP. After compression, the File Header information will be applied. This is performed automatically and is done using the file PFHADD.EXE.

5.3.1.3 The File Header Utility Program (PFHADD.EXE)

The PFHADD.EXE utility program adds the PACSAT File Header information to your files, which will enable them to be uploaded to the satellite via the satellite transmission program (PG.EXE). The File Header aids amateurs using the Viewdir command to decide whether or not they want to actively download a specific file. An example of a PACSAT File Header is shown in Figure 5.2.

```
 1 -- Message I.D.          (42d9)
 2 -- File Size            (1740)
 3 -- File Type             (0)
 4 -- File name             (2A3EC0005)
 5 -- Title                (CA1701A1.ZIP)
 6 -- Key words             (Documentation)
 7 -- Sender               (K16QE)
 9 -- Uploader Callsign     (K16QE)
10 -- Destination          (G0K8KA)
11 -- Posted date          (06/17 04:31)
12 -- Expire Date          (06/20 02:15)
13 -- Priority           (0)
14 -- Compression Type       (2)
15 -- BID                (4221_K16QE)
(This is only for BBS use).
16 -- Body info
17 -- Original name         (CA1701A1.IN)
```

Fig 5.2. *Example of a PACSAT File Header*
Entries are in parentheses

The PFHADD utility will ask you a series of questions, discussed below, which will complete the File Header for the file being processed. When composing your header, keep in mind that amateurs will be searching the satellite's directory

for interesting mail. Well-chosen words will ensure that all interested in your message's subject matter, have an opportunity to see it. One word of caution, once the ENTER key is depressed, no feature exists to re-edit your responses. So, check your entries carefully prior to committing them.

5.3.1.3.1 Source Address

Type your network address. PACSATs do not restrict this field to an amateur callsign, but you should use your callsign unless you have a specific reason for doing otherwise.

5.3.1.3.2 Destination Address

Type the network address of the station(s) to whom you are sending your message. Again, this should usually be an amateur callsign, unless otherwise necessary. If you are sending a file to multiple stations, separate each address with one space.

If the message is of general interest, use "ALL." Be sure to provide additional information about the message when prompted for keywords and message title.

5.3.1.3.3 Message Title

Make it meaningful. Size is limited to 255 characters, but should be as brief as possible. Scanning of the satellite's directory is done quickly because available time during a pass is extremely limited.

5.3.1.3.4 Keywords

A response is optional. Type a list of words or terms which describe your message content. Again, size is limited to 255 characters, but should be concise.

5.3.1.3.5 Message Expiration

The default expiration date is set at two days. You may change this date by entering any other digit. However, you must remember that storage onboard the satellite is limited, thus your file may be deleted sooner if needed.

5.3.1.3.6 File Type

Since you can send any type of binary or ASCII file on a PACSAT server, there must be some way of identifying the type of data in a file. The file type identifier is a number between 0 and 255. Some identifiers have been assigned as standard, and a short list is displayed for you to choose from when prompted for your response. Table 5.1 contains a more detailed listing of possible file types. Note that all files created via the Menu Option "CR" are text files. That is, choose Option 0 from the choices provided.

Table 5.1
File Type Identifiers

OPTION	DESCRIPTION
0	ASCII test
1	RLI/MBL message
2	RLI/MBL import file (multiple messages)
3	UOSAT whole orbit data
6	MSDOS .EXE file
7	MSDOS .COM file
8	Keplerian Elements (NASA format)
9	Keplerian Elements (AMSAT format)
10	DELETED
11	DELETED (?)
12	Multiple files (one or more non-ASCII)
13	Multiple files (all ASCII)
14	GIF format
15	PCX format
16	JPG format
17	Confirmation Message
200	Config. files U/L from command stations
201	AL FTL0/PB activity logs
202	BL broadcast logs

Table 5.1 (Cont'd)
File Type Identifiers

OPTION	DESCRIPTION
203	WD whole data logs
204	ADCS logs
205	TDE data
206	SCTE data
207	Transputer logs (including EISLOG)
208	SEU logs (ELTLOG)
209	CPE files (UO3)
210	Battery charge logs
211	Image files

5.3.1.3.7 Compression Method

All compression methods used via the file transfer mechanisms provided by this menu system use PKZIP. This is Option 2 of the choices provided.

If your file was previously compressed, prior to being compressed again by PKZIP, be sure to note this in the Keywords response section.

5.3.1.4 Exiting The File Header Application Program (PFHADD.EXE)

Upon entering all of your responses, PFHADD will apply the customized header to your file. You will be presented a screen which will redisplay all of your inputs (verifying that the header can be read) and some additional information. Within this additional information, you will notice that your filename has been given an ".out" extension. (Actually, your input file is copied into a file with the same name and an ".out" extension.) Any file with this extension, found in your uploads subdirectory, will be uploaded by the Satellite Transmission Software (PG).

If the desired "filename.out" output file already exists, no output file will be created and an error will be reported.

This will terminate the PFHADD utility and you will be returned to the Frequently Used Satellites Menu.

If PFHADD is terminated normally - without error, you will be able to view the screen described above and asked to "Press any key to continue." Upon completion, you will be returned to the Frequently Used Satellites Menu.

5.3.2 Sending File(s) to a Satellite

Now that you have prepared your file(s) for transmission, and the antenna has begun tracking the satellite, you are ready to send your file(s). But wait! Prior to performing any transmitting, you must first be thoroughly familiar with "good operating practices."

5.3.2.1 Good Operating Practices

Amateur radio cannot prosper without all amateurs understanding what "good operating practices" are and using them continuously. Using amateur satellites is no different; in fact, it is more important that you understand these practices as they apply to the satellites and always operate in the correct manner.

The first good practice is the oldest one around - LISTEN BEFORE YOU TRANSMIT! While you cannot "listen" to the noise packet radio makes to tell you what is happening, you must rely on what is being displayed across your computer screen and know how to interpret its meaning. So, prior to entering the SEND command at the Frequently Used Satellites Menu, you must first access the PB program, as if you wanted to receive messages. That is, enter the REC command for the appropriate satellite at the menu prompt. You really are interested in receiving messages at this time - specifically satellite status messages which will indicate whether or not it is safe to transmit.

Once you have obtained the satellite's downlink, direct your attention to the General Information Window. You will be looking for one of the following messages outlined below.

5.3.2.1.1 BBSTAT Status

Is the PBBS operating? Can you see any BBSTAT messages? If not, the BBS isn't running and trying to "work" it will cause needless transmissions. If it is there, it will look something like this:

PACSAT-12>BBSTAT:Open - This indicates that an uplink channel is open and awaiting a connection. Immediately exit PB (by depressing the "Q" key) and go to Paragraph 5.3.2.2.

PACSAT-12>BBSTAT:Full KG4TM KB9CML VE1HD WB9ANQ - This indicates that all uplink channels are being accessed by those amateurs with the callsigns listed. It is considered common courtesy to wait until you see the OPEN message before attempting to transmit.

PACSAT-12>BBSTAT:Shut - This indicates that the bulletin board is unavailable for connection at this time.

5.3.2.1.2 Status Line

You can't see BBSTAT messages at all? Look at the status line (last line displayed on the screen). Do you see "d:0" or "d:1"? If you see "d:0," this indicates that the digipeater is out of service; therefore, do not transmit or input any broadcast requests. If you see "d:1," this indicates that all is well and you may transmit if the PACSAT is not otherwise busy.

If the Status Line looks as shown below, or starts with an "A" rather than its normal appearance, don't transmit or input any broadcast requests.

A: 0x14C9, P:0x3000/ o:0 1:8700 f:8711 d:0 st:3

This type of Status Line indicates that the BBS and digipeater are not available because code uploading is in progress. Users should NEVER transmit when uploading of code is being performed. Notice, the "d:0" also indicates that transmitting should not be performed.

5.3.2.1.3 Plain ASCII Text

In the General Information Window, you may also see plain ASCII text indicating the status of the satellite. Command stations will usually post a brief message saying what is or will be happening to the satellite - such as, "reloading of code," "switching to raised cosine transmitter tomorrow," and "everything is ok now, use me."

5.3.2.1.4 MBL Mode

You can't see anything described above, but you are getting good signal strength on your transceiver? This means that the satellite may be in MBL (base or command) mode. In short, the satellite is broken. Don't transmit at all. If you happen to see something like this:

```
PACSAT-12:MBL
PACSAT-12:MBL
```

it means that the satellite is broken, and someone is trying to fix it.

5.3.2.2 Accessing the Satellite Transmission Software (PG)

Once you have determined that the satellite is open for connections and have exited PB, you are ready to actually transmit your file via the satellite transmission software, most commonly called "PG." PG is activated by entering the SEND command at the Frequently Used Satellites Menu prompt. For example, if you wanted to transmit files to AO-16 you would enter the following at the prompt, as shown below.

```
Enter Choice (e.g. REC B) and press Enter:  SEND A <Enter>
```

Upon entering this command, you will see a number of lines quickly scroll by on your screen. These lines contain pre-programmed configuration commands which are setting up the DSP-2232 for appropriate transmission. The scrolling will end with the presentation of a screen similar to that shown in Figure 5.3.

The automatic invocation of PG contains the commands to begin uploading all ".out" extension files as soon as a link is established with the satellite. You do not have to do anything the entire time you are in PG, with the exception of adjusting the Main Dial of the transceiver, to maintain the maximum signal strength possible.

5.3.2.2.1 PG Screen Displays

The PG display is divided into three parts. The Main Window is comprised of the first twenty-three lines of the screen. This window displays progress reports, function statuses, and Terminal Node Controller (TNC) commands to list a few. (While transmitting, the DSP-2232 will function as and be referred to as a TNC.) The twenty-fourth line is the Status Line and the twenty-fifth line is the Menu Line.

Again, the entire time you are in PG, you should not push any keys on the keyboard. Everything has been automated to keep the connection time to an absolute minimum, since other stations will be waiting to connect. However, you should have a basic knowledge of what this program is doing and how to operate it.

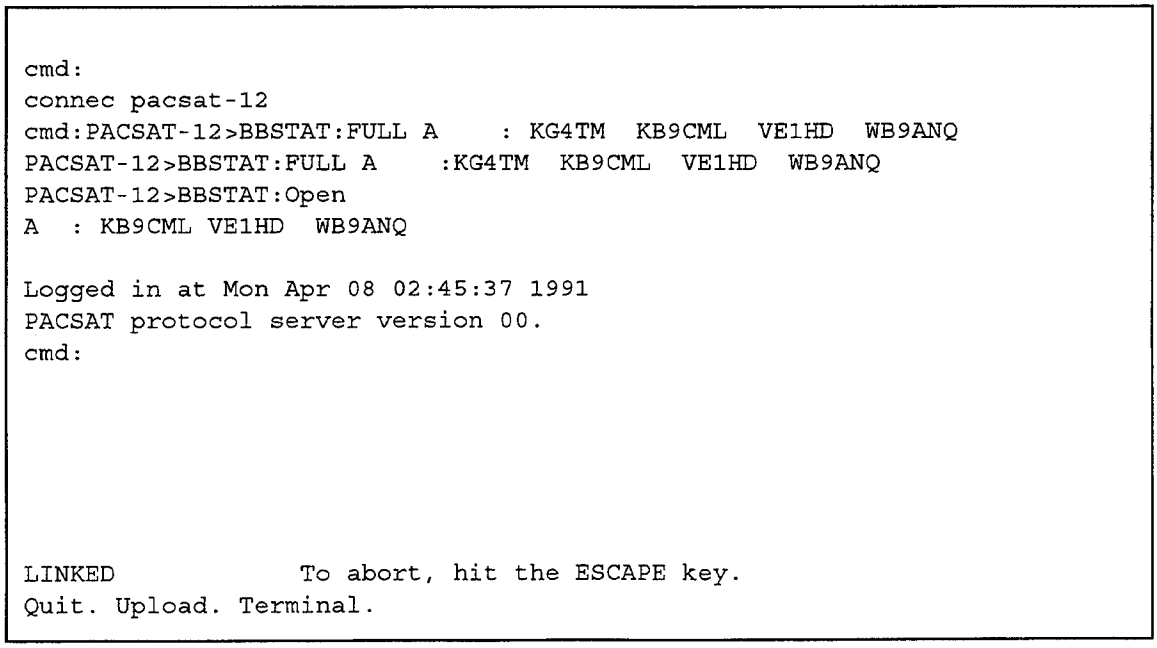


Fig.5.3. *Typical PG Display*

Menu Line

The Menu Line contains three menu option commands. These are QUIT, UPLOAD, and TERMINAL. To initiate one of these commands, merely depress "Q," "U," or "T."

