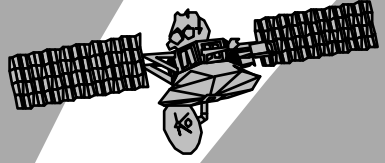
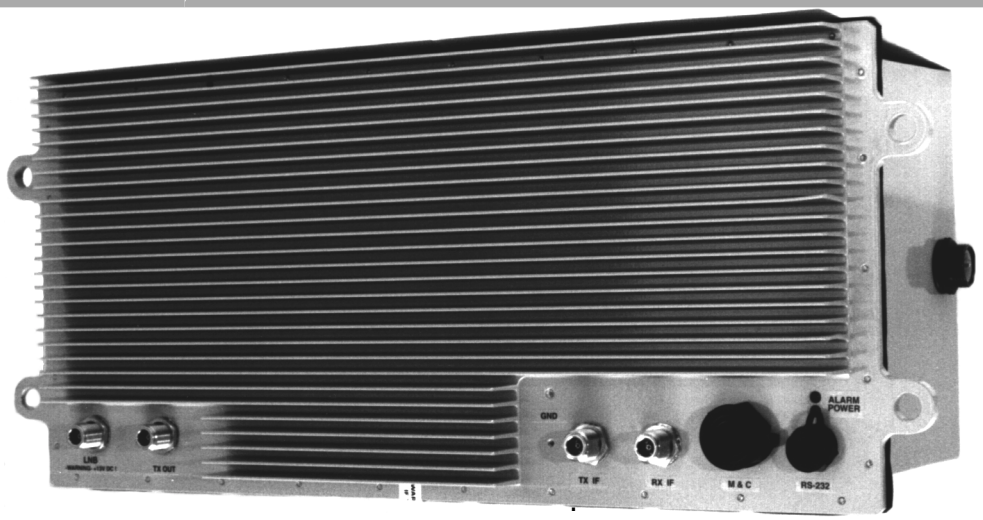
ANACOM

ANASAT®-C Series

C-Band Transceiver Operating Manual



Standard C
Intelsat Extended — EC
INSAT — XC
Russian — RC
PALAPA — PC



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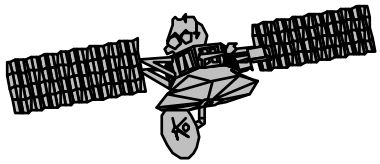

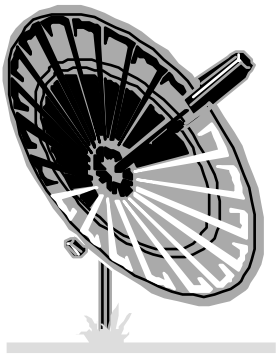

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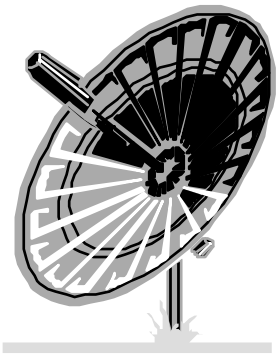

You have just received a AnaSat®-C Transceiver, a *cost-effective* product with no compromise on *quality* and *reliability*. This product should provide tireless performance in any reasonable operating environment.

We, at **ANACOM**, have taken great care to provide a convenient, easy-to-use product in a single package. Our powerful Monitor and Control enables you to set transmit and receive frequencies and gains and monitor numerous major and minor operational parameters using a "dumb terminal" interface. There's no need to worry about available voltages; the internal universal power supply can automatically accommodate virtually all AC voltage possibilities.

Should a situation arise beyond the operator's control, just give us a telephone call. Many situations can be diagnosed and solved by **ANACOM**'s trained customer-service personnel over the phone line using a modem connected to the transceiver.

If you have any questions, require technical assistance or training, or are interested in our optional Windows©-based Supervisor software please call **ANACOM** directly at (408) 379-7482 or FAX to us at (408) 379-7483.

ANACOM Inc.

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Operating Manual

for the

ANASAT®-C-Series

C-Band Transceiver

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Section 1. Introduction

Figure 1-1 The ANASAT®-C VSAT transceiver (5W version shown)

The ANASAT®-C VSAT series C-Band transceivers are designed for continuous outdoor duty in all types of environments. Ideally suited for SCPC, MCPC, and DAMA applications, the ANASAT®-C series transceivers transmit in the 6 GHz frequency range and receive in the 4 GHz range.

The ANASAT®-C VSAT transceivers integrate all necessary functions, including the solid-state power amplifier (PA), into a small, highly integrated outdoor package. The only cabling required to the indoor plant are the IF and AC power cables. The LNC connects to the transceiver with a single coaxial cable.

Designed to interface with any 70 MHz modem, the ANASAT®-C VSAT transceiver may be used in a wide variety of communication networks. The earth stations may be configured in Star, Mesh, or Ring networks and with the optional Station Management System (SMS) tied to a PC, you can monitor and control all local transceivers and other network-compatible equipment.

The ANASAT®-C transceiver upconverts the modulator's 70 MHz IF output to an RF signal in the 6 GHz range for transmission, and downconverts the 4 GHz received RF signal to a 70 MHz IF signal for use by the demodulator.

The PA uses Internally-Matched Field-Effect Transistors (IMFET) to achieve highly linear power and gain with minimal intermodulation distortion (IMD) products.

High Electron Mobility Transistors (HEMT) and Gallium-Arsenide Field-Effect Transistors (GaAs FET) enable the Low-Noise Down-Converter (LNC) to achieve a noise figure better than 45 ºK.

The transmit (TX) and receive (RX) synthesizers are locked to an oven controlled, high-stability crystal oscillator (OCXO) and can provide 1 MHz frequency selection step sizes over the entire bandwidth. TX and RX frequency selection is completely independent for extra flexibility.

In this manual, all frequency ranges reflect the Standard "C" model of the ANASAT®-C transceiver except as noted.

Figure 1-2. The ANASAT®-20C, showing cooling fan

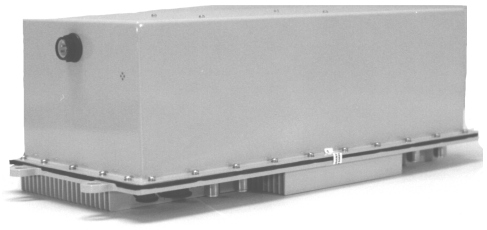


Figure 1-3. Another view of the ANASAT®-5C

Typical Operating Parameters

RF ELECTRICAL SPECIFICATIONS

A. FREQUENCIES

		Model	
(1)	Transmit RF N-connector (CPR-137 Flange optional on 10, 20, and 40 W versions)	C	5925 to 6425 MHz (1 MHz step size)
		EC	5850 to 6425 MHz (1 MHz step size)
		XC	6700 to 7100 MHz (500 kHz step size)
		RC	5975 to 6475 MHz (1 MHz step size)
		PC	6425 to 6725 MHz (1 MHz step size)
(2)	Receive RF (CPR-229G Flange on LNC)	C	3700 to 4200 MHz (1 MHz step size)
		EC	3625 to 4200 MHz (1 MHz step size)
		XC	4500 to 4800 MHz (500 kHz step size)
		RC	3650 to 4150 MHz (1 MHz step size)
		PC	3400 to 3700 MHz (1 MHz step size)
(3)	Transmit IF (N-connector)	all	52 to 88MHz (70 ± 18 MHz) [or 104 to 176 MHz (140 ± 36 MHz) optional]
(4)	Receive IF (N-connector)	all	52 to 88MHz (70 ± 18 MHz) [or 104 to 176 MHz (140 ± 36 MHz) optional]

B. RF POWER LEVELS

(1) Receiver Output
Intermod. By-Product: –35 dBc max., measured with two carriers @ -89 dBm, 30 kHz apart

(2) Transceiver Input: –40 to –20 dBm; +20 dBm max.

(3) Transceiver Output

(a) + 25ºC at Transmit RF Connector

		1dB COMP. PT
-0	(0 dBm)	0 dBm min.
-2	(2 watt)	+33 dBm min.
-5	(5 watt)	+37 dBm min.
-10	(10 watt)	+40 dBm min.
-20	(20 watt)	+43 dBm min.
-40	(40 watt)	+47 dBm min.

(b) Gain Variation, –40ºC to +50ºC @ Transmit RF and under all conditions: ± 1.5 dB

(c) Intermodulation By-Products (IP) (measured at a power output of 9dB composite below the P–1dB spec): –33 dBc max.

RF ELECTRICAL SPECIFICATIONS, continued

C. RECEIVER GAIN

(1)	Overall Gain (at +25ºC)	85 to 100 dB (M & C controlled)
(2)	Gain Variation under all conditions	± 1.5 dB

D. RECEIVER NOISE FIGURE (standard) 0.9 dB (65ºK) max.
(optional) 0.63 dB (45ºK) max.
(optional) 0.5 dB (35ºK) max.

E. INSTANTANEOUS BANDWIDTH

(1) Receiver RF to IF	70 ± 18 MHz [or 140 ± 36 MHz optional]
(2) Transmitter IF to RF	70 ± 18 MHz [or 140 ± 36 MHz optional]

F. IMPEDANCE

(1) Receiver Output (J4)	50Ω; (75Ω optional)
(2) Transmitter Input (J3)	50Ω; (75Ω optional)

G. SYNTHESIZERS

(1) Tuning Step Size	1 MHz, except 0.5 MHz X0 (M & C controlled)
(2) Phase Noise (offset from carrier)	–60 dBc / Hz @ 100 Hz –70 dBc / Hz @ 1 kHz –80 dBc / Hz @ 10 kHz –90 dBc / Hz @ 100 kHz

H. FREQUENCY REFERENCE

Stability over temperature –30ºC to +50ºC	1×10^{-8}
Aging	1×10^{-9} / day

RF / IF CONNECTOR DESIGNATIONS

A.	Antenna (Receive Input, LNC/TR Filter)	CPR-229G Flange
B.	Transceiver Receive Input	N-Type-Female
C.	LNC Output	N-Type-Female
D.	Receiver IF	N-Type-Female
E.	Transmit IF	N-Type-Female
F.	Antenna (Transmit Output)	N-Type Female (CPR-137 Flange optional on 10, 20, and 40W versions)

INTERFACE ELECTRICAL SPECIFICATIONS

(1)	Power Requirement	100 to 240 VAC 50/60 Hz
(2)	Total Power Consumption	
	0 dBm	23 VA typ.
	2 W	47 VA typ.
	5 W	82 VA typ.
	10 W	150 VA typ.
	20 W	225 VA typ.
	40 W	350 VA typ.

INTERFACE CONNECTION DESIGNATIONS

(1)	Ports	2 each RS-232 or, 1 RS-232 & 1 RS-485
(2)	Protocol	w/ RS-232 port supports any “dumb” terminal w/ RS-485 port supports addressed, packetized data per ANACOM SMS software specifications
(3)	Alarm Relays	Form-C for Major and Minor alarms; isolated. Optional independent TX and RX relay alarms.
(4)	Visual Indicators	Flashing GREEN LED indicates active power RED LED indicates summary alarm

MECHANICAL SPECIFICATIONS

A. WEIGHT

(1)	Transceiver	0 dBm output	20 lbs (9.1 kg)
		2 W and 5 W output	27 lbs (12.3 kg)
		10 W and 20 W output	34 lbs (15.4 kg)
		40 W output	38 lbs (17.3 kg)
(2)	LNC		2.0 lbs (0.9 kg

B. SIZE

(1)	Transceiver	0 dBm, 2 W, 5 W output	21.6" x 9.0" x 7.0" (549 x 229 x 178 mm)
		10 W, 20 W output	21.6” x 9.0” x 12.1” (549 x 229 x 307 mm)
		40 W output	21.6” x 9.0” x 13.9” (549 x 229 x 353 mm)
(2)	LNC		3.7" x 2.8" x 3.9" (91x 71 x 99 mm)

MECHANICAL SPECIFICATIONS (con't.)

C. SURFACE FINISH

Painted Surface
(a) Color (per FED-STD-595A, Spec. # 25630) Light Gray
(b) Final Coating: Powder

Unpainted Surfaces: Chem. Film per MIL-C-5541, Class 3

ENVIRONMENTAL SPECIFICATIONS

A. AMBIENT TEMPERATURE CONDITIONS

	(1)	Operating	–40 to +50°C
	(2)	Storage	–60 to +75°C
B. ALTITUDE			15000' ASL max. (4560m)
C. RAIN			20" / hour (508mm/hr)
D. WIND			150 MPH (250km/hr)
E. VIBRATION			
	(1)	Operating	1.0 G random
	(2)	Survival	2.5 G maximum random
F. SHOCK			
	(1)	Operating	10 G
	(2)	Survival	40 G max.

NOTE: Operating parameters subject to change without notice.

Section 2. Installation

The ANASAT®-C transceiver consists of the transceiver, the Low Noise Converter (LNC), and the LNC interconnection cable.

This chapter contains the general requirements for installing the transceiver and LNC on the antenna and making the cable and waveguide connections. Specific mounting methods may vary considerably depending upon particular antenna and site characteristics. Refer to the antenna manufacturer's instructions for more detailed instructions.

ANASAT®-C transceivers are designed for installation and setup without removing the cover. The transceiver may be completely initialized for normal operation using an ASCII terminal or a local computer.

Removal of any cover may jeopardize the weather seal which may cause problems later.

Unpacking

Check to make sure that the transceiver has not suffered any damage in shipment. Compare contents of the crate to ensure items received match those listed on the packing slip. Retain all shipping containers for future use.

Tools and Test Equipment

Have on-hand a standard electrician's tool kit and any tools listed in your antenna installation instructions.

ANASAT®-C Packing List

Unit		Part Number	Quantity
• Transceiver		—	1
• LNC	for C, EC, RC versions	30570	(1)
	for XC (INSAT)	30680	(1)
	for PC (PALAPA)	30816	(1)
• LNC weather seal gasket		10933	1
• 10 ft. (3m) LNC to Transceiver Cable with dual male N-connectors		30641010	1
• Power Cable with 3-pin circular connector (one end)		31185015	1
• Cable-End Connectors:			
	6-pin weathertight circular	10614006	1
	18-pin weathertight circular	10616018	1
• Supervisor Jr. Software Floppy Disk		30673	1
• Grounding Screw, 6-32 x ½"			1
• Grounding Nut, 6-32			1
• Mastic Tape, 30" x ¾"		10932	1
• Operating Manual		30723	1
• Quick Start Guide			1
• M & C Cable, DB9 to 6 pin circular		30720010	1
Optional Accessories:			
• Andrew 1/4" Heliax™ Low Loss Cable, 3 ft. (0.9m)		11706	
• T/R Filter	for C, EC, RC versions	10917	
	for XC (INSAT)	10937	
	for PC (PALAPA)	10972	
• Transceiver Mounting Kit			

Table 2-1. ANASAT®-C Packing List

Safety Precautions

General

Observe normal safety precautions when operating this equipment.

Ensure the ANASAT®-C transceiver and LNC are properly grounded. Do not rely on coaxial cable shields for the ground connection.

If the cover is removed from any ANACOM product, ensure that all:

- gaskets are intact and free of damage prior to reinstallation
- mounting screws are properly installed

Ensure all connectors are properly waterproofed.

Power Supply

Confirm that AC Power is disconnected before removing the transceiver or LNC cover.

Transceiver

Take adequate precautions to ensure the ANASAT®-C transceiver does not transmit a signal until it has been properly connected and set up for authorized frequencies and power levels. The transmitter is normally shipped from the factory with TX ON !

Transmitter RF output power levels are adequate to cause blindness or other serious injury to body tissues. Use caution when working around the transceiver or antenna when the transmitter is active.

Power Amplifier

Be sure the transceiver TX OUT port is properly terminated prior to operation. Ensure all the correct waveguide gaskets are used to prevent water damage.

TO ENSURE PROTECTION OF PERSONNEL AND EQUIPMENT, USE CARE DURING ANTENNA INSTALLATION AND WHENEVER WORKING ON OR AROUND THE SYSTEM.

LNC

Be sure the LNC unit is properly terminated prior to operation. Ensure all the correct waveguide gaskets are used to prevent water damage.

Site Considerations

Peculiar installation requirements of any particular site is the responsibility of the system operator. ANACOM can engineer an optional installation mounting kit, customized for your site and hardware. Contact ANACOM for details.

Antenna

The transceiver must be attached to some form of mounting structure which is usually the antenna feed boom or the antenna bracket structure. Specific mounting procedures will depend on the antenna used. The transceiver and LNC are designed to be mounted on most antennas. Locate and install the antenna according to the antenna manufacturer's instructions. Choose an area that is free of extraneous interference from motors and electronic equipment and has a clear line-of-sight from the antenna to the satellite.

Lightning arrestors should be used at the site to protect personnel and equipment. Size 3/0 or 4/0 stranded copper wire should be used to bond the transceiver to the antenna frame and to the lightning protection ground rod.

Power Requirements

The ANASAT®-C transceiver requires a power source which supplies 110 VAC or 220 VAC at 50 or 60 Hz, through a circuit breaker. Specific circuit breaker size will depend on which transceiver is being used. To assure uninterrupted service, some method of back-up AC power is recommended. Installing surge arrestors and AC power line filters will reduce voltage surges from the AC power input. .

NOTE: AC TRANSIENTS AND SURGES MAY CAUSE DATA TRANSMISSION ERRORS AND LOSS OF SYNCHRONIZATION IN THE TRANSCEIVER SYNTHESIZERS AND/OR THE EXTERNAL MODEM EQUIPMENT.

Transceiver Mounting Considerations

The ANASAT®-C transceiver must be mounted such that:

1. Sufficient support is afforded the transceiver to minimize the effects of antenna sway in strong winds.
2. Air movement is possible across the heat sink fins. Ideally, the fins should be aligned vertically, but this is not required.

NOTE: The length (and associated RF losses) of the interconnecting cables must be considered when determining the location of the transceiver and LNC.

Transceiver Mounting

The ANASAT®-C transceiver is designed for mounting in any position. For optimal heat sink action, the heat sink fins should be vertical, or as nearly vertical as is practical, with the fins mounted on top. Figure 2-1 shows a common installation example where the transceiver is mounted on the antenna feed support arm.

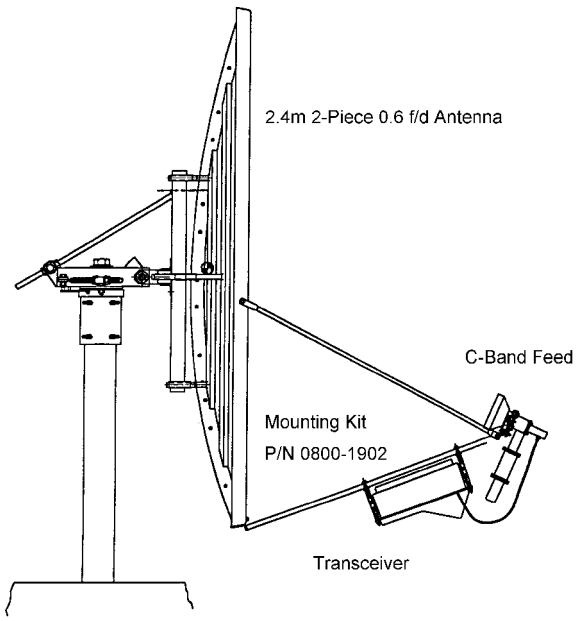


Figure 2-1. Typical transceiver mounting.

When mounting the transceiver, allow enough room to adjust the antenna's azimuth and elevation. Throughout installation and during any polarization, azimuth, or elevation adjustment, ensure the power cables, IF cables, and any waveguide parts are not crimped or pinched.

Grounding

Electrical bonding (grounding) of the transceiver is required to prevent possible damage from lightning or other induced electrical surges.

The transceiver is provided with both an M3, and a #8 grounding point. It is recommended that heavy guage copper wire or copper braid be used to bond this unit to the earth ground (grounding rod) using the most direct (shortest) route possible.

LNC/TR Filter Mounting

The LNC is shown in Figure 2-2. Normally the LNC is directly bolted to the antenna RX feed. In some situations, additional transmit-to-receive isolation may be required to achieve true low-noise receive operation. In that case, the optional TR filter (Figure 4-3) should be bolted between the LNC and the antenna receive port. An appropriate waveguide gasket must be included at both ends of the TR filter. Connect one end of the coaxial cable with male N-connectors (included) to the LNC. Refer to the note at the end of this section regarding watertight connections. Route the 10-foot cable to the transceiver and connect to the LNC N-connector. Longer or shorter cable lengths may be used; contact ANACOM for details.

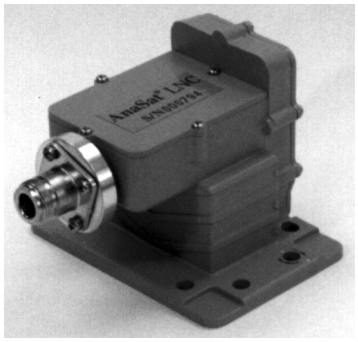


Figure 2-2. LNC assembly.

Cable and Waveguide Connections

Cabling Requirements

Local regulations may require that cables in occupied buildings be installed in steel conduit. Local government agencies may waive this requirement for the use of Plenum cables, which are standard cables entirely encased in solid Teflon. Check the codes in your area.

NOTE: EQUIPMENT OUTAGES DUE TO FAULTY CABLE MATERIALS OR INSTALLATION ARE NOT COVERED BY YOUR WARRANTY.

Figure 2-3 provides the cabling diagram for the ANASAT®-C transceiver.

1. Transmitter Feed

Connect a section of low loss cable with a type N connector between the OMT transmit port and the transceiver's transmit output, TX OUT. Ensure the connections are weather-tight.

