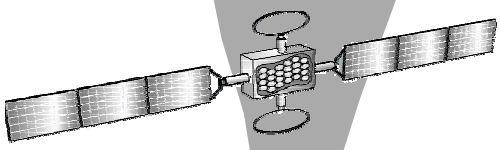
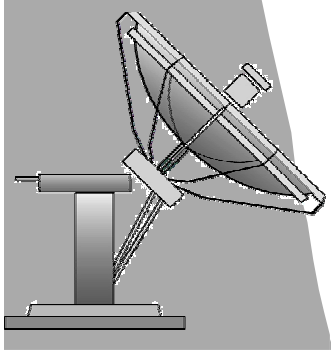
ANACOM, INC

Ku-Band Transceiver Operating Manual



Standard-Ku
Extended-EKu
Super Extended-SEKu

ANASAT®-Ku Series



Rev 04

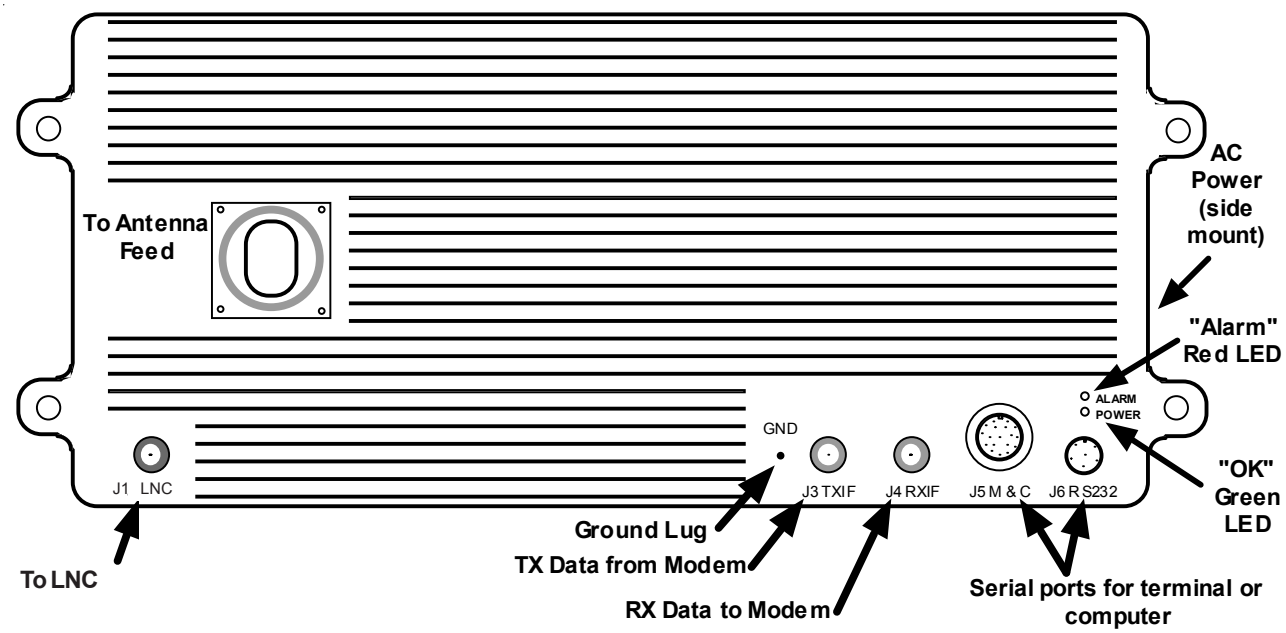
ANASAT®-Ku Quick Start Guide

There's lots more inside the manual, but here are the most important steps:

1. Mount the transceiver and the LNC on the antenna.
2. Connect the cables as shown in the drawing (See page 2-3 of the Operations Manual).
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 blinking, indicating normal internal operation. The red LED must be OFF. If illuminated, it indicates an alarm condition requiring attention. Refer to the ALARM command for details (Appendix A).
5. Using the terminal, configure the transceiver to the proper frequency:
   RXFREQ nnnnn (nnnnn in MHz—see Appendix D for channel)
   TXFREQ nnnnn (nnnnn in MHz—see Appendix D for channel)
6. Configure receive gain and transmit output power:
   RXGAIN nnn nnn ranges from 85 to 100
   TXGAIN nn nn ranges from:

10 to 36 [0Ku]	44 to 70 [2Ku]	47 to 73 [4Ku]
50 to 76 [8Ku]	53 to 79 [16Ku]	53 to 79 [20Ku]
53 to 79 [23Ku]	53 to 79 [25Ku]	57 to 83 [40Ku]
58 to 84 [50Ku]	59 to 85 [60Ku]	60 to 86 [80Ku]
	61 to 87 [100Ku]	62 to 88 [125Ku]

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®-Ku transceiver!

ANACOM

ANASAT®-Ku Series

Ku-Band Transceiver Operating Manual

Standard-Ku
Extended-EKu
Super Extended-SEKu

You have just received an AnaSat®-Ku 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.

If you have any questions, require technical assistance or training please call **ANACOM** directly at (408) 748-7800 or FAX to us at (408) 748-7801. You can also send e-mail to techsupport@anacominc.com and one of our engineers will contact you.

ANACOM Inc.

3000 Tasman Drive
Santa Clara, CA 95054
Tel: (408) 748-7800
Fax: (408) 748-7801

ANACOM
3000 Tasman Drive, Santa Clara CA 95054
Tel: (408) 748-7800 Fax: (408) 748-7801
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Operating Manual

for the

ANASAT®-Ku-Series

Ku-Band Transceiver

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Section 1. Introduction

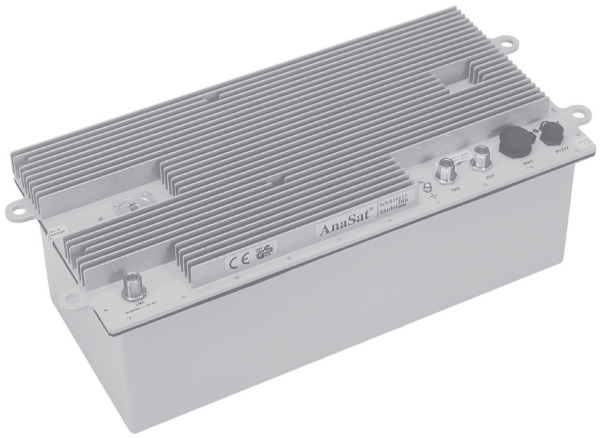

Figure 1-1 The ANASAT®-Ku VSAT transceiver (2W version shown)

The ANASAT®-Ku VSAT series Ku-band transceivers are designed for continuous outdoor duty in all types of environments. Ideally suited for SCPC, MCPC, and DAMA applications, the ANASAT®-Ku series transceivers transmit in the 14 GHz frequency range and receive in the 12 GHz range.

The ANASAT®-Ku 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®-Ku 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®-Ku transceiver upconverts the modulator's 70 MHz IF output to an RF signal in the 14 GHz range for transmission, and downconverts the 12 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 temperature better than 80ºK.

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.

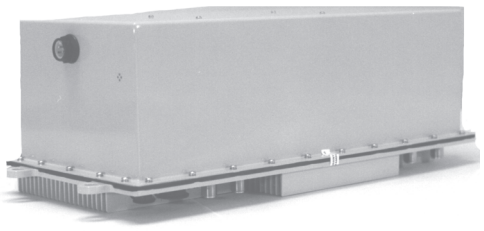

Figure 1-2. Another view of the ANASAT®-Ku

Typical Operating Parameters

RF ELECTRICAL SPECIFICATIONS

A. FREQUENCIES

		Model	
(1)	Transmit RF	Ku	14.0—14.5 GHz
	WR-75 Flange (Threaded & Grooved)	EKu	13.75—14.25 GHz
		SEKu	13.75—14.50 GHz
			(1 MHz step size; M & C Controlled)
(2)	Receive RF		10.95—12.75 GHz
	(WR-75 Flange on LNC Threaded & Grooved)		(1 MHz step size; M & C Controlled)
(3)	Transmit IF (N-connector)		52 to 88MHz (70 ± 18 MHz)
(4)	Receive IF (N-connector)		52 to 88MHz (70 ± 18 MHz)

B. RF POWER LEVELS

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

(2) Transceiver Input: –40 to –20 dBm; +10 dBm max.

(3) Transceiver Input

(a) + 25ºC at Transmit RF Connector

	1dB COMP. PT		1dB COMP. PT
(0 dBm)	0 dBm min.	(25 watt)	44 dBm min.
(2 watt)	33 dBm min.	(40 watt)	46 dBm min.
(4 watt)	36 dBm min.	(50 watt)	47 dBm min.
(8 watt)	39 dBm min.	(60 watt)	47.8 dBm min.
(16 watt)	42 dBm min.	(80 watt)	49 dBm min.
(20 watt)	43 dBm min.	(100 watt)	50 dBm min.
(23 watt)	43.6 dBm min.	(125 watt)	51 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) (Two carriers at 9dB back-off): –30 dBc max.

C. RECEIVER GAIN

(1) Overall Gain (at +25ºC): 85 to 100 dB (M & C controlled)

(2) Gain Variation under all conditions: ± 2 dB

RF ELECTRICAL SPECIFICATIONS, (Con't)

D. RECEIVER NOISE FIGURE (standard)	1.96 dB / 165ºK
(optional)	1.61 dB / 130ºK
(optional)	1.4 dB / 110ºK
E. INSTANTANEOUS BANDWIDTH	
(1) Receiver RF to IF	± 18 MHz for 70 MHz IF
(optional)	± 36 MHz for 140 MHz IF
(2) Transmitter IF to RF	± 18 MHz for 70 MHz IF
(optional)	± 36 MHz for 140 MHz IF
F. IMPEDANCE	
(1) Receiver Output	50W; (75W optional)
(2) Transmitter Input	50W; (75W optional)
G SYNTHESIZERS (Transmitter and Receiver)	
(1) Tuning Step Size	1 MHz (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	
–40ºC to +50ºC	1×10^{-8}
Aging	1×10^{-9} / day

RF / IF CONNECTOR DESIGNATIONS

A.	Receive Input on LNC	WR-75 Flange (Threaded & Grooved)
B.	Transceiver LNC Input	N-Type-Female
C.	LNC Output	N-Type-Female
D.	Receive IF	N-Type-Female
E.	Transmit IF	N-Type-Female
F.	Transmit Output	WR-75 Flange (Threaded & Grooved)

INTERFACE ELECTRICAL SPECIFICATIONS

(1) Power Requirement: 100 to 240 VAC, 47--63 Hz

(2) Typical Power Consumption

0 dBm	41 VA	25 watt	302 VA
2 watt	69 VA	40 watt	767 VA
4 watt	91 VA	50 watt	804 VA
8 watt	160 VA	60 watt	853 VA
16 watt	272 VA	80 watt	1446 VA
20 watt	294 VA	100 watt	1617 VA
23 watt	298 VA	125 watt	1661 VA

INTERFACE ELECTRICAL SPECIFICATIONS (Con't)

(3) Prime Power Recommendation

0 dBm	100 VA	25 watt	720 VA
2 watt	175 VA	40 watt	1690 VA
4 watt	225 VA	50 watt	1768 VA
8 watt	400 VA	60 watt	1876 VA
16 watt	690 VA	80 watt	3181 VA
20 watt	700 VA	100 watt	3557 VA
23 watt	710 VA	125 watt	3654 VA

INTERFACE CONNECTION DESIGNATIONS

(1)	Ports (Configurable)	2 each RS-232 or 1 RS-232 & 1 RS-485
(2)	Protocol	RS-232 port supports any "dumb" terminal or ASCII interface RS-485 port supports addressed packetized data per ANACOM Supervisor™ software specifications
(3)	Alarm Relays	Form-C for Major and Minor alarms; isolated. Independent TX and RX relay alarms in Protection Mode.
(4)	Visual Indicators	Flashing GREEN LED indicates active power Flashing RED LED indicates summary alarm

MECHANICAL SPECIFICATIONS

A. WEIGHT

(1)	Transceiver	
	0 dBm	22 lbs (10.0 kg) max.
	2W	26 lbs (11.8 kg) max.
	4W	27 lbs (12.3 kg) max.
	8W	28 lbs (12.7 kg) max.
	16W	37 lbs (16.8 kg) max.
	20W, 23W and 25W	40 lbs (18.0 kg) max.
	40W, 50W and 60W	67 lbs (30.5 kg) max.
	80W, 100W and 125W	123 lbs (55.8 kg) max.
(2)	LNC	1.75 lbs (0.79 kg) max.