Quit will terminate PG and return you to the Frequently Used Satellites Menu.

Upload will initiate the uploading of all ".out" or ".PUL" extension files. The ".PUL" extension file is discussed later in this chapter.

Terminal emulates a dumb terminal. While in Terminal Mode, return to PG's Main Menu by depressing the F1 key. To send a break signal to your TNC, depress the F2 key. To send any other commands to the TNC, simply type these commands followed by depressing the ENTER key. The TNC will respond to these commands and the response will be displayed on the screen. When you exit the Terminal Mode, PG will reconfigure itself for binary/transparent operation.

Status Line

The Status Line is located above the Menu Line. The first word in the Status Line will always relate to the current "state" of PG. The PG state will either be followed by program configuration information or a supplementary status message, such as shown below.

```
Ready|Pg.exe 920225k|Com1:19200|UOSAT5-12|K16QE-0
```

PG States

When a function is being executed, progress reports will appear in the Main Window, as the PG State Indicator is updated. The State Indicator tells you what PG is doing or waiting for. Table 5.2 contains all possible states that may be displayed.

Table 5.2
PG States

STATES	DESCRIPTION
Ready	The PG Main Menu is active. You can select functions.
Terminal	PG is in Terminal mode.
WAITING	PG is waiting for a BBSTAT "Open" message from the satellite.
BACKOFF	PG is getting ready to make a connect request.
REQUEST	PG has issued a connect request.
LINKED	PG is linked to the satellite, and executing a function.

When an communications function is completed, Ready will appear as the State Indicator. You can initiate a new communications function only in the Ready state.

To abort a communications function when the state is not set to Ready, depress the ESC (escape) key.

Link Establishment

In order to execute a communications function, PG must establish a link to the satellite. During link establishment, PG may go through the WAITING, BACKOFF, REQUEST, and LINKED states.

WAITING State

While in the WAITING state, PG is awaiting a free user position on the satellite. Each PACSAT supports a limited number of concurrent users and the rebroadcast times for beacon messages containing the BBSTAT status varies. In order to avoid a long wait on PACSAT and LUSAT satellites (which may be up to thirty seconds), PG makes an initial connect attempt before receiving a BBSTAT message. If this initial connect attempt fails, PG enters the standard WAITING state.

When PG does receive a BBSTAT:Open beacon, it enters the BACKOFF state.

BACKOFF State

If several stations are in the WAITING state, and PACSAT sends a BBSTAT:Open beacon, all of the stations might attempt to connect immediately. This would result in a collision on the uplink. In an attempt to limit the number of these types of collisions, PG implements a slotted random backoff mode. A random number R between 1 and <max_backoff> is generated. PG then waits (R * <backoff_slot> * 1/18) seconds before moving on to the REQUEST state. After executing the random backoff mode, the station that comes out of the WAITING state first will usually be the one to obtain the next connection.

REQUEST State

Once PG has moved on to the REQUEST state, a connect request is sent to the TNC. PG then waits for one of three events: to get connected; for a busy indication from the satellite; or, for a "retry count exceeded" message from the TNC.

If a connection is established, you will notice that the CON LED on the DSP-2232 will be lit and the PG state will change to LINKED. If a connection is not established, PG will return to the WAITING state.

LINKED State

Upon entering the LINKED state, the communications function will then proceed. You will also notice the byte 0x05 being displayed in the Main Window. This is the first protocol packet (commonly called FTL0) which is always sent to the satellite upon connection.

After the protocol package is sent, the Upload command is executed. (In manual mode, you must depress the "U" key.) This will initiate the upload process. You can watch the progress of the uploads on the screen. PG will advise you when the upload is complete and tell you the total bps and speed of the upload. If for some reason the upload was not

completed, do not worry. You will see the message below and PG will continue the same upload on the next pass you work:

Terminated without sending out all *.out files

PG renames all files after manipulation. If the file was successfully uploaded, the file will be renamed with a satellite assigned sequence number and a ".UL" extension. If the file was not completely uploaded, the file will be given the same sequence number and a ".PUL" extension. On the next upload attempt, PG will first attempt to upload any files with the ".PUL" extension prior to uploading the ".out" extension files.

Keep in mind that you should complete the upload (within two days or so) of any ".PUL" extension files before the satellite deletes the portion of the file that you successfully uploaded. If this happens, PG will continuously try to complete the upload, but will be unable to find the pointer to the file it thinks should be onboard the satellite. Should this occur, via DOS, go into that satellite's uploads subdirectory and delete the ".PUL" file PG continues to seek.

5.3.2.2.2 PG Error Messages

Should there be any error messages, you will see them appear in the middle of your screen and prior to being presented the PG Display. The messages may overlay existing text, but are frequently located below the DSP-2232 set-up configuration commands.

The most common error messages are "The CTS line is stuck off" and "TNC is not responding." The CTS line is located on the back of the CPU and is labeled as such. Occasionally the connector becomes disengaged from the port. To fix it, merely push the connection back together. The TNC error indicates you have not powered on your DSP-2232. Once the error(s) have been corrected, quit the screen by depressing "Q" and re-enter the SEND command at the Frequently Used Satellites Menu prompt.

If any other error messages appear, please consult your resources in an attempt to resolve its cause.

5.3.2.3 Exiting the Satellite Transmission Software (PG)

Upon exiting PG, you will be returned to the Frequently Used Satellites Menu.

5.3.2.3.1 Manual Method

Once you have noticed that all activity has stopped on your display screen, and you can no longer acquire a strong signal strength by manipulating the Main Dial on the transceiver, you should now exit the PG program. If you are still in a state other than Ready you must depress the ESC key until you get back to the Ready state. At the Ready state, you may now depress the "Q" key. This action will result in termination of the PG program.

5.3.2.3.2 Automated Method

Because the PG program has been automated, once all ".PUL" and ".out" files have been transmitted, the program will be automatically terminated. Should you depress the ESC key at any time prior to completing the file upload, PG will rename the file as described above and the program will be terminated.

Chapter 6

UPDATING ORBITAL ELEMENTS

6.0 Accessing a Local Bulletin Board System

The easiest way to obtain the most current list of orbital (or keplerian) elements is to access the NPS' Amateur Radio Club's BBS. Not only does this BBS contain information about orbital elements (called "keps"), it also contains just about all of the information a ham operator would need to keep abreast of current changes in the world of amateur radio. In order to access this BBS, the below listed procedures must be performed. Connecting to other BBS' is exactly the same procedurally; however, station specific changes (e.g., antenna placement, frequency settings, destination callsigns, etc.) must be considered.

It is not necessary to update the orbital elements on a daily or even weekly basis. However, it certainly won't hurt to have them updated more often.

6.1 Configuring the Satellite/Terrestrial Port Controller

In order to connect to the NPS' Amateur Radio Club's BBS, you must first refer to Appendix F to determine the appropriate Satellite/Terrestrial Port Controller Settings. You will be looking for K6LY, which is the destination callsign for this BBS. A connection cannot be made, unless this unit is properly configured. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

6.2 Configuring the ICOM Multiband Transceiver

Appendix F lists the Memory Channel assignments which have been pre-programmed for access to the K6LY BBS. Ensure that the LCD Display shows the proper frequency assignments listed in Appendix E. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

6.3 Redirecting the Antenna

Because you will be attempting to connect to a ground station, the rotors will not be engaged for automatic tracking. Therefore, you must manually move the antenna. In order to connect to K6LY's BBS, you should direct the antenna to approximately 285° looking at the Azimuth Meter display and approximately 112.5° looking at the Elevation Meter display. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

6.4 Manipulating the Menu System

In order to view, receive or transmit files from a BBS, you must enter Menu Option 1 at the Main Menu prompt. This action will invoke the PROCOMM software program.

6.4.1 Using PROCOMM

PROCOMM is a communications software program which enables you to perform all of the functions PB and PG did, but it is used for terrestrial-based destinations. While in PROCOMM, you may access the help screen by simultaneously depressing the ALT and F10 keys. Upon entering PROCOMM, you will be in the Terminal Mode and will be presented with a blank screen. If you depress the ENTER key, you will see the following response.

cmd:

This prompt should look familiar. It is the prompt sent by the DSP-2232 unit. Thus, PROCOMM is a utility that actually communicates via the DSP-2232.

Referring to Appendix F, enter the modem command to configure the DSP-2232 with the proper modem to connect to the BBS. (Recall Chapter 2 discussed the basic operation and manipulation of this unit.)

Next enter your callsign as shown below.

cmd:**MYCALL yourcall/yourcall** <Enter>

You will see a response similar to this:

```
was KD6SUM
now KD6SUM/KD6SUM
cmd:
```

Finally, enter the connect command followed by the destination callsign or address as shown below. The connect command may be abbreviated by simply typing "C."

cmd:**C K6LY** <Enter>

If the DSP-2232 is able to acquire a link, you will have connected to the BBS.

6.4.1.1 Working NPS' Amateur Radio Club's (K6LY) BBS

Once you have established a connection, you will be presented with a welcome screen. When you are presented with the prompt, you may depress the "?" key to get a help menu. In order to obtain a current listing of orbital elements, you must first determine which messages contain these elements. At the prompt type the command to list all messages which contain the word "elements" in its title, as shown below.

>**l"elements"**

You will see a response similar to that depicted in Figure 6.1. Notice AMSAT breaks down the orbital elements by satellite category. NASA originated messages contain the same information that AMSAT messages do, however all of the satellites are compiled in one listing.

Select either the AMSAT Satellite and Misc messages or the NASA message. (A NASA message does not appear in the figure.) Although the AMSAT messages are actually easier to work with, it doesn't matter which you choose. You should, however, try to choose the message that is most current.

```
...Log File Opened...
>
l"elements"
MSG # TR  SIZE TO     FROM   @BBS   DATE    TITLE
 5227 B#  6155 KEPS   K5ARH  AMSAT  940912 Orbital Elements  252.WEATHER
 5223 B#  2600 KEPS   K5ARH  AMSAT  940912 Orbital Elements  252.MISC
 5222 B#  4884 KEPS   K5ARH  AMSAT  940912 Orbital Elements  252.MICROS
 5220 B#  3733 KEPS   K5ARH  AMSAT  940912 Orbital Elements  252.OSCAR
 4967 B#  1914 STS64  KG5U   ALLUS  940909 STS-64 prelaunch elements
Enter right 3 digits of msg #'s to read or enter for none 223
MSG # TR  SIZE TO     FROM   @BBS   DATE    TITLE
 5223 B#  2600 KEPS   K5ARH  AMSAT  940912 Orbital Elements  252.MISC
Forwarding path: N6IYA WD6CMU KA6EYH KA6EYH WB0TAX N5UXT K5ARH

HR AMSAT ORBITAL ELEMENTS FOR MANNED AND MISCELLANEOUS SATELLITES
FROM WA5QGD FORT WORTH,TX September 9, 1994
BID: $ORBS-252.M
TO ALL RADIO AMATEURS BT

Satellite: POSAT
Catalog number: 22829
Epoch time:      94243.20371906
Element set:     313
Inclination:       98.6454 deg
RA of node:       318.3232 deg
Eccentricity:    0.0010119
Arg of perigee:   342.4454 deg
Mean anomaly:      17.6372 deg
Mean motion:   14.28038204 rev/day
More? [Y]es, No or Continuous C

...Remainder of Message Purposely Deleted...

*** END OF MSG # 5223 from K5ARH @ K5ARH.#LFTLA.LA.USA.NA
Press Enter to continue
>
...Log File Closed...
bye
KD6SUM de K6LY: 73 --- NPSARC
*** DISCONNECTED: K6LY
cmd:
```

Fig.6.1. *Typical BBS Activity*

Prior to displaying the message you have chosen, you first want to capture it to a file. Depress the ALT and F1 keys simultaneously. This will open a log file. From this point on, all activity displayed on the screen will also be sent to this file. PROCOMM will ask you if you want to use the

this file. PROCOMM will ask you if you want to use the default file or enter a new filename. You will need to access this file later so you should type in something that is familiar to you, such as ELEMENTS.