For transceivers with the CPR-137 flange option, connect a section of flexible CPR-137G waveguide between the antenna OMT transmit port and the transceiver's transmit output, TX OUT. (Waveguide should be attached to the antenna feed per manufacturer's instructions). Ensure a gasket is fitted at each flange.

2. 70MHz Modem

Attach a coaxial cable with male N-connectors between the transceiver's TX IF (see Figure 2-3) and the modulator IF OUTPUT. Make sure that the connections are weather-tight.

Attach a coaxial cable with male N-connectors between the transceiver's RX IF (see Figure 2-3) and the demodulator IF INPUT. Make sure that the connections are weather-tight.

3. AC Power

Attach the AC input cable to the 3-pin connector on the transceiver. Run the AC cable to the power source *but do not attach yet*. The supplied power cable has a three-pin weather-tight circular connector attached to one end. The other end is terminated with flying leads. Attach the proper AC power connector for your location to the other end of this cable.

Color code:
Black ..... AC Hot power lead
White ..... AC Neutral power lead
Green ..... Ground

4. LNC

Attach the RF cable between the LNC connector and the transceiver LNC input connector. If a longer cable is required, insure that the replacement cable is designed for low loss at microwave frequencies. Maximum loss of the LNC cable must be 5 dB or less at 5 GHz!

5. Terminal Connections

A data terminal or a computer with terminal software connects to the ANASAT®-C via either RS-232 or RS-485 serial ports. Appendix C shows the pinout of the serial outputs. Both 6-pin and 18-pin weather-tight circular connectors are included. An optional serial computer cable is available from ANACOM.

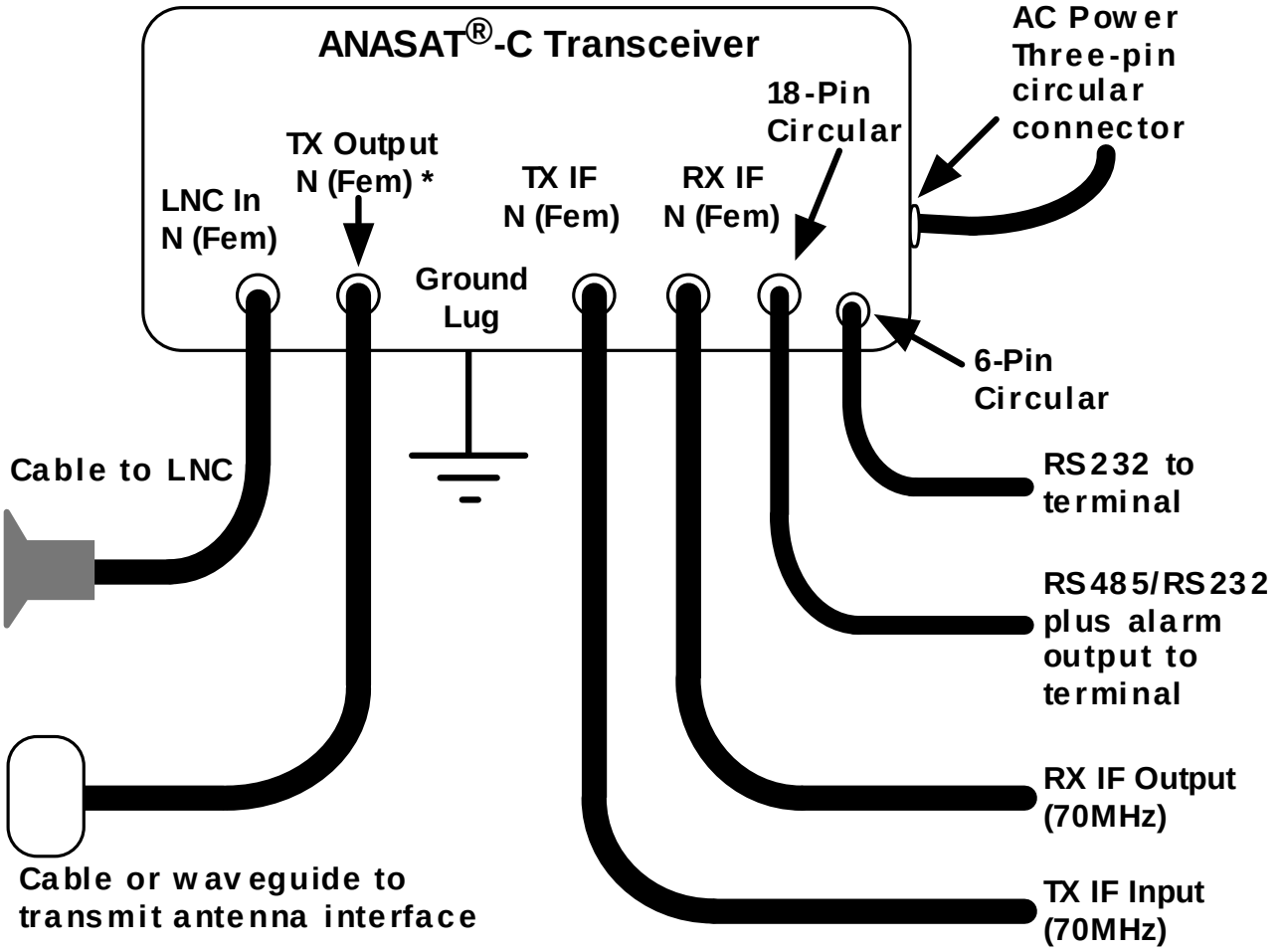


Figure 2-3 ANASAT®-C Cabling Interconnection Diagram.

Final Check

Recheck all bolts and cabling. Refer to figure 2-3 to verify cable connections.

After all other connections have been made, connect the AC power cord to an active outlet.

Water Resistance Wrap

The application of moisture-resistant wrap (mastic tape) to all connectors is recommended to prevent water entry and resultant water damage. Apply the mastic tape as follows:

1. Ensure that all connectors are tight.
2. Pre-cut the mastic tape to the desired size and remove the protective wax liner from the tape.
3. Center the tape on the connector to be sealed and wrap the tape tightly around the connector. Squeeze the tape tightly and ensure that both ends of the tape have formed around the connector and the cable.
4. Apply the mastic tape to all connectors that may be exposed to moisture.

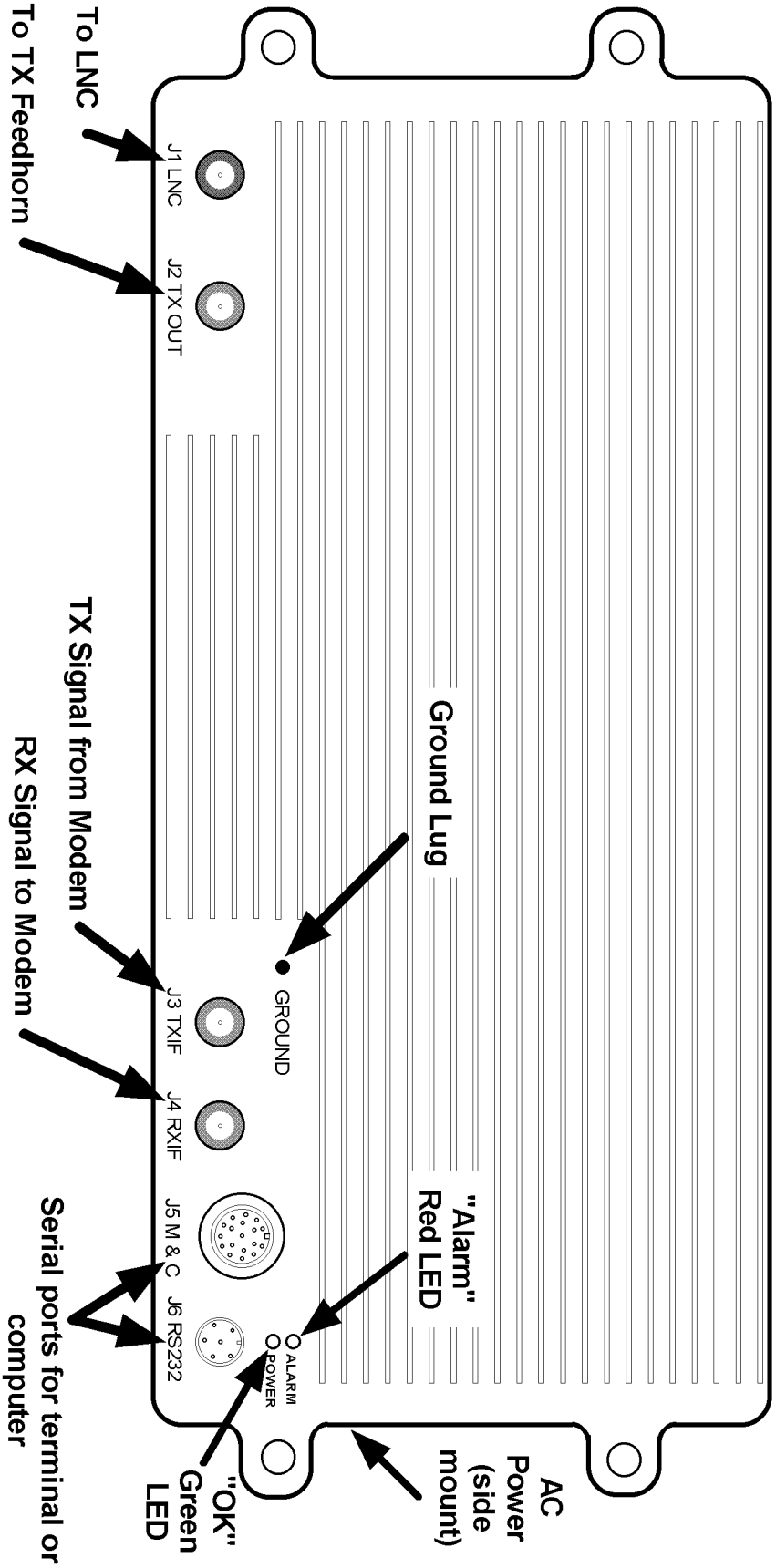


Figure 2-4. Transceiver cable connectors.

Section 3. Operation

Preliminary Steps

After the ANACOM®-C hardware is mounted and verified, the antenna must be aimed toward the desired satellite. Follow the antenna/mount manufacturer's instructions, using coordinates provided by the satellite operator. *Do not transmit until you have received authorization from the satellite network operation center, and a transmit power level from its engineering staff.*

Terminal Connection and Configuration

Autolink:

The Anacom M&C features automatic baudrate sensing on the serial ports. If wrong baudrate is detected, the M&C will drop to 1200 baud and wait for user to move to 1200 baud. Anacom provides a diskette with both our Supervisor® and Supervisor Jr.® software on it, that will perform the autolink with the ODU automatically, regardless of the last used settings.

Connect a terminal or computer running terminal emulation software to either serial port. Generally, COM 0 (using the 6-pin circular weathertight connector) is used for on-site maintenance and control. COM 1 is often used in its RS-485 mode, with multi-unit, packetized protocol and differential mode signals good for moderately long distance (up to 4000 feet or 1200m) remote control. Either port or either serial protocol can be used to accomplish setup. Set the terminal to 1200 baud, eight data bits, no parity, and one stop bit (1200,N,8,1 protocol). Refer to Appendix C for wiring diagrams for the COM ports.

Frequency Programming

TXC; RXC

The transmit and receive frequencies are set independently using the TXCHAN (TXC) and RXCHAN (RXC) commands. Refer to Appendix E for a table of channel numbers versus frequency. NOTE: Appendix E assumes an IF of 70 MHz for both TX IN and RX OUT. Add or subtract any difference between the actual IF and 70 MHz to determine the exact RF frequency employed.

TXF; RXF

Direct frequency entry in MHz can also be done by typing TXF**** or RXF**** where **** are the transceiver frequencies for 70 MHz (or 140 MHz) TXIF & RXIF.

Operating frequencies for standard C-band channels are calculated with the following formulas:

f_{TX} = TX IF_{IN} + 5854 + Ch# MHz

f_{RX} = RX IF_{OUT} + 3629 + Ch# MHz

For example, if the following commands are given to the transceiver:

```
RXCHAN 50

TXCHAN 50
```

Then with a TX IN intermediate frequency of 72.5 MHz the result is an output frequency of 5976.5 MHz. Likewise, with an RX OUT IF of 67.5 MHz , then the received RF frequency is 3746.5 MHz.

For XC (INSAT) frequencies, the formulas are:

f_{TX} = TX IF_{IN} + (13259 + Ch#) / 2 MHz

f_{RX} = RX IF_{OUT} + (8859 + Ch#) / 2 MHz

NOTE: XC CHANNEL SPACING (STEP SIZE) IS 0.5 MHZ.

For RC (Russian) frequencies, the formulas are:

f_{TX} = TX IF_{IN} + 5904 + Ch# MHz

f_{RX} = RX IF_{OUT} + 3579 + Ch# MHz

For PC (PALAPA) frequencies, the formulas are:

f_{TX} = TX IF_{IN} + 6354 + Ch# MHz

f_{RX} = RX IF_{OUT} + 3329 + Ch# MHz

Both f_{TX} and f_{RX} may be directly entered and displayed via the M & C by using the TXFREQ and RXFREQ commands. These commands will change the terminal display from channel number to RF frequency. These frequencies assume exactly 70 MHz IF.

Antenna Adjustment

Do not transmit while adjusting the antenna position.

Follow the antenna manufacturer's instructions for antenna position adjustment. For final alignment, contact the satellite operator and get the correct polarization, azimuth, and elevation of the satellite and also confirm the desired transponder is operational.

Apply power to the ANASAT®-C. While the transceiver requires about 5 minutes for the OCXO to reach full stability, antenna adjustments may be performed by monitoring other signals, such as beacons, immediately.

Connect a spectrum analyzer to the RX IF output. Set the ANASAT®-C to the desired frequency using the RXCHAN (or RXFREQ) command, as described above. While monitoring the IF output for signals, slowly sweep the antenna through azimuth and elevation. Adjust antenna position for maximum signal strength.

M & C Operation

Terminal Display

The M & C terminal display gives a complete accounting of transceiver alarms and status. The display is sent to the terminal every 30 seconds. This interval can be changed with the UTIMER command. (See Appendix A).

The top line shows the transceiver model and serial number.

The second line gives the primary transceiver operating parameters:

- status of the TXREQ setting: "ON" or "OFF"

  "ON" indicates the transceiver will transmit when all major transmitter alarms are cleared. This is the normal setting.

  "OFF" indicates the transmitter will not turn on even if all alarms are clear.

```
                  ANASAT 5C Transceiver   REV:04  S/N: 123456
TXREQ on|TX ON AIR
alarm status: CLEAR
                               | TXCHAN  129    | RXCHAN 119
                               | TXGAIN  68.0   | RXGAIN  97.5
monitor points: OSLLOCK: clear| TXLOCK:  clear | RXLOCK:  clear | PA1:  7.3|
FANERR: clear | OSLPLL:   4.5 | TXPLL:     4.3 | RXPLL:     5.2 | PA2:  8.7|
TEMP:     36C | DIP: 00000000 | TXMUTE:  clear | LNCV:     13.0 | PA3:  9.8|
XTAL:   CLEAR | P12V:    13.1 | TX IN:     -31 |                 | PA4: 10.1|
N5V:     -5.1 | P5V:      5.0 | TXout:      18 | RXout:    -7   | PA5:  0.0|
last reset: 52 seconds          TXpeak:     18                    | PA6:  0.1|
DTE1: PC_MODE | UTIMER:  30.0 |TERMTYPE:   TTY |ECHO on|CRLF  on|BAUDRATE 1200
COMMAND>_
```

Figure 3-1. Remote M & C terminal screen display.

- Transmitter status is either “TX ON AIR” or “TX OFF AIR”

The third line gives a summary alarm indication. The alarm can be “CLEAR”, “MINOR”, or “MAJOR”. See Appendix B for specific alarms.

The fourth and fifth lines give TX and RX channel (or frequency) and gain values.

- TXCHAN number is the actual transmit channel selected.
- TXFREQ number is the actual transmit frequency for 70 MHz (140 MHz) input.
- TXGAIN is the actual transmit gain value selected in dB.
- RXCHAN number is the actual receive channel selected.
- RXFREQ number is the actual receive frequency for 70 MHz (140 MHz) output.
- RXGAIN is the actual receiver gain value selected in dB.

The remainder for the display give detailed monitoring information as follows:

- OSL LOCK gives alarm status of the OSL phase locked loop; NORMAL or FAULT
- TXLOCK gives alarm status of the transmit phase locked loop; NORMAL or FAULT
- RXLOCK gives alarm status of the receive phase locked loop; NORMAL or FAULT
- FANERR gives alarm status of the cooling fan (ANASAT-10C and ANASAT-20C only).
- OSLPLL shows the actual VCO control voltage of the offset loop.
- TXPLL shows the actual VCO control voltage of the TX synthesizer.
- RXPLL shows the actual VCO control voltage of the RX synthesizer.
- TEMP shows the internal heat sink temperature in °C.
- TXMUTE gives the status of the TX override circuits, any of which will turn off the transmitter.
- LNC shows the LNC supply voltage.
- DIP shows the settings of the internal DIP switches (8 bits). See Appendix D.
- XTAL gives the status of the internal reference crystal. The two possible status are WARMING or NORMAL. By default, WARMING will disable the transmitter.
- P12V shows the internal 13 volt power supply voltage.
- P5V shows the internal 5 volt power supply voltage.
- N5V shows the internal –5 volt power supply voltage.
- UTIMER gives the present value of the user timer which controls the cycle time of the display in seconds.
- TXin shows the approximate transmitter input (TX IF) power level in dBm.
- TXout shows the approximate transmitter output power level in dBm.
- TXpeak shows the recent (60 sec) peak transmitter output power level in dBm.
- RXout shows the approximate composite receiver output power level in dBm.
- TERMTYPE gives the present terminal type selection. Options are: “TTY”, “VT52”, and “VT100”.
- ECHO gives the present setting for the terminal echo function. When “ON”, the serial port will echo all characters typed. When this parameter is “OFF” then the port will not echo characters.
- CRLF gives the present setting for the serial port to issue a line feed (LF) after each carriage return (CR). Options are “ON” or “OFF”.
- BAUDRATE shows the present terminal communications speed setting in bits per second (bps).
- PA1 through PA6 give show the voltages for each stage of the transmitter power amplifier. Note that the 0C, 2C and 5C models do not use all six voltages.

Gain Adjustments

Transmitter Gain

After the transceiver has warmed up for at least 5 minutes (OCXO warm-up) the transmitter may be activated. Set the transmit gain to achieve the desired output level (in dBm) with the transmit gain control, TXGAIN. Output power is selectable in 1 dB steps. Smaller steps can be entered, for example: TXG 62.5 and the M&C will attempt to provide that gain as closely as possible.

Maintaining proper output power is vital for maximizing signal-to-noise ratios over the radio path. Low power levels produce noisy signals; excessive power robs downlink strength from other stations sharing the transponder.

Adjust the transmitter gain to attain the desired output power level. Use a calibrated watt meter for this task. The M&C gives an uncalibrated reading of output power which is good for long term monitoring, but it is not intended to replace a calibrated meter.

When transmitting multiple carriers, run the output power with an output back-off sufficient to meet the spectral density mask requirements.

Receiver Gain

Set receive gain by monitoring RX IF output level and adjust the RXGAIN parameter via the terminal. RXGAIN allow adjustment over a 15dB range, from 85dB to 100dB (including LNC gain), in 1 dB steps. Smaller step sizes can be entered, for example: RXG 87.5

Receiver gain should be set to a value where the desired receive signal is centered in the modem AGC range. At the same time, the composite signal, containing all received signals in the transceiver passband, must not exceed the modem's maximum rated input level. Account for IF cabling losses when calculating the RXGAIN value.

RX IF output is monitored by the M & C unit; a Summary alarm is generated if this output level drops below a specific level (generally when the LNC is not attached). The M & C uses an internal detector on the RX output to monitor RX output power. This is shown in the terminal display window in dBm. The RX output power value shown is not accurate enough to rely on for measuring the desired signal. The detector is broadband and will respond to ALL signals in the transponder, including noise.

Receiver gain setting is usually not as critical as transmit gain: excessive gain may cause modem receiver overloading and result in distortion on the received signal; insufficient gain presents reduced signal-to-noise ratios. Ideal RX gain puts the desired IF signal amplitude near the midpoint of the modem AGC range.

Basic M & C Commands

1. Using the terminal, configure the transceiver to the proper frequency:

`RXCHAN nnn`	nnn ranges from 1 to 501
`TXCHAN nnn`	nnn ranges from 1 to 501 (see Appendix E).

2. Configure receive gain and transmit gain.

`RXGAIN nnn`	nnn ranges from 85 to 100 in 1 dB steps
`TXGAIN nn`	nn ranges from:
10 to 36dB	[ANASAT-0C]
44 to 70dB	[ANASAT-2C]
48 to 74 dB	[ANASAT-5C]
51 to 77 dB	[ANASAT-10C]
54 to 80 dB	[ANASAT-20C]
57 to 83 dB	[ANASAT-40C]

NOTE: GAIN SETTINGS AND POWER READINGS ARE NOT INTENDED TO REPLACE A CALIBRATED POWER METER.

Transmit gain is adjustable in 1 dB steps; to program 60 dB of gain, merely type:

```
TXGAIN 60 <cr>
```

For 60.5 dB of gain, type

```
TXGAIN 60.5 <cr>
```

NOTE: THE DECIMAL POINT IS ONLY NECESSARY WHEN 0.5dB OF GAIN RESOLUTION IS ATTEMPTED. FRACTIONAL VALUES MAY BE REQUESTED, BUT ONLY THE NEAREST WHOLE VALUE WILL BE DISPLAYED.