B. SIZE

(1)	Transceiver	
	0dBm, 2W, 4W	21.6" x 9.0" x 7.0" (549 x 229 x 178 mm)
	8W	21.6" x 9.0" x 11.6" (549 x 229 x 295 mm)
	16W, 20W, 23W and 25W	21.6" x 9.0" x 13.0" (549 x 229 x 330 mm)
	40W, 50W and 60W	21.6" x 13" x 13.6" (549 x 330 x 353 mm)
	80W, 100W and 125W	34" x 11.5" x 13" (864 x 292 x 330 mm)
(2)	LNC	8.4" x 2.9" x 1.75" - (213 x 74 x 44.4 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-K-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. (5000m)
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®-Ku 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®-Ku 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®-Ku Packing List

Unit	Part Number	Quantity
• Transceiver —	1	
• LNC, wide mouth	30784	1
Accessory Kit for Ku-Band:		
• 10 ft. (3m) LNC to Transceiver Cable with male N-connectors (longer cables also available)	31198-010	1
• Power Cable with 4-pin circular connector (one end)	31185	1
• Cable-End Connectors:		
6-pin weathertight circular	10614006	1
18-pin weathertight circular	10616018	1
• Supervisor Software CD	30673	1
• 10 ft. (3m) M&C 6 Pin to DB-9 Pin RS232 Cable	30720-010	1
• LNC Screws		
Screw, 6-32 x 7/16"	11806007	5
Washer, 6-32, Flat #6	11811001	5
Washer, 6-32, Split #6	11815001	5
Nut, 6-32	11819002	5
O-Ring Gasket	10950	1
• Operating Manual	30956	1
• Quick Start Guide		1
Optional Accessories:		
• Transceiver Mounting Kit, TX Reject Filter	Contact Factory	

Table 2-1. ANASAT®-Ku Packing List

Safety Precautions

General

Observe normal safety precautions when operating this equipment.

Ensure the ANASAT®-Ku 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®-Ku 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®-Ku transceiver requires a power source which supplies 110 VAC or 220 VAC at 50 or 60 Hz, through a circuit breaker. Size of circuit breaker depends on model. 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. Provide an isolation filter to clean up power line interference and/or voltage variations, as required.

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®-Ku 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®-Ku 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. For transceivers equipped with a fan, this suggestion does not apply.

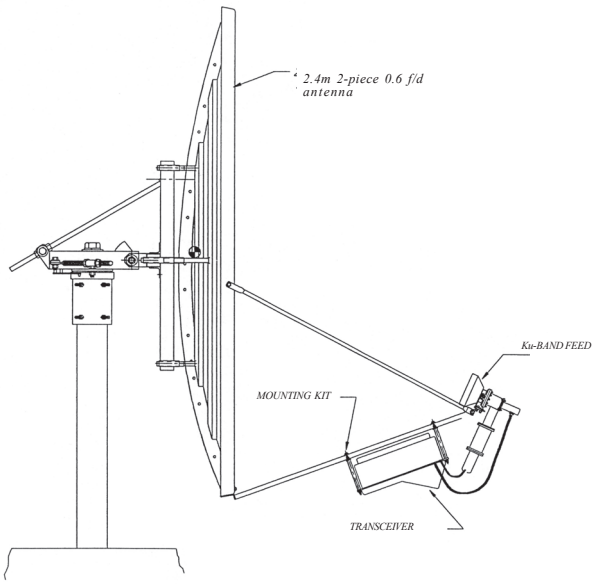

Figure 2-1. Typical transceiver mounting.

Figure 2-1 shows a common installation example where the transceiver is mounted on the antenna feed support arm.

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 cables and waveguide are not crimped or pinched.

Figures 2-1a and 2-1b in next pages shows the transceiver mounting for single thread.

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 ground point. It is recommended that 000 AWG 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. The LNC is directly bolted to the antenna RX feed. An appropriate waveguide gasket must be included at the feed point. 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 cable lengths may be used under certain circumstances; contact ANACOM for details.

Caution: Never touch the ground-plane antenna pin found inside the wave-guide flange of the LNC. The front-end preamp is susceptible to static discharge.

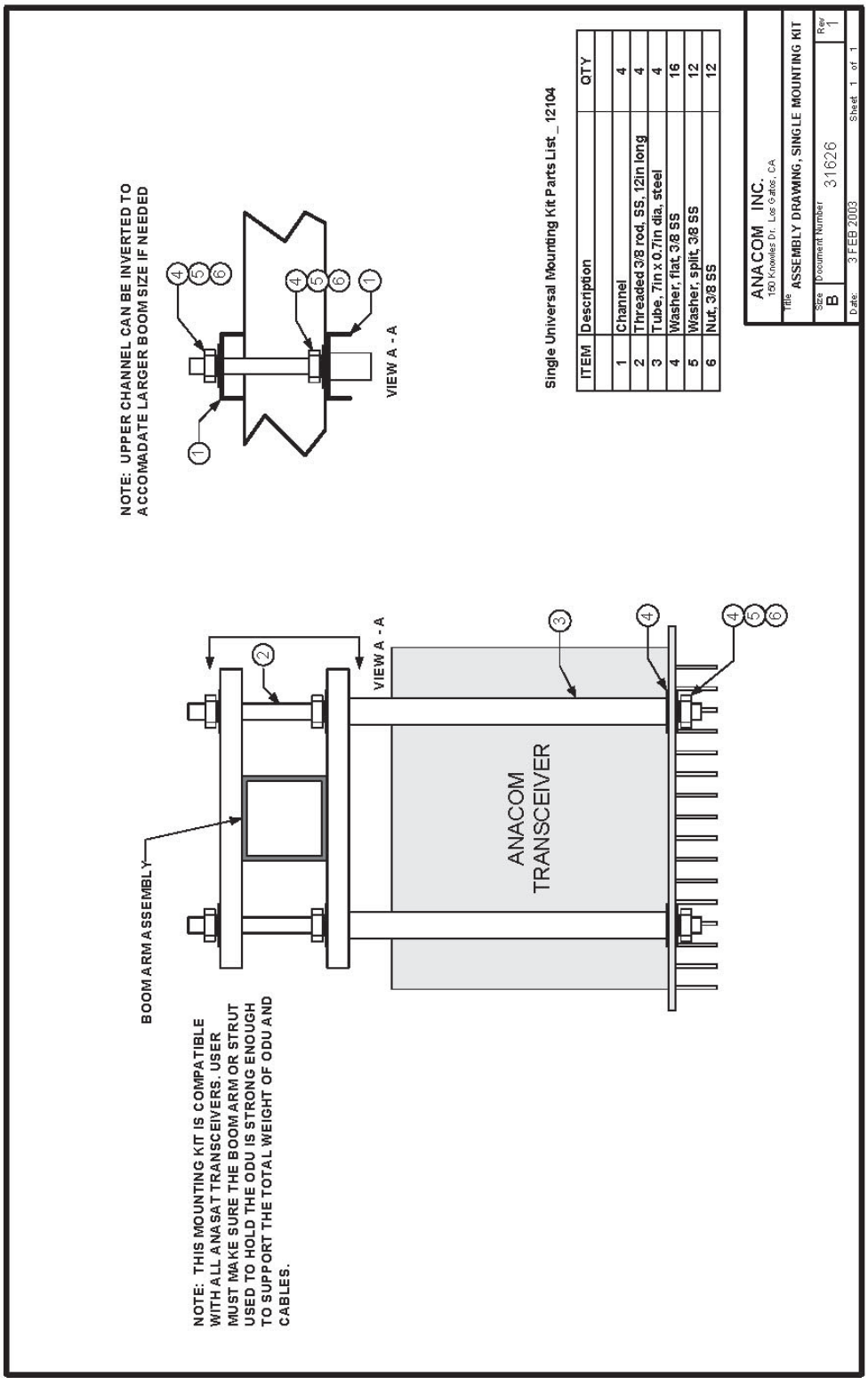

Figure 2-1a Transceiver Mounting for Single Thread

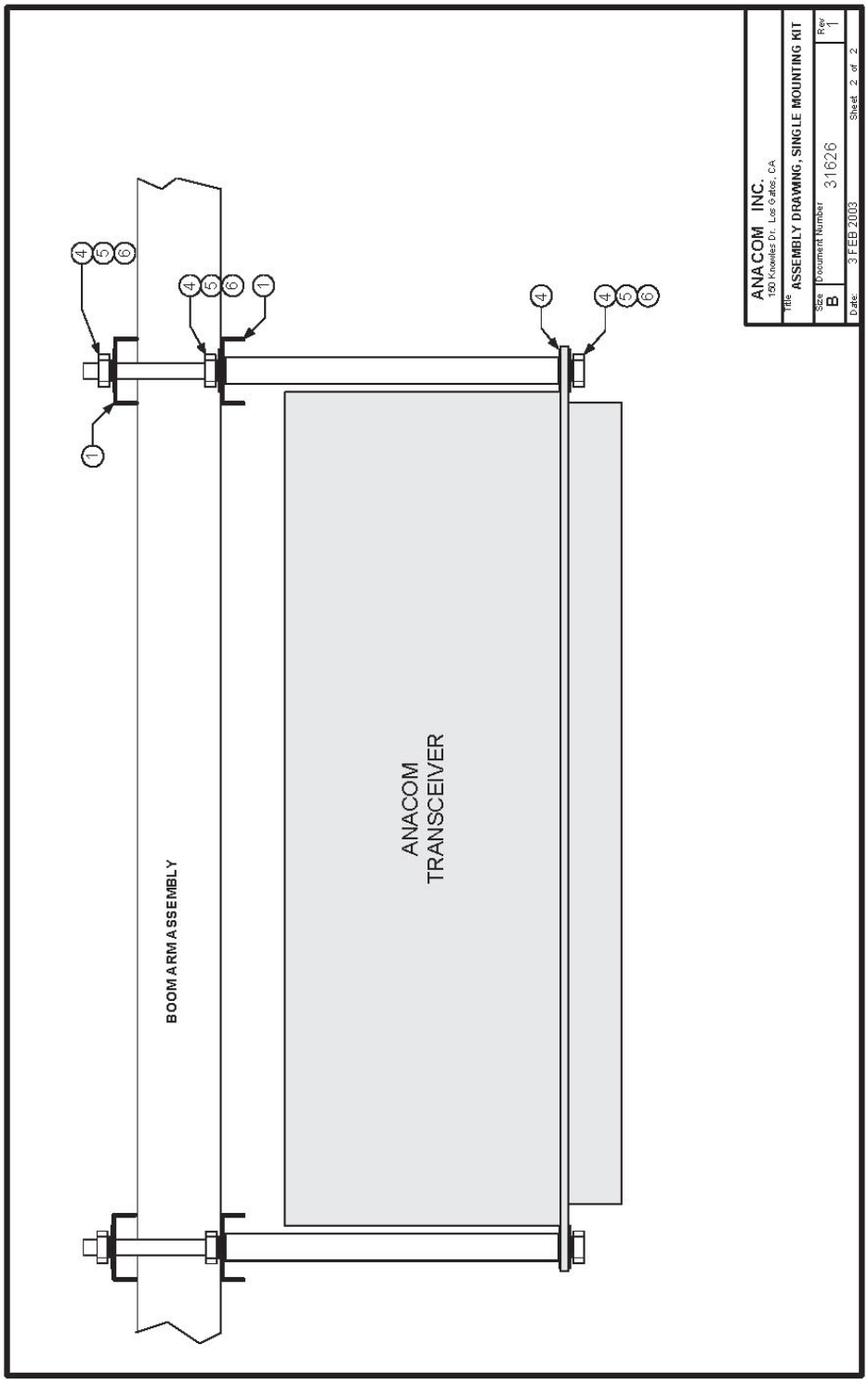

Figure 2-1b Transceiver Mounting for Single Thread

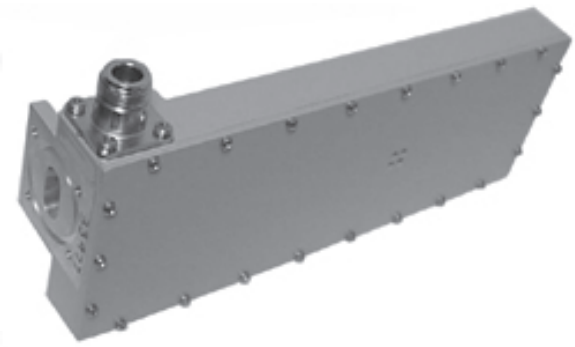

Figure 2-2. LNC assembly.

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.

Figures 2-3, 2-4, and 2-5 provides the cabling diagram for the ANASAT®-Ku transceiver.

1. AC Power

Attach the AC input cable to the 4-pin connector on the transceiver. Run the AC cable to the power source *but do not attach*. The supplied power cable has a four-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:

Brown.....AC Hot power lead
Blue.....AC Neutral power lead
Green/Yellow..... Ground

2. Transmitter Feed

Referring to Figure 2-4, connect a section of waveguide between the 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 and that the connections are weather-tight.

3. 70MHz Modem

Attach a coaxial cable with male N-connectors between the transceiver's TX IF (see Figure 2-5) 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 2-5) and the demodulator IF INPUT. Make sure that the connections are weather-tight.

Figure 2-3. AC Power Connection.