After you have opened the log file, you may now display the contents of the elements file by entering the appropriate command. Usually, you will be asked to enter the right three numbers corresponding to the message number of interest. Type those numbers and press ENTER. If you find yourself at a prompt, without this solicitation, enter the read command followed by the message number, as shown below.

>r 9834

6.4.1.2 Exiting NPS' Amateur Radio Club's (K6LY) BBS

Once the contents of the file(s) have been displayed, simultaneously depress the ALT and F1 keys again. This will close the log file. You may now exit the BBS by typing "bye" at the prompt. You will then be logged off and returned to the Terminal Mode.

6.4.2 Exiting PROCOMM

To exit PROCOMM depress the ALT and "X" keys simultaneously. You will be asked if you want to exit to DOS, yes or no? Depress the "Y" (yes) key and press ENTER. You will now be returned to the Main Menu screen.

6.4.3 Setting the Computer System's Clock and Date

Prior to actually updating the orbital elements, you should first ensure that the computer system's clock and date are accurate. In order to do this, you must exit the menu system by entering Menu Option 4. You will then be at your root directory, with the root directory prompt.

At the prompt, enter the following commands and type in the correct time and date as shown. If the time and date are accurate, simply depress ENTER. (This example assumes F:\ is your root directory.)

F:**time** <Enter>
Current time is 9:34:07.34a
Enter new time: **9:36:08a** <Enter>

F:**date** <Enter>
Current date is Tue 08-24-1994
Enter new date: **<Enter>** (the date was accurate)

F:**menu** <Enter> (this will return you to the Main Menu)

6.4.4 Accessing INSTANT*TRACK*

A subutility, provided by the INSTANT*TRACK* software, has the ability to automatically update orbital elements. At the Main Menu screen enter Menu Option 2. You will be presented with INSTANT*TRACK*'s Main Menu. At the menu prompt, select Menu Option 5 (Update Satellite Elements). You will now be presented with the Update Satellite Elements Menu shown in Figure 6.2.

```
09/12/94 23:07:12 UTC     Update Satellite Elements

Action Desired:
  1. ALL:    Read in elements for ALL satellites in file.
  2. ONE:    Read in elements for ONE specific satellite.
  3. UPDATE: Read in elements for ALL satellites EXCEPT those
             for which the program already has newer elements.
  4. OLD:    Delete satellites with old orbital elements.
  5. CRASH:  Delete satellites that have crashed.
  6. DELETE: Delete a satellite manually.
  7. SQUISH: Compact the satellite elements database.
  8. EDIT:   View / Edit satellite elements by hand.
  Q. QUIT:   Return to main menu.

Selection:

-------------------------------------------------------------------------

          ao-10     ao-13     ao-16     do-17     lo-19     fo-20
  Azim    99.745°  220.707°   53.311°  139.951°  232.959°  188.650°
  Elev    -8.171°  -50.884°  -46.302°  -71.820°  -36.798°   -0.326°
```

***Fig.6.2.** INSTANTTRACK's Update Satellites Menu*

Select Menu Option 3. This option will update all satellite elements, except those that already contain more recent data.

Upon executing this step you will see the request below. Enter the appropriate response, at the prompt.

File format:

1. AMSAT format file.
2. NASA format file.

Selection:

You will then be asked to enter the name of the file that is in AMSAT or NASA format. Continuing our example, we stored the AMSAT elements in the file called ELEMENTS which is loaded under the PROCOMM directory. Thus, having chosen Menu Option 1 from the above choices, we would respond as indicated below.

Enter name of file in AMSAT format: **F:\PROCOMM\ELEMENTS**

The file will be located and all applicable elements will be updated. Had you chosen a NASA formatted file, the process would have been the same. The only exception is that when INSTANT*TRACK* is processing the elements, it doesn't automatically bypass any extraneous characters that may be in the file. In this case, continue to depress the ENTER key when presented with what appears to be an error.

6.4.5 Exiting INSTANT*TRACK*

Once you have completed updating the orbital elements, depress "Q" (quit) two times to exit the program. The first "Q" will leave the Update Satellite Elements Menu and the second "Q" will terminate the program.

Chapter 7

CONTINGENCY PROCEDURES

7.1 Emergency Procedures

Although the Ham Station is not considered to be an essential equipment item. Some contingency procedures are available (although, as of this writing, a formal plan has not been documented) and you should be aware of them.

7.1.1 Electrical Power Outage

Should Bullard Hall lose electrical power, the Ham Station computer may not lose power, but the peripheral equipment most likely will. The SSAG Engineer's have purchased an Uninterrupted Power Supply (UPS) system which will provide at least fifteen minutes of power to all critical systems. Until such time that the entire Ham Station is upgraded to "critical equipment" status, it will not be connected to the UPS bus.

The UPS system is configured to remain on-line for approximately fifteen minutes. After fifteen minutes a generator will automatically take over power supply operations. This generator will last eight hours on a tank of either propane or natural gas. Upon completion of each tank of gas, the generator must be given about a twenty minute rest period, at which time the UPS can be re-engaged. Then the generator may be started again.

7.1.2 Natural Catastrophe or Other Equipment Failure

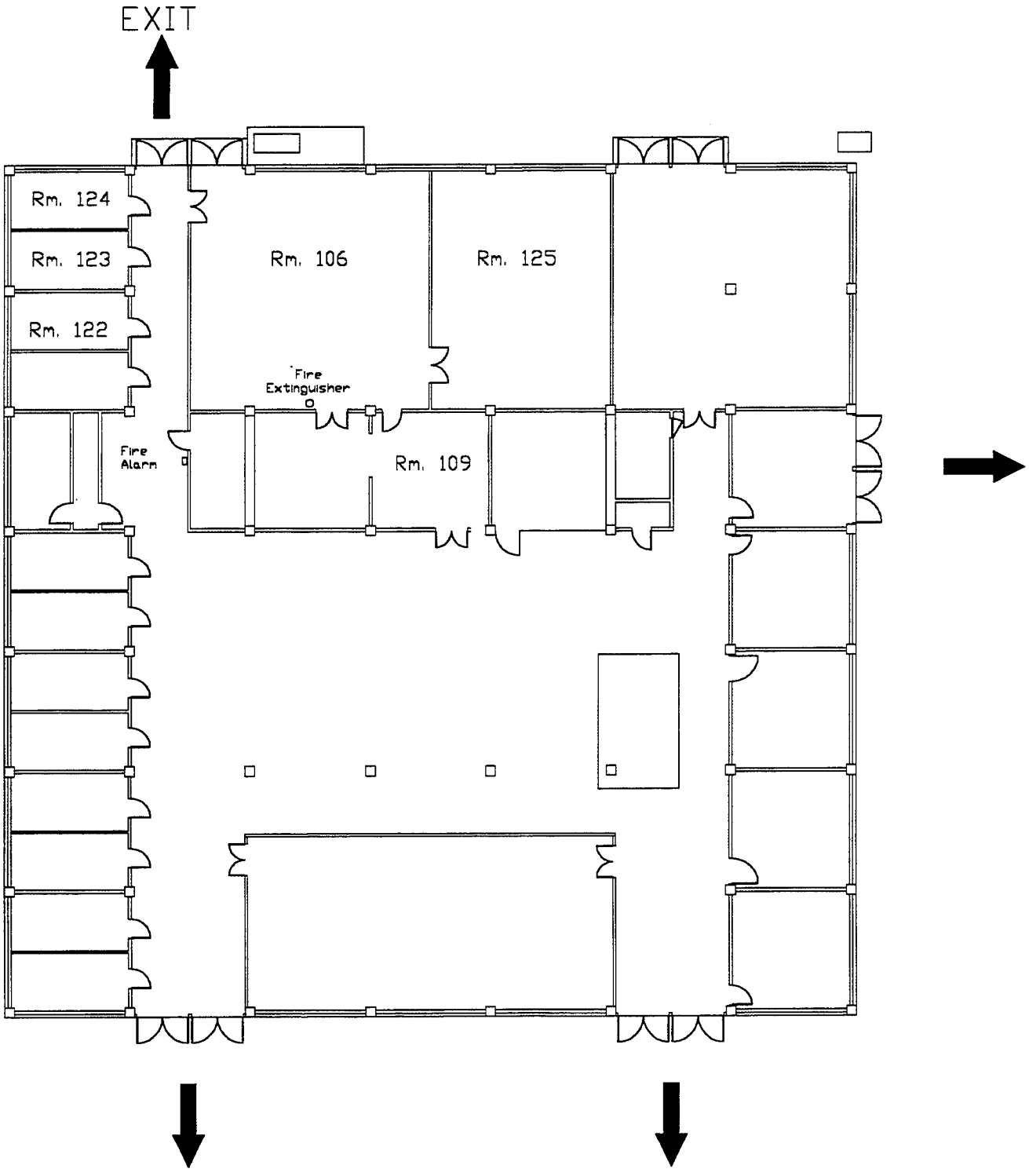
If a failure should occur in the antenna system or existing lines, or a natural catastrophe occurs at the master station location, a portable tower, radio, computer, generator and UPS system may be placed in a van and used anywhere. Again, the only requirement for prolonged operation is the access to natural gas or propane.

7.1.2 Fire

Appendix A contains the physical layout of the SSAG Engineer's spaces, the Ham Station location, and the fire escape routes from these areas.

APPENDIX A

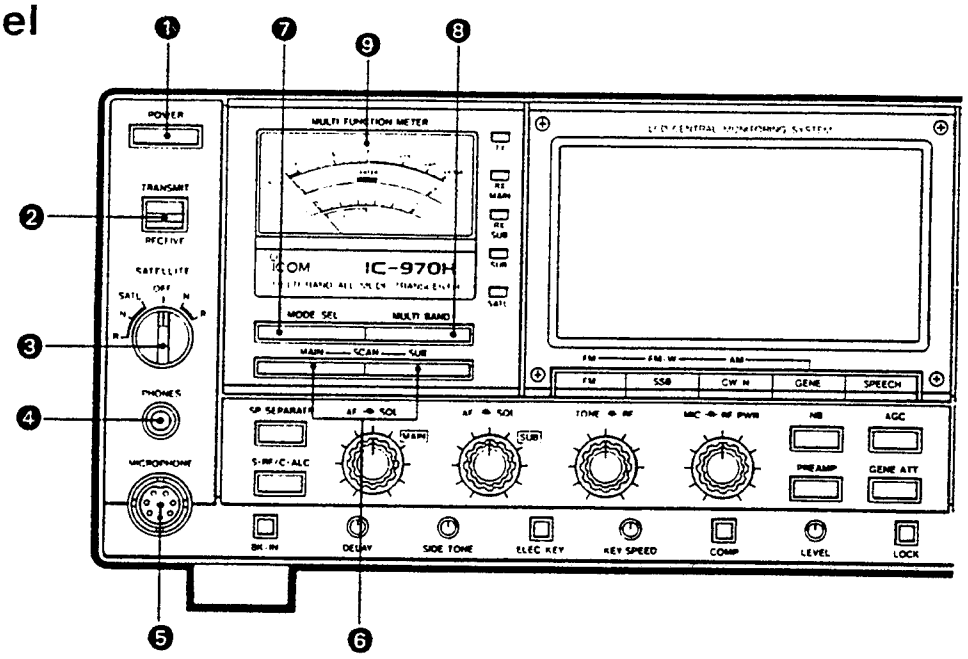
PHYSICAL LAYOUT OF SSAG SPACES


EXIT
Rm. 124
Rm. 123
Rm. 122
Rm. 106
Rm. 125
Fire Extinguisher
Fire Alarm
Rm. 109

APPENDIX B

ICOM TRANSCEIVER CONTROL FUNCTIONS

■ Front panel



❶ POWER SWITCH [POWER]
Turns power ON and OFF.