3. Enable the Transmitter:

`TX ON`	(`TX OFF` takes the transmitter OFF air)

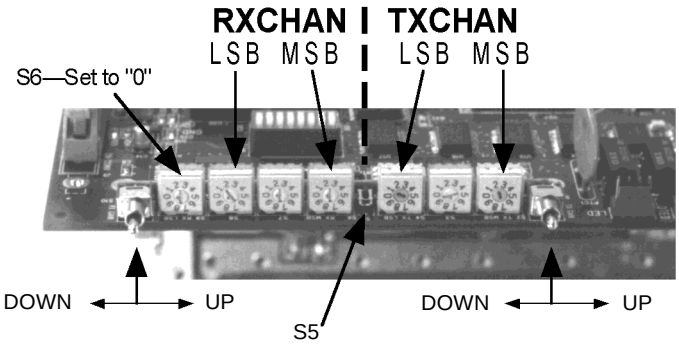


Figure 3-2. The optional switch kit, used for manual transceiver control.

Configuring the ANASAT®-C Via Hardware

The optional hardware switch package is required for hardware configuration.

Although not recommended and rarely (if ever) necessary, the ANASAT®-C may be opened and configured via mechanical switches. Do not open the transceiver unless serial data communications is impossible.

There are only two reasons to open the transceiver:

- The M & C is inaccessible via either of the two serial ports
- No terminal (or computer with terminal software) is available

Use extreme caution when opening the transceiver. Do not expose the unsealed transceiver or unprotected subassemblies to moisture.

Open the transceiver by removing the screws attaching the heat sink to the bottom cover. Inside the ANASAT®-C transceiver are two banks of three decade switches, one bank for TX channel selection, the other for RX channel selection. Momentary contact (spring loaded, center-OFF toggle switches) allow manual receive gain and transmit gain control. A quick push will change the gain by about 0.5 dB. Pushing and holding the switch will sweep the gain in rapid 0.5dB steps, and the longer the switch is held, the faster the step rate. These controls are illustrated in Figure 3-2, and are described in Appendix D.

TX channels are selected by rotating the three decade switches to indicate the desired channel number (see Appendix E). For example, if channel 123 is desired, set the TX LSB switch to “3”, the center TX switch to “2”, and the TX MSB switch to “1”. Then push the center switch, S5. Note that the transceiver must have power applied when S5 is pressed.

Receive channels are selected in the same manner as the Transmit channels. Switch S6 must always be set to “0” if it is installed.

Between the receive and transmit channel selector switches is a momentary-contact push switch. Press this ENTER switch to activate the new transmit and receive channel selections and save the new data into nonvolatile FLASH memory. While gain adjustments are effective immediately, channel switching is not performed until the ENTER switch is pressed.

Transmit and receive gain adjustments are made by the same techniques used under M & C terminal control, as described above. Remember, any manual setting can be changed via the serial port later.

After manually configuring the transceiver, carefully mount the gasket and cover back onto the transceiver heat sink. Insure a watertight seal. The screws used to attach the cover to the heat sink must ALL be tightened securely.

ANASAT®-C Quick Start Guide

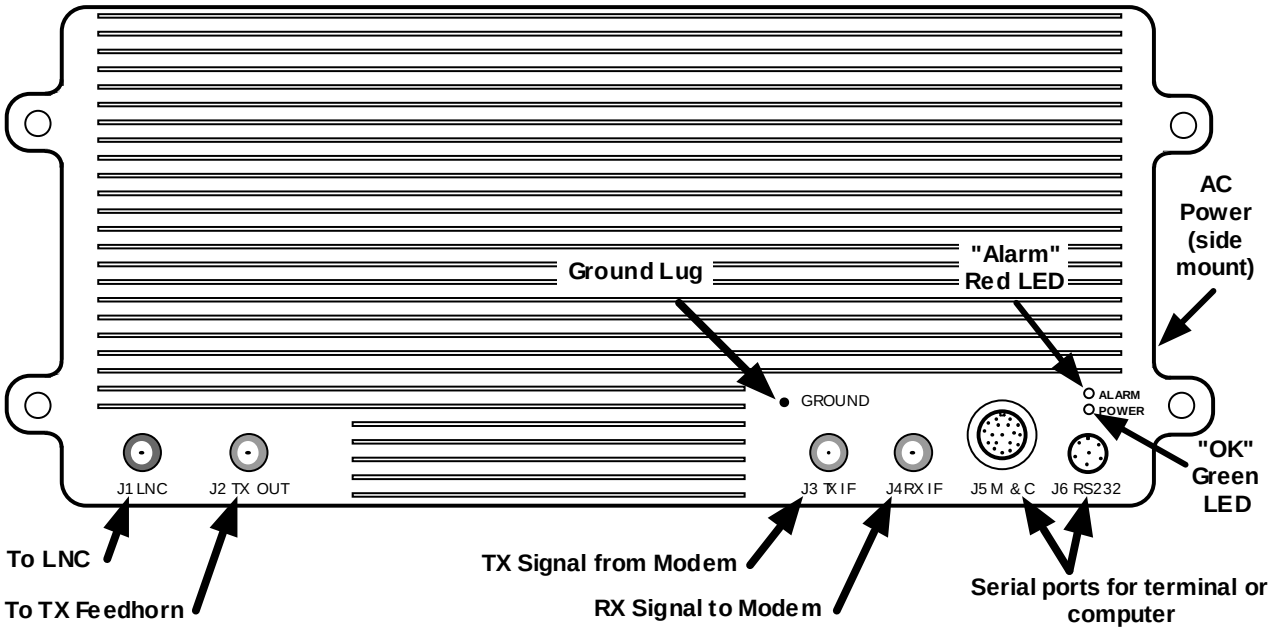
1. Mount the transceiver and the LNC on the antenna.
2. Connect the cables shown in the drawing (See page 2-5).
3. Connect a terminal to a serial port, configured to 1200bps, 8 data bits, no parity, 1 stop bit, CR/LF Off. Connection diagrams are in Appendix C.

4. Install a proper power connector on the (included) power cable. Plug the cable into 110 or 240VAC, 50/60Hz. Verify the green LED on the transceiver is illuminated, indicating normal internal operation. The red LED is usually OFF. If illuminated, it indicates an error condition requiring attention. Refer to the ALARM command for details (Appendix A).

5. Using the terminal, configure the transceiver to the proper frequency:
   `RXFREQ nnnn` (where nnnn is in MHz) or `RXCHAN nnn` (see Appendix E)
   `TXFREQ nnnn` (where nnnn is in MHz) or `TXCHAN nnn` (see Appendix E)

6. Configure receive gain and transmit output power:
   `RXGAIN nnn` nnn ranges from 85 to 100
   `TXGAIN nn` nn ranges from: 10 to 26 [ANASAT-0C] 44 to 70 [ANASAT-2C]
   48 to 74 [ANASAT-5C] 51 to 77 [ANASAT-10C]
   54 to 80 [ANASAT-20C] 57 to 83 [ANASAT-40C]

7. Enable the Transmitter:
   `TX ON` (`TX OFF` takes the transmitter OFF air)



That's really all you must do! Good luck with your new ANASAT®-C transceiver!

Section 4. Theory of Operation

The ANASAT®-C transceiver outdoor unit (ODU) consists of five major blocks, as shown in Figure 4-1. These blocks are:

- Low noise converter (LNC) and Transmit Reject (TR) filter
- Transmit/Receive Converter
- Power Amplifier (PA)
- Monitor and Control Unit (M & C)
- Universal Input switch-mode power supply

Signal Path

Receive signals from the antenna feed through CPR-229G waveguide into the TR Filter, which prevents the transmit signal and receiver image frequencies from passing into the low noise converter (LNC). The LNC amplifies and mixes the C-band receive signal, outputting an L-band IF signal to the converter module. The receive converter portion of the converter module synthesizes the proper mixer frequencies for the second converter, which outputs the (nominal) 70 MHz receive output at the RX IF N-connector on the transceiver.

Transmit signals at (nominally) 70MHz are input to the TX IF N-connector on the transceiver. This signal is double converted to the desired C-band frequency in the converter module and output to the linear power amplifier (PA). PA output of up to 2W, 5W, 10W, or 20W, depending upon transceiver version, feeds the antenna.

Control and Power Systems

The microprocessor-based M & C unit monitors the transceiver's parameters to insure proper operation and reliable, long term service. Two serial ports provide local or remote terminal access. Manual control is available in event serial communications are unavailable (optional switch package required).

Power distribution is controlled with each of several supply voltages and currents carefully monitored. An active feedback negative bias voltage supply guarantees proper control of PA power.

Two LEDs, a flashing green indicating proper operation and a red warning of a Summary alarm, are mounted on the transceiver for test-equipment-free status indication.

Low Noise Converter and Transmit Reject Filter

The receive signal from the antenna's feed horn is fed via a CPR-229G waveguide coupler into the (optional) Transmit Reject (TR) filter (refer to Figures 4-2 and 4-3). This filter attenuates both the transmit signal and the receiver's image (LO + IF), preventing severe overload of the LNC. TR filter passband characteristics are shown in Figure 4-4.

The LNC is bolted to the TR filter at the feed horn of the antenna and consists of two blocks: a C-band low noise amplifier (LNA) and a block converter that mixes the C-band receive signal with the 5 GHz local oscillator from the receive converter module to produce an L-band output.

The LNA consists of a three-stage GaAs FET preamplifier. Negative gate bias for the GaAs FETs is generated inside the block converter.

The amplified C-band signal is mixed with the 5 GHz local oscillator (LO) signal from the converter module in the transceiver. A filter passes the difference frequency and outputs this L-band signal to an N-connector. A cable carries this output to the converter module inside the transceiver.

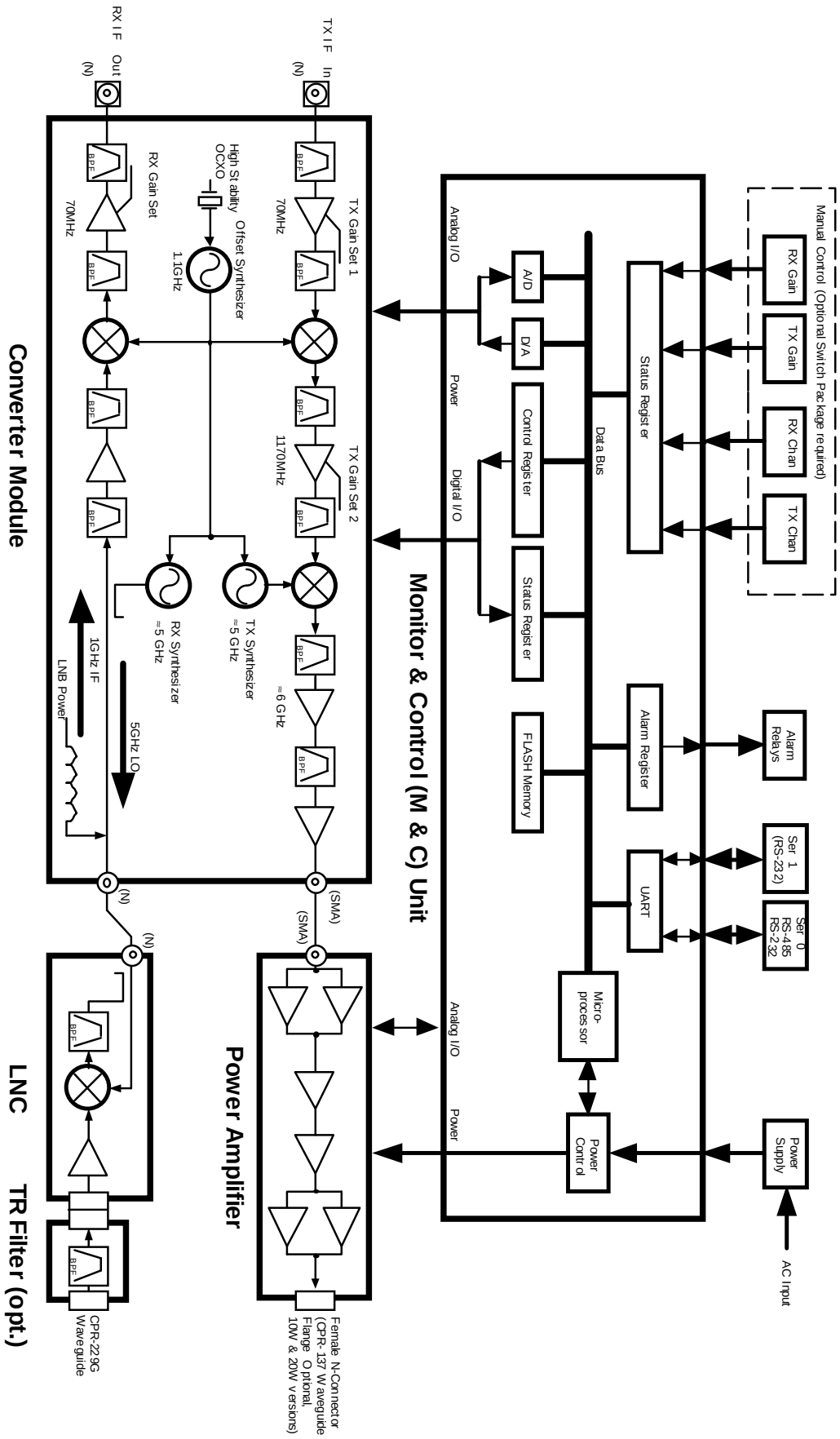


Figure 4-1. ANASAT®-C Transceiver Block Diagram

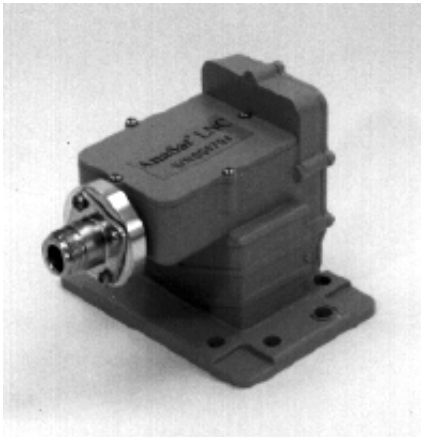


Figure 4-2. The LNC

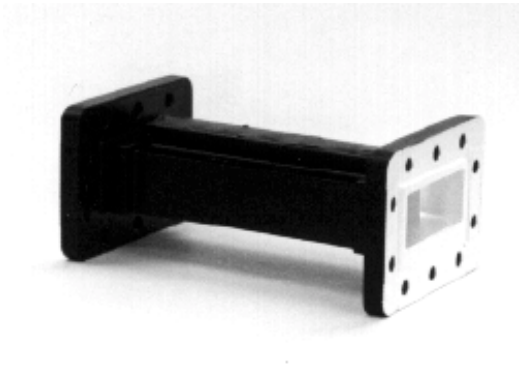


Figure 4-3. The Optional TR Filter

Only one coaxial cable is needed between the transceiver and the LNC. This cable carries three signals:

- L-band signal output from the LNC
- ≈5 GHz LO input from the converter
- +12V DC power from the converter module.

Combining and separation are accomplished with and inductor for the supply voltage and a pick-off coupling for the LO.

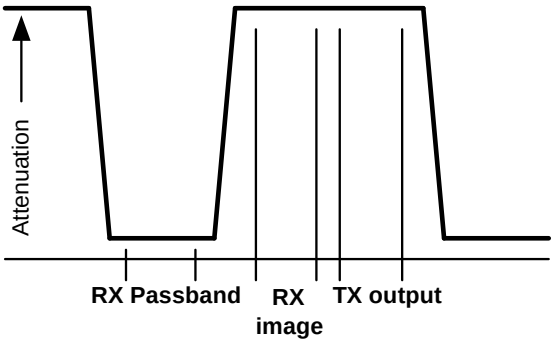


Figure 4-4. TR Filter Passband Characteristics.

Converter Module

The converter module (Figure 4-5) is located inside the transceiver and consists of two sections, the receive converter and the transmit converter. The converter module takes an extremely stable 10 MHz reference signal from the Monitor & Control unit and synthesizes all necessary mixing frequencies.

Receive Converter Signal Path

The receive converter takes its input from the LNC via an N-connector on the transceiver (refer to Figure 4-6). A short coaxial cable connects the type-N connector on the heat sink to the converter unit itself. A diplexer at this input allows this single connector to perform three functions: signal IF input from the LNC, LO output to the LNC, and DC power to the LNC.

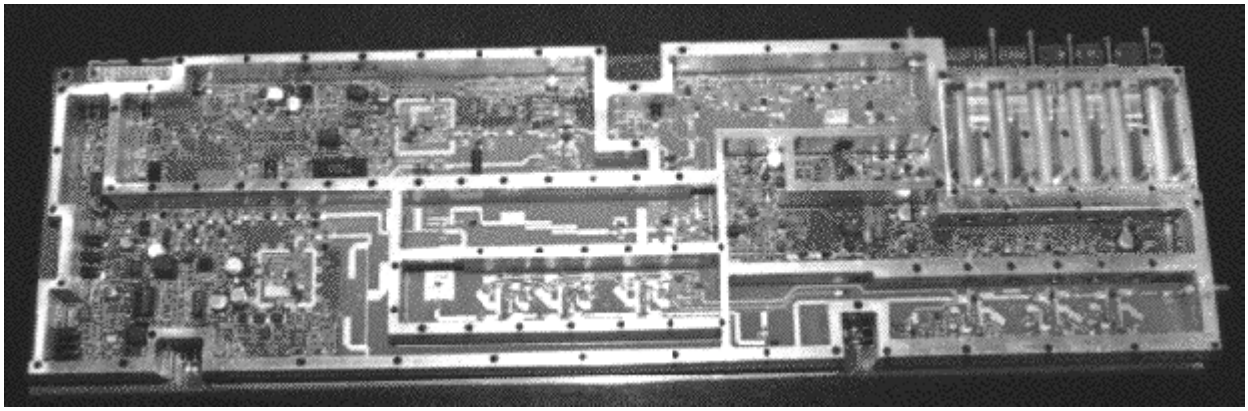


Figure 4-5. Converter Module Assembly.

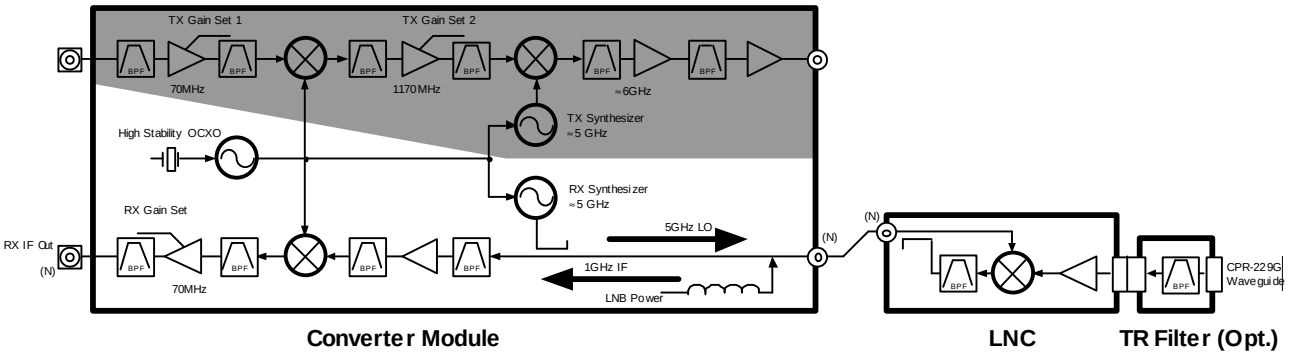


Figure 4-6. Converter Module, Receive Portion.

The L-band receive signal is extracted by the input diplexer and is filtered by a mechanically-tuned 6-pole filter. A single-stage amplifier provides +10 dB of gain. Another mechanical filter cleans the signal before it is mixed with a 1.1GHz LO frequency, producing the (nominal) 70 MHz receive output. An L-C network selects only the 70 MHz mixer output and passes this signal to a variable gain amplifier. This variable gain amplifier is adjustable over a 15dB range and is operator-adjustable by terminal commands via the M & C unit. A final LC bandpass filter connects the variable gain amplifier to the 50Ω N-connector output on the ODU. An external 50Ω to 75Ω transformer is available from ANACOM as an option.

The +12V DC supply to the LNC is fused with a self-resetting “polyswitch”. This polyswitch is located on the M & C board.

Frequency Synthesizers

The converter module generates all necessary frequencies with phase-locked-loop (PLL) synthesizers. All PLLs are referenced from a single 10 MHz clock mounted on the M & C board. This master oscillator is a highly stable 10 MHz oven controlled crystal oscillator (OXCO) accurate to 1 x 10^{-8} Hz (0.01 Hz at 10MHz). This oscillator is fine tuned to compensate for normal aging effects automatically from the M & C unit.

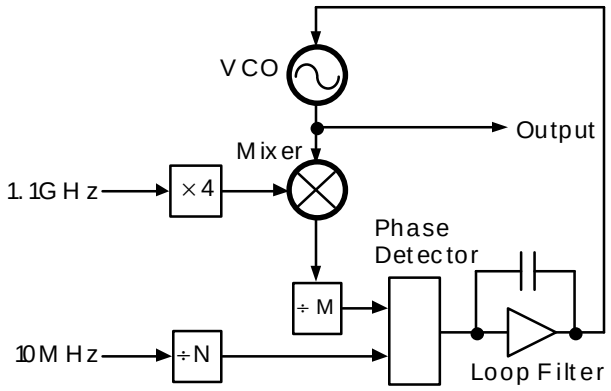


Figure 4-7. Phase-Locked Loop Frequency Synthesizer Block diagram.

Offset Loop

The first synthesized frequency is the 1.1GHz offset loop signal that is used by both the transmit and the receive converters. This signal is split and fed to the second receive mixer and the first transmit mixer.