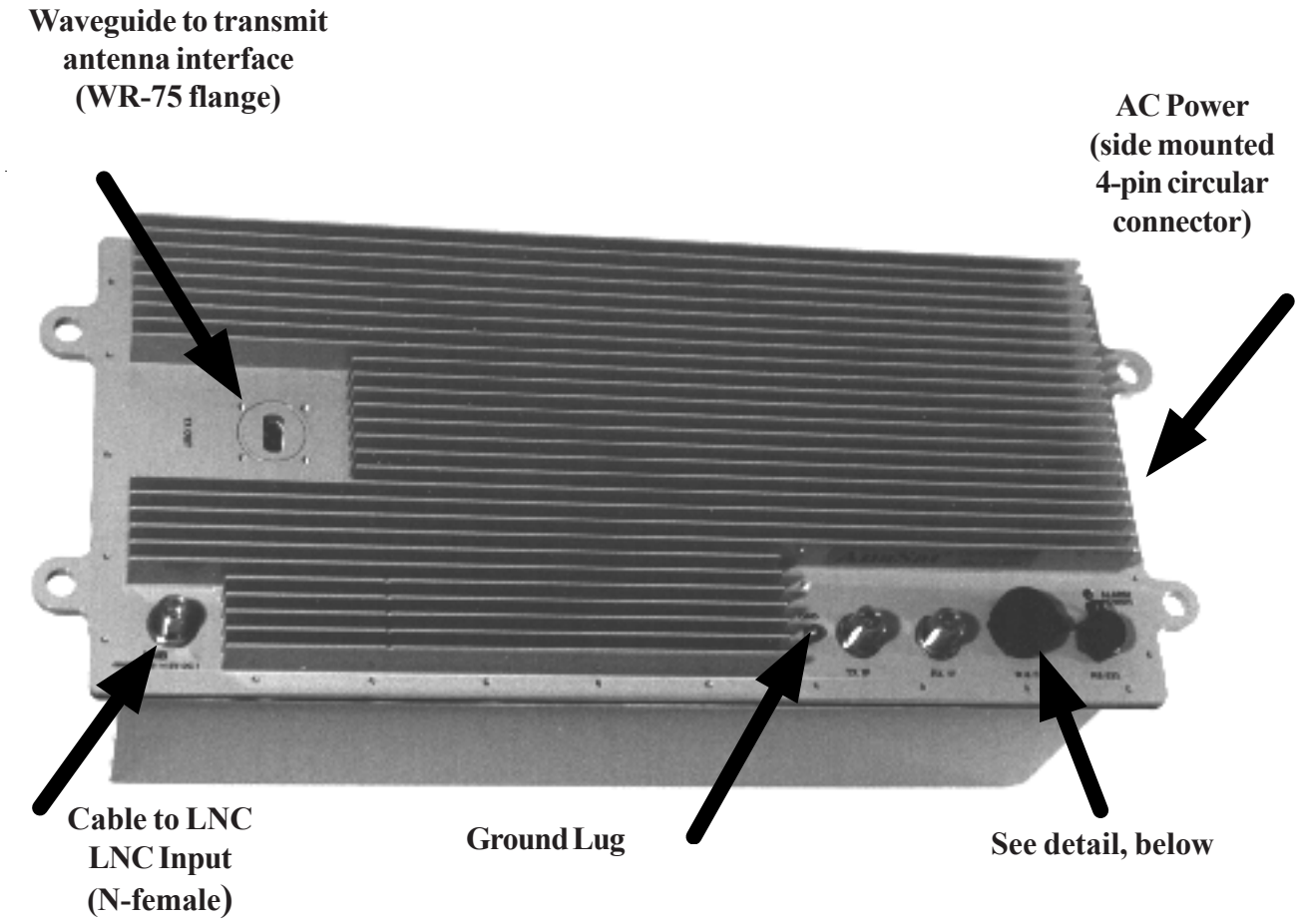

Figure 2-4. ANASAT®-Ku Cabling Interconnection Diagram for the entire transceiver.

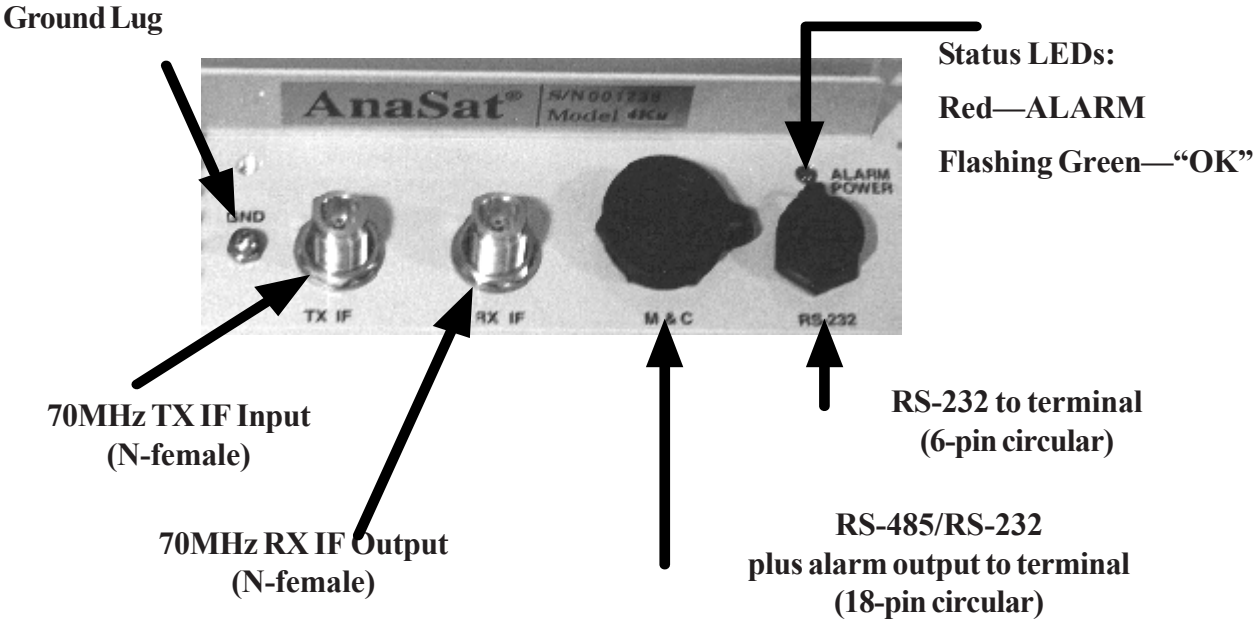

Figure 2-5. ANASAT®-Ku Cabling Interconnections M & C and IF Connections close-up.

4. LNC

Attach the RF cable between the LNC connector and the transceiver LNC input connector(refer to Figure 2-4). If a longer cable is required, ensure that the replacement cable is designed for low loss at microwave frequencies. Maximum loss of the LNC cable must be 10 dB or less at 10 GHz!

5. Terminal Connections

A data terminal or a computer with terminal software connects to the ANASAT®-Ku 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.

Final Check

Recheck all bolts and cabling. Refer to Figures 2-3, 2-4, and 2-5 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. See Figure 2-6. 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.

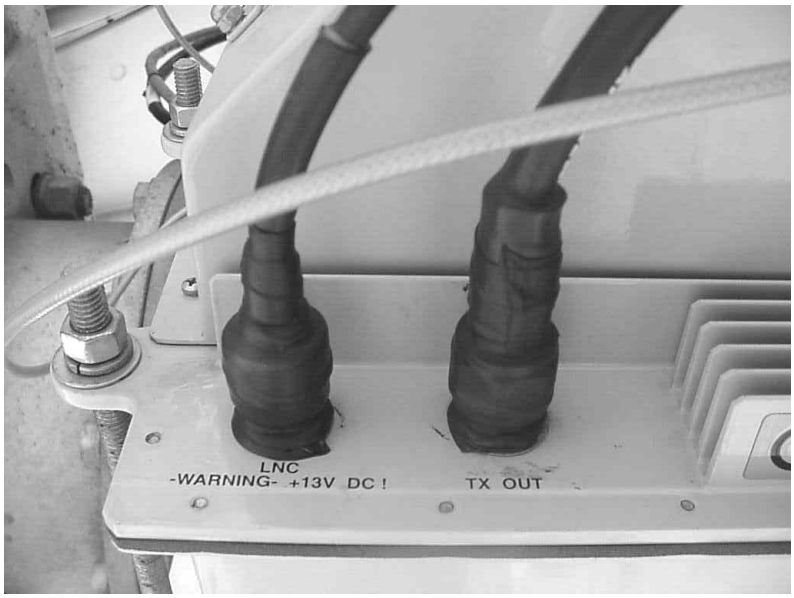

Figure 2-6. Mastic Tape application

ANASAT®-Ku Quick Start Guide

There's lots more inside the manual, but here are the most important steps:

1. Mount the transceiver and the LNC on the antenna.
2. Connect the cables as shown in the drawing (See page 2-3 of the Operations Manual).
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 blinking, indicating normal internal operation. The red LED must be OFF. If illuminated, it indicates an alarm condition requiring attention. Refer to the ALARM command for details (Appendix A).
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   RXFREQ nnnnn (nnnnn in MHz—see Appendix D for channel)
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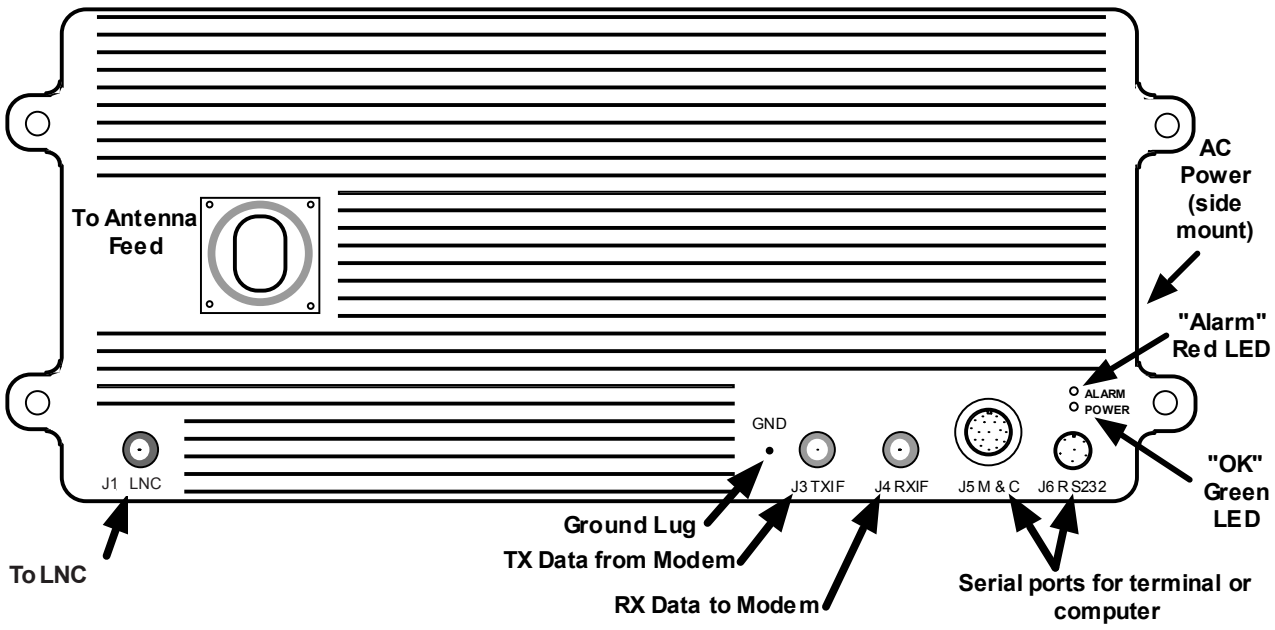
6. Configure receive gain and transmit output power:
   RXGAIN nnn nnn ranges from 85 to 100
   TXGAIN nn nn ranges from:

10 to 36 [0Ku]	44 to 70 [2Ku]	47 to 73 [4Ku]
50 to 76 [8Ku]	53 to 79 [16Ku]	53 to 79 [20Ku]
53 to 79 [23Ku]	53 to 79 [25Ku]	57 to 83 [40Ku]
58 to 84 [50Ku]	59 to 85 [60Ku]	60 to 86 [80Ku]
	61 to 87 [100Ku]	62 to 88 [125Ku]

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



Section 3. Operation

Preliminary Steps

After the ANACOM®-Ku 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.*

AnaCom Transceivers are shipped from the factory with TX ON as active.

Terminal Connection and Configuration

Autolink

The AnaCom M&C feature 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 CD with both our Supervisor and Supervisor Jr. software on it, that will establish a link 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 1 (using the 6-pin circular connector) is used for on-site maintenance and control. COM 0 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 desired. This also assumes exactly 70MHz (or 140 MHz) TXIF & RXIF.

Operating frequencies for standard Ku-Band channels are calculated with the following formulas:

f_{TX} = TX IF_{IN} + 13929 + Ch# MHz

f_{RX} = RX IF_{OUT} + 10879 + Ch# MHz

For negative channels:

f_{TX} = TX IF_{IN} + 13930 + 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 14,051.5 MHz. Likewise, with an RX OUT IF of 67.5 MHz , then the received RF frequency is 10,996.5 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 an IF of exactly 70 MHz.

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

Please note that the fan, on units so equipped, is thermostatically controlled and does not turn on when the unit is very cold.

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.