❷ TRANSMIT/RECEIVE SWITCH [TRANSMIT/RECEIVE]
Selects transmit or receive.

❸ SATELLITE SWITCH [SATELLITE]
Allows tracking operation for satellite communications.

• OFF
For normal operation. The MAIN and SUB bands have no frequency tracking relation.

• N (NORMAL)
The MAIN and SUB band frequencies simultaneously change in the same direction. (Normal tracking)

• R (REVERSE)
The MAIN and SUB band frequencies simultaneously change in the opposite direction each other. (Reverse tracking)

• SATL (SATELLITF)
Enters SATELLITE MEMORY mode. The [MEMO-CH] selector is used for satellite memory channel selection.

Use for programming frequencies. The MAIN and SUB band frequencies have no tracking relation.

• SATL-N (NORMAL)
When the [SUB] switch is ON: The MAIN band frequency simultaneously changes with the SUB band frequency in the same direction each other.
When the [SUB] switch is OFF: Only MAIN band frequency changes.

• SATL-R (REVERSE)
When the [SUB] switch is ON: The MAIN band frequency simultaneously changes with the SUB band frequency in the opposite direction.
When the [SUB] switch is OFF: Only the MAIN band frequency changes.

❹ HEADPHONES JACK [PHONES]
Accepts a standard 1/4 inch plug from 4 – 16 Ω mono or stereo headphones.

❺ MICROPHONE CONNECTOR
Accepts an optional microphone

❻ SCAN SWITCHES

• MAIN BAND SCAN SWITCH [MAIN-SCAN]
Starts and stops a scan function in the MAIN band.

• SUB BAND SCAN SWITCH [SCAN-SUB]
Starts and stops a scan function in the SUB band.

❼ MODE SELECT SWITCH [MODE-SEL]
Activates the mode-select function.

- [MEMO-CH] selects only the same mode memory channels as currently displayed mode.
- The mode-select scan is selected instead of the memory scan.

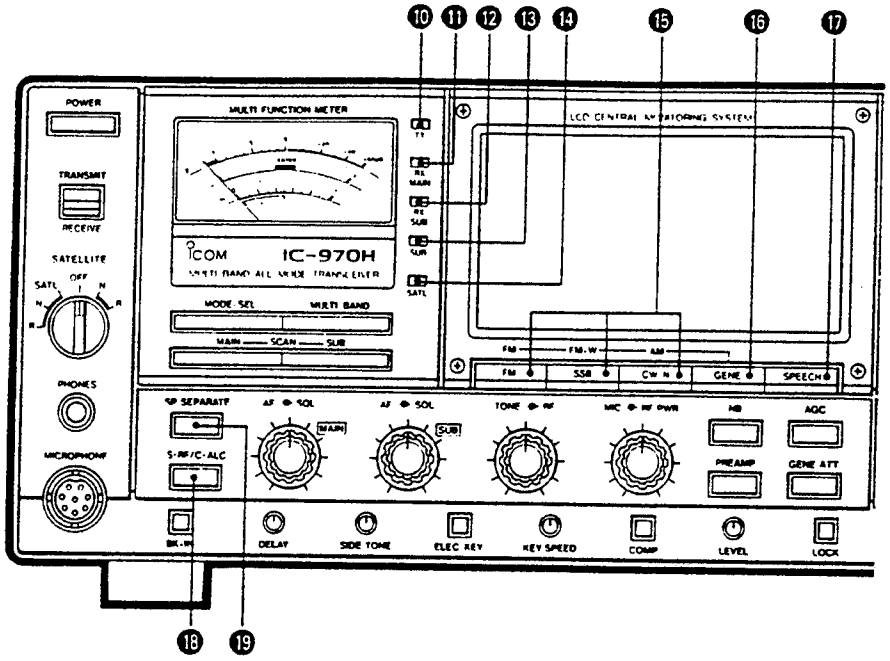
❽ MULTI-BAND SWITCH [MULTI-BAND]

Activates the multi-band memory function.

- [MEMO-CH] selects SUB band and undisplayed band memory channels (except the general coverage receiver band).
- The multi-band memory scan is selected instead of the memory scan.

The function can be used when an optional band unit is installed.

❾ MULTI-FUNCTION METER
Acts for the MAIN band. Functions as an S-meter (signal strength meter) or center meter while receiving and an RF meter or ALC meter while transmitting. See item ⓲ for selection.



⑩ TRANSMIT INDICATOR [TX]

Lights up in red while transmitting.

⑪ MAIN BAND RECEIVE INDICATOR [RX MAIN]

Lights up in green while the MAIN band is in receive with the squelch open.

⑫ SUB BAND RECEIVE INDICATOR [RX SUB]

Lights up in green while the SUB band is in receive with the squelch open.

⑬ SUB BAND INDICATOR [SUB]

Lights up in red when the SUB band control is selected.

⑭ SATELLITE INDICATOR [SATL]

Lights up in red when a satellite memory is used and lights up in green when the tracking operation is in the MAIN and SUB bands.

⑮ MODE SWITCHES

Select the desired operating mode.

FM wide (FM-W) and AM modes can be selected when an optional UX-R96 RECEIVE UNIT is installed.

⑯ GENERAL COVERAGE SWITCH [GENE]

Selects an optional UX-R96 RECEIVER UNIT.

⑰ SPEECH SWITCH [SPEECH]

Activates an optional UT-36 VOICE SYNTHESIZER UNIT for announcing the selected band (MAIN or SUB) frequency in English.

⑱ METER FUNCTION SWITCH [S-RF/C-ALC]

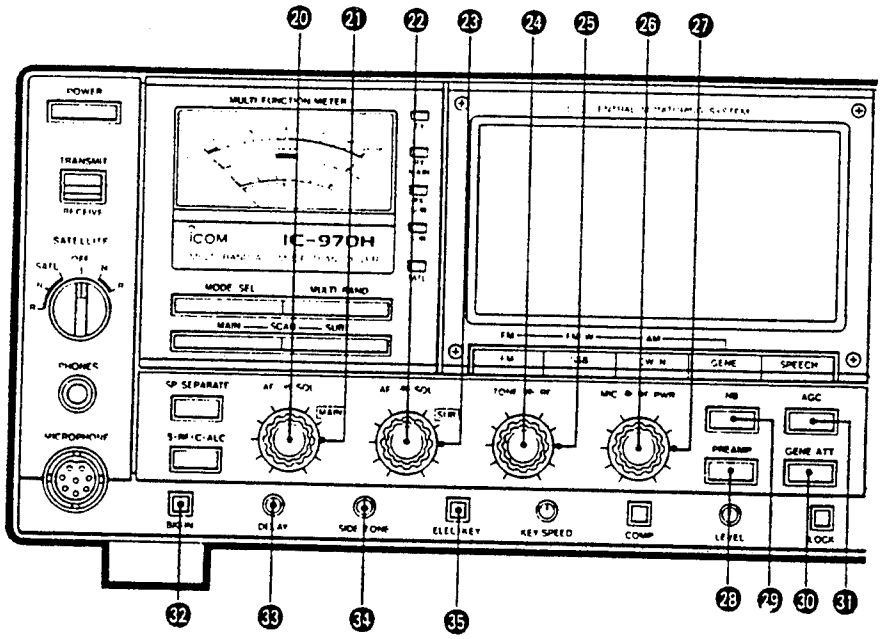
Selects the function of the multi-function meter ⑨ for the MAIN band as follows:

MODE	FM		SSB/CW	
	RECEIVE	TRANSMIT	RECEIVE	TRANSMIT
S-RF (OUT)	S-meter	RF meter	S-meter	RF meter
C-ALC (IN)	Center meter	ALC meter	S-meter	ALC meter

⑲ SPEAKER SEPARATE SWITCH [SP SEPARATE]

Selects the internal and external speaker combination as follows:

[SP SEPARATE] SWITCH	ON (IN)	OFF (OUT)
When no external speaker is connected.	The internal speker outputs the MAIN band audio only.	The internal speaker outputs both MAIN and SUB bands audio.
When an external speaker is connected.	The internal speaker outputs the MAIN band audio. The external speaker outputs the SUB band audio.	The external speaker outputs both MAIN and SUB bands audio.
When stereo headphones are connected.	The left speaker outputs MAIN band audio. The right speaker outputs SUB band audio.	The left and right speakers output mixed audios.



⑳ MAIN BAND AF CONTROL [AF]
Adjusts the MAIN band audio level.

㉑ MAIN BAND SQUELCH CONTROL [SQL]
Adjusts the MAIN band squelch threshold level.

㉒ SUB BAND AF CONTROL [AF]
Adjusts the SUB band audio level.

㉓ SUB BAND SQUELCH CONTROL [SQL]
Adjusts the SUB band squelch threshold level.

㉔ TONE CONTROL [TONE]
Adjusts the receive audio frequency response of the MAIN band.

The SUB band frequency response is fixed.

㉕ RF GAIN CONTROL [RF]
Adjusts gain at the MAIN band receiver RF stage.

The SUB band RF gain is fixed.

㉖ MIC GAIN CONTROL [MIC]
Adjusts the microphone input gain.

㉗ RF POWER CONTROL [RF PWR]
Adjusts transmit output power.

㉘ PREAMP SWITCH [PREAMP]
Activates an optional external preamplifiers.

NOTE: The antenna connectors of the displayed band frequencies output DC voltages when [PREAMP] is pushed IN. **BE CAREFUL** when connecting a non-Icom preamplifier or linear amplifier.

㉙ NOISE BLANKER SWITCH [NB]
Blanks pulse-type noise such as vehicle ignition noise from the receiving audio.

Noise blanker activates in SSB, CW and AM (optional) modes on both MAIN and SUB bands.

㉚ GENERAL COVERAGE BAND ATTENUATOR SWITCH [GENE ATT]
Attenuates receiving signals with 20 dB attenuation when an optional UX-R96 RECEIVER UNIT is selected.

㉛ AGC (Auto Gain Control) SWITCH [AGC]
Selects the time constant of the AGC circuit.

▙ : AGC slow
▙ : AGC fast

The SUB band AGC time constant is fixed as "slow" for SSB mode and "fast" for CW mode.

㉜ CW SEMI BREAK-IN SWITCH [BK-IN]
Activates the CW semi break-in function.

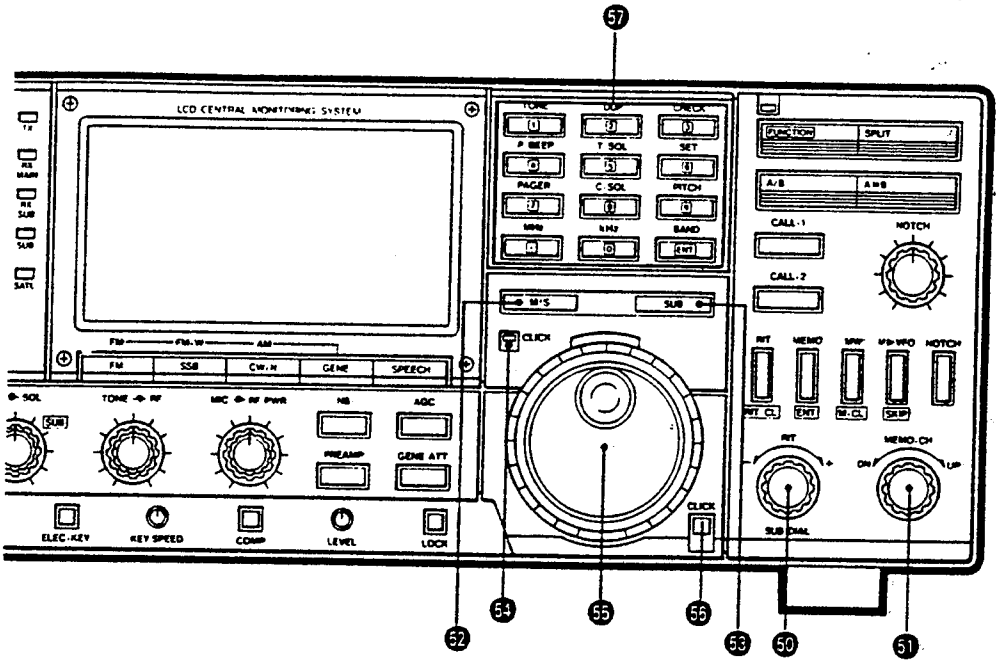
㉝ CW BREAK-IN DELAY CONTROL [DELAY]
Adjusts the transmit-to-receive switching delay time for CW semi break-in operation.