Receive Synthesizer

The receive synthesizer generates the tunable ≈5 GHz LO used by the LNC. Referring to Figures 4-6 and 4-7, the 1.1 GHz offset loop signal is applied to a x 4 multiplier and mixed with a 5 GHz VCO. The resulting 300 MHz to 800 MHz output is fed into a programmable divider and fed to a phase detector that compares it to the 10 MHz reference clock. Phase detector output voltage is filtered and drives a 2.3 GHz to 2.7 GHz VCO. This frequency is doubled and fed into the previously mentioned mixer, closing the loop. Other C-band frequencies are generated by an almost identical circuit.

Transmit Synthesizer

The transmit synthesizer generates a tunable 4.75 GHz to 5.25 GHz LO used by the second transmit mixer to produce the final transmit output frequency. Referring to Figures 4-7 and 4-8, the 1.1 GHz offset loop signal is applied to

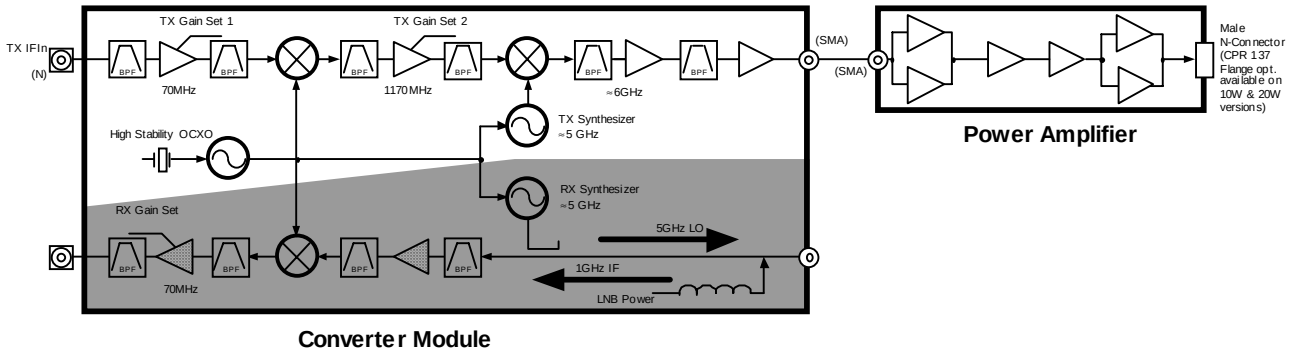


Figure 4-8. Converter Module, Transmit Portion.

a x 4 multiplier and mixed with a 5 GHz VCO. The resulting 300 MHz to 800 MHz output is fed into a programmable divider and fed to a phase detector that compares it to the 10 MHz reference clock. Phase detector output voltage is filtered and drives a 2.3 GHz to 2.7 GHz VCO, which is frequency doubled and fed into the previously mentioned mixer, completing the loop.

Transmit Converter Signal Path

The Transmit converter takes the nominal 70 MHz signal input from a 50Ω N-connector on the transceiver (refer to Figure 4-8). (Note: an external 75Ω to 50Ω transformer is available from ANACOM as an option). This signal passes through an LC filter and into the transmit variable gain amplifier. This amplifier is gain-adjusted by a control voltage from the M & C unit, and has a gain variation of 26dB in 1dB steps. Another LC bandpass filter removes any out-of-band noise and presents the signal to the first transmit mixer. This mixer adds the 1.1 GHz offset loop frequency to the TX IF, producing a 1170 MHz nominal output. This L-band output passes through a mechanical filter into the second gain block. The signal amplitude is adjusted by a control signal from the M & C unit and the amplified signal flows through another mechanical filter.

The L-band output is now applied to the second transmit mixer, where it is combined with the 5 GHz transmit synthesizer output and becomes a C-band signal of the desired frequency. A mechanical bandpass filter selects the proper mixer product and applies it to a three-stage amplifier. A final mechanical filter is used before the transmit signal is applied to the SMA jack that couples it to the PA.

Power Amplifier

ANASAT®-C series transceivers are available in six versions, with maximum transmit output powers of 0 dBm, 2, 5, 10, 20, and 40 watts.

Four different power amplifier (PA) modules are employed to economically achieve the different output ratings.

The 0 dBm unit “0W” transceiver has no power amplifier. The up converter output is fed directly to the outside with a type-N connector.

Construction

The PA module is a highly linear amplifier built on soft-board Duroid™ PC board substrate material silver epoxied inside a 0.75-inch thick machined aluminum block. This assembly is bolted to the center of the transceiver heat sink for excellent thermal conductivity. Power for each stage is provided via individual feedthroughs drilled into the machined block and has separate ferrite bead isolation for each connection. Aluminum bars securely fasten the soft board into the cavity.

2 Watt Module

The 2 watt PA module, which is similar to the 5 watt module shown in Figure 4.9 takes its input from the transmit converter on the converter module. This input handles up to +10 dBm and is connected to the converter board via coaxial cable using SMA connectors.

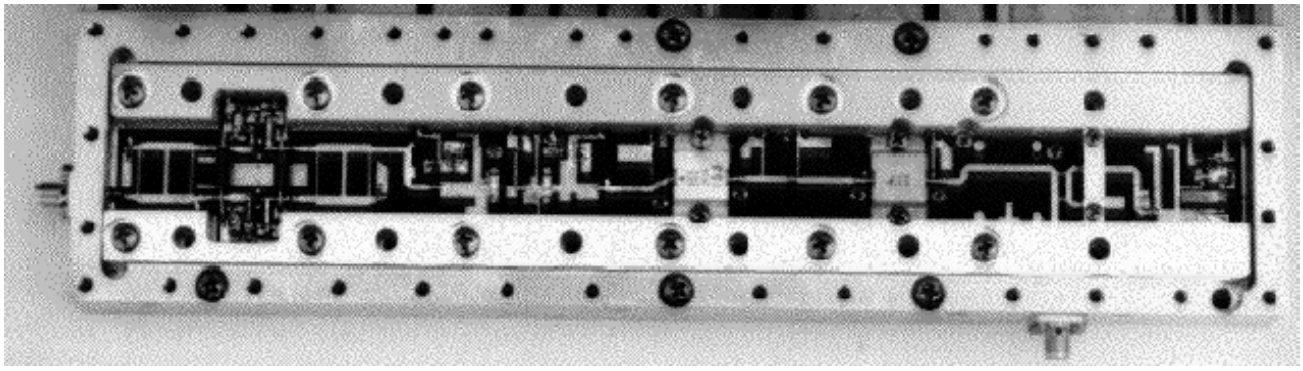


Figure 4-9 5W Power Amplifier Module.

Good RF grounding and thermal properties are assured by the use of Teflon® (Duroid™) PC board substrate material which is permanently attached to the cavity.

Transmit input is applied to a hybrid coupler which feeds a balanced two-transistor amplifier. A second hybrid coupler converts this balanced output to a single ended input for the three-stage amplifier. Maximum final output power is a minimum of 2 Watts at the 1dB compression point.

Output is applied to a SMA connector mounted on the soft board. A coaxial cable connects to a 50Ω N-connector mounted on the heat sink of the transceiver.

A directional coupler and power detector monitors the output power level and reports to the M & C unit.

5 Watt Module

The 5 watt module, shown in Figure 4-9, takes its input from the transmit converter on the converter module. This input handles up to +10 dBm and is connected to the converter board via coaxial cable using SMA connectors.

Good RF grounding and thermal properties are assured by the use of Teflon® (Duroid™) PC board substrate material which is permanently attached to the cavity.

Transmit input is applied to a hybrid coupler which feeds a balanced two-transistor amplifier. A second hybrid coupler converts this balanced output to a single-ended input for the four-stage amplifier. Maximum final output power is a minimum of 5 Watts.

DO NOT ATTEMPT REPAIR OR REMOVE THE P.A. CIRCUIT BOARD! SEVERE DAMAGE WILL RESULT.

Output is applied to a SMA connector mounted on the soft board. A coaxial cable connects to a 50Ω N-connector mounted on the heat sink of the transceiver.

A directional coupler and power detector monitors the output power level and reports to the M & C unit.

10 Watt Module

The 10 watt PA module, which is similar to the 20 watt unit shown in Figure 4-10, takes its input from the transmit converter on the converter module. This input handles up to +10dBm and is connected to the converter board via coaxial cable using SMA connectors.

Good RF grounding and thermal properties are assured by the use of Teflon® (Duroid™) PC board substrate material which is permanently attached to the cavity.

Transmit input is applied to a hybrid coupler which feeds a balanced two-transistor amplifier. A second hybrid coupler converts this balanced output to a single-ended input for the four-stage amplifier.

This drive power is fed into another hybrid coupler and on into the two-transistor balanced final amplifier. This balanced output passes through another hybrid to combine the signal into a single-ended 10W output which is fed into a female SMA connector mounted on the

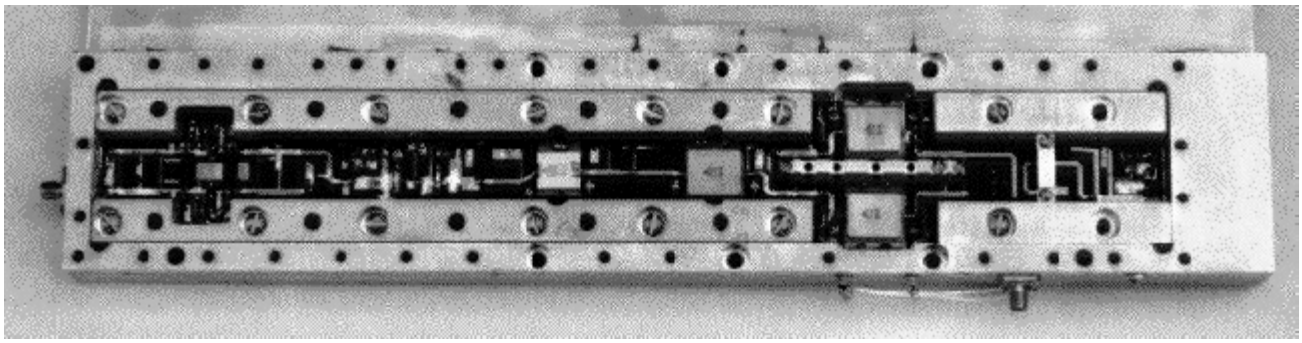


Figure 4-10 20W Power Amplifier Module.

soft board. A coaxial cable connects to a 50Ω N-connector mounted on the heat sink of the transceiver. A directional coupler and detector diode monitors output power and reports to the M & C unit.

If the transceiver is configured with the optional CPR137 waveguide port, awaveguide launch is mounted under the heatsink and mates to the PA module via a short semi-rigid cable.

Power for each stage is individually filtered and applied through ferrite beads via cutouts in the aluminum housing. Both gate bias and drain power for the final three stages are fed with press-fit filtered terminals for excellent sealing and isolation.

20 Watt Module

The 20 watt PA module, shown in Figure 4-10, takes its input from the transmit converter on the converter module. This input handles up to +10 dBm and is connected to the converter board via semi-rigid cable using SMA connectors.

Good RF grounding and thermal properties are assured by the use of Teflon®

WARNING

DO NOT ATTEMPT REPAIR OR REMOVE THE P.A. CIRCUIT BOARD! SEVERE DAMAGE WILL RESULT.

(Duroid™) PC board substrate material which is permanently attached to the cavity.

Transmit input is applied to a hybrid coupler which feeds a balanced two-transistor amplifier. A second hybrid coupler converts this balanced output to a single-ended input for the four-stage amplifier.

This drive power is fed into another hybrid coupler and on into the two-transistor balanced final amplifier. This balanced output passes through another hybrid to combine the signal into a single-ended 20W output which is fed into a female SMA connector mounted on the soft board. A coaxial cable connects to a 50Ω N-connector mounted on the heat sink of the transceiver. A directional coupler and detector diode monitors output power and reports to the M & C unit.

If the transceiver is configured with the optional CPR137 waveguide port, awaveguide launch is mounted under the heatsink and mates to the PA module via a short semi-rigid cable.

Power for each stage is individually filtered and applied through ferrite beads via cutouts in the aluminum housing. Both gate bias and drain power for the final three stages are fed with press-fit filtered terminals for excellent sealing and isolation.

40 Watt Module

The 40 watt PA module, similar to the 20W module shown in Figure 4-10, takes its input from the transmit converter on the converter module. This input handles up to +10 dBm and is connected to the converter board via semi-rigid cable using SMA connectors.

Good RF grounding and thermal properties are assured by the use of Teflon® (Duroid™) PC board substrate material which is permanently attached to the cavity.

Transmit input is applied to a hybrid coupler which feeds a balanced two-transistor amplifier. A second hybrid coupler converts this balanced output to a single-ended input for the four-stage amplifier.

WARNING ! ***DO NOT ATTEMPT REPAIR OR REMOVE THE P.A. CIRCUIT BOARD! SEVERE DAMAGE WILL RESULT.***

This drive power is fed into another hybrid coupler and on into the two-transistor balanced final amplifier. This balanced output passes through another hybrid to combine the signal into a single-ended 20W output which is fed into a female SMA connector mounted on the soft board. A coaxial cable connects to a 50Ω N-connector mounted on the heat sink of the transceiver. A directional coupler and detector diode monitors output power and reports to the M & C unit.

If the transceiver is configured with the optional CPR137 waveguide port, awaveguide launch is mounted under the heatsink and mates to the PA module via a short semi-rigid cable.

Power for each stage is individually filtered and applied through ferrite beads via cutouts in the aluminum housing. Both gate bias and drain power for the final three stages are fed with press-fit filtered terminals for excellent sealing and isolation.

Monitor and Control Unit

The monitor and control unit (M & C), Figures 4-11 and 4-12, is a microprocessor-based controller providing transceiver diagnostics, remote command, power distribution, active bias voltage for the PA, and a highly accurate and stable reference frequency.

Microprocessor-Based Functions

The heart of the M & C unit is the 80C188 microprocessor, operating at 8 MHz. It has 128K of SRAM and two 1MB FLASH electrically erasable programmable read-only memories for program and variable storage.

The microprocessor allows long term, completely unattended remote operation of the ANASAT®-C transceiver. All functions are accessible remotely via either of the two serial ports, which allow remote monitoring and diagnostics as well as normal frequency and power control. If serial communications are impossible, the transceiver's cover may be removed to access the manual adjustments located inside. (The optional switch package is required).

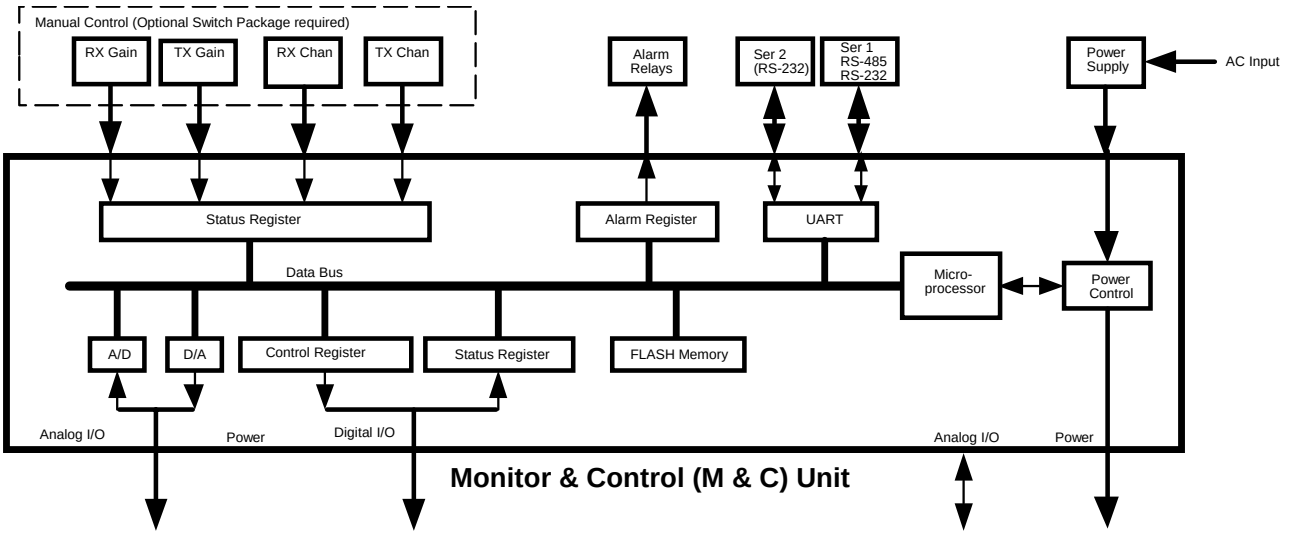


Figure 4-11. The Monitor and Control (M & C) unit.

Analog-to-digital (ADC) and digital-to-analog (DAC) converters are used by the microprocessor to monitor operating parameters and control the transceiver.

Two external LEDs, a flashing green lamp indicating proper system operation, and a red one warning of a Summary alarm are controlled by the microprocessor. These lamps provide obvious, immediate status feedback to any on-site operator or maintenance personnel.

Serial Ports

Serial communications are provided through two communications ports. COM0 is either RS-232 or RS-485 compatible. COM1 is RS-232 compatible. Both ports allow communications rates between 300bps and 57.6kbps, and use eight data bits, no parity, and one stop bit. Both ports are set at the factory to 1200bps.

Monitor Inputs

The following analog inputs are monitored by the microprocessor via the ADC:

- PA temperature
- All three PLL synthesizer VCO control voltages
- PA power output
- PA GaAs FET negative gate bias
- Each individual PA power supply
- Main +13V power supply
- M & C board +5V power supply
- LNC power supply
- TX IF power input (70 MHz)
- RX IF power output (70 MHz)

The following digital inputs are monitored by the microprocessor:

- Synthesizer lock detect alarm (monitors all three PLLs separately)
- Cooling fan failure (if fan is installed)

Control Outputs

The microprocessor controls:

- TX gain
- RX gain
- OCXO fine frequency adjust
- Transmit ON/OFF switching
- Sequenced PA power supply control
- Serial control data for the transmit and receive frequency synthesizers.

The PA power supplies are sequenced on power-up to limit the initial power surge that would otherwise result.

The programmable counters in the PLL frequency synthesizers are loaded by the microprocessor. Both are connected to the same data and clock lines, and have independent strobes.

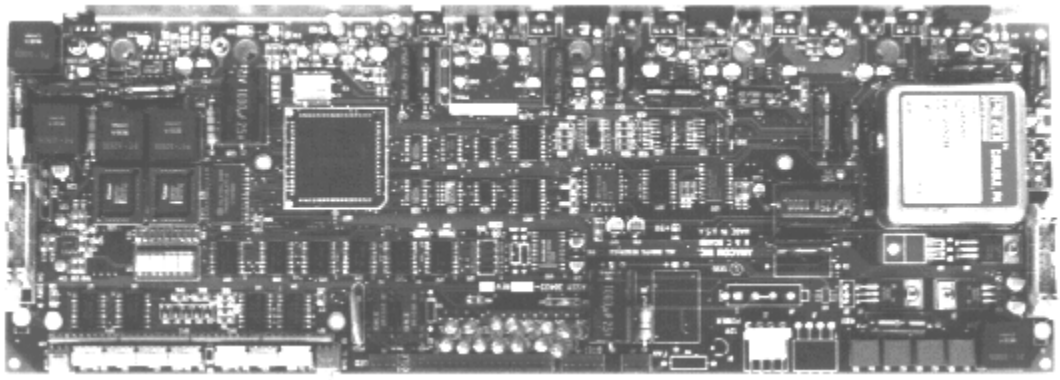


Figure 4-12. Monitor and Control Unit Board.

Non-Microprocessor-Based Monitor Functions

Separate monitor functions are implemented in hardware as a fail-safe in the unlikely event of a microprocessor lock-up. These functions disable the transmitter independently of any microprocessor commands.

- Heat sink overtemperature fault
- –5V GaAs FET bias supply failure
- Offset PLL failure
- Transmit synthesizer failure

Alarm Relays

Two mechanical relays are used in the ANASAT®-C transceiver for alarm indication. One is for major alarms and the other is for minor alarm conditions. The red LED mounted on the transceiver is illuminated whenever either the minor or major alarm relays indicate a problem exists.

The major alarm relay has normally-closed contacts, so it defaults to the alarm state when power is off.

The alarm relays can be re-configured via software to become summary TX and RX alarm relays. See ALARM_MODE in Appendix A.

Power Distribution

The M & C unit takes +13V DC input from the system power supply and generates several additional supplies:

- +5V for the M & C unit
- +5V for the converter unit
- +12V for programming the FLASH memory and running the LNC
- –5V for the GaAs FET active bias
- 11V for the PA (PA1 through PA6)

All supplies are regulated through low noise linear regulators. The 11V supply for the PA is actually four, five, or six separate regulators (the number of regulators employed depends upon which transceiver PA power level used) for isolation and power surge control reasons. Voltage and/or current is monitored for each supply. Additionally, a high accuracy, temperature compensated voltage reference is employed for the DAC and ADC.

PA Active Bias Generation

The GaAs FETs used in the PA require a negative gate voltage for operation. These very expensive devices are easily destroyed with improper bias. ANASAT®-C transceivers employ an active bias circuit with feedback to automatically control the DC power consumption of each PA stage.

Microwave Synthesizer Frequency Reference

All transceiver operating frequencies are synthesized from one 10 MHz reference oscillator. This clock is a high accuracy, high stability oven controlled crystal oscillator (OCXO) module guaranteed within $\pm 1 \times 10^{-8}$ Hz. The M & C unit periodically compensates for crystal aging automatically.

Power Supply

ANASAT®-C transceivers use a wide input voltage (100 to 240VAC, 50/60Hz) switching power supply to develop the +13V used as the internal power source. An internal circuit senses which input voltage range is being used and automatically switches modes. Figure 4-13 shows how the power supply is mounted in the transceiver. The AC input is connected via a 3-pin circular connector.