- Transmitter status is either "TX ON AIR" or "TX OFF AIR"

```
                          AnaSat 2Ku Transceiver     REV:04   S/N:006592
TKREQ on | TX ON AIR
alarm status: CLEAR
                                  | TXCHAN: 251     | RXCHAN:  901
                                  | TXGAIN: 64.0    | RXGAIN:  100
monitor points: TXMUTE: clear     | TXLOCK: locked  | RXLOCK:  locked | PA1:  8.6
FANERR: clear   |                 | TXPLL:  6.9     | RXPLL:   7.7    | PA2:  8.6
TEMP:   25C     | DIP:  00000000  | TXOPLL: 6.6     | FTLLOCK: locked | PA3:  8.4
XTAL:   normal  | P12V: 13.4      | TXin:   -49     | FTLPLL:  7.2    | PA4: 10.2
N5V:    -5.4    | P5V:  5.0       | TXout:  11      | RXout: > -3     | PA5: 10.3
last reset: 44 seconds            | TXpeak: 11      | LNCV:    13.2   | PA6:  N/A
DTE1 PC_MODE    UTIMER off        | TERMTYPE TTY    | ECHO on|CRLP on | BAUDRATE 9600

COMMAND >
```

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. Alternately, TXFREQ number is the actual transmit frequency for 70 MHz (140 MHz) input. Valid channel numbers range from 1 to 501, depending on model.

- TXGAIN is the actual transmit gain value selected in dBm.

- RXCHAN number is the actual receive channel selected; or RXFREQ number is the actual receive frequency for 70 MHz (140 MHz) output. Valid channel numbers range from 1 to 1801.

- RXGAIN is the actual receiver gain value selected in dBm.

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 (if a fan is installed).

- 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 over ride circuits, any of which will turn off the transmitter.

- LNC shows the LNC supply voltage.

- 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 gives the voltages for each stage of the transmitter power amplifier. Note that some low power models do not use all six voltages. As a special case, the 0dBm uses PA1 through PA6 to display up

to six different status or voltage points on an external high power amplifier. (HPA)

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.

Caution: It is recommended that the transmitter not be driven into saturation for long periods of time. The input power in dBm plus the requested TX gain in dB should not exceed the P1dB rating for the given transmitter.

TX input (dBm) + TX Gain (dBm) <= TX p1dB rating (dBm)

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 nnnn`	nnnn ranges from 1 to 1801
`TXCHAN nnn`	nnn ranges from 1 to 501 (see Appendix D).

2. Configure receive gain and transmit gain.

`RXGAIN nnn`	nnn ranges from 85 to 100
`TXGAIN nn`	nn ranges from:

10 to 36 [0Ku]	44 to 70 [2Ku]
47 to 73 [4Ku]	50 to 76 [8Ku]
53 to 79 [16Ku]	53 to 79 [20Ku]
53 to 79 [23Ku]	53 to 79 [25Ku]
57 to 83 [40Ku]	]58 to 84 [50Ku]
59 to 85 [60Ku]	60 to 86 [80Ku]
61 to 87 [100Ku]	62 to 88 [125Ku]

Note:

Gain settings and power readings are not intended to replace a calibrated Power Meter.

TX and RX gains are 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)

Section 4. Theory of Operation

The ANASAT®-Ku transceiver consists of five major blocks, as shown in Figure 4-1. These blocks are:

- Low Noise Converter (LNC)
- 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 waveguide into the Low Noise Converter (LNC), with its integral Transmit Reject (TR) Filter, which separates the transmit signal and receiver image frequencies. The LNC amplifies and mixes the Ku-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 Ku-band frequency in the converter module and output to the linear power amplifier (PA). PA output of up to 50W, depending upon transceiver version, feeds the antenna.

Control and Power Systems

The microprocessor-based M & C unit monitors the transceiver's parameters to ensure proper operation and reliable, long term service. Two serial ports provide local or remote terminal access.

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 status indication.

Low Noise Converter

The receive signal from the antenna's feed horn is fed via a WR-75 waveguide flange into the LNC, which is bolted to the feed horn of the antenna. The LNC consists of two blocks: a Ku-band low noise amplifier (LNA) and a block converter that mixes the Ku-band receive signal with the local oscillator (LO) from the receive converter module to produce an L-band output. (See Figure 4.2)

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

If the LNC has been purchased with the RF port option, then the signal at its RF frequency is available with about 20 dB of gain.

The amplified Ku-band signal is mixed with the 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.

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

- L-band signal output from the LNC
- LO input from the converter
- +13V DC power from the converter module.

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

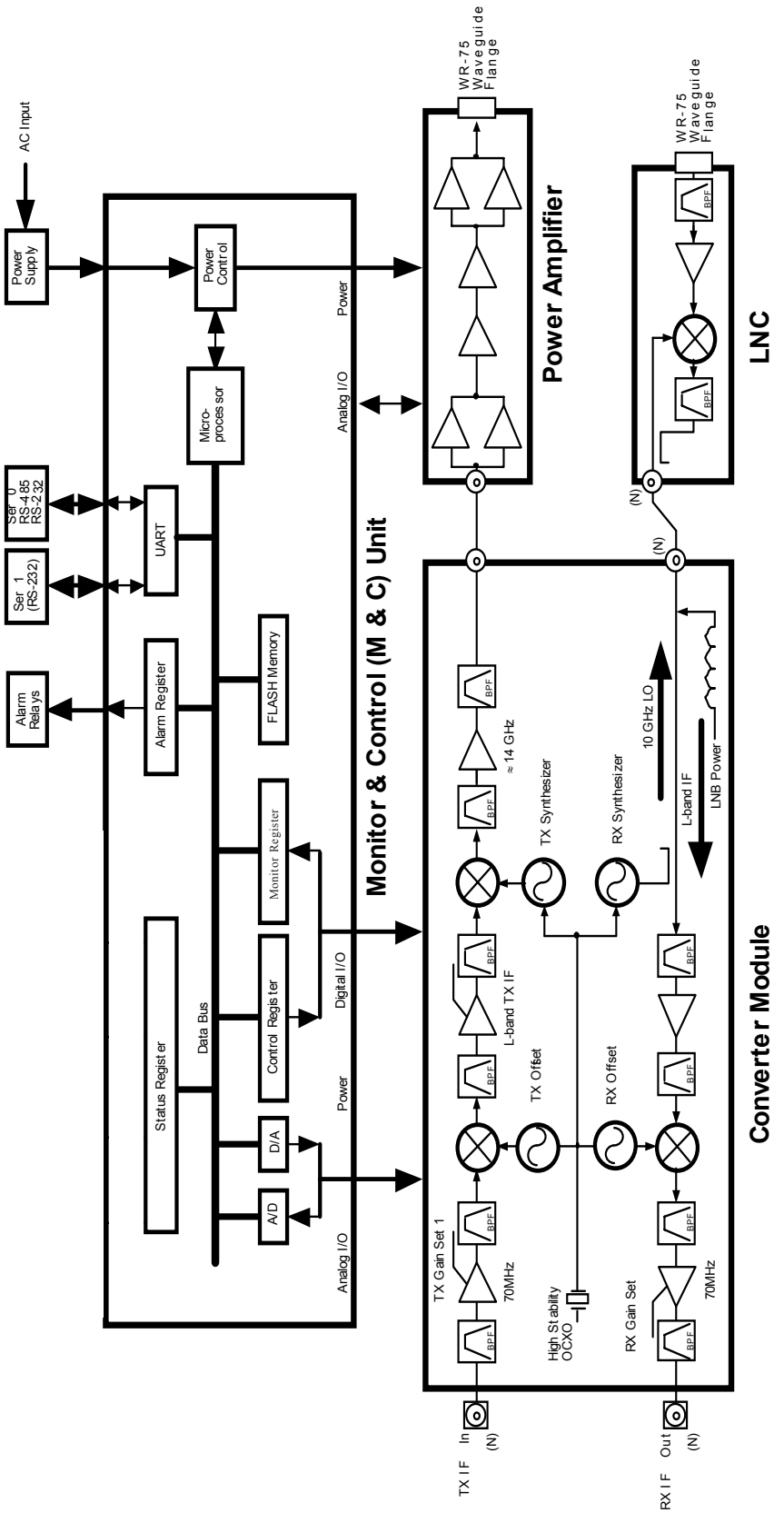


Figure 4-1. ANASAT®-Ku Transceiver Block Diagram

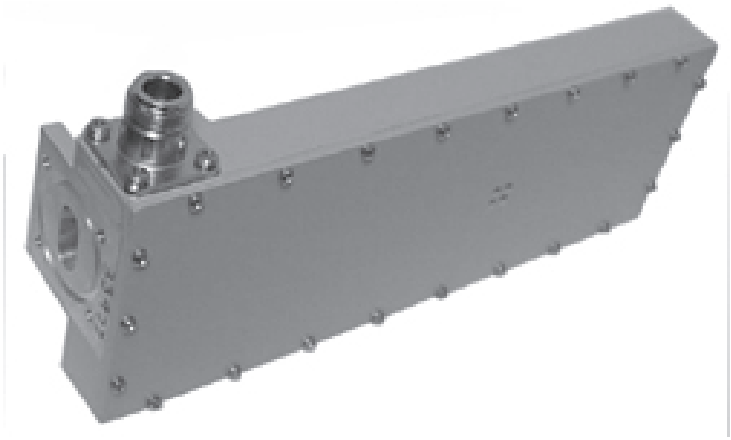


Figure 4-2. The LNC

Converter Module

The converter module 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 4-3). 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.

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 an L-band 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 transceiver. An external 50Ω to 75Ω transformer is available from ANACOM as an option.

The +13V DC supply to the LNC is fused with a self-resetting “polyfuse”. This polyfuse 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. The 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.

Transmit Offset Loop

The first synthesized frequency is the L-band offset loop signal that is used by the transmit converter. This signal is fed to the first transmit mixer.

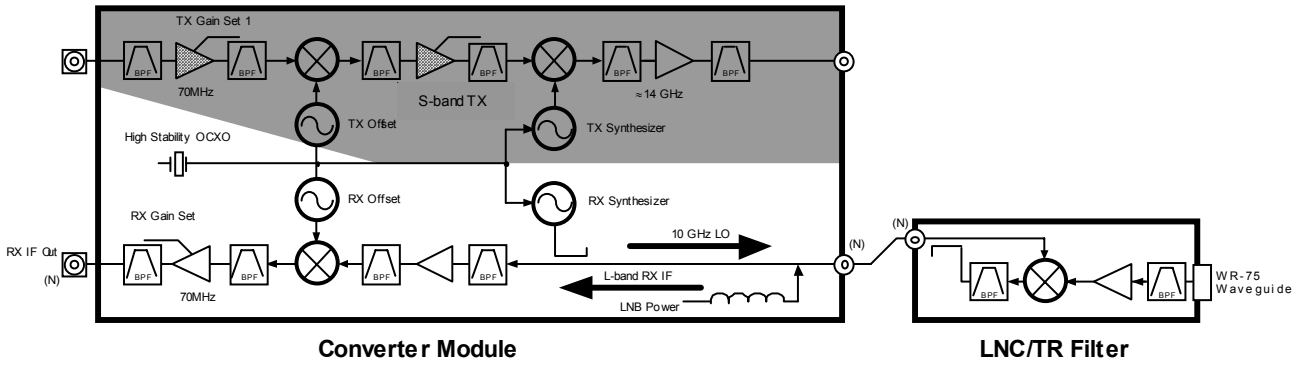


Figure 4-3. Converter Module, Receive Portion.

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 4-4). (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 offset loop frequency to the TX IF, producing an S-band output. This output passes through a mechanical filter into the second gain block and then through another mechanical filter.

The S-band output is now applied to the second transmit mixer, where it is combined with the 10 GHz transmit synthesizer output and becomes a Ku-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 PA.

Power Amplifier

ANASAT®-Ku series transceivers are available in thirteen different versions, with maximum transmit output powers of up to 125 watts.

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

NOTE: the 0 dBm 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 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.

PA Module

The PA module 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 amplifier. A second hybrid coupler converts this balanced output to a single-ended input for the amplifier.

This drive power is fed into another hybrid coupler and on into the balanced final amplifier. This balanced output passes through another hybrid to combine the signal into a single-ended output which is fed into a WR-75 waveguide flange that mates directly to the PA module and bolts to the heat sink. A directional coupler monitors output characteristics and reports to the M & C unit.

Power for each stage of the higher power PAs is individually filtered and applied through ferrite

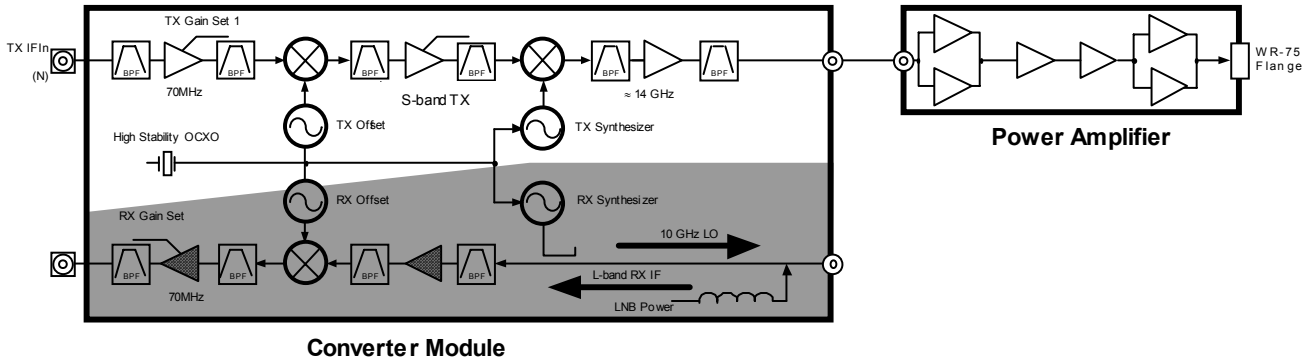


Figure 4-4. Converter Module, Transmit Portion.