To activate this control, push IN [BK-IN] ㉜.

㉞ CW SIDE TONE CONTROL [SIDE TONE]
Adjusts the CW side tone level regardless of the [AF] control position.

㉟ ELECTRONIC KEYER SWITCH [ELEC-KEY]

Activates an optional IC-EX243 ELECTRONIC KEYER UNIT.



⑰ KEYBOARD

After pushing [FUNCTION], the keyboard functions as digit keys.

When [FUNCTION] has not been pushed, a key has its own function.

TONE [1]	Turns ON and OFF the subaudible tone encoder. Functions in FM only.	p. 22
DUP [2]	Selects – duplex, + duplex and simplex in sequence.	p. 22
CHECK [3]	Checks the transmit frequency when duplex is selected.	p. 21
P.BEEP [4]	Turns ON and OFF the pocket beep function. Functions in FM only.	p. 36
T-SQL [5]	Turns ON and OFF the optional tone squelch function. Functions in FM only.	p. 36
SET [6]	Sets the offset frequency, tone frequency and DTMF code.	pgs. 22
PAGER [7]	Turns ON and OFF the pager function. Functions in FM only.	p. 33
C-SQL [8]	Turns ON and OFF the code squelch function. Functions in FM only.	p. 33
PITCH [9]	Sets the tuning pitch. Functions in FM only.	p. 18
MHz [.]	Sets the tuning steps at 1 MHz.	p. 18
kHz [0]	Sets the tuning steps at 1 kHz.	p. 18
BAND [ENT]	Selects the operating band when an optional band unit is installed.	p. 16

⑱ RIT CONTROL [RIT]

When "RIT" appears on the MAIN band display: Sets the RIT shift frequency.

When "RIT" does not appear: Sets the SUB band frequency.

⑲ MEMORY CHANNEL SELECTOR [MEMO-CH]

Selects the memory channel.

⑳ MAIN/SUB BAND SWITCH [M/S]

Exchanges the MAIN and SUB bands.

㉑ SUB BAND SWITCH [SUB]

Accesses the SUB band for tuning purposes.

㉒ CLICK INDICATOR [CLICK]

Lights up while operating the dial click function.

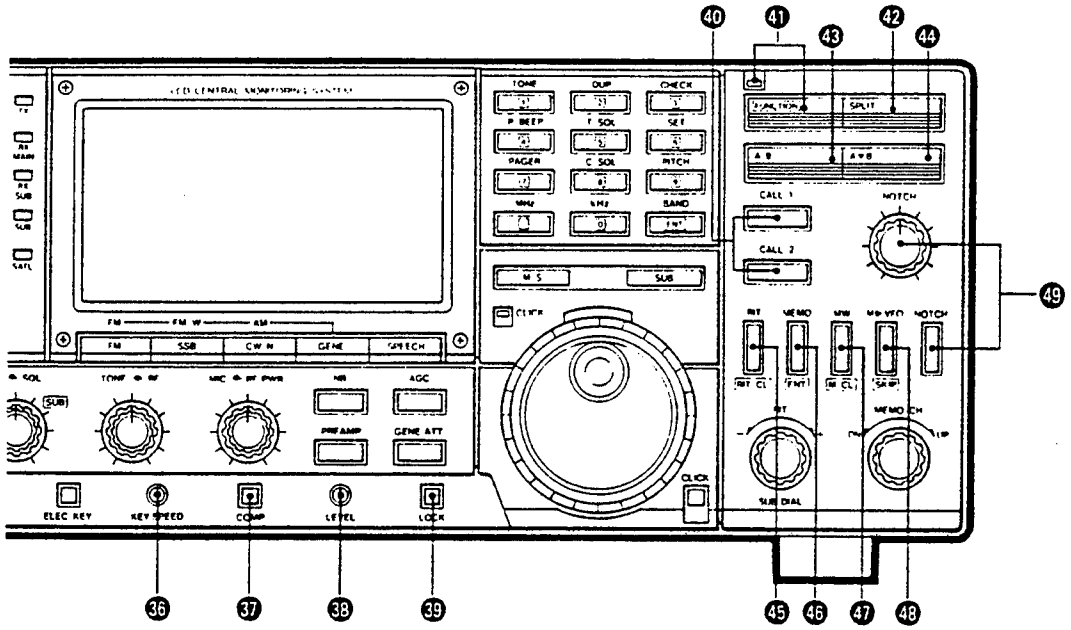
㉓ MAIN DIAL

Sets the displayed frequency.

㉔ CLICK SWITCH [CLICK]

Activates the dial click function.

The dial click function may not operate depending on the condition such as operating mode, internal S1 switch position, etc.



㊱ KEYING SPEED CONTROL [KEY SPEED]
Adjusts the keying speed when operating in CW mode with an optional IC-EX243.

To activate this control, push IN [ELEC-KEY] ㉟.

㊲ SPEECH COMPRESSOR SWITCH [COMP]
Activates the built-in speech compressor.

㊳ COMPRESSOR LEVEL CONTROL [LEVEL]
Adjusts the speech compressor level.

To activate this control, push IN [COMP] ㊲.

㊴ LOCK SWITCH [LOCK]
Deactivates the main dial and electrically locks the currently displayed frequencies.

㊵ CALL SWITCHES [CALL-1]/[CALL-2]
Call up a user-programmable call channel.

• **[CALL-1]**
The call-1 channel remains on one frequency in all bands.

• **[CALL-2]**
The call-2 channel remains on a frequency in each band.

㊶ FUNCTION SWITCH AND INDICATOR [FUNCTION]
The switch activates the secondary function of switches ㊺ ~ ㊽ and the keyboard for digit entry.

The red indicator lights up when the switch is pushed.

㊷ SPLIT SWITCH [SPLIT]
Selects split operation — Receiving on VFO A and transmitting on VFO B or vice versa.

㊸ VFO SWITCH [A/B]
Selects VFO mode and changes VFO A and B.

㊹ VFO EQUALIZING SWITCH [A = B]
Equalizes contents of the undisplayed VFO to the displayed VFO.

㊺ RIT SWITCH [RIT]
Activates the RIT (Receive Incremental Tuning) function.

After pushing [FUNCTION], this switch clears the displayed RIT shift frequency.

㊻ MEMORY SWITCH [MEMO]
Selects MEMORY mode.

After pushing [FUNCTION] and digit keys, this switch selects the memory channel directly.

㊼ MEMORY WRITE SWITCH [MW]
Stores the displayed frequency, mode and repeater informaion into the displayed memory channel.

After pushing [FUNCTION], this switch clears the displayed memory contents.

㊽ FREQUENCY TRANSFER SWITCH [M▶VFO]

Transfer the displayed memory or call channel information into a VFO.

After pushing [FUNCTION], this switch sets the skip function into the displayed memory channel.

㊾ NOTCH FILTER CONTROL AND SWITCH [NOTCH]

• **NOTCH SWITCH**
Activates the notch filter function to reduce an interference signal.

• **NOTCH CONTROL**
Adjusts the center frequency of the notch filter.

 The notch filter functions in the MAIN band only.

APPENDIX C

LIST OF TECHNICAL REFERENCES

The following document titles are provided for your information and review, should you need additional assistance in a specific area. (Publication information, etc., is listed in full within the Bibliography.) All of these documents should be located adjacent to the Ham Station, unless otherwise posted.

1. DSP-2232 Multi-Mode Data Controller User's Manual
2. ICOM Multiband Transceiver Instruction Guide
3. Yaesu Elevation-Azimuth Dual Controller Instruction Guide
4. PB and PG Update Documents

Other useful documents include:

1. The RS Satellites Operating Guide
2. The PACSAT Beginner's Guide
3. The AMSAT Digital Satellite Guide
4. Decoding Telemetry from the Amateur Satellites
5. The Satellite Experimenter's Handbook
6. A Beginner's Guide to OSCAR-13

APPENDIX D

SATELLITE DESCRIPTIONS

Telemetry aquisition and display of A-O-16, 18, 19 and U-O-22 is performed by 'DTLM.EXE' written by Jeff ward, G0/K8KA, available from AMSAT-UK, London, E12 5EQ.

A straight forward 70cm SSB/CW receiver is suitable for the CW TLM.

FREQUENCIES used for LUSAT-OSCAR 19 (LO-19)

Uplinks	145.840, 145.860, 145.880, 145.900 MHz (AFSK/FM)
Downlink (PSK)	437.15355 MHz (BPSK/SSB)
Downlink (RC)	437.12580 MHz (BPSK/SSB)
CW Beacon	437.125 MHz (CW)

Pat Gowen, G3IOR 1 May 1992

14129.SAT

Characteristics of AMSAT-OSCAR-10 (A-O-10)

This satellite was the first functional AMSAT-DL Phase-III satellite launched by ESA's ARIANE from French Guiana and placed by kick-motor firing into a highly elliptical orbit with a 36,000 Km Apogee and a 1,500 Km Perigee. The period is some 10 hours. It has two transponders, but the 'U' Mode 1269 MHz to 435 MHz transponder is no longer functional. OSCAR-10 is now on 435/145 MHz Mode 'B' continuously whilst the battery is well charged by a favourable sun-angle.

The Internal Housekeeping Unit has failed due to radiation damage, thus no transponder nor antenna switching is now possible. The end-of-arm beam antennas are inoperative, only the monopole antennas being actoivated. The telemetry beacon has failed leaving only a plain carrier. The batteries are aging, and due to no command capability remaining, the solar cells can no longer be steered into sunlight. Thus, users are requested NOT to use the transponder when poor regulation of the power supply is demonstrated by FM'ing of the beacon signal.

The uplink requirements for A-O-10 are accomplished by 25 - 50 watts of CW or LSB from any conventional 70cm TX to an azimuth/elevation controlled 12 X/Y Yagi or 10 turn RHCP Helix. The dowlink requires an azimuth and elevation controlled 10 element RHCP Yagi or 8 turn Helix to a low noise pre-amplifier at the antenna feeding any USB 2m RX.

Frequencies for AMSAT-OSCAR 10 (AO-10)

General Beacon	145.809 MHz (Unmodulated carrier)
Engineering Beacon	145.987 MHz (Switched off)
Mode B Uplink	435.030 - 435.180 MHz (SSB,CW)
Mode B Downlink	145.825 - 145.975 MHz (SSB,CW,inverting)

Pat Gowen, G3IOR 25 April 1992

The manning MIR cosmonauts are given amateur radio training and examinations by Boris Stepanove UW3AX and Leonid Labutin UA3CR, and have been allocated callsigns of elevating numeric 'U' then 'R' with 'MIR' suffix, e.g. U1MIR, U2MIR, etc., currently R0MIR.

MIR is equipped with with 2.5 watt and 25 watt 2m FM transceivers, an AX.25 1200 baud standard PACKET terminal and a MAILBOX R0MIR-1. These facilities can function simultaneously. The station has an additional add on that permits a continuous information bulletin transmissions or the re- transmission of uplinked earth calls on a one minute receive one minute transmit cycling basis. Soon 432 MHz transceivers may be added to the station. The antenna is a dual band 435/145 MHz 5/8 wavelength whip mounted on the spacecraft hull exterior adjacent to the main solar panel array.

Whilst the general VHF communications link frequency for MIR is 143.625 MHz WB FM, the normally used amateur radio frequency is S.22 (145.550 MHz) simplex 10 KHz deviation speech and PACKET FM, although specially nominated channels splitting uplink and downlink may be used for special events.

MIR is a strong signal, easily heard on any 2m FM receiver equipped with simple antennas. To actually work MIR, in theory a 1 watt hand held 2m transceiver would give an adequate signal, but due to the enormous level of activity heard within the spacecraft footprint from MIR's height, in practice a far higher eirp is needed to provide the FM capture effect to overcome QRM.