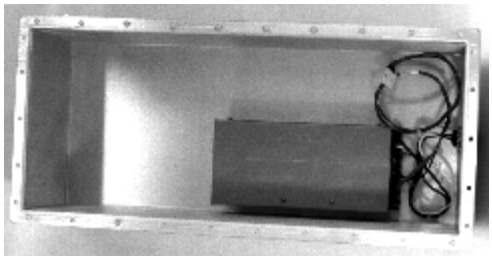


Figure 4-13

The 13V Power supply is mounted inside the cover.

Section 5. Maintenance

ANASAT®-C series transceivers are designed for a minimum of maintenance. The onboard microprocessor monitors all vital functions to ensure proper operation. Periodic scheduled maintenance is not required.

Aging of the ovenized reference oscillator is automatically microprocessor compensated, further reducing maintenance worries.

Various operational voltages may be monitored via either serial port.

At the time of installation, it is recommended that each of these points be recorded. If problems occur later, these initial recorded values can be of great help troubleshooting the system. The following table may be used to record the operating parameters. Note that several of these values are specific to the setup. For example, the RX SYNTH voltage will change if RX CHAN (the receive frequency) is changed.

Parameter	Normal Range	Installed Value
TXCHAN	*model dependent*	
TXGAIN	*model dependent*	
RXCHAN	*model dependent*	
RXGAIN	85 to 100	
OSLPLL	1.9 to 11 volts	
TXPLL	1.9 to 11 volts	
RXPLL	1.9 to 11 volts	
TEMP	–30 to +60	
LNCV	+11 to +14	
P12V	+12 to +14	
P5V	+4.7 to +5.3	
N5V	–5.3 to –4.3	
TXin	–40 to –20 dBm	
TXout	*model dependent*	
RXout	*site dependent*	
PA1	0V or 5 to 11 volts	
PA2	0V or 5 to 11volts	
PA3	0V or 5 to 11volts	
PA4	0V or 5 to 11volts	
PA5	0V or 5 to 11volts	
PA6	0V or 5 to 11volts	

LNC Replacement

Although the ANASAT-C family of transceivers is designed to need no normal maintenance, if it ever becomes necessary to replace the LNC, this procedure may be accomplished in the field with a minimum of equipment..

Two indications point to a faulty LNC:

1) Improper LNC Voltage

2) Receive IF output level low

Both of the above parameters are reported by the remote M & C terminal display.

LNC Replacement Procedure

Transmitter RF output power levels are adequate to cause blindness or other serious injury to body tissues. Use caution when working around the transceiver or antenna when the transmitter is active.

1) Remove power from the transceiver.

2) Disconnect the coax cable N-connector from the LNC.

3) Unbolt the LNC from the antenna mount. Save the weather tight gasket for reuse.

4) Attach the new LNC to the flange, using the gasket.

5) Reconnect the coax cable to the LNC N-connector.

6) Reapply power.

7) Verify receive gain with a known signal.

Checking Receive Gain

After the LNC is replaced, the system gain calibration may be affected. Check receive gain with a known signal.

1) Connect a satellite modem or a spectrum analyzer to the transceiver IF output (RXIF).

2) Monitor RXIF output from a known signal source (satellite or signal generator source).

3) Connect a terminal to the RS-232 or M & C ports on the transceiver. Using the M & C command `RXGAIN nnn` (see Appendix A), adjust receive gain until the modem or spectrum analyzer shows an acceptable signal level.

4) If necessary, use the `OFFSET_RXG` command for accurate receive gain correlation (see Appendix A for details).

LIMITED WARRANTY

If this product should fail due to defects in materials or workmanship, ANACOM Inc. will, at its sole option, repair or replace it with new or rebuilt parts, free of charge, for two (2) years from the date of its shipment from the ANACOM factory. This warranty covers only failures due to defects in materials and workmanship which occur during normal use during the period of the warranty. It does not cover damage which occurs in shipment or failures caused by products not supplied by ANACOM Inc. or its authorized contractors or agents, or any failure caused by operation of the product outside of its published electrical or environmental specifications, or any causes other than ordinary use. Expendable components are not covered by this warranty.

In order to exercise your rights to repairs under the warranty, you must first contact ANACOM to obtain a repair authorization number. If it is necessary to return the product for repair, you are responsible for paying the cost of shipping it to ANACOM. ANACOM will pay the cost of shipping the product to you when repairs are completed.

There are no express warranties except as listed above. In no event shall ANACOM be liable for special, incidental, or consequential damages, or taxes or license fees arising from the use of this product, or arising out of any breach of this warranty. All express and implied warranties, including the warranties of merchantability and fitness for a particular purpose, are limited to the applicable warranty period set forth above. No employee or representative of ANACOM is authorized to modify this warranty or ANACOM's standard warranty for any product.

Non-warranty repair service is available from ANACOM for a nominal charge. Non-warranty repair service can be obtained by contacting ANACOM and requesting a return authorization number, as described above. You are responsible for paying the cost of shipping the unit both to and from ANACOM for any non-warranty repairs. Non-warranty repair service is available for any ANACOM product up to five years from the date of its first shipment from ANACOM's factory.

Appendix A. M & C Command Set

The transceiver will not respond to any command until a carriage return has been entered, terminating the command input. Multiple commands may be entered before a carriage return, using "**;**" as a delimiter. Example:

```
TXCHAN 54; RXCHAN 36;SAVE
```

will set the transmit channel to 54, the receive channel to 36 and save these changes to a FLASH EEPROM. A transceiver response to user input can also be delimited in similar fashion.

If a command is not recognized, an error message is returned. For example, if "`foo <cr>`" is entered, the following is returned:

```
??????? foo
```

Alphabetical Listing of M & C Commands

Command	Page
ALARMS	A-2
ALARM_MODE	A-3
BAUDRATE	A-3
CLEAR_PASSWORD	A-3
CLS	A-3
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ECHO	A-4
HELP	A-4
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MODEM_MODE	A-4
MODEM_STRING	A-4
MSG	A-5
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PC_MODE	A-5
PORT_TO_PORT	A-5
REFRESH	A-5
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WARMUP	A-7

ANASAT®-C
M & C Commands

ALARMS

This command returns a list of raised alarms for the given transceiver. The possible alarms are: `WARMING, FANERR, OSLOCK, TXLOCK, RXLOCK, UCMUTE, PATEMP, TXOUT, P12V, PA, N5V, OSLPLL, TXPLL, RXPLL, P5V, LNCV, PROMERR and RXOUT`.

If there are no alarms then "`ALARMS CLEAR`" is returned. Status of all individual alarms is evaluated ten times a second.

Alarms are categorized as **MAJOR** and **MINOR**, major alarms cause the external red LED on the transceiver to begin flashing. If there are no alarms, the status of the transceiver is CLEAR.

MAJOR ALARMS

OSLOCK	raised when the OFFSET PLL has lost lock
TXLOCK	raised when the TX PLL has lost lock
RXLOCK	raised when the RX PLL has lost lock
UCMUTE	raised when the hardware mute circuit on the M & C board is active (this includes external TX shutdown)
PATEMP	when the heat sink temperature exceeds approx 85°C
PA	raised when any active power amplifier voltage drops too low
N5V	raised when the -5 volt supply drops too far
LNCV	raised when the LNC supply voltage drops too far
RXOUT	raised when the RX IF output power becomes too low
PROMERR	raised if a write or erase operation in the PROM fails

MINOR

WARMING	when the warm-up software function is active upon reset or power cycling (power turn on)
FANERR	raised when fan current becomes too low (if a fan is installed)
TXOUT	raised when PA output is deemed by software to be too high
P12V	the primary 13V supply drops below a specified level
P5V	the 5V supply on the M & C board drops below a specified level
OSLOOP	OS VCXO voltage exceeds a specified range –may still be locked
TXLOOP	UC VCXO voltage exceeds a specified range –may still be locked
RXLOOP	DC VCXO voltage exceeds a specified range –may still be locked

There are alarm conditions which can shutdown the PA stage: WARMING and OSLOCK, TXLOCK, PATEMP, and N5F. When these alarms are active, the PA stage is shutdown via the supply lines which feed it. This may cause the PA alarm to be raised as well. The WARMUP alarm may be disabled with the `WARMUP` command.

ALARM_MODE [NORMAL | PROTECTION]

There are two modes for alarm relay operation: Normal and Protection. In the NORMAL mode, the relays operate as MAJOR and MINOR relays as described above. In PROTECTION mode, the relays become redefined as TX and RX summary fault relays. The relay normally called MAJOR becomes the TX relay and the relay normally called MINOR becomes the RX relay.

In normal operation, the MAJOR relay is energized so that a power fault causes the relay to relax and thus provide an alarm contact closure. The MINOR relay is normally not energized (non-alarm state). During PROTECTION operation, both relays are normally energized (no alarms). Therefore, the RX relay has reverse definition of its contacts (NO and NC) for PROTECTION operation compared to its NORMAL operation.

BAUDRATE [300 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600]

This command sets the baudrate of the serial channel the user is presently connected to. Both serial ports have been programmed for 8 bits, no parity and 1 stop bit. These parameters are not user changeable.

CLEAR_PASSWORD PASSWORD

This command will clear an existing password. Note that the password must be given in order for it to be cleared.

CLS

In terminal mode, 25 line feeds are sent to the terminal, effectively clearing the screen. In VT52 and VT100 modes, CLS refreshes the display.

CRLF [ON | OFF]

This command is only relevant to dumb-terminal mode. It sets (or returns) carriage-return/line-feed status. "`CRLF ON`" will command the M & C computer to insert a line-feed in display output following a carriage return. This can be necessary to make some terminal displays operate properly. In other cases this would be redundant.

DTE

DTE0 [COMMAND]

DTE1 [COMMAND]

These commands return a string of data regarding the specified serial port. If no port is specified then the present serial port is used.

Using `DTE0 and DTE1` it is possible to change some of the serial port parameters for the serial port other than the one the operator is presently connected to. This could be especially useful for baud rate. Example of operator input from a terminal attached to serial port 0:

```
dte1 baudrate 19200
```

The valid commands which can be used in this fashion for the opposing serial port are `BAUDRATE, TERMTYPE, ECHO, CRLF, MODEM_MODE, PC_MODE,` and `TERMINAL_MODE.`

See the explanations for those commands elsewhere in this appendix.

ECHO [ON | OFF]

This command is only relevant in dumb-terminal mode. It sets (or returns) character echo mode. For example, if the operator is running a terminal emulation program on his PC with local echo disabled, type

```
ECHO ON
```

to enable echo back from the M & C computer. If the terminal is displaying doubled up characters, use `ECHO OFF`.

HELP
?
H

This command displays a menu of available commands for quick reference.

LABEL [TEXT]

This command erases or [sets] an alphanumeric string up to 32 characters long that the user can use to "title" or describe the purpose of the given ODU.

LOCK PASSWORD

With this command most M & C functions will be locked and further user access will be denied until the `UNLOCK` command is given. Those commands which remain user accessible are: `UNLOCK, CLS, ALARMS,` and `LIST.`

If a password has been established with the `SET_PASSWORD` command then that password must be used with the `LOCK` command. If there is no established password (if `CLEAR_PASSWORD` has been used, for instance), then M & C functions will be locked; but they can be unlocked without a password. There are two solutions to the problem of having a locked unit and/or a forgotten password:

1. The unit can be reset using the internal DIP switches. See Appendix D.
2. If the unit is attached to a modem, and presently accessible remotely, telephone ANACOM.

MODE

This command returns either `MODEM_MODE` or `PC_MODE.` Example: `MODE` might return `MODE MODEM_MODE` when the user is connected to the unit via a phone line and a Hayes compatible modem.

MODEM_MODE

This command is used to tell the M & C computer that a Hayes compatible modem is attached to the serial port. The way this would be used is a user would enter this command from a PC using a null modem cable, then disconnect the PC and attach a modem directly to the port via a modem cable. `RX, TX, DCD` and signal GND lines must be properly connected.

Once `MODEM_MODE` is activated, the M & C computer will no longer display dumb terminal display updates or generate packets in packet mode until the DATA-CARRIER_DETECT line becomes active, indicating the modem is off-hook and connected to another modem.

MODEM_STRING [TEXT]

When the M & C computer is in modem mode it will periodically send a Hayes compatible initialization string of up to 40 characters to the modem to make sure it is properly configured. The user can get [set] this string via this command. The default string as part of factory settings is:

```
MODEM_STRING AT S0=1 &C1 &S0 \Q0 E0
```

MSG TEXT

This command allows an operator connected to one serial port to send an ASCII message to someone connected to the other port. A message received will appear on the other operator's screen prefixed with the prompt `MESSAGE>`.

OFFSET [TXGAIN | RXGAIN] [number]

This command gets [sets] a floating point offset for TX or RX calibration tables. The valid arguments are: `TXGAIN, RXGAIN.`

The default values for these offsets is 0. Example usage:

```
OFFSET TXGAIN 2
```

The result of this is that the output would be 2 dB greater than what would otherwise be transmitted. In other words, the TX gain range would be shifted down by two decibels. If a `TXGAIN` of 72 dB were requested, the calibration data interpolation would be done internally with the value of 74 dB. If the user measures the TX gain with a power meter and finds that gain is high by 1.5 dB, then he might enter:

```
OFFSET TXGAIN -1.5
```

PC_MODE

This is the converse of `MODEM_MODE.` At any time, the user may type `PC_MODE` and the M & C computer will again behave as if a PC or network is directly attached to the serial port rather than a modem.

PORT_TO_PORT [ON|OFF]

This command sets (gets) the status of the port_to_port function. When active on, then function re-transmits all serial port data from COM0 to COM1 and also from COM1 to COM0 regardless of data content. If the M & C interprets data as a legitimate command then the command is acted on. Otherwise the data is ignored by the M & C. When ON, the M & C does not issue ??????? when data is received which does not conform to a proper command.

WARNING: When this function is ON, the M & C will not automatically change baudrate to 1200 when the external data is changed to 1200.

REFRESH

This command refreshes the RF hardware to presently chosen receive and transmit channels and gain settings.

RESET

This command resets the M & C computer. Power-on time will reset to zero. Warning: `RESET` will shut down the transceiver momentarily.

RXCHAN [number | INC | DEC]

This command gets [sets] the receive channel number. See Appendix E for channel frequency information. *NOTE: Channel 0 is not a valid selection*.

RXFREQ [number]

This command gets [sets] receiver frequency (MHz) for RXOUT at 70 MHz (140 MHz). The range of [number] depends on the model.

RXGAIN [number]

This command gets [sets] receiver gain. The acceptable range is a two or three digit integer between 85 and 100 (dB).

SAVE

This command saves present M & C operating parameters to a FLASH EEPROM.

SET_PASSWORD PASSWORD PASSWORD

The M & C computer supports password control of M & C functions. One potential use of this feature would be for leaving an ODU connected to a modem on an open telephone line. A valid password must be an alphanumeric string with no imbedded blanks, and between four and eight characters long inclusive. It must be given twice to ensure accuracy.

An existing password must first be cleared before setting a new password. This is done with the CLEAR_PASSWORD command.

TERMTYPE [TTY | VT52 | VT100]

This command is only relevant to dumb-terminal mode. It sets (or returns) the terminal emulation mode.

TTY Terminal Mode: this is a basic 80 character by 25 line ASCII “dumb” terminal mode.

VT52 Mode: This is a standard terminal emulation, more intelligent than TTY.

VT100 Mode: This in an enhanced communications terminal emulator with a fixed display window.

There are some control characters that will be filtered by the terminal driver when the M & C computer is in terminal mode. These control characters will be ignored in packet mode.

CTRL-E: This will erase the screen, similar to the CLS command.

CTRL-R: This repeats execution of the last Carriage return terminated command.

CTRL-Q: refer to the description of CTRL-S.

CTRL-S: Periodic screen updates will be squelched until the user has finished entering present command or hits CTRL-Q.

CTRL-BS: (Backspace) The present input command will be erased

TX [ON | OFF]
TXREQ [ON | OFF]
TXREQUEST [ON | OFF]

This command requests activation of the transmitter. This is done by enabling the PA supply voltages. TXREQ ON will indicate the operator’s desire to begin transmission. With no argument TXREQ simply return its present state as ON or OFF. Note that the unit will be shipped with TXREQ set to OFF.

Exactly when are we “ON AIR?” The answer is when TXREQ is ON, the hardware alarm TXMUTE is clear, and the transmitter is not software inhibited to allow the crystal reference oscillator time to warm-up at power-on. See the WARMUP command for details.

TXCHAN [number]

This command gets [sets] the transmit channel number. The acceptable range depends upon model type. See Appendix E for channel frequency information. *Channel 0 is not a valid selection*.

TXFREQ [number]

This command gets [sets] the transmit channel number. The acceptable range depends upon the model type. The [number] is the actual transmit frequency output with TXIF at 70 MHz [or 140 MHz].

TXGAIN [number | INC | DEC]

This command gets [sets] or returns the transmit gain. The acceptable range of the number is dependent upon model.

nn ranges from: 10 to 36dB for the ANASAT-0C
44 to 70dB for the ANASAT-2C
48 to 74 dB for the ANASAT-5C
51 to 77 dB for the ANASAT-10C
54 to 80 dB for the ANASAT-20C
54 to 83 dB for the ANASAT -40C

UNLOCK PASSWORD

This command will unlock M & C functions for user access.

UTIMER [NUMBER]

This command is only relevant to dumb-terminal mode. It sets (or returns) the number of seconds between automatic display updates. Note that changing baud rate will automatically revert to a default appropriate for that particular baudrate.

WARMUP [ON | OFF | CANCEL]

Upon transceiver power-up, a 5 minute period will pass to allow the reference oscillator crystal oven sufficient warm up time. The unit is shipped with this flag set OFF, but can be changed by the user. Because there is no way for the M & C computer to know how long it has been off the air, a reset or momentary loss of power will cause a warm-up countdown to occur when the feature is in use. `WARMUP CANCEL` will terminate a warm-up countdown and immediately enable the transmitter.

TXD; TXDAC [NUMBER]

This command bypasses the transmit numerical gain compensation by the M&C. It will issue [number] 1 to 255 to the TX gain control element. This is for troubleshooting use only and transceiver should not be left in this mode as the numerical compensation (temp. + freq.) would be disabled.

RXD; RXDAC [NUMBER]

This command bypasses the receive numerical gain compensation by the M&C. It will issue [number] 0 to 255 to the RX gain control element. This is for troubleshooting use only and transceiver should not be left in this mode as the numerical compensation (temp. + freq.) would be disabled.

Appendix B. Alarm List

The ANASAT-C transceiver features sophistocated internal monitoring. If an abnormal condition occurs, a description of the abnormality is sent via the M & C serial port to the operator's console.

These alarms are divided into two categories: major alarms and minor alarms. When a TX major alarm condition is detected, the transmitter is immediately pulled OFF the air. An advisory message is sent to the operator via the serial port and the red ALARM LED, visible from outside the transceiver, begins flashing. Most major alarms are generated directly by hardware detectors inside the unit. Minor alarms do not disable the transmitter or light the LED, but still cause an advisory message on the serial port. Most minor alarms are generated by M & C software routines which look for out of tolerance conditions.

	MAJOR ALARMS
OSLOCK	the OS PLL is not locked
TXLOCK	the TX PLL is not locked
RXLOCK	the RX PLL is not locked
PATEMP	the PA heat sink temperature becomes excessive
PA	one of the PA voltages is too low or too high
N5V	the –5 volt supply is out of tolerance
LNCV	the LNC supply voltage is too low
PROMERR	the M & C PROM checksum fails
RXOUT	the RX output noise floor becomes too low
-	external power loss

	MINOR
WARMING	the warm-up software function is enabled upon reset or power-up
FANERR	fan fails (if a fan is installed)
TXMUTE	when the TX is disabled (internally by alarms or externally)
P12V	the primary +13V supply is too low
P5V	the +5V supply on the M&C board is too low
OSLPLL	OS VCO voltage is out of range — can still be locked
TXPLL	UC VCO voltage is out of range — can still be locked
RXPLL	DC VCO voltage is out of range — can still be locked

	ALARMS WHICH TURN OFF TRANSMITTER
WARMING	software settable to mute the TX during the warmup period, or not
PATEMP	PA temperature is excessive. Automatically resets when cooler
TXMUTE	when the TX is disabled (internally by alarms or externally)
OSLOCK	OS PLL is not locked
UCLOCK	UC PLL is not locked
N5V	the –5V supply failed. Probable PA damage if PA is not shut down.

For situations when the ALARM_MODE is set to PROTECTION, the alarm relays are re-defined as TX and RX alarm relays instead of MAJOR and MINOR. The M & C software still considers the alarms as either major or minor and will communicate alarms via the serial ports and the front panel red LED as major or minor.