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 4-6 and 4-7, 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.

WARNING

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

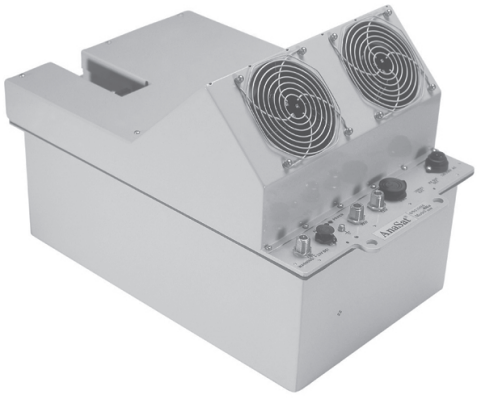


Figure 4-5 50 Watt EKu Band unit

Microprocessor-Based Functions

The heart of the M & C unit is the 80C188 microprocessor, operating at 16 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®-Ku 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.

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:

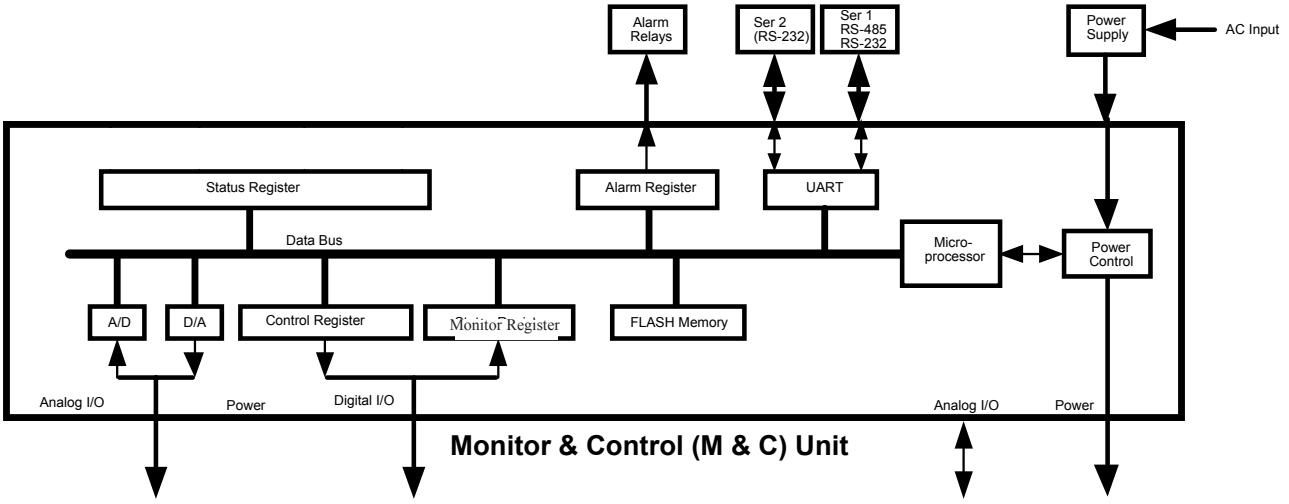


Figure 4-6 The Monitor and Control (M & C) unit.

- PA temperature
- All four PLL synthesizer VCO control voltages
- PA power output
- –5V DC supply
- 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 alarms
- Cooling fan failure (on units equipped with a fan)

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.

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
- Transmit offset PLL failure
- Transmit synthesizer failure

Alarm Relays

Two mechanical relays are used in the ANASAT®-Ku 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
- +13V 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®-Ku 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 x 10^{-8} Hz. The ANASAT®-Ku M & C unit periodically compensates for crystal aging automatically.

If your transceiver has been ordered with the EXTERNAL 10 MHz CRYSTAL REFERENCE SWITCH option, then that option can be activated using the EXTREF command.

Example:

EXTREF ON

When active, the transceiver's synthesizers lock the external reference. If this option has been activated, but an inadequate external reference signal is present, then the EXTREF alarm will be raised: this is a MAJOR alarm. The transceiver is not going to switch back to the internal crystal reference when

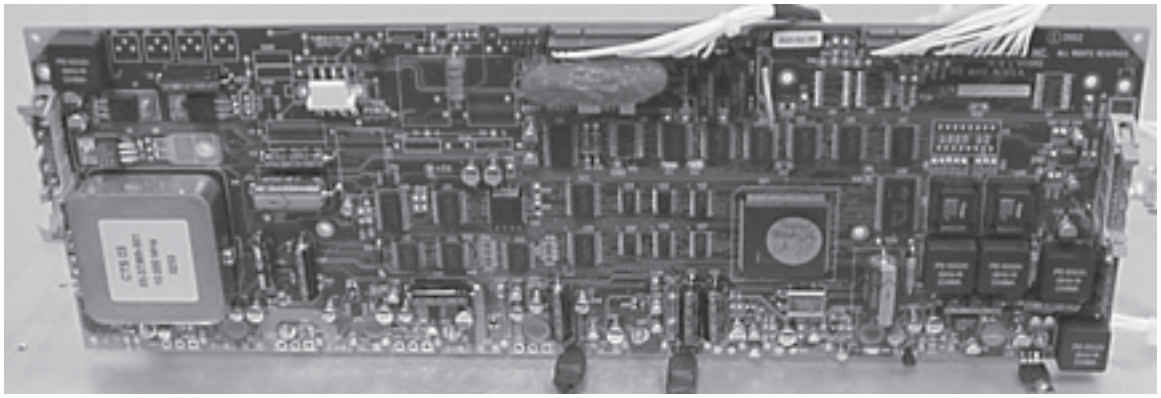


Figure 4-7 Monitor and Control Board.

this option is active but an external source is missing or inadequate.

To return to conventional operation using the internal reference source, use the command:

EXTREF OFF

A minimum signal level recommended for an external reference is +5 dBm.

Power Supply

ANASAT®-Ku transceivers use a wide input voltage (100 to 240VAC, 47 to 63Hz) 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 4-8a and 48b shows how the power supply is mounted in the transceiver. The AC input is connected via a 4-pin circular connector.

Figure 4-8a The 13V Power supply is mounted inside the bottom cover. Model 4Watt.

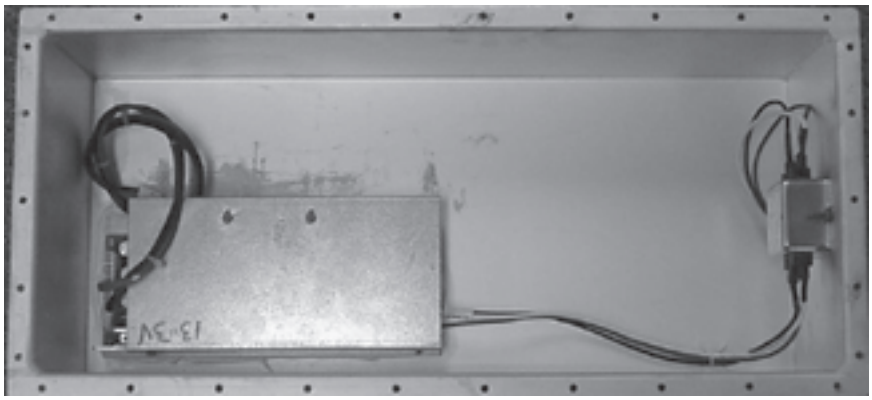
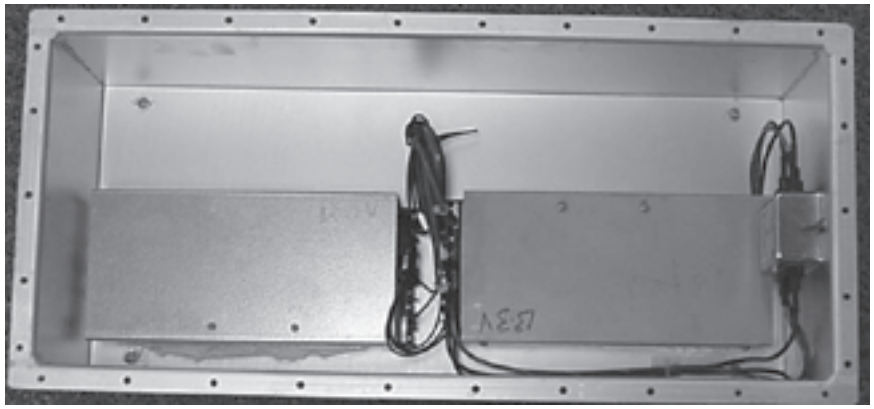


Figure 4-8b The 13V Power supply is mounted inside the bottom cover. Model 16Watt.



Section 5. Maintenance

ANASAT®-Ku series transceivers are designed for a minimum of maintenance. The on-board 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	1 to 1801	
RXGAIN	85 to 100	
OSLPLL	1.9 to 11 volts	
TXPLL	1.9 to 11 volts	
RXFTL	1.9 to 11 volts	
RXCTL	1.9 to 11 volts	
TEMP	–30 to +50	
LNC	+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	N/A	
PA2	N/A	
PA3	N/A	
PA4	N/A	
PA5	N/A	
PA6	N/A	

LNC Replacement

Although the ANASAT®-Ku 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; although a faulty LNC cable can also cause these symptoms.

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 to the N-connector on 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 command `RXGAIN nnnn` (see Appendix A), adjust receive gain until the modem or spectrum analyzer reports 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 a period of two (2) years from the date of shipment from the AnaCom factory. This warranty covers only failures due to defects in materials and workmanship that occurs during the period of the warranty. It does not cover damage that occurs during shipment, failure caused by operation of the product outside the published electrical or environmental specifications, or malfunctions caused by misuse of the product. Expendable components are not covered under this warranty.

In order for the customer to exercise their rights to repairs under the warranty, the customer must first contact AnaCom to obtain a repair authorization number (RMA). If it is necessary to return the product for repair, the customer is responsible for paying the cost of shipping it to AnaCom. AnaCom will pay the cost of shipping the product back to the customer when the repairs are completed. All import duties, customs fees, taxes of any kind, or any related fees are the sole responsibility of the customer.

Spare parts, repairs, or replacements are warranted to be free from defects in material or workmanship for ninety (90) days or the remainder of the limited warranty period, whichever is longer.

There are no express or implied warranties except as listed above. In no event shall AnaCom be liable for special, incidental, or consequential damages 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 (RMA), as described above. The customer is responsible for paying the cost of the shipping to and from AnaCom for any non-warranty repairs. Non-warranty repair service will be available for any AnaCom product for a minimum of 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 nonvolatile 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

ANASAT®-Ku Band 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, TXIN, 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 (units with fans only)
TXIN	raised when TX input is deemed by software to be too high
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 alarms conditions which can shutdown the PA stage: WARMING and OSLOCK, TXLOCK, PATEMP, and N5V. 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.

EXTREF [ON | OFF]

If ON, the ODU is programmed to accept an optional external 10MHz frequency reference source. If one is not present, a new alarm, EXTREF is raised. When an external reference signal appears while the EXTREF alarm is raised, the alarm will be dropped.

If OFF is given, then the internal source is used regardless of whether the optional reference source switch is indicating an external source is present or not.

The default setting is EXTREF OFF.

INFO

Returns information about software and hardware revision numbers.

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*.

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] (OLD UNITS,OBSOLETE)

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 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 power amplifier gain. The acceptable range of the number is dependent upon model.

nn ranges from:
10 to 36 dB for the ANASAT 0Ku
44 to 70 dB for the ANASAT 2Ku
47 to 73 dB for the ANASAT 4Ku
50 to 76 dB for the ANASAT 8Ku
53 to 79 dB for the ANASAT 16Ku
53 to 79 dB for the ANASAT 20Ku
53 to 79 dB for the ANASAT 23Ku
53 to 79 dB for the ANASAT 25Ku
57 to 83 dB for the ANASAT 40Ku
58 to 84 dB for the ANASAT 50Ku
59 to 85 dB for the ANASAT 60Ku
60 to 86 dB for the ANASAT 80Ku
61 to 87 dB for the ANASAT 100Ku
62 to 88 dB for the ANASAT 125Ku

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®-Ku 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 transceiver. 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 is 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 (units with fans only)
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 as major or minor.