Whilst QSO's have been made from mobile and portable stations on earth at quiet times or from remote areas, in Europe and other high S.22 populated areas some 100 watts to a steerable azimuth/elevation tracking circularly polarised ten element Yagi is recommended for reliability in effective communications. QSL's are via RW3DR QTHR.

Pat Gowen, G3IOR 15th May 1994

20442.SAT

CHARACTERISTICS of LUSAT-OSCAR 19 (LO-19)

This satellite is one of the family of the MICROSATS launched by ESA from Kourou with the SPOT-II satellite in January 1990. Antennas as for those used for UO-14 (UoSAT-OSCAR-22) are recommended with a similar 145 MHz TX preferably with Varactor Drive. The 435 MHz SSB receiver needs to be equipped with AFC.

To demodulate the BPSK you will need a G3RUH FUJI BPSK Modem (or others for which please see WEBERSAT WO-18 etc) and a modified TNC with the original Modem disconnected. The software and micro requirements are the same as those recommended for U-O-14.

Programs such as PG.EXE (for transmit and receive) and PB.EXE (file reception etc) are suitable using the recommended TNC settings of FRACK 6 and MAXF 1

Frequencies RADIO SPUTNIK 10 (RS-10)

Beacon/ROBOT	29.357 MHz (CW)
Beacon/ROBOT	29.403 MHz (CW)
Mode A Uplink	145.860 - 145.900 MHz (SSB,CW)
Mode A Downlink	29.360 - 29.400 MHz (SSB,CW)
ROBOT A Uplink	145.820 MHz (CW)
ROBOT A Downlink	29.357 or 29.403 MHz (CW)
Beacon/ROBOT	29.357 MHz (CW)
Beacon/ROBOT	29.403 MHz (CW)
Mode K Uplink	21.160 - 21.200 MHz (SSB,CW)
Mode K Downlink	29.360 - 29.400 MHz (SSB,CW)
ROBOT K Uplink	21.120 MHz (CW)
ROBOT K Downlink	29.357 or 29.403 MHz (CW)
Beacon/ROBOT	145.857 MHz (CW)
Beacon/ROBOT	145.903 MHz (CW)
Mode T Uplink	21.160 - 21.200 MHz (SSB,CW)
Mode T Downlink	145.860 - 145.900 MHz (SSB,CW)
ROBOT T Uplink	21.120 MHz (CW)
ROBOT T Downlink	145.857 or 145.903 MHz (CW)

Frequencies for RADIO SPUTNIK 11 (RS-11)

Beacon/ROBOT	29.407 MHz (CW)
Beacon/ROBOT	29.453 MHz (CW)
Mode A Uplink	145.910 - 145.950 MHz (SSB,CW)
Mode A Downlink	29.410 - 29.450 MHz (SSB,CW)
ROBOT A Uplink	145.830 MHz (CW)
ROBOT A Downlink	29.407 or 29.453 MHz (CW)
Beacon/ROBOT	29.407 MHz (CW)
Beacon/ROBOT	29.453 MHz (CW)
Mode K Uplink	21.210 - 21.250 MHz (SSB,CW)
Mode K Downlink	29.410 - 29.450 MHz (SSB,CW)
ROBOT K Uplink	21.130 MHz (CW)
ROBOT K Downlink	29.407 or 29.453 MHz (CW)
Beacon/ROBOT	145.907 MHz (CW)
Beacon/ROBOT	145.953 MHz (CW)
Mode T Uplink	21.210 - 21.250 MHz (SSB,CW)
Mode T Downlink	145.910 - 145.950 MHz (SSB,CW)
ROBOT T Uplink	21.130 MHz (CW)
ROBOT T Downlink	145.907 or 145.953 MHz (CW)

Pat Gowen, G3IOR 27 April 1992

16609.SAT

CHARACTERISTICS of MIR

MIR (Meaning 'Peace' [and 'Earth']) is the USSR/Russian Federation continously manned Space Station that followed it's predecessor 'SALYUT' series into orbit on 19 February 1986. It has numerous modules attached such as KWANT-1, KWANT-II, KRISTALL and others that are given seperate NASA designators although part of the same object. It is in circular earth 51.6 degree inclination orbit of a period averaging some 92.3 minutes, a perigee averaging 363 Km and an apogee of 410 Km, but over a period of 3 to 5 weeks frictional drag will lower the orbit and decrease the period. It will then be boosted, placing the spacecraft again in to a higher orbit with increased period and lower mean motion. For this reason, orbital data needs to be constantly checked and updated by a rapid topical source such as the
AMSAT Nets, otherwise serious incremental tracking errors may result.

Frequencies for RADIO SPUTNIK 13 (RS-13) [Nominal - yet to be measured]

Beacon/ROBOT	29.458 MHz (CW)
Beacon/ROBOT	29.504 MHz (CW)
Mode A Uplink	145.960 - 146.000 MHz (SSB,CW)
Mode A Downlink	29.460 - 29.500 MHz (SSB,CW)
ROBOT A Uplink	145.840 MHz (CW)
ROBOT A Downlink	29.458 or 29.504 MHz (CW)
Beacon/ROBOT	29.458 MHz (CW)
Beacon/ROBOT	29.504 MHz (CW)
Mode K Uplink	21.260 - 21.300 MHz (SSB,CW)
Mode K Downlink	29.460 - 29.500 MHz (SSB,CW)
ROBOT K Uplink	21.138 MHz (CW)
ROBOT K Downlink	29.458 or 29.504 MHz (CW)
Beacon/ROBOT	145.862 MHz (CW)
Beacon/ROBOT	145.908 MHz (CW)
Mode T Uplink	21.260 - 21.300 MHz (SSB,CW)
Mode T Downlink	145.960 - 146.000 MHz (SSB,CW)
ROBOT T Uplink	21.138 MHz (CW)
ROBOT T Downlink	145.862 or 145.908 MHz (CW)

Note: RS-13 has not been activated for enough time over the UK to yet permit accurate frequency measurement within the confines of the Doppler shift. It would be appreciated, if heard, for a

Pat Gowen, G3IOR 25 April 1992

18129.SAT

CHARACTERISTICS of RS-10/11

The pair of transponders RS-10 and RS-11 are mated to a NAVSAT satellite launched from the USSR in 1987, and are powered from the major spacecraft's supply. They are in a circular orbit of altitude 1000 Km with a 105 minute period. At this time the RS-10 satellite on mode 'A' is active continuously, with RS-11 kept in reserve. Various transponder modes are possible, 'A', 'K', 'T', and combined 'KT' or 'KA'. The telemetry beacon(s) send the housekeeping information in Morse Code 20 wpm CW. The ROBOT may be called at any speed between 6 and 50 wpm and will respond at the called speed. The formula is 'RS10 de G9XXX AR'. The return instructive response may be 'QRZ', 'RPT', 'QRS', 'QRQ', etc., but when your call is correctly entered, it will respond to you fully and give a QSO number.

For 'A' mode only 10 watts of 2m CW or USB to a 5 element trained Yagi or 50 watts to a Ground Plane or Crossed Dipole (Turnstile) are needed, which need not be circularly polarized. For the 10m downlink, a sloping dipole or ground plane to the shack receiver will suffice, although a 10m beam works better for DX. If the receiver is old, then a pre-amplifier will improve the signal to noise. For Mode 'K' and 'T' needs see RS-12/13.

21089.SAT

CHARACTERISTICS of RS-12/13

RS-12 and 13 were launched at 0236 UTC on February 5 1991 into a 1019 Km apogee 961 Km perigee 83 degree inclination 104.87 minute period orbit. They are a pair of seperate transponders matched to a major scientific satellite, obtaining their power supplies from that source. The transponders are basically alike, and have similar modes to their predecessors RS-10 and 11, to which please refer for the main characteristics and full functioning information.

Whilst RS-10 and 11 are maintained in mode 'A' (145/29 MHz) transponder operation, RS-12 is currently activated in 'K' mode, 21 MHz uplink, 29 MHz downlink. RS-13 is presently kept on standby. From time to time 'T' mode with the 21 MHz uplink and 145 MHz downlink, often in tandem with 'K' ('KT' mode) will come on. Later operation may revert to 'A' or 'KA' mode.

Mode 'K' is a fascinating mode which permitted the first mutual sub-horizon and antipodal satellite QSO between G3IOR and ZL1APM. It can provide fascinating ionospheric findings and propogational information according to satellite signal path insolation.

Low angle high gain beams are neither vital for the strong 29 MHz downlink nor for the 21 MHz uplink, although they may help to reduce the QRM from FM stations invading the satellite band. Simple antennas such as ground planes, long wires and dipoles with some 50 watts of 21 MHz SSB or CW can produce sub-horizon access permitting DX QSO's when neither 21 nor 29 MHz are open for communication. As most amateurs have HF transceivers available, this mode permits large numbers of the rarer DXCC countries that to be active via satellite that are not equipped for VHF and UHF.

Frequencies for RADIO SPUTNIK (RS-12)

Beacon/ROBOT	29.408 MHz (CW)
Beacon/ROBOT	29.454 MHz (CW)
Mode A Uplink	145.910 - 145.950 MHz (SSB,CW)
Mode A Downlink	29.411 - 29.451 MHz (SSB,CW)
ROBOT A Uplink	145.831 MHz (CW)
ROBOT A Downlink	29.408 or 29.454 MHz (CW)
Beacon/ROBOT	29.408 MHz (C)
Beacon/ROBOT	29.454 MHz (CW)
Mod K Uplink	21.210 - 21.250 MHz (SSB,CW)
Mde K Downlink	29.411 - 29.451 MHz (SSB,CW)
OBOT K Uplink	21.130 MHz (CW)
ROBOT K Downlink	29.408 or 29.454 MHz (CW)
Beacon/ROBOT	145.913 MHz (CW)
Beacon/ROBOT	145.959 MHz (CW)
Mode T Uplink	21.210 - 21.250 MHz (SSB,CW)
Mode T Downlink	145.917 - 145.956 MHz (SSB,CW)
ROBOT T Uplink	21.130 MHz (CW)
ROBOT T Downlink	145.913 or 145.959 MHz (CW)

20437.SAT

CHARACTERISTICS of OSCAR-14 (Uo-14 or UoSAT-D)

This satellite, also known as UoSAT-D, was designed and built by the UoSAT University of Surrey AMSAT Group. It was launched with the microsat cluster with the ARIANE SPOT-II launch from Kourou in January 1990.

It runs on 9600 bauds which requires a G3RUH (or K9NG) modem for this very high baud rate speed, and a modified TNC with the original modem disconnected. (The TNC-320 and PK-232 are not recommended). An IBM micro with PG software or an ATARI with PE1HCL.NET software running completes the needs for 9600 bauds operation.

For the 145 MHz FM uplink use a 5 element cross or circularly polarized Yagi from a 25 watt transmitter with direct modulation of the varactor. The 435 MHz FM receiver must possess 20 KHz bandwidth and have output taken direct from the discriminator. The receive antenna ideally needs to be a 435 MHz 12 X/Y or multibeam. Both antennas require azimuth-elevation track pointing.

FREQUENCIES and MODES for UoSAT-OSCAR 14 (UO-14)

Uplink	145.975 MHz (FSK/FM) 9600 bps PSK AX.25.
Downlink 1	435.070 MHz (FSK/FM) .
Downlink 2	435.070 MHz (AFSK/FM) 1200 bps AFSK etc.

NOTE: At this point in time UoSAT-D is in use for third world support VITA and SATELIFE mission medical communications on specially allocated frequencies just outside our 435 and 145 MHz amateur bands. The heavier load of amateur traffic is now provided exclusively on UO-22 which has a greater memory capacity and two uplink frequencies.

Pat Gowen, G3IOR 27 April 1992

20441.SAT

CHARACTERISTICS of WEBERSAT-OSCAR 18 (WO-18)

This satellite is one of the family of the MICROSATS launched by ESA from Kourou with the SPOT-II satellite in January 1990. Antennas as for those used for UO-14 (UoSAT-OSCAR-22) are recommended with a similar 145 MHz TX preferably with Varactor Drive. AFC is not required as the modem tracks the Doppler shift up and down by 'clicks'.

WEBERSAT has a Impact Detector, sends picture images, and Whole Orbit Data (WOD) thus providing a high scientific research user basis.