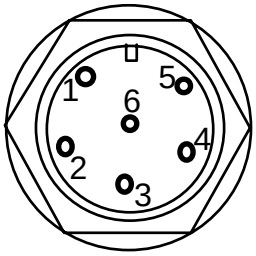
In PROTECTION mode, the alarm relays will engage based on the following alarm list:

	TX
OSLOCK	the OS PLL fails to lock
TXLOCK	the TX PLL fails to lock
PATEMP	the PA temperature is too high
N5V	the –5V supply is out of tolerance
PA	one of the PA supply voltages is out of tolerance
-	external power loss

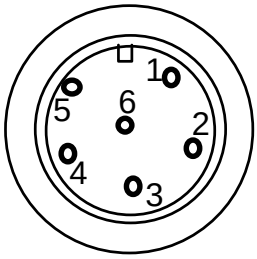
	RX
LNCV	LNC voltage too low
OSLOCK	OS PLL is not locked
RXLOCK	RX PLL is not locked
RXOUT	RX output noise floor is too low (low gain)
-	external power loss

Appendix C. Serial Port Wiring

COM1, 6-Pin Circular Weathertight Connector



Cable Wire View

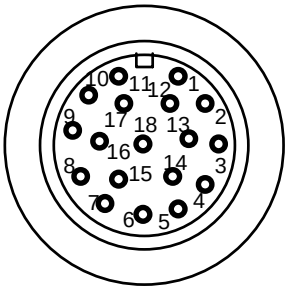


Cable End View

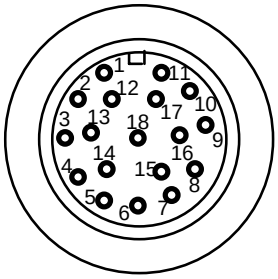
Pin	Signal	Description
1	DTR	Data Terminal Ready
2	DCD	Data Carrier Detect
3	DSR	Data Set Ready
4	RXD	Receive Data
5	TXD	Transmit Data
6	GND	Ground

Note dimple next to pin 1

COM0, 18-Pin Circular Weathertight Connector



Cable End View



Cable Wire View

Pin	Signal	Description	Pin	Signal	Description
1	RY1NO	Minor Alarm Normally Open	10	RX+	Differential Receive Data
2	RY1NC	Minor Alarm Normally Close	11	RX-	Differential Receive Data
3	RY1C	Minor Alarm Common	12	RS485	RS485 Jumper (open for 232)
4	RY2NO	Major Alarm Normally Open	13	TXM	TX Mute*
5	RY2NC	Major Alarm Normally Close	14	DTR	Data Terminal Ready
6	RY2C	Major Alarm Common	15	DCD	Data Carrier Detect
7	P13V	+13V DC Power	16	RXD	Receive Data
8	TX+	Differential Transmit Data	17	TXD	Transmit Data
9	TX-	Differential Transmit Data	18	GND	Ground

Note dimple next to pin 1

RS485/RS232 Selection

(COM1, 18-Pin Connector Only)

Pin 12 of the 18-pin Weathertight circular connector is the RS485/RS232 mode select pumper pin. Connect Pin 12 to Ground (Pin 18) for RS485 operation. Leave open for RS232 operation. This has no effect on the other serial port.

Data Terminal Connection

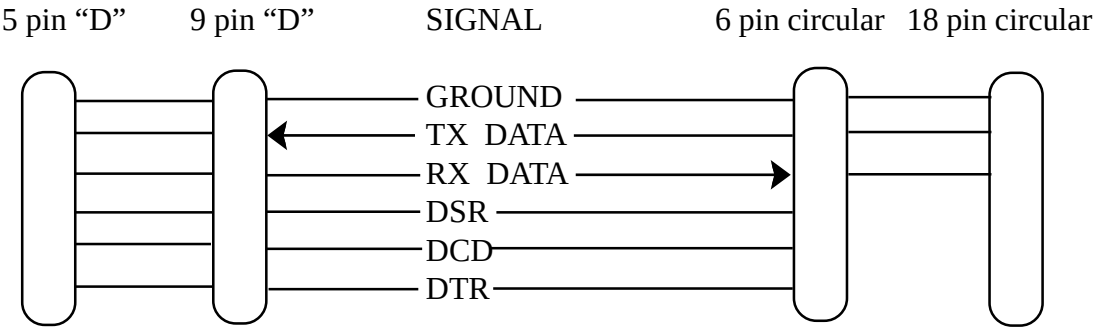
Using a serial cable with a connector on one end that matches your terminal equipment (either a "dumb" terminal or a computer running terminal emulator or modem software), connect the 6-pin or 18-pin Weathertight circular connector to the other end, following Figure C-5 and the applicable previous table.

Alternative Alarm Relay Wiring

For protected installations, it may be desired to operate the transceiver with the alarm relays reporting separate TX and RX alarms instead of the normal Major and Minor alarms. See Appendix A for the ALARM_MODE command. When operating in PROTECTION mode, the alarm relays on the M&C connector should be wired per this chart:

Pin	Signal	Description
1	RY1NC	RX Alarm Normally Closed
2	RY1NO	RX Alarm Normally Open
3	RY1C	RX Alarm Common
4	RY2NO	TX Alarm Normally Open
5	RY2NC	TX Alarm Normally Closed
6	RY2C	TX Alarm Common

Note: Only the first 6 pins of this 18 pin connector are shown. All other pins are as shown on the previous page.



Note: Select either the 9 or 25 pin female "D" connector to match your particular data terminal. Some terminals may not need the DTR, DSR, or DCD connections.

Figure C-1. RS232 Serial Cable Connections. Computer or terminal connections.

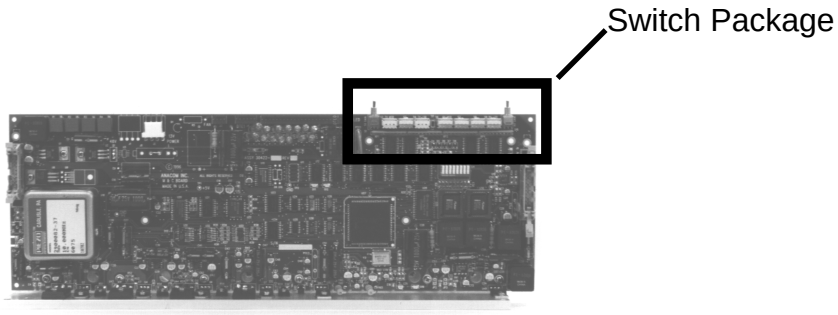
Anacom provides a 10 ft. long M&C cable with each unit with DB-9 & 6 pin circular connectors.

Appendix D. Hardware Configuring the Transceiver

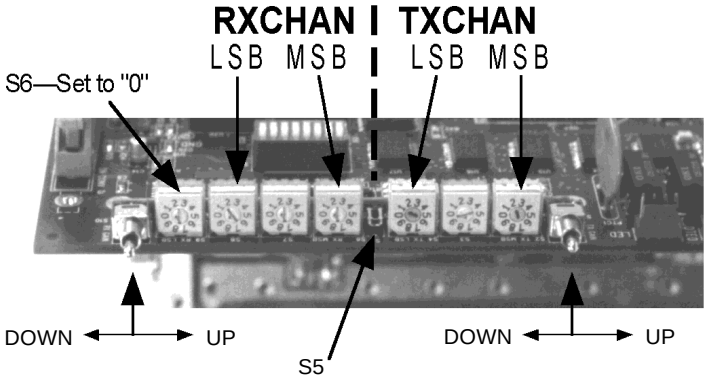
(Optional switch package required)

The optional switch package is located on the end of the M & C board opposite the crystal oscillator.

Use extreme caution when opening the transceiver. Do not expose the unprotected transceiver or subassemblies to moisture.



M & C Board. Switches are on the upper right side of the board (inside box).



A close-up view of the optional switch package.

M & C Unit DIP Switch Positions

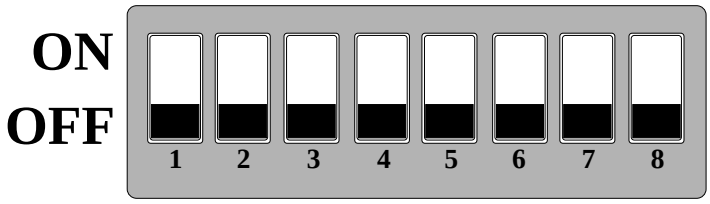


Figure D-1. ANASAT®-C Internal DIP Switches. Switches shown in the factory default (OFF) position.

Switch	Function	OFF	ON
1	Reserved	—	—
2	Clear Password	Normal	Clear Password
3	Terminal Baud Rate Selection	(see Table)	
4	Terminal Baud Rate Selection	(see Table)	
5	Terminal Baud Rate Selection	(see Table)	
6	Terminal Type	TTY	VT100
7	Terminal Mode (note 1)	DTE1	DCE1
8	Hard Reset (note 2)	Normal	Reset on reboot

Note 1: DTE1 is PC or terminal mode. DCE1 is modem mode.
Note 2: DIP switch settings will override saved parameters.

Terminal Baud Rate Selection

Note: all serial communications with the ANASAT®-C Transceiver are accomplished with eight data bits, no parity, and one stop bit (8N1) protocol.

DIP Switch			Baud Rate
3	4	5	(bps)
1	1	1	300
0	0	0	1200
1	0	0	2400
0	1	0	4800
1	1	0	9600
0	0	1	19,200
1	0	1	38,400
0	1	1	57,600

ANASAT®-C Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
1	3700	5925	51	3750	5975	101	3800	6025	151	3850	6075
2	3701	5926	52	3751	5976	102	3801	6026	152	3851	6076
3	3702	5927	53	3752	5977	103	3802	6027	153	3852	6077
4	3703	5928	54	3753	5978	104	3803	6028	154	3853	6078
5	3704	5929	55	3754	5979	105	3804	6029	155	3854	6079
6	3705	5930	56	3755	5980	106	3805	6030	156	3855	6080
7	3706	5931	57	3756	5981	107	3806	6031	157	3856	6081
8	3707	5932	58	3757	5982	108	3807	6032	158	3857	6082
9	3708	5933	59	3758	5983	109	3808	6033	159	3858	6083
10	3709	5934	60	3759	5984	110	3809	6034	160	3859	6084
11	3710	5935	61	3760	5985	111	3810	6035	161	3860	6085
12	3711	5936	62	3761	5986	112	3811	6036	162	3861	6086
13	3712	5937	63	3762	5987	113	3812	6037	163	3862	6087
14	3713	5938	64	3763	5988	114	3813	6038	164	3863	6088
15	3714	5939	65	3764	5989	115	3814	6039	165	3864	6089
16	3715	5940	66	3765	5990	116	3815	6040	166	3865	6090
17	3716	5941	67	3766	5991	117	3816	6041	167	3866	6091
18	3717	5942	68	3767	5992	118	3817	6042	168	3867	6092
19	3718	5943	69	3768	5993	119	3818	6043	169	3868	6093
20	3719	5944	70	3769	5994	120	3819	6044	170	3869	6094
21	3720	5945	71	3770	5995	121	3820	6045	171	3870	6095
22	3721	5946	72	3771	5996	122	3821	6046	172	3871	6096
23	3722	5947	73	3772	5997	123	3822	6047	173	3872	6097
24	3723	5948	74	3773	5998	124	3823	6048	174	3873	6098
25	3724	5949	75	3774	5999	125	3824	6049	175	3874	6099
26	3725	5950	76	3775	6000	126	3825	6050	176	3875	6100
27	3726	5951	77	3776	6001	127	3826	6051	177	3876	6101
28	3727	5952	78	3777	6002	128	3827	6052	178	3877	6102
29	3728	5953	79	3778	6003	129	3828	6053	179	3878	6103
30	3729	5954	80	3779	6004	130	3829	6054	180	3879	6104
31	3730	5955	81	3780	6005	131	3830	6055	181	3880	6105
32	3731	5956	82	3781	6006	132	3831	6056	182	3881	6106
33	3732	5957	83	3782	6007	133	3832	6057	183	3882	6107
34	3733	5958	84	3783	6008	134	3833	6058	184	3883	6108
35	3734	5959	85	3784	6009	135	3834	6059	185	3884	6109
36	3735	5960	86	3785	6010	136	3835	6060	186	3885	6110
37	3736	5961	87	3786	6011	137	3836	6061	187	3886	6111
38	3737	5962	88	3787	6012	138	3837	6062	188	3887	6112
39	3738	5963	89	3788	6013	139	3838	6063	189	3888	6113
40	3739	5964	90	3789	6014	140	3839	6064	190	3889	6114
41	3740	5965	91	3790	6015	141	3840	6065	191	3890	6115
42	3741	5966	92	3791	6016	142	3841	6066	192	3891	6116
43	3742	5967	93	3792	6017	143	3842	6067	193	3892	6117
44	3743	5968	94	3793	6018	144	3843	6068	194	3893	6118
45	3744	5969	95	3794	6019	145	3844	6069	195	3894	6119
46	3745	5970	96	3795	6020	146	3845	6070	196	3895	6120
47	3746	5971	97	3796	6021	147	3846	6071	197	3896	6121
48	3747	5972	98	3797	6022	148	3847	6072	198	3897	6122
49	3748	5973	99	3798	6023	149	3848	6073	199	3898	6123
50	3749	5974	100	3799	6024	150	3849	6074	200	3899	6124

ANASAT®-C Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
201	3900	6125	251	3950	6175	301	4000	6225	351	4050	6275
202	3901	6126	252	3951	6176	302	4001	6226	352	4051	6276
203	3902	6127	253	3952	6177	303	4002	6227	353	4052	6277
204	3903	6128	254	3953	6178	304	4003	6228	354	4053	6278
205	3904	6129	255	3954	6179	305	4004	6229	355	4054	6279
206	3905	6130	256	3955	6180	306	4005	6230	356	4055	6280
207	3906	6131	257	3956	6181	307	4006	6231	357	4056	6281
208	3907	6132	258	3957	6182	308	4007	6232	358	4057	6282
209	3908	6133	259	3958	6183	309	4008	6233	359	4058	6283
210	3909	6134	260	3959	6184	310	4009	6234	360	4059	6284
211	3910	6135	261	3960	6185	311	4010	6235	361	4060	6285
212	3911	6136	262	3961	6186	312	4011	6236	362	4061	6286
213	3912	6137	263	3962	6187	313	4012	6237	363	4062	6287
214	3913	6138	264	3963	6188	314	4013	6238	364	4063	6288
215	3914	6139	265	3964	6189	315	4014	6239	365	4064	6289
216	3915	6140	266	3965	6190	316	4015	6240	366	4065	6290
217	3916	6141	267	3966	6191	317	4016	6241	367	4066	6291
218	3917	6142	268	3967	6192	318	4017	6242	368	4067	6292
219	3918	6143	269	3968	6193	319	4018	6243	369	4068	6293
220	3919	6144	270	3969	6194	320	4019	6244	370	4069	6294
221	3920	6145	271	3970	6195	321	4020	6245	371	4070	6295
222	3921	6146	272	3971	6196	322	4021	6246	372	4071	6296
223	3922	6147	273	3972	6197	323	4022	6247	373	4072	6297
224	3923	6148	274	3973	6198	324	4023	6248	374	4073	6298
225	3924	6149	275	3974	6199	325	4024	6249	375	4074	6299
226	3925	6150	276	3975	6200	326	4025	6250	376	4075	6300
227	3926	6151	277	3976	6201	327	4026	6251	377	4076	6301
228	3927	6152	278	3977	6202	328	4027	6252	378	4077	6302
229	3928	6153	279	3978	6203	329	4028	6253	379	4078	6303
230	3929	6154	280	3979	6204	330	4029	6254	380	4079	6304
231	3930	6155	281	3980	6205	331	4030	6255	381	4080	6305
232	3931	6156	282	3981	6206	332	4031	6256	382	4081	6306
233	3932	6157	283	3982	6207	333	4032	6257	383	4082	6307
234	3933	6158	284	3983	6208	334	4033	6258	384	4083	6308
235	3934	6159	285	3984	6209	335	4034	6259	385	4084	6309
236	3935	6160	286	3985	6210	336	4035	6260	386	4085	6310
237	3936	6161	287	3986	6211	337	4036	6261	387	4086	6311
238	3937	6162	288	3987	6212	338	4037	6262	388	4087	6312
239	3938	6163	289	3988	6213	339	4038	6263	389	4088	6313
240	3939	6164	290	3989	6214	340	4039	6264	390	4089	6314
241	3940	6165	291	3990	6215	341	4040	6265	391	4090	6315
242	3941	6166	292	3991	6216	342	4041	6266	392	4091	6316
243	3942	6167	293	3992	6217	343	4042	6267	393	4092	6317
244	3943	6168	294	3993	6218	344	4043	6268	394	4093	6318
245	3944	6169	295	3994	6219	345	4044	6269	395	4094	6319
246	3945	6170	296	3995	6220	346	4045	6270	396	4095	6320
247	3946	6171	297	3996	6221	347	4046	6271	397	4096	6321
248	3947	6172	298	3997	6222	348	4047	6272	398	4097	6322
249	3948	6173	299	3998	6223	349	4048	6273	399	4098	6323
250	3949	6174	300	3999	6224	350	4049	6274	400	4099	6324

ANASAT®-C Satellite Channels

Ch.	RX MHz	TX MHz
401	4100	6325
402	4101	6326
403	4102	6327
404	4103	6328
405	4104	6329
406	4105	6330
407	4106	6331
408	4107	6332
409	4108	6333
410	4109	6334
411	4110	6335
412	4111	6336
413	4112	6337
414	4113	6338
415	4114	6339
416	4115	6340
417	4116	6341
418	4117	6342
419	4118	6343
420	4119	6344
421	4120	6345
422	4121	6346
423	4122	6347
424	4123	6348
425	4124	6349
426	4125	6350
427	4126	6351
428	4127	6352
429	4128	6353
430	4129	6354
431	4130	6355
432	4131	6356
433	4132	6357
434	4133	6358
435	4134	6359
436	4135	6360
437	4136	6361
438	4137	6362
439	4138	6363
440	4139	6364
441	4140	6365
442	4141	6366
443	4142	6367
444	4143	6368
445	4144	6369
446	4145	6370
447	4146	6371
448	4147	6372
449	4148	6373
450	4149	6374

Ch.	RX MHz	TX MHz
451	4150	6375
452	4151	6376
453	4152	6377
454	4153	6378
455	4154	6379
456	4155	6380
457	4156	6381
458	4157	6382
459	4158	6383
460	4159	6384
461	4160	6385
462	4161	6386
463	4162	6387
464	4163	6388
465	4164	6389
466	4165	6390
467	4166	6391
468	4167	6392
469	4168	6393
470	4169	6394
471	4170	6395
472	4171	6396
473	4172	6397
474	4173	6398
475	4174	6399
476	4175	6400
477	4176	6401
478	4177	6402
479	4178	6403
480	4179	6404
481	4180	6405
482	4181	6406
483	4182	6407
484	4183	6408
485	4184	6409
486	4185	6410
487	4186	6411
488	4187	6412
489	4188	6413
490	4189	6414
491	4190	6415
492	4191	6416
493	4192	6417
494	4193	6418
495	4194	6419
496	4195	6420
497	4196	6421
498	4197	6422
499	4198	6423
500	4199	6424

Ch.	RX MHz	TX MHz
501	4200	6425

ANASAT®-EC Satellite Channels

Ch.	RX MHz	TX MHz
–75	3625	5850
–74	3626	5851
–73	3627	5852
–72	3628	5853
–71	3629	5854
–70	3630	5855
–69	3631	5856
–68	3632	5857
–67	3633	5858
–66	3634	5859
–65	3635	5860
–64	3636	5861
–63	3637	5862
–62	3638	5863
–61	3639	5864
–60	3640	5865
–59	3641	5866
–58	3642	5867
–57	3643	5868
–56	3644	5869
–55	3645	5870
–54	3646	5871
–53	3647	5872
–52	3648	5873
–51	3649	5874
–50	3650	5875
–49	3651	5876
–48	3652	5877
–47	3653	5878
–46	3654	5879
–45	3655	5880
–44	3656	5881
–43	3657	5882
–42	3658	5883
–41	3659	5884
–40	3660	5885
–39	3661	5886
–38	3662	5887
–37	3663	5888
–36	3664	5889
–35	3665	5890
–34	3666	5891
–33	3667	5892
–32	3668	5893
–31	3669	5894
–30	3670	5895
–29	3671	5896
–28	3672	5897
–27	3673	5898
–26	3674	5899
–25	3675	5900
–24	3676	5901
–23	3677	5902
–22	3678	5903
–21	3679	5904
–20	3680	5905
–19	3681	5906
–18	3682	5907
–17	3683	5908
–16	3684	5909
–15	3685	5910
–14	3686	5911
–13	3687	5912
–12	3688	5913
–11	3689	5914
–10	3690	5915
–9	3691	5916
–8	3692	5917
–7	3693	5918
–6	3694	5919
–5	3695	5920
–4	3696	5921
–3	3697	5922
–2	3698	5923
–1	3699	5924
1	3700	5925
2	3701	5926
3	3702	5927
4	3703	5928
5	3704	5929
6	3705	5930
7	3706	5931
8	3707	5932
9	3708	5933
10	3709	5934
11	3710	5935
12	3711	5936
13	3712	5937
14	3713	5938
15	3714	5939
16	3715	5940
17	3716	5941
18	3717	5942
19	3718	5943
20	3719	5944
21	3720	5945
22	3721	5946
23	3722	5947
24	3723	5948
25	3724	5949
26	3725	5950
27	3726	5951
28	3727	5952
29	3728	5953
30	3729	5954
31	3730	5955
32	3731	5956
33	3732	5957
34	3733	5958
35	3734	5959
36	3735	5960
37	3736	5961
38	3737	5962
39	3738	5963
40	3739	5964
41	3740	5965
42	3741	5966
43	3742	5967
44	3743	5968
45	3744	5969
46	3745	5970
47	3746	5971
48	3747	5972
49	3748	5973
50	3749	5974
51	3750	5975
52	3751	5976
53	3752	5977
54	3753	5978
55	3754	5979
56	3755	5980
57	3756	5981
58	3757	5982
59	3758	5983
60	3759	5984
61	3760	5985
62	3761	5986
63	3762	5987
64	3763	5988
65	3764	5989
66	3765	5990
67	3766	5991
68	3767	5992
69	3768	5993
70	3769	5994
71	3770	5995
72	3771	5996
73	3772	5997
74	3773	5998
75	3774	5999
76	3775	6000
77	3776	6001
78	3777	6002
79	3778	6003
80	3779	6004
81	3780	6005
82	3781	6006
83	3782	6007
84	3783	6008
85	3784	6009
86	3785	6010
87	3786	6011
88	3787	6012
89	3788	6013
90	3789	6014
91	3790	6015
92	3791	6016
93	3792	6017
94	3793	6018
95	3794	6019
96	3795	6020
97	3796	6021
98	3797	6022
99	3798	6023
100	3799	6024
101	3800	6025
102	3801	6026
103	3802	6027
104	3803	6028
105	3804	6029
106	3805	6030
107	3806	6031
108	3807	6032
109	3808	6033
110	3809	6034
111	3810	6035
112	3811	6036
113	3812	6037
114	3813	6038
115	3814	6039
116	3815	6040
117	3816	6041
118	3817	6042
119	3818	6043
120	3819	6044
121	3820	6045
122	3821	6046
123	3822	6047
124	3823	6048
125	3824	6049