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

TX

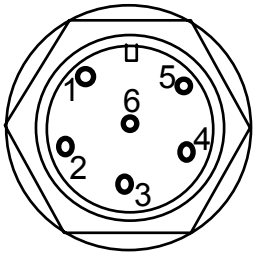
OSLOCK	the OS PLL fails to lock
TXLOCK	the TX PLL fails to lock
PATEMP	the PA temperature is too high
N5V	the –5V supply is out of tolerance
PA	one of the PA supply voltages is out of tolerance
—	external power loss

RX

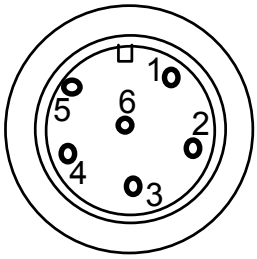
LNCV	LNC voltage too low
OSLOCK	OS PLL is not locked
RXLOCK	RX PLL is not locked
RXOUT	RX output noise floor is too low (low gain)
—	external power loss

Appendix C. Serial Port Wiring

COM1, 6-Pin Circular Weathertight Connector



Cable Wire View

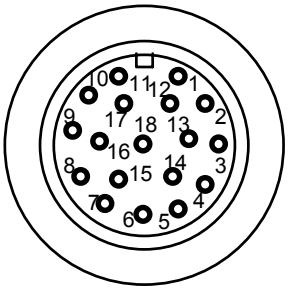


Cable End View

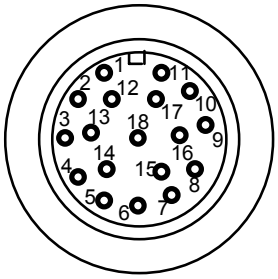
Pin	Signal	Description
1	DTR	Data Terminal Ready
2	DCD	Data Carrier Detect
3	DSR	Data Set Ready
4	RXD	Receive Data
5	TXD	Transmit Data
6	GND	Ground

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

TXD = Data to be transmitted by transceiver
RXD = Data received by transceiver

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-1 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.

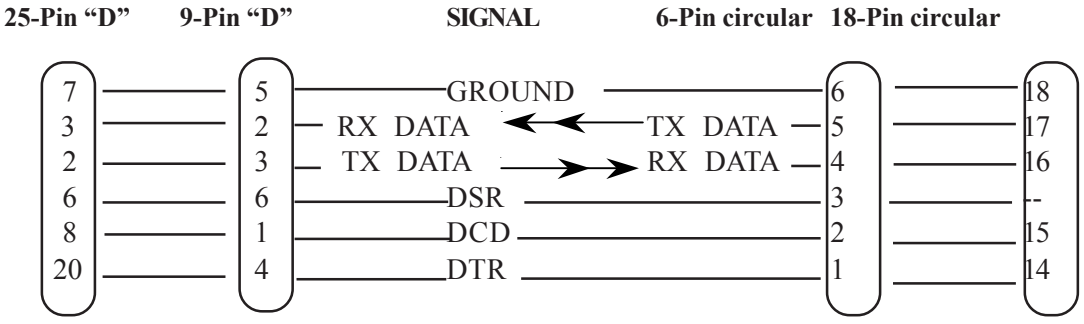


Figure C-1. RS232 Serial Cable Connections. Computer or terminal connections.

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.

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

Appendix D. Ku-Band Satellite Channel Frequencies

ANASAT®-Ku Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
1	14000	46	14045	91	14090	136	14135	181	14180	226	14225
2	14001	47	14046	92	14091	137	14136	182	14181	227	14226
3	14002	48	14047	93	14092	138	14137	183	14182	228	14227
4	14003	49	14048	94	14093	139	14138	184	14183	229	14228
5	14004	50	14049	95	14094	140	14139	185	14184	230	14229
6	14005	51	14050	96	14095	141	14140	186	14185	231	14230
7	14006	52	14051	97	14096	142	14141	187	14186	232	14231
8	14007	53	14052	98	14097	143	14142	188	14187	233	14232
9	14008	54	14053	99	14098	144	14143	189	14188	234	14233
10	14009	55	14054	100	14099	145	14144	190	14189	235	14234
11	14010	56	14055	101	14100	146	14145	191	14190	236	14235
12	14011	57	14056	102	14101	147	14146	192	14191	237	14236
13	14012	58	14057	103	14102	148	14147	193	14192	238	14237
14	14013	59	14058	104	14103	149	14148	194	14193	239	14238
15	14014	60	14059	105	14104	150	14149	195	14194	240	14239
16	14015	61	14060	106	14105	151	14150	196	14195	241	14240
17	14016	62	14061	107	14106	152	14151	197	14196	242	14241
18	14017	63	14062	108	14107	153	14152	198	14197	243	14242
19	14018	64	14063	109	14108	154	14153	199	14198	244	14243
20	14019	65	14064	110	14109	155	14154	200	14199	245	14244
21	14020	66	14065	111	14110	156	14155	201	14200	246	14245
22	14021	67	14066	112	14111	157	14156	202	14201	247	14246
23	14022	68	14067	113	14112	158	14157	203	14202	248	14247
24	14023	69	14068	114	14113	159	14158	204	14203	249	14248
25	14024	70	14069	115	14114	160	14159	205	14204	250	14249
26	14025	71	14070	116	14115	161	14160	206	14205	251	14250
27	14026	72	14071	117	14116	162	14161	207	14206	252	14251
28	14027	73	14072	118	14117	163	14162	208	14207	253	14252
29	14028	74	14073	119	14118	164	14163	209	14208	254	14253
30	14029	75	14074	120	14119	165	14164	210	14209	255	14254
31	14030	76	14075	121	14120	166	14165	211	14210	256	14255
32	14031	77	14076	122	14121	167	14166	212	14211	257	14256
33	14032	78	14077	123	14122	168	14167	213	14212	258	14257
34	14033	79	14078	124	14123	169	14168	214	14213	259	14258
35	14034	80	14079	125	14124	170	14169	215	14214	260	14259
36	14035	81	14080	126	14125	171	14170	216	14215	261	14260
37	14036	82	14081	127	14126	172	14171	217	14216	262	14261
38	14037	83	14082	128	14127	173	14172	218	14217	263	14262
39	14038	84	14083	129	14128	174	14173	219	14218	264	14263
40	14039	85	14084	130	14129	175	14174	220	14219	265	14264
41	14040	86	14085	131	14130	176	14175	221	14220	266	14265
42	14041	87	14086	132	14131	177	14176	222	14221	267	14266
43	14042	88	14087	133	14132	178	14177	223	14222	268	14267
44	14043	89	14088	134	14133	179	14178	224	14223	269	14268
45	14044	90	14089	135	14134	180	14179	225	14224	270	14269

ANASAT®-Ku Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
271	14270	321	14320	371	14370	421	14420	471	14470		
272	14271	322	14321	372	14371	422	14421	472	14471		
273	14272	323	14322	373	14372	423	14422	473	14472		
274	14273	324	14323	374	14373	424	14423	474	14473		
275	14274	325	14324	375	14374	425	14424	475	14474		
276	14275	326	14325	376	14375	426	14425	476	14475		
277	14276	327	14326	377	14376	427	14426	477	14476		
278	14277	328	14327	378	14377	428	14427	478	14477		
279	14278	329	14328	379	14378	429	14428	479	14478		
280	14279	330	14329	380	14379	430	14429	480	14479		
281	14280	331	14330	381	14380	431	14430	481	14480		
282	14281	332	14331	382	14381	432	14431	482	14481		
283	14282	333	14332	383	14382	433	14432	483	14482		
284	14283	334	14333	384	14383	434	14433	484	14483		
285	14284	335	14334	385	14384	435	14434	485	14484		
286	14285	336	14335	386	14385	436	14435	486	14485		
287	14286	337	14336	387	14386	437	14436	487	14486		
288	14287	338	14337	388	14387	438	14437	488	14487		
289	14288	339	14338	389	14388	439	14438	489	14488		
290	14289	340	14339	390	14389	440	14439	490	14489		
291	14290	341	14340	391	14390	441	14440	491	14490		
292	14291	342	14341	392	14391	442	14441	492	14491		
293	14292	343	14342	393	14392	443	14442	493	14492		
294	14293	344	14343	394	14393	444	14443	494	14493		
295	14294	345	14344	395	14394	445	14444	495	14494		
296	14295	346	14345	396	14395	446	14445	496	14495		
297	14296	347	14346	397	14396	447	14446	497	14496		
298	14297	348	14347	398	14397	448	14447	498	14497		
299	14298	349	14348	399	14398	449	14448	499	14498		
300	14299	350	14349	400	14399	450	14449	500	14499		
301	14300	351	14350	401	14400	451	14450	501	14500		
302	14301	352	14351	402	14401	452	14451				
303	14302	353	14352	403	14402	453	14452				
304	14303	354	14353	404	14403	454	14453				
305	14304	355	14354	405	14404	455	14454				
306	14305	356	14355	406	14405	456	14455				
307	14306	357	14356	407	14406	457	14456				
308	14307	358	14357	408	14407	458	14457				
309	14308	359	14358	409	14408	459	14458				
310	14309	360	14359	410	14409	460	14459				
311	14310	361	14360	411	14410	461	14460				
312	14311	362	14361	412	14411	462	14461				
313	14312	363	14362	413	14412	463	14462				
314	14313	364	14363	414	14413	464	14463				
315	14314	365	14364	415	14414	465	14464				
316	14315	366	14365	416	14415	466	14465				
317	14316	367	14366	417	14416	467	14466				
318	14317	368	14367	418	14417	468	14467				
319	14318	369	14368	419	14418	469	14468				
320	14319	370	14369	420	14419	470	14469				

ANASAT®-EKu Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
-250	13750	-200	13800	-150	13850	-100	13900	-50	13950	1	14000
-249	13751	-199	13801	-149	13851	-99	13901	-49	13951	2	14001
-248	13752	-198	13802	-148	13852	-98	13902	-48	13952	3	14002
-247	13753	-197	13803	-147	13853	-97	13903	-47	13953	4	14003
-246	13754	-196	13804	-146	13854	-96	13904	-46	13954	5	14004
-245	13755	-195	13805	-145	13855	-95	13905	-45	13955	6	14005
-244	13756	-194	13806	-144	13856	-94	13906	-44	13956	7	14006
-243	13757	-193	13807	-143	13857	-93	13907	-43	13957	8	14007
-242	13758	-192	13808	-142	13858	-92	13908	-42	13958	9	14008
-241	13759	-191	13809	-141	13859	-91	13909	-41	13959	10	14009
-240	13760	-190	13810	-140	13860	-90	13910	-40	13960	11	14010
-239	13761	-189	13811	-139	13861	-89	13911	-39	13961	12	14011
-238	13762	-188	13812	-138	13862	-88	13912	-38	13962	13	14012
-237	13763	-187	13813	-137	13863	-87	13913	-37	13963	14	14013
-236	13764	-186	13814	-136	13864	-86	13914	-36	13964	15	14014
-235	13765	-185	13815	-135	13865	-85	13915	-35	13965	16	14015
-234	13766	-184	13816	-134	13866	-84	13916	-34	13966	17	14016
-233	13767	-183	13817	-133	13867	-83	13917	-33	13967	18	14017
-232	13768	-182	13818	-132	13868	-82	13918	-32	13968	19	14018
-231	13769	-181	13819	-131	13869	-81	13919	-31	13969	20	14019
-230	13770	-180	13820	-130	13870	-80	13920	-30	13970	21	14020
-229	13771	-179	13821	-129	13871	-79	13921	-29	13971	22	14021
-228	13772	-178	13822	-128	13872	-78	13922	-28	13972	23	14022
-227	13773	-177	13823	-127	13873	-77	13923	-27	13973	24	14023
-226	13774	-176	13824	-126	13874	-76	13924	-26	13974	25	14024
-225	13775	-175	13825	-125	13875	-75	13925	-25	13975	26	14025
-224	13776	-174	13826	-124	13876	-74	13926	-24	13976	27	14026
-223	13777	-173	13827	-123	13877	-73	13927	-23	13977	28	14027
-222	13778	-172	13828	-122	13878	-72	13928	-22	13978	29	14028
-221	13779	-171	13829	-121	13879	-71	13929	-21	13979	30	14029
-220	13780	-170	13830	-120	13880	-70	13930	-20	13980	31	14030
-219	13781	-169	13831	-119	13881	-69	13931	-19	13981	32	14031
-218	13782	-168	13832	-118	13882	-68	13932	-18	13982	33	14032
-217	13783	-167	13833	-117	13883	-67	13933	-17	13983	34	14033
-216	13784	-166	13834	-116	13884	-66	13934	-16	13984	35	14034
-215	13785	-165	13835	-115	13885	-65	13935	-15	13985	36	14035
-214	13786	-164	13836	-114	13886	-64	13936	-14	13986	37	14036
-213	13787	-163	13837	-113	13887	-63	13937	-13	13987	38	14037
-212	13788	-162	13838	-112	13888	-62	13938	-12	13988	39	14038
-211	13789	-161	13839	-111	13889	-61	13939	-11	13989	40	14039
-210	13790	-160	13840	-110	13890	-60	13940	-10	13990	41	14040
-209	13791	-159	13841	-109	13891	-59	13941	-9	13991	42	14041
-208	13792	-158	13842	-108	13892	-58	13942	-8	13992	43	14042
-207	13793	-157	13843	-107	13893	-57	13943	-7	13993	44	14043
-206	13794	-156	13844	-106	13894	-56	13944	-6	13994	45	14044
-205	13795	-155	13845	-105	13895	-55	13945	-5	13995	46	14045
-204	13796	-154	13846	-104	13896	-54	13946	-4	13996	47	14046
-203	13797	-153	13847	-103	13897	-53	13947	-3	13997	48	14047
-202	13798	-152	13848	-102	13898	-52	13948	-2	13998	49	14048
-201	13799	-151	13849	-101	13899	-51	13949	-1	13999	50	14049