To demodulate you will need a BPSK Modem and a modified TNC with the original Modem disconnected. The software and micro requirements are the same as those recommended for U-O-14. Modems recommended by G4WFQ for 1200 bps BPSK are G3RUH JAS-1, Pac-Comm PSK-1, TAPR PSK Modem, LL Grace DSP-12, and DSP-2232. Modems suitable for 9600 bps FSK are G3RUH, Pac-Comm NB-96, Kantronics DE9600, Tasco TMB-965, K9NG, Gracelis PackeTwin, LL Grace DSP-12 and DSP-2232.

Software requirements for WEBERSAT: Capture RAW KISS data with any dumb terminal program that stores frames to disc, without stripping 8th bit, i.e. TLMDC-11, YAPP-B, etc.

'WEBERWARE 1.0', available from AMSAT-UK, London, E12 5EQ, will process and display the camera picture images.

Telemetry aquisition and display of A-O-16, 18, 19 and U-O-22 is performed by 'DTLM.EXE' written by Jeff Ward, G0/K8KA, available from AMSAT-UK, London, E12 5EQ.

FREQUENCIES used for WEBERSAT-OSCAR 18 (WO-18)

Downlink (PSK)	437.0751 MHz (BPSK/SSB)
Downlink (RC)	437.1020 MHz (BPSK/SSB)
Uplink ATV (NTSC)	1265.000 MHz (TV/AM)

Pat Gowen, G3IOR 1 May 1992

21575.SAT

CHARACTERISTICS of OSCAR-22 (UoSAT-F) (UoSAT-5) (U-O-22)

This gravity gradient stabilized satellite is yet another from the University of Surrey AMSAT Group's stable. It was launched with SARA-OSCAR-23 into a 780km high 98 degree inclination orbit by ESA on ARIANE. It is fundamentally similar to UoSAT-14, but has a greater memory capacity (512 KBytes providing 800 messages) and two seperate uplink frequencies. Please see the details for OSCAR-14 (U-O-14) for the transmit, receive, antenna and ancillary equipment needs for this satellite, which like UoSAT-14 also sends AX.25 data at 9600 bps on the downlink. Similar programs may be used.

UO-22 also carries a camera with a 110 degree wide-angle lens which gives a broad field of view, this giving superb earth pictures broadcast using the PACSAT protocol. Images represent an earth coverage of 1600 x 1800 km. Each image is 578 x 576 pixels, giving a ground resolution of some 2 Km. (A pixel is 8 bits, giving a black and white image with 256 grey levels).

Telemetry aquisition and display of A-O-16, 18, 19 and U-O-22 is performed by 'DTLM.EXE' written by Jeff Ward, G0/K8KA, available from AMSAT-UK, London, E12 5EQ.

UoSAT-F FREQUENCIES:

Single Channel Downlink on 435.120 MHz, 9600 bps FSK, (1200 bps AFSK backup) with commandable 5 or 2 watts of power.

Uplinks: 145.900 and 145.975 MHz. (Geoff Ward, G0/K8KA, controller at the Unversity of Surrey recommends broadcast requests and other PB operations on 145.900 MHz whilst uploaders use 145.975 MHz). Uplink is 9600 bps FSK (1200 bps AFSK backup).

N.B.: Note that this satellite is highly popular for forwarding long distance packet radio messages, and is hence in high use with access difficulties often evidenced due to this factor.

Casual listeners using a normal 435 MHz receiver will not hear tonal frequencies as such, but may notice a slight audio content with elevated 'S' meter readings.

Pat Gowen, G3IOR 1 May 1992

20439.SAT

INFORMATION ON PACSAT, OSCAR-16, A-O-16, Indicator PACSAT-12.

This satellite is one of the family of the MICROSATS launched by ESA from Kourou with the SPOT-II satellite in January 1990. Antennas as for those used for UO-14 (UoSAT-OSCAR-22) are recommended with a similar 145 MHz TX. The 435 MHz SSB receiver needs to be equipped with AFC.

It runs a BBS, transmits 1200 bps AX.25 PSK on a frequency of 437.025 MHz, and has uplinks at 145.900, 145.920, 145.940 and 145.960 MHz. A special PSK modem TNC adaptation is required. As for all these microsats, antennas as used and given for UO-14 are recommended. The 145 MHz FM Tx is as for UO-14, with varactor drive desirable. 100 watts of FM is recommended as an uplink. e.g. 10w to a 10 dB gain preferably circularly polarised az- el adjustable 2m antenna. A Helix 10T or similar gain circularly polarised
10 - 14 dB gain 435 MHz receiving antenna is recommended.

The 435 MHz SSB Rx needs to be equipped with AFC. Use a G3RUH FUJI BPSK modem and a modified TNC with the original modem disconnected. The software and micro may be as for UO-14. For the AO-16 2400 MHz downlink only, a simple helix can be used going to a 13cm/2m or 10m converter, with the same modem and TNC as used for 435 MHz reception.

PC Software such as the PG.EXE programmes is needed (for transmission and reception), or PB.EXE for the numerous files reception. The server line are needed to access is:

bbscall pacsat-11

Change your normal TNC parameters to: FRACK 6
MAXF 1

Telemetry aquisition and display of A-O-16, 18, 19 and U-O-22 is performed by 'DTLM.EXE' written by Jeff Ward, G0/K8KA, available from AMSAT-UK, London, E12 5EQ.

Pat Gowen, G3IOR 1 May 1992

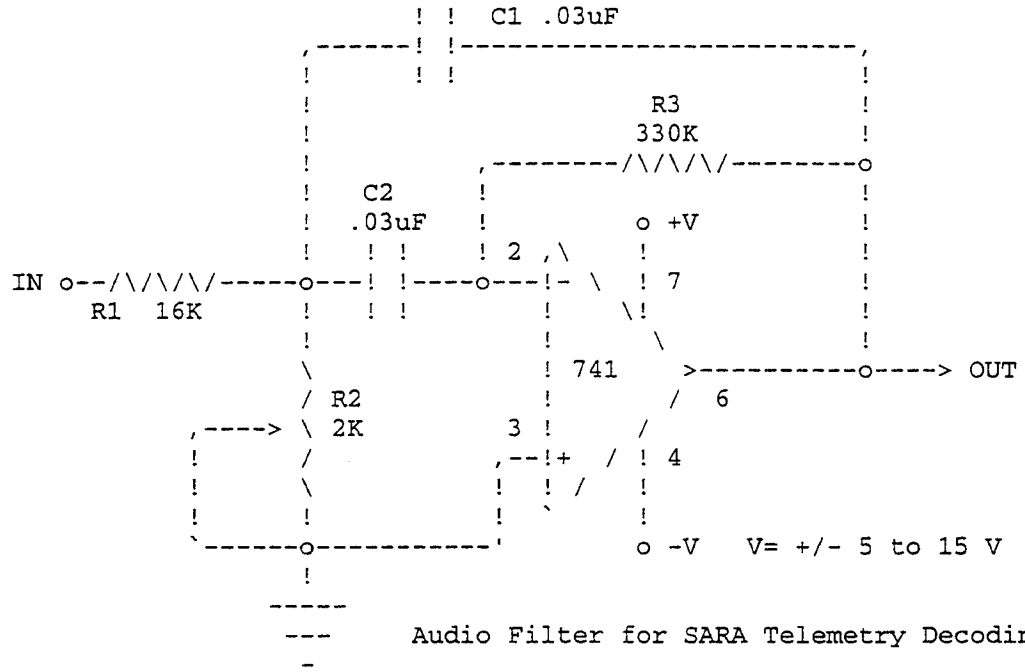
21578.SAT

Characteristics of SARA NASA Cat.No. 21578

SARA is an acronym of 'Satellite Amateur de Radio-Astronomie' (Amateur Radio Astronomy Satellite), a very small 19 Kg satellite constructed by radio amateur engineers of ESIEESPACE near Paris. SARA was launched by ARIANE with OSCAR-22 from ESA in Kourou into a solar-synchronous 100 minute period orbit that passes over earth locations between 1000 and 1400 UTC and again between 2200 and 0200 UTC local time. SARA's callsign is transmitted in ASCII in the first line as FX0SAT, as is the full QTH of ESIEESPACE.

SARA's function is the study of eight channels of radio emissions of the planet Jupiter between 2 and 15 MHz, which are unable to penetrate earth's ionosphere. It transmits the data as 300 bauds digital temetry on 145.955 MHz FM +/- 5 KHz deviation, which is receivable on any 2m FM receiver, preferably with a pre-amplifier and good cross polarized azimuth-elevation trained Yagi, as the signal is not very strong.

A 500 Hz sub-carrier contains the battery voltage information, defined by V (in Volts) = 0.0148 x F, where F is the tone frequency received. A 220 Hz sub-carrier gives the structure temperature by T (in Deg.C) = 0.714 x (F - 164.2) where F is the tone frequency received. The 50 Hz bandwidth audio filter circuit below from Hilburn and Johnson's Manual of Active Filter Design will function between the receiver audio output and a frequency meter with R2 set at 2K for 210 HZ and at 350 Ohms for 500 Hz



Audio Filter for SARA Telemetry Decoding.

Reception reports are welcomed and will be QSL'd, and further information is available from BELAMSAT, ON1KHP, Thier des Critchions 2, 4032 CHENEE, Belgium, who also publish 'BELAMSAT SATELLITE NEWS' magazine.

Pat Gowen, G3IOR 27 April 1992

14781.SAT

CHARACTERISTICS of OSCAR-11 (U-O-11) (UoSAT-2)

This gravity gradient stabilized satellite was designed and built by the University of Surrey AMSAT Group and launched from the USA into a circular 700 Km high Quasi-Polar 98 minute period orbit.

OSCAR-11 has no transponders, but transmits valuable scientific telemetry including 'WOD' (Whole Orbit Data) of many of it's channels. These include numerous temperatures, magnetometer readings, radiation and micro-meteorite impact data. It also transmits regular bulletins of general amateur radio and space interest. It has played a useful function in providing tracking data and Doppler positioning to numerous scientific expeditions inluding the joint Canadian Russian trans-polar ski-trek. A voice encoder also provides spoken telemetry and uplinked messages.

The transmissions are easily received using a simple crossed dipole (turnstile) or a small preferably circularly polarized Yagi to any conventional 2m FM receiver without modification. A CCD Camera provides earth pictures

Demodulators and computer Programs are available from AMSAT-UK for directly translating the telemetry, WOD, pictures, bulletins etc. directly from the audio socket of the receiver or via taped recordings to a computer.

FREQUENCIES for UoSAT-OSCAR-11

Beacon	145.826 MHz (AFSK/FM)
Beacon	435.025 MHz (AFSK/FM)
Beacon	2401.500 MHz (AFSK/FM)

QTH for AMSAT-UK: Ron Broadbent, G3AAJ,
Secretary AMSAT-UK,
94 Herongate Road,
Wanstead Park,
London
E12 5EQ
United Kingdom.

Reports of OSCAR-11 and it's educational use deployment are welcomed by:

UoSAT Spacecraft Laboratory,
School of Electronic and Electrical Engineering,
University of Surrey,
Guildford,
Surrey,
GU12 5XH
United Kingdom.

Pat Gowen, G3IOR @ GB7VLS

19216.SAT

CHARACTERISTICS of OSCAR-13

This second functioning Phase III-B satellite was launched by ESA's ARIANE-4 from French Guiana on 15 June 1988 into a highly elliptical 'Molniya' type orbit with a 36,000 Kn Apogee and a 2546 Km Perigee. Due to Lunar and Solar effects the orbit is becoming more elliptical, and the lowering perigee atmospheric frictional drag is set to shorten the life of this spacecraft. The period is some 11 hours. Four transponders are carried that are placed on according to ground command control.