ANASAT®-EC Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
126	3825	6050	176	3875	6100	226	3925	6150	276	3975	6200
127	3826	6051	177	3876	6101	227	3926	6151	277	3976	6201
128	3827	6052	178	3877	6102	228	3927	6152	278	3977	6202
129	3828	6053	179	3878	6103	229	3928	6153	279	3978	6203
130	3829	6054	180	3879	6104	230	3929	6154	280	3979	6204
131	3830	6055	181	3880	6105	231	3930	6155	281	3980	6205
132	3831	6056	182	3881	6106	232	3931	6156	282	3981	6206
133	3832	6057	183	3882	6107	233	3932	6157	283	3982	6207
134	3833	6058	184	3883	6108	234	3933	6158	284	3983	6208
135	3834	6059	185	3884	6109	235	3934	6159	285	3984	6209
136	3835	6060	186	3885	6110	236	3935	6160	286	3985	6210
137	3836	6061	187	3886	6111	237	3936	6161	287	3986	6211
138	3837	6062	188	3887	6112	238	3937	6162	288	3987	6212
139	3838	6063	189	3888	6113	239	3938	6163	289	3988	6213
140	3839	6064	190	3889	6114	240	3939	6164	290	3989	6214
141	3840	6065	191	3890	6115	241	3940	6165	291	3990	6215
142	3841	6066	192	3891	6116	242	3941	6166	292	3991	6216
143	3842	6067	193	3892	6117	243	3942	6167	293	3992	6217
144	3843	6068	194	3893	6118	244	3943	6168	294	3993	6218
145	3844	6069	195	3894	6119	245	3944	6169	295	3994	6219
146	3845	6070	196	3895	6120	246	3945	6170	296	3995	6220
147	3846	6071	197	3896	6121	247	3946	6171	297	3996	6221
148	3847	6072	198	3897	6122	248	3947	6172	298	3997	6222
149	3848	6073	199	3898	6123	249	3948	6173	299	3998	6223
150	3849	6074	200	3899	6124	250	3949	6174	300	3999	6224
151	3850	6075	201	3900	6125	251	3950	6175	301	4000	6225
152	3851	6076	202	3901	6126	252	3951	6176	302	4001	6226
153	3852	6077	203	3902	6127	253	3952	6177	303	4002	6227
154	3853	6078	204	3903	6128	254	3953	6178	304	4003	6228
155	3854	6079	205	3904	6129	255	3954	6179	305	4004	6229
156	3855	6080	206	3905	6130	256	3955	6180	306	4005	6230
157	3856	6081	207	3906	6131	257	3956	6181	307	4006	6231
158	3857	6082	208	3907	6132	258	3957	6182	308	4007	6232
159	3858	6083	209	3908	6133	259	3958	6183	309	4008	6233
160	3859	6084	210	3909	6134	260	3959	6184	310	4009	6234
161	3860	6085	211	3910	6135	261	3960	6185	311	4010	6235
162	3861	6086	212	3911	6136	262	3961	6186	312	4011	6236
163	3862	6087	213	3912	6137	263	3962	6187	313	4012	6237
164	3863	6088	214	3913	6138	264	3963	6188	314	4013	6238
165	3864	6089	215	3914	6139	265	3964	6189	315	4014	6239
166	3865	6090	216	3915	6140	266	3965	6190	316	4015	6240
167	3866	6091	217	3916	6141	267	3966	6191	317	4016	6241
168	3867	6092	218	3917	6142	268	3967	6192	318	4017	6242
169	3868	6093	219	3918	6143	269	3968	6193	319	4018	6243
170	3869	6094	220	3919	6144	270	3969	6194	320	4019	6244
171	3870	6095	221	3920	6145	271	3970	6195	321	4020	6245
172	3871	6096	222	3921	6146	272	3971	6196	322	4021	6246
173	3872	6097	223	3922	6147	273	3972	6197	323	4022	6247
174	3873	6098	224	3923	6148	274	3973	6198	324	4023	6248
175	3874	6099	225	3924	6149	275	3974	6199	325	4024	6249

ANASAT®-EC Satellite Channels

Ch.	RX MHz	TX MHz
326	4025	6250
327	4026	6251
328	4027	6252
329	4028	6253
330	4029	6254
331	4030	6255
332	4031	6256
333	4032	6257
334	4033	6258
335	4034	6259
336	4035	6260
337	4036	6261
338	4037	6262
339	4038	6263
340	4039	6264
341	4040	6265
342	4041	6266
343	4042	6267
344	4043	6268
345	4044	6269
346	4045	6270
347	4046	6271
348	4047	6272
349	4048	6273
350	4049	6274
351	4050	6275
352	4051	6276
353	4052	6277
354	4053	6278
355	4054	6279
356	4055	6280
357	4056	6281
358	4057	6282
359	4058	6283
360	4059	6284
361	4060	6285
362	4061	6286
363	4062	6287
364	4063	6288
365	4064	6289
366	4065	6290
367	4066	6291
368	4067	6292
369	4068	6293
370	4069	6294
371	4070	6295
372	4071	6296
373	4072	6297
374	4073	6298
375	4074	6299
376	4075	6300
377	4076	6301
378	4077	6302
379	4078	6303
380	4079	6304
381	4080	6305
382	4081	6306
383	4082	6307
384	4083	6308
385	4084	6309
386	4085	6310
387	4086	6311
388	4087	6312
389	4088	6313
390	4089	6314
391	4090	6315
392	4091	6316
393	4092	6317
394	4093	6318
395	4094	6319
396	4095	6320
397	4096	6321
398	4097	6322
399	4098	6323
400	4099	6324
401	4100	6325
402	4101	6326
403	4102	6327
404	4103	6328
405	4104	6329
406	4105	6330
407	4106	6331
408	4107	6332
409	4108	6333
410	4109	6334
411	4110	6335
412	4111	6336
413	4112	6337
414	4113	6338
415	4114	6339
416	4115	6340
417	4116	6341
418	4117	6342
419	4118	6343
420	4119	6344
421	4120	6345
422	4121	6346
423	4122	6347
424	4123	6348
425	4124	6349
426	4125	6350
427	4126	6351
428	4127	6352
429	4128	6353
430	4129	6354
431	4130	6355
432	4131	6356
433	4132	6357
434	4133	6358
435	4134	6359
436	4135	6360
437	4136	6361
438	4137	6362
439	4138	6363
440	4139	6364
441	4140	6365
442	4141	6366
443	4142	6367
444	4143	6368
445	4144	6369
446	4145	6370
447	4146	6371
448	4147	6372
449	4148	6373
450	4149	6374
451	4150	6375
452	4151	6376
453	4152	6377
454	4153	6378
455	4154	6379
456	4155	6380
457	4156	6381
458	4157	6382
459	4158	6383
460	4159	6384
461	4160	6385
462	4161	6386
463	4162	6387
464	4163	6388
465	4164	6389
466	4165	6390
467	4166	6391
468	4167	6392
469	4168	6393
470	4169	6394
471	4170	6395
472	4171	6396
473	4172	6397
474	4173	6398
475	4174	6399
476	4175	6400
477	4176	6401
478	4177	6402
479	4178	6403
480	4179	6404
481	4180	6405
482	4181	6406
483	4182	6407
484	4183	6408
485	4184	6409
486	4185	6410
487	4186	6411
488	4187	6412
489	4188	6413
490	4189	6414
491	4190	6415
492	4191	6416
493	4192	6417
494	4193	6418
495	4194	6419
496	4195	6420
497	4196	6421
498	4197	6422
499	4198	6423
500	4199	6424
501	4200	6425

ANASAT®-XC Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
1	4500.0	6700.0	51	4525.0	6725.0	101	4550.0	6750.0	151	4575.0	6775.0
2	4500.5	6700.5	52	4525.5	6725.5	102	4550.5	6750.5	152	4575.5	6775.5
3	4501.0	6701.0	53	4526.0	6726.0	103	4551.0	6751.0	153	4576.0	6776.0
4	4501.5	6701.5	54	4526.5	6726.5	104	4551.5	6751.5	154	4576.5	6776.5
5	4502.0	6702.0	55	4527.0	6727.0	105	4552.0	6752.0	155	4577.0	6777.0
6	4502.5	6702.5	56	4527.5	6727.5	106	4552.5	6752.5	156	4577.5	6777.5
7	4503.0	6703.0	57	4528.0	6728.0	107	4553.0	6753.0	157	4578.0	6778.0
8	4503.5	6703.5	58	4528.5	6728.5	108	4553.5	6753.5	158	4578.5	6778.5
9	4504.0	6704.0	59	4529.0	6729.0	109	4554.0	6754.0	159	4579.0	6779.0
10	4504.5	6704.5	60	4529.5	6729.5	110	4554.5	6754.5	160	4579.5	6779.5
11	4505.0	6705.0	61	4530.0	6730.0	111	4555.0	6755.0	161	4580.0	6780.0
12	4505.5	6705.5	62	4530.5	6730.5	112	4555.5	6755.5	162	4580.5	6780.5
13	4506.0	6706.0	63	4531.0	6731.0	113	4556.0	6756.0	163	4581.0	6781.0
14	4506.5	6706.5	64	4531.5	6731.5	114	4556.5	6756.5	164	4581.5	6781.5
15	4507.0	6707.0	65	4532.0	6732.0	115	4557.0	6757.0	165	4582.0	6782.0
16	4507.5	6707.5	66	4532.5	6732.5	116	4557.5	6757.5	166	4582.5	6782.5
17	4508.0	6708.0	67	4533.0	6733.0	117	4558.0	6758.0	167	4583.0	6783.0
18	4508.5	6708.5	68	4533.5	6733.5	118	4558.5	6758.5	168	4583.5	6783.5
19	4509.0	6709.0	69	4534.0	6734.0	119	4559.0	6759.0	169	4584.0	6784.0
20	4509.5	6709.5	70	4534.5	6734.5	120	4559.5	6759.5	170	4584.5	6784.5
21	4510.0	6710.0	71	4535.0	6735.0	121	4560.0	6760.0	171	4585.0	6785.0
22	4510.5	6710.5	72	4535.5	6735.5	122	4560.5	6760.5	172	4585.5	6785.5
23	4511.0	6711.0	73	4536.0	6736.0	123	4561.0	6761.0	173	4586.0	6786.0
24	4511.5	6711.5	74	4536.5	6736.5	124	4561.5	6761.5	174	4586.5	6786.5
25	4512.0	6712.0	75	4537.0	6737.0	125	4562.0	6762.0	175	4587.0	6787.0
26	4512.5	6712.5	76	4537.5	6737.5	126	4562.5	6762.5	176	4587.5	6787.5
27	4513.0	6713.0	77	4538.0	6738.0	127	4563.0	6763.0	177	4588.0	6788.0
28	4513.5	6713.5	78	4538.5	6738.5	128	4563.5	6763.5	178	4588.5	6788.5
29	4514.0	6714.0	79	4539.0	6739.0	129	4564.0	6764.0	179	4589.0	6789.0
30	4514.5	6714.5	80	4539.5	6739.5	130	4564.5	6764.5	180	4589.5	6789.5
31	4515.0	6715.0	81	4540.0	6740.0	131	4565.0	6765.0	181	4590.0	6790.0
32	4515.5	6715.5	82	4540.5	6740.5	132	4565.5	6765.5	182	4590.5	6790.5
33	4516.0	6716.0	83	4541.0	6741.0	133	4566.0	6766.0	183	4591.0	6791.0
34	4516.5	6716.5	84	4541.5	6741.5	134	4566.5	6766.5	184	4591.5	6791.5
35	4517.0	6717.0	85	4542.0	6742.0	135	4567.0	6767.0	185	4592.0	6792.0
36	4517.5	6717.5	86	4542.5	6742.5	136	4567.5	6767.5	186	4592.5	6792.5
37	4518.0	6718.0	87	4543.0	6743.0	137	4568.0	6768.0	187	4593.0	6793.0
38	4518.5	6718.5	88	4543.5	6743.5	138	4568.5	6768.5	188	4593.5	6793.5
39	4519.0	6719.0	89	4544.0	6744.0	139	4569.0	6769.0	189	4594.0	6794.0
40	4519.5	6719.5	90	4544.5	6744.5	140	4569.5	6769.5	190	4594.5	6794.5
41	4520.0	6720.0	91	4545.0	6745.0	141	4570.0	6770.0	191	4595.0	6795.0
42	4520.5	6720.5	92	4545.5	6745.5	142	4570.5	6770.5	192	4595.5	6795.5
43	4521.0	6721.0	93	4546.0	6746.0	143	4571.0	6771.0	193	4596.0	6796.0
44	4521.5	6721.5	94	4546.5	6746.5	144	4571.5	6771.5	194	4596.5	6796.5
45	4522.0	6722.0	95	4547.0	6747.0	145	4572.0	6772.0	195	4597.0	6797.0
46	4522.5	6722.5	96	4547.5	6747.5	146	4572.5	6772.5	196	4597.5	6797.5
47	4523.0	6723.0	97	4548.0	6748.0	147	4573.0	6773.0	197	4598.0	6798.0
48	4523.5	6723.5	98	4548.5	6748.5	148	4573.5	6773.5	198	4598.5	6798.5
49	4524.0	6724.0	99	4549.0	6749.0	149	4574.0	6774.0	199	4599.0	6799.0
50	4524.5	6724.5	100	4549.5	6749.5	150	4574.5	6774.5	200	4599.5	6799.5

ANASAT®-XC Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
201	4600.0	6800.0	251	4625.0	6825.0	301	4650.0	6850.0	351	4675.0	6875.0
202	4600.5	6800.5	252	4625.5	6825.5	302	4650.5	6850.5	352	4675.5	6875.5
203	4601.0	6801.0	253	4626.0	6826.0	303	4651.0	6851.0	353	4676.0	6876.0
204	4601.5	6801.5	254	4626.5	6826.5	304	4651.5	6851.5	354	4676.5	6876.5
205	4602.0	6802.0	255	4627.0	6827.0	305	4652.0	6852.0	355	4677.0	6877.0
206	4602.5	6802.5	256	4627.5	6827.5	306	4652.5	6852.5	356	4677.5	6877.5
207	4603.0	6803.0	257	4628.0	6828.0	307	4653.0	6853.0	357	4678.0	6878.0
208	4603.5	6803.5	258	4628.5	6828.5	308	4653.5	6853.5	358	4678.5	6878.5
209	4604.0	6804.0	259	4629.0	6829.0	309	4654.0	6854.0	359	4679.0	6879.0
210	4604.5	6804.5	260	4629.5	6829.5	310	4654.5	6854.5	360	4679.5	6879.5
211	4605.0	6805.0	261	4630.0	6830.0	311	4655.0	6855.0	361	4680.0	6880.0
212	4605.5	6805.5	262	4630.5	6830.5	312	4655.5	6855.5	362	4680.5	6880.5
213	4606.0	6806.0	263	4631.0	6831.0	313	4656.0	6856.0	363	4681.0	6881.0
214	4606.5	6806.5	264	4631.5	6831.5	314	4656.5	6856.5	364	4681.5	6881.5
215	4607.0	6807.0	265	4632.0	6832.0	315	4657.0	6857.0	365	4682.0	6882.0
216	4607.5	6807.5	266	4632.5	6832.5	316	4657.5	6857.5	366	4682.5	6882.5
217	4608.0	6808.0	267	4633.0	6833.0	317	4658.0	6858.0	367	4683.0	6883.0
218	4608.5	6808.5	268	4633.5	6833.5	318	4658.5	6858.5	368	4683.5	6883.5
219	4609.0	6809.0	269	4634.0	6834.0	319	4659.0	6859.0	369	4684.0	6884.0
220	4609.5	6809.5	270	4634.5	6834.5	320	4659.5	6859.5	370	4684.5	6884.5
221	4610.0	6810.0	271	4635.0	6835.0	321	4660.0	6860.0	371	4685.0	6885.0
222	4610.5	6810.5	272	4635.5	6835.5	322	4660.5	6860.5	372	4685.5	6885.5
223	4611.0	6811.0	273	4636.0	6836.0	323	4661.0	6861.0	373	4686.0	6886.0
224	4611.5	6811.5	274	4636.5	6836.5	324	4661.5	6861.5	374	4686.5	6886.5
225	4612.0	6812.0	275	4637.0	6837.0	325	4662.0	6862.0	375	4687.0	6887.0
226	4612.5	6812.5	276	4637.5	6837.5	326	4662.5	6862.5	376	4687.5	6887.5
227	4613.0	6813.0	277	4638.0	6838.0	327	4663.0	6863.0	377	4688.0	6888.0
228	4613.5	6813.5	278	4638.5	6838.5	328	4663.5	6863.5	378	4688.5	6888.5
229	4614.0	6814.0	279	4639.0	6839.0	329	4664.0	6864.0	379	4689.0	6889.0
230	4614.5	6814.5	280	4639.5	6839.5	330	4664.5	6864.5	380	4689.5	6889.5
231	4615.0	6815.0	281	4640.0	6840.0	331	4665.0	6865.0	381	4690.0	6890.0
232	4615.5	6815.5	282	4640.5	6840.5	332	4665.5	6865.5	382	4690.5	6890.5
233	4616.0	6816.0	283	4641.0	6841.0	333	4666.0	6866.0	383	4691.0	6891.0
234	4616.5	6816.5	284	4641.5	6841.5	334	4666.5	6866.5	384	4691.5	6891.5
235	4617.0	6817.0	285	4642.0	6842.0	335	4667.0	6867.0	385	4692.0	6892.0
236	4617.5	6817.5	286	4642.5	6842.5	336	4667.5	6867.5	386	4692.5	6892.5
237	4618.0	6818.0	287	4643.0	6843.0	337	4668.0	6868.0	387	4693.0	6893.0
238	4618.5	6818.5	288	4643.5	6843.5	338	4668.5	6868.5	388	4693.5	6893.5
239	4619.0	6819.0	289	4644.0	6844.0	339	4669.0	6869.0	389	4694.0	6894.0
240	4619.5	6819.5	290	4644.5	6844.5	340	4669.5	6869.5	390	4694.5	6894.5
241	4620.0	6820.0	291	4645.0	6845.0	341	4670.0	6870.0	391	4695.0	6895.0
242	4620.5	6820.5	292	4645.5	6845.5	342	4670.5	6870.5	392	4695.5	6895.5
243	4621.0	6821.0	293	4646.0	6846.0	343	4671.0	6871.0	393	4696.0	6896.0
244	4621.5	6821.5	294	4646.5	6846.5	344	4671.5	6871.5	394	4696.5	6896.5
245	4622.0	6822.0	295	4647.0	6847.0	345	4672.0	6872.0	395	4697.0	6897.0
246	4622.5	6822.5	296	4647.5	6847.5	346	4672.5	6872.5	396	4697.5	6897.5
247	4623.0	6823.0	297	4648.0	6848.0	347	4673.0	6873.0	397	4698.0	6898.0
248	4623.5	6823.5	298	4648.5	6848.5	348	4673.5	6873.5	398	4698.5	6898.5
249	4624.0	6824.0	299	4649.0	6849.0	349	4674.0	6874.0	399	4699.0	6899.0
250	4624.5	6824.5	300	4649.5	6849.5	350	4674.5	6874.5	400	4699.5	6899.5

ANASAT®-XC Satellite Channels

Ch.	RX MHz	TX MHz
401	4700.0	6900.0
402	4700.5	6900.5
403	4701.0	6901.0
404	4701.5	6901.5
405	4702.0	6902.0
406	4702.5	6902.5
407	4703.0	6903.0
408	4703.5	6903.5
409	4704.0	6904.0
410	4704.5	6904.5
411	4705.0	6905.0
412	4705.5	6905.5
413	4706.0	6906.0
414	4706.5	6906.5
415	4707.0	6907.0
416	4707.5	6907.5
417	4708.0	6908.0
418	4708.5	6908.5
419	4709.0	6909.0
420	4709.5	6909.5
421	4710.0	6910.0
422	4710.5	6910.5
423	4711.0	6911.0
424	4711.5	6911.5
425	4712.0	6912.0
426	4712.5	6912.5
427	4713.0	6913.0
428	4713.5	6913.5
429	4714.0	6914.0
430	4714.5	6914.5
431	4715.0	6915.0
432	4715.5	6915.5
433	4716.0	6916.0
434	4716.5	6916.5
435	4717.0	6917.0
436	4717.5	6917.5
437	4718.0	6918.0
438	4718.5	6918.5
439	4719.0	6919.0
440	4719.5	6919.5
441	4720.0	6920.0
442	4720.5	6920.5
443	4721.0	6921.0
444	4721.5	6921.5
445	4722.0	6922.0
446	4722.5	6922.5
447	4723.0	6923.0
448	4723.5	6923.5
449	4724.0	6924.0
450	4724.5	6924.5