ANASAT®-EKu Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
51	14050	101	14100	151	14150	201	14200	251	14250		
52	14051	102	14101	152	14151	202	14201				
53	14052	103	14102	153	14152	203	14202				
54	14053	104	14103	154	14153	204	14203				
55	14054	105	14104	155	14154	205	14204				
56	14055	106	14105	156	14155	206	14205				
57	14056	107	14106	157	14156	207	14206				
58	14057	108	14107	158	14157	208	14207				
59	14058	109	14108	159	14158	209	14208				
60	14059	110	14109	160	14159	210	14209				
61	14060	111	14110	161	14160	211	14210				
62	14061	112	14111	162	14161	212	14211				
63	14062	113	14112	163	14162	213	14212				
64	14063	114	14113	164	14163	214	14213				
65	14064	115	14114	165	14164	215	14214				
66	14065	116	14115	166	14165	216	14215				
67	14066	117	14116	167	14166	217	14216				
68	14067	118	14117	168	14167	218	14217				
69	14068	119	14118	169	14168	219	14218				
70	14069	120	14119	170	14169	220	14219				
71	14070	121	14120	171	14170	221	14220				
72	14071	122	14121	172	14171	222	14221				
73	14072	123	14122	173	14172	223	14222				
74	14073	124	14123	174	14173	224	14223				
75	14074	125	14124	175	14174	225	14224				
76	14075	126	14125	176	14175	226	14225				
77	14076	127	14126	177	14176	227	14226				
78	14077	128	14127	178	14177	228	14227				
79	14078	129	14128	179	14178	229	14228				
80	14079	130	14129	180	14179	230	14229				
81	14080	131	14130	181	14180	231	14230				
82	14081	132	14131	182	14181	232	14231				
83	14082	133	14132	183	14182	233	14232				
84	14083	134	14133	184	14183	234	14233				
85	14084	135	14134	185	14184	235	14234				
86	14085	136	14135	186	14185	236	14235				
87	14086	137	14136	187	14186	237	14236				
88	14087	138	14137	188	14187	238	14237				
89	14088	139	14138	189	14188	239	14238				
90	14089	140	14139	190	14189	240	14239				
91	14090	141	14140	191	14190	241	14240				
92	14091	142	14141	192	14191	242	14241				
93	14092	143	14142	193	14192	243	14242				
94	14093	144	14143	194	14193	244	14243				
95	14094	145	14144	195	14194	245	14244				
96	14095	146	14145	196	14195	246	14245				
97	14096	147	14146	197	14196	247	14246				
98	14097	148	14147	198	14197	248	14247				
99	14098	149	14148	199	14198	249	14248				
100	14099	150	14149	200	14199	250	14249				

ANASAT®-SEKu Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
-250	13750	-200	13800	-150	13850	-100	13900	-50	13950	1	14000
-249	13751	-199	13801	-149	13851	-99	13901	-49	13951	2	14001
-248	13752	-198	13802	-148	13852	-98	13902	-48	13952	3	14002
-247	13753	-197	13803	-147	13853	-97	13903	-47	13953	4	14003
-246	13754	-196	13804	-146	13854	-96	13904	-46	13954	5	14004
-245	13755	-195	13805	-145	13855	-95	13905	-45	13955	6	14005
-244	13756	-194	13806	-144	13856	-94	13906	-44	13956	7	14006
-243	13757	-193	13807	-143	13857	-93	13907	-43	13957	8	14007
-242	13758	-192	13808	-142	13858	-92	13908	-42	13958	9	14008
-241	13759	-191	13809	-141	13859	-91	13909	-41	13959	10	14009
-240	13760	-190	13810	-140	13860	-90	13910	-40	13960	11	14010
-239	13761	-189	13811	-139	13861	-89	13911	-39	13961	12	14011
-238	13762	-188	13812	-138	13862	-88	13912	-38	13962	13	14012
-237	13763	-187	13813	-137	13863	-87	13913	-37	13963	14	14013
-236	13764	-186	13814	-136	13864	-86	13914	-36	13964	15	14014
-235	13765	-185	13815	-135	13865	-85	13915	-35	13965	16	14015
-234	13766	-184	13816	-134	13866	-84	13916	-34	13966	17	14016
-233	13767	-183	13817	-133	13867	-83	13917	-33	13967	18	14017
-232	13768	-182	13818	-132	13868	-82	13918	-32	13968	19	14018
-231	13769	-181	13819	-131	13869	-81	13919	-31	13969	20	14019
-230	13770	-180	13820	-130	13870	-80	13920	-30	13970	21	14020
-229	13771	-179	13821	-129	13871	-79	13921	-29	13971	22	14021
-228	13772	-178	13822	-128	13872	-78	13922	-28	13972	23	14022
-227	13773	-177	13823	-127	13873	-77	13923	-27	13973	24	14023
-226	13774	-176	13824	-126	13874	-76	13924	-26	13974	25	14024
-225	13775	-175	13825	-125	13875	-75	13925	-25	13975	26	14025
-224	13776	-174	13826	-124	13876	-74	13926	-24	13976	27	14026
-223	13777	-173	13827	-123	13877	-73	13927	-23	13977	28	14027
-222	13778	-172	13828	-122	13878	-72	13928	-22	13978	29	14028
-221	13779	-171	13829	-121	13879	-71	13929	-21	13979	30	14029
-220	13780	-170	13830	-120	13880	-70	13930	-20	13980	31	14030
-219	13781	-169	13831	-119	13881	-69	13931	-19	13981	32	14031
-218	13782	-168	13832	-118	13882	-68	13932	-18	13982	33	14032
-217	13783	-167	13833	-117	13883	-67	13933	-17	13983	34	14033
-216	13784	-166	13834	-116	13884	-66	13934	-16	13984	35	14034
-215	13785	-165	13835	-115	13885	-65	13935	-15	13985	36	14035
-214	13786	-164	13836	-114	13886	-64	13936	-14	13986	37	14036
-213	13787	-163	13837	-113	13887	-63	13937	-13	13987	38	14037
-212	13788	-162	13838	-112	13888	-62	13938	-12	13988	39	14038
-211	13789	-161	13839	-111	13889	-61	13939	-11	13989	40	14039
-210	13790	-160	13840	-110	13890	-60	13940	-10	13990	41	14040
-209	13791	-159	13841	-109	13891	-59	13941	-9	13991	42	14041
-208	13792	-158	13842	-108	13892	-58	13942	-8	13992	43	14042
-207	13793	-157	13843	-107	13893	-57	13943	-7	13993	44	14043
-206	13794	-156	13844	-106	13894	-56	13944	-6	13994	45	14044
-205	13795	-155	13845	-105	13895	-55	13945	-5	13995	46	14045
-204	13796	-154	13846	-104	13896	-54	13946	-4	13996	47	14046
-203	13797	-153	13847	-103	13897	-53	13947	-3	13997	48	14047
-202	13798	-152	13848	-102	13898	-52	13948	-2	13998	49	14048
-201	13799	-151	13849	-101	13899	-51	13949	-1	13999	50	14049

ANASAT®-SEKu Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
51	14050	101	14100	151	14150	201	14200	251	14250	301	14300
52	14051	102	14101	152	14151	202	14201	252	14251	302	14301
53	14052	103	14102	153	14152	203	14202	253	14252	303	14302
54	14053	104	14103	154	14153	204	14203	254	14253	304	14303
55	14054	105	14104	155	14154	205	14204	255	14254	305	14304
56	14055	106	14105	156	14155	206	14205	256	14255	306	14305
57	14056	107	14106	157	14156	207	14206	257	14256	307	14306
58	14057	108	14107	158	14157	208	14207	258	14257	308	14307
59	14058	109	14108	159	14158	209	14208	259	14258	309	14308
60	14059	110	14109	160	14159	210	14209	260	14259	310	14309
61	14060	111	14110	161	14160	211	14210	261	14260	311	14310
62	14061	112	14111	162	14161	212	14211	262	14261	312	14311
63	14062	113	14112	163	14162	213	14212	263	14262	313	14312
64	14063	114	14113	164	14163	214	14213	264	14263	314	14313
65	14064	115	14114	165	14164	215	14214	265	14264	315	14314
66	14065	116	14115	166	14165	216	14215	266	14265	316	14315
67	14066	117	14116	167	14166	217	14216	267	14266	317	14316
68	14067	118	14117	168	14167	218	14217	268	14267	318	14317
69	14068	119	14118	169	14168	219	14218	269	14268	319	14318
70	14069	120	14119	170	14169	220	14219	270	14269	320	14319
71	14070	121	14120	171	14170	221	14220	271	14270	321	14320
72	14071	122	14121	172	14171	222	14221	272	14271	322	14321
73	14072	123	14122	173	14172	223	14222	273	14272	323	14322
74	14073	124	14123	174	14173	224	14223	274	14273	324	14323
75	14074	125	14124	175	14174	225	14224	275	14274	325	14324
76	14075	126	14125	176	14175	226	14225	276	14275	326	14325
77	14076	127	14126	177	14176	227	14226	277	14276	327	14326
78	14077	128	14127	178	14177	228	14227	278	14277	328	14327
79	14078	129	14128	179	14178	229	14228	279	14278	329	14328
80	14079	130	14129	180	14179	230	14229	280	14279	330	14329
81	14080	131	14130	181	14180	231	14230	281	14280	331	14330
82	14081	132	14131	182	14181	232	14231	282	14281	332	14331
83	14082	133	14132	183	14182	233	14232	283	14282	333	14332
84	14083	134	14133	184	14183	234	14233	284	14283	334	14333
85	14084	135	14134	185	14184	235	14234	285	14284	335	14334
86	14085	136	14135	186	14185	236	14235	286	14285	336	14335
87	14086	137	14136	187	14186	237	14236	287	14286	337	14336
88	14087	138	14137	188	14187	238	14237	288	14287	338	14337
89	14088	139	14138	189	14188	239	14238	289	14288	339	14338
90	14089	140	14139	190	14189	240	14239	290	14289	340	14339
91	14090	141	14140	191	14190	241	14240	291	14290	341	14340
92	14091	142	14141	192	14191	242	14241	292	14291	342	14341
93	14092	143	14142	193	14192	243	14242	293	14292	343	14342
94	14093	144	14143	194	14193	244	14243	294	14293	344	14343
95	14094	145	14144	195	14194	245	14244	295	14294	345	14344
96	14095	146	14145	196	14195	246	14245	296	14295	346	14345
97	14096	147	14146	197	14196	247	14246	297	14296	347	14346
98	14097	148	14147	198	14197	248	14247	298	14297	348	14347
99	14098	149	14148	199	14198	249	14248	299	14298	349	14348
100	14099	150	14149	200	14199	250	14249	300	14299	350	14349

ANASAT®-SEKu Transmit Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
351	14350	401	14400	451	14450	501	14500				
352	14351	402	14401	452	14451						
353	14352	403	14402	453	14452						
354	14353	404	14403	454	14453						
355	14354	405	14404	455	14454						
356	14355	406	14405	456	14455						
357	14356	407	14406	457	14456						
358	14357	408	14407	458	14457						
359	14358	409	14408	459	14458						
360	14359	410	14409	460	14459						
361	14360	411	14410	461	14460						
362	14361	412	14411	462	14461						
363	14362	413	14412	463	14462						
364	14363	414	14413	464	14463						
365	14364	415	14414	465	14464						
366	14365	416	14415	466	14465						
367	14366	417	14416	467	14466						
368	14367	418	14417	468	14467						
369	14368	419	14418	469	14468						
370	14369	420	14419	470	14469						
371	14370	421	14420	471	14470						
372	14371	422	14421	472	14471						
373	14372	423	14422	473	14472						
374	14373	424	14423	474	14473						
375	14374	425	14424	475	14474						
376	14375	426	14425	476	14475						
377	14376	427	14426	477	14476						
378	14377	428	14427	478	14477						
379	14378	429	14428	479	14478						
380	14379	430	14429	480	14479						
381	14380	431	14430	481	14480						
382	14381	432	14431	482	14481						
383	14382	433	14432	483	14482						
384	14383	434	14433	484	14483						
385	14384	435	14434	485	14484						
386	14385	436	14435	486	14485						
387	14386	437	14436	487	14486						
388	14387	438	14437	488	14487						
389	14388	439	14438	489	14488						
390	14389	440	14439	490	14489						
391	14390	441	14440	491	14490						
392	14391	442	14441	492	14491						
393	14392	443	14442	493	14492						
394	14393	444	14443	494	14493						
395	14394	445	14444	495	14494						
396	14395	446	14445	496	14495						
397	14396	447	14446	497	14496						
398	14397	448	14447	498	14497						
399	14398	449	14448	499	14498						
400	14399	450	14449	500	14499						