Frequencies for AMSAT-OSCAR 13 (AO-13)

General Beacon	145.812 MHz (PSK,CW,RTTY)
Engineering Beacon	145.985 MHz (PSK,CW,RTTY)
Mode B Uplink	435.423 - 435.573 MHz (SSB,CW)
Mode B Downlink	145.825 - 145.975 MHz (SSB,CW,inverting)
General Beacon	435.651 MHz (PSK,RTTY)
Engineering Beacon	435.677 MHz (PSK,RTTY)
Mode L Uplink	1269.351 - 1269.641 MHz (SSB,CW)
Mode L Downlink	435.715 - 436.005 MHz (SSB,CW,inverting)
Mode J Uplink	144.423 - 144.473 MHz (SSB,CW)
Mode J Downlink	435.940 - 435.990 MHz (SSB,CW,inverting)
Beacon	2400.325 MHz (PSK,RTTY)
Beacon	2400.664 MHz (PSK,RTTY)
Mode S Uplink	435.603 - 435.639 MHz (SSB,CW,FM)
Mode S Downlink	2400.711 - 2400.747 MHz (SSB,CW,FM)
RUDAK Uplink	1269.710 MHz (Inoperative)
RUDAK Downlink	435.677 MHz (Inoperative)

The 145.812 MHz beacon sends CW telemetry at the hour and half hour, RTTY at the quarter and three-quarter hours, and PSK all the rest of the time. Updated information on mode switching and status is supplied by this beacon. The 145.985 MHz beacon is much stronger, and is mainly used in controlled magnotorquing by the command stations DB2OS, G3RUH and VK6AGR.

The Mode 'B' uplink requirements for A-O-13 are accomplished by using 25 - 50 watts of CW or LSB from any conventional 70cm TX to a 12 X/Y Yagi or a 10 turn RHCP Helix with azimuth/elevation pointing. The dowlink requires an azimuth/elevation pointing 10 element RHCP Yagi or 8 turn Helix to a low noise pre-amplifier at the antenna feeding any USB 2m RX.

Mode 'J' requires exactly the same antennas as for Mode 'B', with reversed transmitters and receivers, with a Low Noise pre-amplifier on the 70 cm receiver.

'L' mode needs a pair of 23cm 20 element Quad Loop Yagis fed with at least 100 watts of CW or SSB. The downlink needs are as for Mode 'J'.

'S' Mode needs some 50 watts of 435 MHz CW or SSB from the same 70cm antenna, and an azimuth/elevation controlled 20 turn Helix for 2400 MHz with a good low noise front end. A 13cm to 2m or 13cm to 10m converter may be used feeding the main station 2 or 10m receiver.

Pat Gowen, G3IOR 25 April 1992

Beacons and telemetry RM-1 system:

CW telemetry 8 channels	145.822 MHz	0.2 Watts
Digital telemetry 30 channels	145.952 MHz	0.4 Watts
	1100 bps,BPSK/FM, deviation 2kHz	
Digital telemetry Rudak-2	145.983 MHz	3.0 Watts
	BPSK 1200 bps AX.25 (like FO-20)	

Beacons and telemetry RM-2 system:

CW telemetry 8 channels	145.948 MHz	0.2 Watts
Digital telemetry 30 channels	145.838 MHz	0.4 Watts
	1100 bps,BPSK/FM, deviation 2kHz	
	Digital BPSK/FM, deviation 2kHz	

Transponders RM-1

Linear transponder: inversely heterodyned translator

Uplink passband	435.102 to 435.022 MHz
Downlink passband	145.852 to 145.932 MHz
Transmitter output max	10 Watts
Bandwith (3db)	80 kHz

MAXIMUM uplink EIRP required about 100 Watts (10w will do!)

Digital transponder Rudak-2: digipeater and store & forward packet communication (AX.25), telecommunications experiment with digital signal processing up to nearly 20 kHz, 1 MByte RAM discphase-M.

RX-2 435.155 MHz (AFC) 2400 bps,BPSK, Biphase-S
RX-3a 435.193 MHz (AFC) 4800 bps,RSM
RX-3b 435.193 MHz (AFC) 9600 bps,RSM
RX-4 435.041 MHz (digital AFC) RX for RTX-DSP

Downlink frequency: 145.983 MHz 3 watts (very strong!).

The downlink can be switched to the following operating modes:

Mode 1: 1200 bps, BPSK, NRZI,(NRZ-S) (like FO-20)
Mode 2: 400 bps, BPSK, Biphase-S (Oscar-13 beacon)
Mode 3: 2400 bps, BPSK, Biphase-S
Mode 4: 4800 bps, RSM, NRZIC (Biphase-M) (like 4800 bps uplink)
Mode 5: 9600 bps, RSM, NRZI (NRZ-S)+Scrambler (like 9600 bps uplink)
Mode 6: CW keying (only for special events)
Mode 7: FSK (F1 or F2B),e.g. RTTY, SSTV, FAX, etc. (for special events)
Mode 8: FM modulated by D/A signals from DSP-RISC processor (speech)

Transponder RM-2 system:

Linear transponder: inversely heterodyned translator

Uplink passband	435.123 to 435.043 MHz
Downlink frequencies	145.866 to 145.946 MHz
Transmitter output max	10 Watt max.
Bandwith (3db)	80 kHz
Uplink EIRP required about	100 Watts

Antennas: 435 MHz receiving antenna (shared by analog and digital modes)
Helix +3 db max RHCP. 145 MHz transmitting antenna: Half wave dipole.

Power supply (up to 100w) comes from the main GEOS satellite power supply system. System RM-1 consumption 47 Watts. System RM-2 consumption 40 Watts

Date: 18 May 94 15:21:30 EDT
From: Ray Soifer <71331.1337@CompuServe.COM>
To: <amsat-bb@amsat.org>
Subject: Satellite "C" Files for FBB BBSs
Message-Id: <940518192130_71331.1337_FHA22-1@CompuServe.COM>

The following is a series of files written by Pat Gowen, G3IOR, intended to be uploaded by sysops of F6FBB packet bulletin boards into the "Characteristiques" portion of the BBS's satellite-tracking software. These files provide the user with essential how-to-use data covering most of the popular amateur radio spacecraft in use today. Once uploaded by the sysop, the user would access these "Characteristiques" files by first entering the file-server mode with the command F, then selecting the satellite-tracking feature with the command T, and at the next prompt entering the command C.

21087.SAT

CHARACTERISTICS of AMSAT-OSCAR 21 (AO-21 & RS-14) NASA Cat.No: 21087

Both the RM-1 and RM-2 analogue (SSB & CW) transponders of RS-14 alias OSCAR-21 have extremely sensitive analoge receivers, and even one watt eirp of 70cm CW can be heard well on the 2m downlink, which is very strong.

FREQUENCY and MODE LISTING for RS-14/OSCAR-21:

Beacon	145.822 MHz (CW)
Beacon	145.952 MHz (BPSK/FM)
Beacon	145.983 MHz (BPSK/SSB)
Mode B Uplink 1	435.022 - 435.102 MHz (SSB,CW)
Mode B Downlink 1	145.852 - 145.932 MHz (SSB,CW,inverting)
RUDAK 2 Uplink 1	435.016 MHz (AFSK/FM)
RUDAK 2 Uplink 2	435.155 MHz (BPSK/FM)
RUDAK 2 Uplink 3	435.193 MHz (BPSK/FM)
RUDAK 2 Uplink 4	435.041 MHz (Various modes)
RUDAK 2 Downlink	145.983 MHz (Various modes)
Beacon	145.948 MHz (CW)
Beacon	145.838 MHz (BPSK/FM)
Beacon	145.800 MHz (BPSK/FM)
Mode B Uplink 2	435.043 - 435.123 MHz (SSB,CW)
Mode B Downlink 2	145.866 - 145.946 MHz (SSB,CW,inverting)

RS-14 was launched piggy-back onboard the USSR geological research satellite on 29 January 1990 from the North Cosmodrome at Plesetsk into a slightly elliptical quasi-polar orbit with an inclination of 83 degrees, a 1000km apogee and 105 minute period.The satellite possesses a telemetry system, command link equipment, transponders and power supply, thermal control, and amateur linear and digital transponders, telemetry system, command link equipment and power supply, which are a combined project of the USSR (transponders, structure etc) and AMSAT-DL groups (RUDAK and ancillary equipment). The RUDAK is an advanced system providing a host of digital modes.

The main satellite attitude control is maintained by the earth's gravity field by gravity gradient control by means of a 9 meter boom pointing away from earth. It has a planned service lifetime of 3 years

Radio-M1/Rudak-2 System specifications

Two sets of the equipment are installed aboard the satellite, a primary mode 'B' linear transponder RM-1, RUDAK-2 with subsystems, and a secondary (reserve) mode 'B' linear transponder RM-2 with subsystems.

APPENDIX E

SATELLITE LINK FREQUENCIES

Amateur Digital Satellites, Modes and Frequencies

satellite	downlink frequency Mhz	downlink mode	bdcstcall downlink ID	uplink frequency MHz	uplink mode	bbscall uplink ID
UO-11	145.825	FM	UoSAT-2	n/a	n/a	n/a
	435.025	FM	UoSAT-2			
	2401.500	FM	UoSAT-2			
AO-16	435.050	SSB	PACSAT-11	145.900	FM	PACSAT-12
	"	SSB		145.920	FM	PACSAT-12
	"	SSB		145.940	FM	PACSAT-12
	"	SSB		145.960	FM	PACSAT-12
	437.025	SSB		same as above		
	2401.143	SSB		same as above		
DO-17	145.825	FM	DOVE	n/a	n/a	n/a
	2401.2205	SSB				
WO-18	437.102	SSB	WO-18	1265.00	AM	
	437.075	SSB				
LO-19	437.125	SSB	LUSAT-11	145.840	FM	LUSAT-12
	"	SSB		145.860	FM	LUSAT-12
	"	SSB		145.880	FM	LUSAT-12
	"	SSB		145.900	FM	LUSAT-12
	437.150	SSB	LUSAT-11	same as above		
FO-20	435.910	SSB	8J1JBS	145.850	FM	8J1JBS
				145.890	FM	8J1JBS
				145.910	FM	8J1JBS
AO-21	145.983	FM		435.016	FM	
	"	SSB(2400bps)		435.155	SSB	
	"	SSB(4800bps)		435.193	SSB	
	"	SSB(9600bps)		435.193	SSB	
	"	SSB,FM,WEFAX		435.041	RTX-DSP	
UO-22	435.120	FM	UOSAT5-11	145.900	FM	UOSAT5-12
				145.975		
KO-23	435.175	FM	HL01-11	145.850	FM	HL01-12
				145.900	FM	HL01-12
KO-25	435.175	FM	HL02-11	145.870	FM	HL02-12
				145.980	FM	
	436.500	FM	same as above			
IT-26	435.867	SSB	ITMSAT-11	145.875	FM	ITMSAT-12
				145.900	FM	
				145.925	FM	
				145.950	FM	
	435.822	SSB		same as above		
AO-27	436.800	FM	EYESAT-11	145.850	FM	EYESAT-12
PoSAT	435.275	FM	POSAT-11	145.925	FM	POSAT-12
				145.980	FM	
Mir	145.55	FM	R0MIR*	145.55	FM	R0MIR*
SAREX	145.55	FM	W5RRR-1*	144.49	FM	

APPENDIX F

MEMORY CHANNEL AND EQUIPMENT SETTINGS

SAT/BBS	MEM CHNL	UPLINK	DOWNLINK	MODEM
AO-16	1	145.900 FM	435.050 SSB	23
WO-18	2	1265.00 AM	437.102 SSB	23
LO-19	3	145.840 FM	437.125 SSB	23
FO-20	4	145.850 FM	435.910 SSB	23
AO-21	5	435.016 FM	145.983 FM	18
UO-22	6	145.900 FM	435.120 FM	52
KO-23	7	145.850 FM	435.175 FM	18
KO-25	8	145.870 FM	435.175 FM	18
IT-26	9	145.875 FM	435.867 SSB	23
AO-27	10	145.850 FM	436.800 FM	23
PoSAT	11	145.925 FM	435.275 FM	18
MIR	12	144.490 FM	145.550 FM	22
K6LY	2 & P2	144.970 FM	450.000 FM	22

MODEM	DATA RATE	DSP-PORT	SWITCH BOX
52	9600 FSK	P1	PORT 2/PORT 1
23	1200 PSK	P2	AFSK/PORT 1
22	1200 AFSK	P2	AFSK/9600
18	9600 FSK	P1	PORT 2/PORT 1

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