Ch.	RX MHz	TX MHz
451	4725.0	6925.0
452	4725.5	6925.5
453	4726.0	6926.0
454	4726.5	6926.5
455	4727.0	6927.0
456	4727.5	6927.5
457	4728.0	6928.0
458	4728.5	6928.5
459	4729.0	6929.0
460	4729.5	6929.5
461	4730.0	6930.0
462	4730.5	6930.5
463	4731.0	6931.0
464	4731.5	6931.5
465	4732.0	6932.0
466	4732.5	6932.5
467	4733.0	6933.0
468	4733.5	6933.5
469	4734.0	6934.0
470	4734.5	6934.5
471	4735.0	6935.0
472	4735.5	6935.5
473	4736.0	6936.0
474	4736.5	6936.5
475	4737.0	6937.0
476	4737.5	6937.5
477	4738.0	6938.0
478	4738.5	6938.5
479	4739.0	6939.0
480	4739.5	6939.5
481	4740.0	6940.0
482	4740.5	6940.5
483	4741.0	6941.0
484	4741.5	6941.5
485	4742.0	6942.0
486	4742.5	6942.5
487	4743.0	6943.0
488	4743.5	6943.5
489	4744.0	6944.0
490	4744.5	6944.5
491	4745.0	6945.0
492	4745.5	6945.5
493	4746.0	6946.0
494	4746.5	6946.5
495	4747.0	6947.0
496	4747.5	6947.5
497	4748.0	6948.0
498	4748.5	6948.5
499	4749.0	6949.0
500	4749.5	6949.5

Ch.	RX MHz	TX MHz
501	4750.0	6950.0
502	4750.5	6950.5
503	4751.0	6951.0
504	4751.5	6951.5
505	4752.0	6952.0
506	4752.5	6952.5
507	4753.0	6953.0
508	4753.5	6953.5
509	4754.0	6954.0
510	4754.5	6954.5
511	4755.0	6955.0
512	4755.5	6955.5
513	4756.0	6956.0
514	4756.5	6956.5
515	4757.0	6957.0
516	4757.5	6957.5
517	4758.0	6958.0
518	4758.5	6958.5
519	4759.0	6959.0
520	4759.5	6959.5
521	4760.0	6960.0
522	4760.5	6960.5
523	4761.0	6961.0
524	4761.5	6961.5
525	4762.0	6962.0
526	4762.5	6962.5
527	4763.0	6963.0
528	4763.5	6963.5
529	4764.0	6964.0
530	4764.5	6964.5
531	4765.0	6965.0
532	4765.5	6965.5
533	4766.0	6966.0
534	4766.5	6966.5
535	4767.0	6967.0
536	4767.5	6967.5
537	4768.0	6968.0
538	4768.5	6968.5
539	4769.0	6969.0
540	4769.5	6969.5
541	4770.0	6970.0
542	4770.5	6970.5
543	4771.0	6971.0
544	4771.5	6971.5
545	4772.0	6972.0
546	4772.5	6972.5
547	4773.0	6973.0
548	4773.5	6973.5
549	4774.0	6974.0
550	4774.5	6974.5

Ch.	RX MHz	TX MHz
551	4775.0	6975.0
552	4775.5	6975.5
553	4776.0	6976.0
554	4776.5	6976.5
555	4777.0	6977.0
556	4777.5	6977.5
557	4778.0	6978.0
558	4778.5	6978.5
559	4779.0	6979.0
560	4779.5	6979.5
561	4780.0	6980.0
562	4780.5	6980.5
563	4781.0	6981.0
564	4781.5	6981.5
565	4782.0	6982.0
566	4782.5	6982.5
567	4783.0	6983.0
568	4783.5	6983.5
569	4784.0	6984.0
570	4784.5	6984.5
571	4785.0	6985.0
572	4785.5	6985.5
573	4786.0	6986.0
574	4786.5	6986.5
575	4787.0	6987.0
576	4787.5	6987.5
577	4788.0	6988.0
578	4788.5	6988.5
579	4789.0	6989.0
580	4789.5	6989.5
581	4790.0	6990.0
582	4790.5	6990.5
583	4791.0	6991.0
584	4791.5	6991.5
585	4792.0	6992.0
586	4792.5	6992.5
587	4793.0	6993.0
588	4793.5	6993.5
589	4794.0	6994.0
590	4794.5	6994.5
591	4795.0	6995.0
592	4795.5	6995.5
593	4796.0	6996.0
594	4796.5	6996.5
595	4797.0	6997.0
596	4797.5	6997.5
597	4798.0	6998.0
598	4798.5	6998.5
599	4799.0	6999.0
600	4799.5	6999.5
601	4800.0	7000.0

ANASAT®-PC Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
1	3400	6425	51	3450	6475	101	3500	6525	151	3550	6575
2	3401	6426	52	3451	6476	102	3501	6526	152	3551	6576
3	3402	6427	53	3452	6477	103	3502	6527	153	3552	6577
4	3403	6428	54	3453	6478	104	3503	6528	154	3553	6578
5	3404	6429	55	3454	6479	105	3504	6529	155	3554	6579
6	3405	6430	56	3455	6480	106	3505	6530	156	3555	6580
7	3406	6431	57	3456	6481	107	3506	6531	157	3556	6581
8	3407	6432	58	3457	6482	108	3507	6532	158	3557	6582
9	3408	6433	59	3458	6483	109	3508	6533	159	3558	6583
10	3409	6434	60	3459	6484	110	3509	6534	160	3559	6584
11	3410	6435	61	3460	6485	111	3510	6535	161	3560	6585
12	3411	6436	62	3461	6486	112	3511	6536	162	3561	6586
13	3412	6437	63	3462	6487	113	3512	6537	163	3562	6587
14	3413	6438	64	3463	6488	114	3513	6538	164	3563	6588
15	3414	6439	65	3464	6489	115	3514	6539	165	3564	6589
16	3415	6440	66	3465	6490	116	3515	6540	166	3565	6590
17	3416	6441	67	3466	6491	117	3516	6541	167	3566	6591
18	3417	6442	68	3467	6492	118	3517	6542	168	3567	6592
19	3418	6443	69	3468	6493	119	3518	6543	169	3568	6593
20	3419	6444	70	3469	6494	120	3519	6544	170	3569	6594
21	3420	6445	71	3470	6495	121	3520	6545	171	3570	6595
22	3421	6446	72	3471	6496	122	3521	6546	172	3571	6596
23	3422	6447	73	3472	6497	123	3522	6547	173	3572	6597
24	3423	6448	74	3473	6498	124	3523	6548	174	3573	6598
25	3424	6449	75	3474	6499	125	3524	6549	175	3574	6599
26	3425	6450	76	3475	6500	126	3525	6550	176	3575	6600
27	3426	6451	77	3476	6501	127	3526	6551	177	3576	6601
28	3427	6452	78	3477	6502	128	3527	6552	178	3577	6602
29	3428	6453	79	3478	6503	129	3528	6553	179	3578	6603
30	3429	6454	80	3479	6504	130	3529	6554	180	3579	6604
31	3430	6455	81	3480	6505	131	3530	6555	181	3580	6605
32	3431	6456	82	3481	6506	132	3531	6556	182	3581	6606
33	3432	6457	83	3482	6507	133	3532	6557	183	3582	6607
34	3433	6458	84	3483	6508	134	3533	6558	184	3583	6608
35	3434	6459	85	3484	6509	135	3534	6559	185	3584	6609
36	3435	6460	86	3485	6510	136	3535	6560	186	3585	6610
37	3436	6461	87	3486	6511	137	3536	6561	187	3586	6611
38	3437	6462	88	3487	6512	138	3537	6562	188	3587	6612
39	3438	6463	89	3488	6513	139	3538	6563	189	3588	6613
40	3439	6464	90	3489	6514	140	3539	6564	190	3589	6614
41	3440	6465	91	3490	6515	141	3540	6565	191	3590	6615
42	3441	6466	92	3491	6516	142	3541	6566	192	3591	6616
43	3442	6467	93	3492	6517	143	3542	6567	193	3592	6617
44	3443	6468	94	3493	6518	144	3543	6568	194	3593	6618
45	3444	6469	95	3494	6519	145	3544	6569	195	3594	6619
46	3445	6470	96	3495	6520	146	3545	6570	196	3595	6620
47	3446	6471	97	3496	6521	147	3546	6571	197	3596	6621
48	3447	6472	98	3497	6522	148	3547	6572	198	3597	6622
49	3448	6473	99	3498	6523	149	3548	6573	199	3598	6623
50	3449	6474	100	3499	6524	150	3549	6574	200	3599	6624

ANASAT®-PC Satellite Channels

Ch.	RX MHz	TX MHz
201	3600	6625
202	3601	6626
203	3602	6627
204	3603	6628
205	3604	6629
206	3605	6630
207	3606	6631
208	3607	6632
209	3608	6633
210	3609	6634
211	3610	6635
212	3611	6636
213	3612	6637
214	3613	6638
215	3614	6639
216	3615	6640
217	3616	6641
218	3617	6642
219	3618	6643
220	3619	6644
221	3620	6645
222	3621	6646
223	3622	6647
224	3623	6648
225	3624	6649
226	3625	6650
227	3626	6651
228	3627	6652
229	3628	6653
230	3629	6654
231	3630	6655
232	3631	6656
233	3632	6657
234	3633	6658
235	3634	6659
236	3635	6660
237	3636	6661
238	3637	6662
239	3638	6663
240	3639	6664
241	3640	6665
242	3641	6666
243	3642	6667
244	3643	6668
245	3644	6669
246	3645	6670
247	3646	6671
248	3647	6672
249	3648	6673
250	3649	6674

Ch.	RX MHz	TX MHz
251	3650	6675
252	3651	6676
253	3652	6677
254	3653	6678
255	3654	6679
256	3655	6680
257	3656	6681
258	3657	6682
259	3658	6683
260	3659	6684
261	3660	6685
262	3661	6686
263	3662	6687
264	3663	6688
265	3664	6689
266	3665	6690
267	3666	6691
268	3667	6692
269	3668	6693
270	3669	6694
271	3670	6695
272	3671	6696
273	3672	6697
274	3673	6698
275	3674	6699
276	3675	6700
277	3676	6701
278	3677	6702
279	3678	6703
280	3679	6704
281	3680	6705
282	3681	6706
283	3682	6707
284	3683	6708
285	3684	6709
286	3685	6710
287	3686	6711
288	3687	6712
289	3688	6713
290	3689	6714
291	3690	6715
292	3691	6716
293	3692	6717
294	3693	6718
295	3694	6719
296	3695	6720
297	3696	6721
298	3697	6722
299	3698	6723
300	3699	6724

Ch.	RX MHz	TX MHz
301	3700	6725
302	3701	6726

ANASAT®-RC Satellite Channels

Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz	Ch.	RX MHz	TX MHz
1	3650	5975	51	3700	6025	101	3750	6075	151	3800	6125
2	3651	5976	52	3701	6026	102	3751	6076	152	3801	6126
3	3652	5977	53	3702	6027	103	3752	6077	153	3802	6127
4	3653	5978	54	3703	6028	104	3753	6078	154	3803	6128
5	3654	5979	55	3704	6029	105	3754	6079	155	3804	6129
6	3655	5980	56	3705	6030	106	3755	6080	156	3805	6130
7	3656	5981	57	3706	6031	107	3756	6081	157	3806	6131
8	3657	5982	58	3707	6032	108	3757	6082	158	3807	6132
9	3658	5983	59	3708	6033	109	3758	6083	159	3808	6133
10	3659	5984	60	3709	6034	110	3759	6084	160	3809	6134
11	3660	5985	61	3710	6035	111	3760	6085	161	3810	6135
12	3661	5986	62	3711	6036	112	3761	6086	162	3811	6136
13	3662	5987	63	3712	6037	113	3762	6087	163	3812	6137
14	3663	5988	64	3713	6038	114	3763	6088	164	3813	6138
15	3664	5989	65	3714	6039	115	3764	6089	165	3814	6139
16	3665	5990	66	3715	6040	116	3765	6090	166	3815	6140
17	3666	5991	67	3716	6041	117	3766	6091	167	3816	6141
18	3667	5992	68	3717	6042	118	3767	6092	168	3817	6142
19	3668	5993	69	3718	6043	119	3768	6093	169	3818	6143
20	3669	5994	70	3719	6044	120	3769	6094	170	3819	6144
21	3670	5995	71	3720	6045	121	3770	6095	171	3820	6145
22	3671	5996	72	3721	6046	122	3771	6096	172	3821	6146
23	3672	5997	73	3722	6047	123	3772	6097	173	3822	6147
24	3673	5998	74	3723	6048	124	3773	6098	174	3823	6148
25	3674	5999	75	3724	6049	125	3774	6099	175	3824	6149
26	3675	6000	76	3725	6050	126	3775	6100	176	3825	6150
27	3676	6001	77	3726	6051	127	3776	6101	177	3826	6151
28	3677	6002	78	3727	6052	128	3777	6102	178	3827	6152
29	3678	6003	79	3728	6053	129	3778	6103	179	3828	6153
30	3679	6004	80	3729	6054	130	3779	6104	180	3829	6154
31	3680	6005	81	3730	6055	131	3780	6105	181	3830	6155
32	3681	6006	82	3731	6056	132	3781	6106	182	3831	6156
33	3682	6007	83	3732	6057	133	3782	6107	183	3832	6157
34	3683	6008	84	3733	6058	134	3783	6108	184	3833	6158
35	3684	6009	85	3734	6059	135	3784	6109	185	3834	6159
36	3685	6010	86	3735	6060	136	3785	6110	186	3835	6160
37	3686	6011	87	3736	6061	137	3786	6111	187	3836	6161
38	3687	6012	88	3737	6062	138	3787	6112	188	3837	6162
39	3688	6013	89	3738	6063	139	3788	6113	189	3838	6163
40	3689	6014	90	3739	6064	140	3789	6114	190	3839	6164
41	3690	6015	91	3740	6065	141	3790	6115	191	3840	6165
42	3691	6016	92	3741	6066	142	3791	6116	192	3841	6166
43	3692	6017	93	3742	6067	143	3792	6117	193	3842	6167
44	3693	6018	94	3743	6068	144	3793	6118	194	3843	6168
45	3694	6019	95	3744	6069	145	3794	6119	195	3844	6169
46	3695	6020	96	3745	6070	146	3795	6120	196	3845	6170
47	3696	6021	97	3746	6071	147	3796	6121	197	3846	6171
48	3697	6022	98	3747	6072	148	3797	6122	198	3847	6172
49	3698	6023	99	3748	6073	149	3798	6123	199	3848	6173
50	3699	6024	100	3749	6074	150	3799	6124	200	3849	6174

ANASAT®-RC Satellite Channels

Ch.	RX MHz	TX MHz
201	3850	6175
202	3851	6176
203	3852	6177
204	3853	6178
205	3854	6179
206	3855	6180
207	3856	6181
208	3857	6182
209	3858	6183
210	3859	6184
211	3860	6185
212	3861	6186
213	3862	6187
214	3863	6188
215	3864	6189
216	3865	6190
217	3866	6191
218	3867	6192
219	3868	6193
220	3869	6194
221	3870	6195
222	3871	6196
223	3872	6197
224	3873	6198
225	3874	6199
226	3875	6200
227	3876	6201
228	3877	6202
229	3878	6203
230	3879	6204
231	3880	6205
232	3881	6206
233	3882	6207
234	3883	6208
235	3884	6209
236	3885	6210
237	3886	6211
238	3887	6212
239	3888	6213
240	3889	6214
241	3890	6215
242	3891	6216
243	3892	6217
244	3893	6218
245	3894	6219
246	3895	6220
247	3896	6221
248	3897	6222
249	3898	6223
250	3899	6224

Ch.	RX MHz	TX MHz
251	3900	6225
252	3901	6226
253	3902	6227
254	3903	6228
255	3904	6229
256	3905	6230
257	3906	6231
258	3907	6232
259	3908	6233
260	3909	6234
261	3910	6235
262	3911	6236
263	3912	6237
264	3913	6238
265	3914	6239
266	3915	6240
267	3916	6241
268	3917	6242
269	3918	6243
270	3919	6244
271	3920	6245
272	3921	6246
273	3922	6247
274	3923	6248
275	3924	6249
276	3925	6250
277	3926	6251
278	3927	6252
279	3928	6253
280	3929	6254
281	3930	6255
282	3931	6256
283	3932	6257
284	3933	6258
285	3934	6259
286	3935	6260
287	3936	6261
288	3937	6262
289	3938	6263
290	3939	6264
291	3940	6265
292	3941	6266
293	3942	6267
294	3943	6268
295	3944	6269
296	3945	6270
297	3946	6271
298	3947	6272
299	3948	6273
300	3949	6274

Ch.	RX MHz	TX MHz
301	3950	6275
302	3951	6276
303	3952	6277
304	3953	6278
305	3954	6279
306	3955	6280
307	3956	6281
308	3957	6282
309	3958	6283
310	3959	6284
311	3960	6285
312	3961	6286
313	3962	6287
314	3963	6288
315	3964	6289
316	3965	6290
317	3966	6291
318	3967	6292
319	3968	6293
320	3969	6294
321	3970	6295
322	3971	6296
323	3972	6297
324	3973	6298
325	3974	6299
326	3975	6300
327	3976	6301
328	3977	6302
329	3978	6303
330	3979	6304
331	3980	6305
332	3981	6306
333	3982	6307
334	3983	6308
335	3984	6309
336	3985	6310
337	3986	6311
338	3987	6312
339	3988	6313
340	3989	6314
341	3990	6315
342	3991	6316
343	3992	6317
344	3993	6318
345	3994	6319
346	3995	6320
347	3996	6321
348	3997	6322
349	3998	6323
350	3999	6324

Ch.	RX MHz	TX MHz
351	4000	6325
352	4001	6326
353	4002	6327
354	4003	6328
355	4004	6329
356	4005	6330
357	4006	6331
358	4007	6332
359	4008	6333
360	4009	6334
361	4010	6335
362	4011	6336
363	4012	6337
364	4013	6338
365	4014	6339
366	4015	6340
367	4016	6341
368	4017	6342
369	4018	6343
370	4019	6344
371	4020	6345
372	4021	6346
373	4022	6347
374	4023	6348
375	4024	6349
376	4025	6350
377	4026	6351
378	4027	6352
379	4028	6353
380	4029	6354
381	4030	6355
382	4031	6356
383	4032	6357
384	4033	6358
385	4034	6359
386	4035	6360
387	4036	6361
388	4037	6362
389	4038	6363
390	4039	6364
391	4040	6365
392	4041	6366
393	4042	6367
394	4043	6368
395	4044	6369
396	4045	6370
397	4046	6371
398	4047	6372
399	4048	6373
400	4049	6374

ANASAT®-RC Satellite Channels

Ch.	RX MHz	TX MHz
401	4050	6375
402	4051	6376
403	4052	6377
404	4053	6378
405	4054	6379
406	4055	6380
407	4056	6381
408	4057	6382
409	4058	6383
410	4059	6384
411	4060	6385
412	4061	6386
413	4062	6387
414	4063	6388
415	4064	6389
416	4065	6390
417	4066	6391
418	4067	6392
419	4068	6393
420	4069	6394
421	4070	6395
422	4071	6396
423	4072	6397
424	4073	6398
425	4074	6399
426	4075	6400
427	4076	6401
428	4077	6402
429	4078	6403
430	4079	6404
431	4080	6405
432	4081	6406
433	4082	6407
434	4083	6408
435	4084	6409
436	4085	6410
437	4086	6411
438	4087	6412
439	4088	6413
440	4089	6414
441	4090	6415
442	4091	6416
443	4092	6417
444	4093	6418
445	4094	6419
446	4095	6420
447	4096	6421
448	4097	6422
449	4098	6423
450	4099	6424

Ch.	RX MHz	TX MHz
451	4100	6425
452	4101	6426
453	4102	6427
454	4103	6428
455	4104	6429
456	4105	6430
457	4106	6431
458	4107	6432
459	4108	6433
460	4109	6434
461	4110	6435
462	4111	6436
463	4112	6437
464	4113	6438
465	4114	6439
466	4115	6440
467	4116	6441
468	4117	6442
469	4118	6443
470	4119	6444
471	4120	6445
472	4121	6446
473	4122	6447
474	4123	6448
475	4124	6449
476	4125	6450
477	4126	6451
478	4127	6452
479	4128	6453
480	4129	6454
481	4130	6455
482	4131	6456
483	4132	6457
484	4133	6458
485	4134	6459
486	4135	6460
487	4136	6461
488	4137	6462
489	4138	6463
490	4139	6464
491	4140	6465
492	4141	6466
493	4142	6467
494	4143	6468
495	4144	6469
496	4145	6470
497	4146	6471
498	4147	6472
499	4148	6473
500	4149	6474

Ch.	RX MHz	TX MHz
501	4150	6475

Appendix F. Converting dBm to Watts and Watts to dBm

dBm	W
20	0.10
20.50	0.11
21	0.13
21.50	0.14
22	0.16
22.50	0.18
23	0.20
23.50	0.22
24	0.25
24.50	0.28
25	0.32
25.50	0.35
26	0.40
26.50	0.45
27	0.50
27.50	0.56
28	0.63
28.50	0.71
29	0.79
29.50	0.89
30	1
30.50	1.12
31	1.26
31.50	1.41
32	1.58
32.50	1.78
33	2
33.50	2.24
34	2.51
34.50	2.82
35	3.16
35.50	3.55
36	3.98
36.50	4.47
37	5.01
37.50	5.62
38	6.31
38.50	7.08
39	7.94
39.50	8.91
40	10
40.50	11.22
41	12.59
41.50	14.13
42	15.85
42.50	17.78
43	19.95
43.50	22.39
44	25.12

W	dBm
1	30
2	33.01
3	34.77
4	36.02
5	36.99
6	37.78
7	38.45
8	39.03
9	39.54
10	40
11	40.41
12	40.79
13	41.14
14	41.46
15	41.76
16	42.04
17	42.30
18	42.55
19	42.79
20	43.01
21	43.22
22	43.42
23	43.61
24	43.80
25	43.97
26	44.14
27	44.31
28	44.47
29	44.62
30	44.77
32	45.05
34	45.31
36	45.56
38	45.80
40	46.02
42	46.23
44	46.43
46	46.63
48	46.81
50	47.00