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
1	10950	51	11000	101	11050	151	11100	201	11150	251	11200
2	10951	52	11001	102	11051	152	11101	202	11151	252	11201
3	10952	53	11002	103	11052	153	11102	203	11152	253	11202
4	10953	54	11003	104	11053	154	11103	204	11153	254	11203
5	10954	55	11004	105	11054	155	11104	205	11154	255	11204
6	10955	56	11005	106	11055	156	11105	206	11155	256	11205
7	10956	57	11006	107	11056	157	11106	207	11156	257	11206
8	10957	58	11007	108	11057	158	11107	208	11157	258	11207
9	10958	59	11008	109	11058	159	11108	209	11158	259	11208
10	10959	60	11009	110	11059	160	11109	210	11159	260	11209
11	10960	61	11010	111	11060	161	11110	211	11160	261	11210
12	10961	62	11011	112	11061	162	11111	212	11161	262	11211
13	10962	63	11012	113	11062	163	11112	213	11162	263	11212
14	10963	64	11013	114	11063	164	11113	214	11163	264	11213
15	10964	65	11014	115	11064	165	11114	215	11164	265	11214
16	10965	66	11015	116	11065	166	11115	216	11165	266	11215
17	10966	67	11016	117	11066	167	11116	217	11166	267	11216
18	10967	68	11017	118	11067	168	11117	218	11167	268	11217
19	10968	69	11018	119	11068	169	11118	219	11168	269	11218
20	10969	70	11019	120	11069	170	11119	220	11169	270	11219
21	10970	71	11020	121	11070	171	11120	221	11170	271	11220
22	10971	72	11021	122	11071	172	11121	222	11171	272	11221
23	10972	73	11022	123	11072	173	11122	223	11172	273	11222
24	10973	74	11023	124	11073	174	11123	224	11173	274	11223
25	10974	75	11024	125	11074	175	11124	225	11174	275	11224
26	10975	76	11025	126	11075	176	11125	226	11175	276	11225
27	10976	77	11026	127	11076	177	11126	227	11176	277	11226
28	10977	78	11027	128	11077	178	11127	228	11177	278	11227
29	10978	79	11028	129	11078	179	11128	229	11178	279	11228
30	10979	80	11029	130	11079	180	11129	230	11179	280	11229
31	10980	81	11030	131	11080	181	11130	231	11180	281	11230
32	10981	82	11031	132	11081	182	11131	232	11181	282	11231
33	10982	83	11032	133	11082	183	11132	233	11182	283	11232
34	10983	84	11033	134	11083	184	11133	234	11183	284	11233
35	10984	85	11034	135	11084	185	11134	235	11184	285	11234
36	10985	86	11035	136	11085	186	11135	236	11185	286	11235
37	10986	87	11036	137	11086	187	11136	237	11186	287	11236
38	10987	88	11037	138	11087	188	11137	238	11187	288	11237
39	10988	89	11038	139	11088	189	11138	239	11188	289	11238
40	10989	90	11039	140	11089	190	11139	240	11189	290	11239
41	10990	91	11040	141	11090	191	11140	241	11190	291	11240
42	10991	92	11041	142	11091	192	11141	242	11191	292	11241
43	10992	93	11042	143	11092	193	11142	243	11192	293	11242
44	10993	94	11043	144	11093	194	11143	244	11193	294	11243
45	10994	95	11044	145	11094	195	11144	245	11194	295	11244
46	10995	96	11045	146	11095	196	11145	246	11195	296	11245
47	10996	97	11046	147	11096	197	11146	247	11196	297	11246
48	10997	98	11047	148	11097	198	11147	248	11197	298	11247
49	10998	99	11048	149	11098	199	11148	249	11198	299	11248
50	10999	100	11049	150	11099	200	11149	250	11199	300	11249

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
301	11250	351	11300	401	11350	451	11400	501	11450	551	11500
302	11251	352	11301	402	11351	452	11401	502	11451	552	11501
303	11252	353	11302	403	11352	453	11402	503	11452	553	11502
304	11253	354	11303	404	11353	454	11403	504	11453	554	11503
305	11254	355	11304	405	11354	455	11404	505	11454	555	11504
306	11255	356	11305	406	11355	456	11405	506	11455	556	11505
307	11256	357	11306	407	11356	457	11406	507	11456	557	11506
308	11257	358	11307	408	11357	458	11407	508	11457	558	11507
309	11258	359	11308	409	11358	459	11408	509	11458	559	11508
310	11259	360	11309	410	11359	460	11409	510	11459	560	11509
311	11260	361	11310	411	11360	461	11410	511	11460	561	11510
312	11261	362	11311	412	11361	462	11411	512	11461	562	11511
313	11262	363	11312	413	11362	463	11412	513	11462	563	11512
314	11263	364	11313	414	11363	464	11413	514	11463	564	11513
315	11264	365	11314	415	11364	465	11414	515	11464	565	11514
316	11265	366	11315	416	11365	466	11415	516	11465	566	11515
317	11266	367	11316	417	11366	467	11416	517	11466	567	11516
318	11267	368	11317	418	11367	468	11417	518	11467	568	11517
319	11268	369	11318	419	11368	469	11418	519	11468	569	11518
320	11269	370	11319	420	11369	470	11419	520	11469	570	11519
321	11270	371	11320	421	11370	471	11420	521	11470	571	11520
322	11271	372	11321	422	11371	472	11421	522	11471	572	11521
323	11272	373	11322	423	11372	473	11422	523	11472	573	11522
324	11273	374	11323	424	11373	474	11423	524	11473	574	11523
325	11274	375	11324	425	11374	475	11424	525	11474	575	11524
326	11275	376	11325	426	11375	476	11425	526	11475	576	11525
327	11276	377	11326	427	11376	477	11426	527	11476	577	11526
328	11277	378	11327	428	11377	478	11427	528	11477	578	11527
329	11278	379	11328	429	11378	479	11428	529	11478	579	11528
330	11279	380	11329	430	11379	480	11429	530	11479	580	11529
331	11280	381	11330	431	11380	481	11430	531	11480	581	11530
332	11281	382	11331	432	11381	482	11431	532	11481	582	11531
333	11282	383	11332	433	11382	483	11432	533	11482	583	11532
334	11283	384	11333	434	11383	484	11433	534	11483	584	11533
335	11284	385	11334	435	11384	485	11434	535	11484	585	11534
336	11285	386	11335	436	11385	486	11435	536	11485	586	11535
337	11286	387	11336	437	11386	487	11436	537	11486	587	11536
338	11287	388	11337	438	11387	488	11437	538	11487	588	11537
339	11288	389	11338	439	11388	489	11438	539	11488	589	11538
340	11289	390	11339	440	11389	490	11439	540	11489	590	11539
341	11290	391	11340	441	11390	491	11440	541	11490	591	11540
342	11291	392	11341	442	11391	492	11441	542	11491	592	11541
343	11292	393	11342	443	11392	493	11442	543	11492	593	11542
344	11293	394	11343	444	11393	494	11443	544	11493	594	11543
345	11294	395	11344	445	11394	495	11444	545	11494	595	11544
346	11295	396	11345	446	11395	496	11445	546	11495	596	11545
347	11296	397	11346	447	11396	497	11446	547	11496	597	11546
348	11297	398	11347	448	11397	498	11447	548	11497	598	11547
349	11298	399	11348	449	11398	499	11448	549	11498	599	11548
350	11299	400	11349	450	11399	500	11449	550	11499	600	11549

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
601	11550	651	11600	701	11650	751	11700	801	11750	851	11800
602	11551	652	11601	702	11651	752	11701	802	11751	852	11801
603	11552	653	11602	703	11652	753	11702	803	11752	853	11802
604	11553	654	11603	704	11653	754	11703	804	11753	854	11803
605	11554	655	11604	705	11654	755	11704	805	11754	855	11804
606	11555	656	11605	706	11655	756	11705	806	11755	856	11805
607	11556	657	11606	707	11656	757	11706	807	11756	857	11806
608	11557	658	11607	708	11657	758	11707	808	11757	858	11807
609	11558	659	11608	709	11658	759	11708	809	11758	859	11808
610	11559	660	11609	710	11659	760	11709	810	11759	860	11809
611	11560	661	11610	711	11660	761	11710	811	11760	861	11810
612	11561	662	11611	712	11661	762	11711	812	11761	862	11811
613	11562	663	11612	713	11662	763	11712	813	11762	863	11812
614	11563	664	11613	714	11663	764	11713	814	11763	864	11813
615	11564	665	11614	715	11664	765	11714	815	11764	865	11814
616	11565	666	11615	716	11665	766	11715	816	11765	866	11815
617	11566	667	11616	717	11666	767	11716	817	11766	867	11816
618	11567	668	11617	718	11667	768	11717	818	11767	868	11817
619	11568	669	11618	719	11668	769	11718	819	11768	869	11818
620	11569	670	11619	720	11669	770	11719	820	11769	870	11819
621	11570	671	11620	721	11670	771	11720	821	11770	871	11820
622	11571	672	11621	722	11671	772	11721	822	11771	872	11821
623	11572	673	11622	723	11672	773	11722	823	11772	873	11822
624	11573	674	11623	724	11673	774	11723	824	11773	874	11823
625	11574	675	11624	725	11674	775	11724	825	11774	875	11824
626	11575	676	11625	726	11675	776	11725	826	11775	876	11825
627	11576	677	11626	727	11676	777	11726	827	11776	877	11826
628	11577	678	11627	728	11677	778	11727	828	11777	878	11827
629	11578	679	11628	729	11678	779	11728	829	11778	879	11828
630	11579	680	11629	730	11679	780	11729	830	11779	880	11829
631	11580	681	11630	731	11680	781	11730	831	11780	881	11830
632	11581	682	11631	732	11681	782	11731	832	11781	882	11831
633	11582	683	11632	733	11682	783	11732	833	11782	883	11832
634	11583	684	11633	734	11683	784	11733	834	11783	884	11833
635	11584	685	11634	735	11684	785	11734	835	11784	885	11834
636	11585	686	11635	736	11685	786	11735	836	11785	886	11835
637	11586	687	11636	737	11686	787	11736	837	11786	887	11836
638	11587	688	11637	738	11687	788	11737	838	11787	888	11837
639	11588	689	11638	739	11688	789	11738	839	11788	889	11838
640	11589	690	11639	740	11689	790	11739	840	11789	890	11839
641	11590	691	11640	741	11690	791	11740	841	11790	891	11840
642	11591	692	11641	742	11691	792	11741	842	11791	892	11841
643	11592	693	11642	743	11692	793	11742	843	11792	893	11842
644	11593	694	11643	744	11693	794	11743	844	11793	894	11843
645	11594	695	11644	745	11694	795	11744	845	11794	895	11844
646	11595	696	11645	746	11695	796	11745	846	11795	896	11845
647	11596	697	11646	747	11696	797	11746	847	11796	897	11846
648	11597	698	11647	748	11697	798	11747	848	11797	898	11847
649	11598	699	11648	749	11698	799	11748	849	11798	899	11848
650	11599	700	11649	750	11699	800	11749	850	11799	900	11849

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
901	11850	951	11900	1001	11950	1051	12000	1101	12050	1151	12100
902	11851	952	11901	1002	11951	1052	12001	1102	12051	1152	12101
903	11852	953	11902	1003	11952	1053	12002	1103	12052	1153	12102
904	11853	954	11903	1004	11953	1054	12003	1104	12053	1154	12103
905	11854	955	11904	1005	11954	1055	12004	1105	12054	1155	12104
906	11855	956	11905	1006	11955	1056	12005	1106	12055	1156	12105
907	11856	957	11906	1007	11956	1057	12006	1107	12056	1157	12106
908	11857	958	11907	1008	11957	1058	12007	1108	12057	1158	12107
909	11858	959	11908	1009	11958	1059	12008	1109	12058	1159	12108
910	11859	960	11909	1010	11959	1060	12009	1110	12059	1160	12109
911	11860	961	11910	1011	11960	1061	12010	1111	12060	1161	12110
912	11861	962	11911	1012	11961	1062	12011	1112	12061	1162	12111
913	11862	963	11912	1013	11962	1063	12012	1113	12062	1163	12112
914	11863	964	11913	1014	11963	1064	12013	1114	12063	1164	12113
915	11864	965	11914	1015	11964	1065	12014	1115	12064	1165	12114
916	11865	966	11915	1016	11965	1066	12015	1116	12065	1166	12115
917	11866	967	11916	1017	11966	1067	12016	1117	12066	1167	12116
918	11867	968	11917	1018	11967	1068	12017	1118	12067	1168	12117
919	11868	969	11918	1019	11968	1069	12018	1119	12068	1169	12118
920	11869	970	11919	1020	11969	1070	12019	1120	12069	1170	12119
921	11870	971	11920	1021	11970	1071	12020	1121	12070	1171	12120
922	11871	972	11921	1022	11971	1072	12021	1122	12071	1172	12121
923	11872	973	11922	1023	11972	1073	12022	1123	12072	1173	12122
924	11873	974	11923	1024	11973	1074	12023	1124	12073	1174	12123
925	11874	975	11924	1025	11974	1075	12024	1125	12074	1175	12124
926	11875	976	11925	1026	11975	1076	12025	1126	12075	1176	12125
927	11876	977	11926	1027	11976	1077	12026	1127	12076	1177	12126
928	11877	978	11927	1028	11977	1078	12027	1128	12077	1178	12127
929	11878	979	11928	1029	11978	1079	12028	1129	12078	1179	12128
930	11879	980	11929	1030	11979	1080	12029	1130	12079	1180	12129
931	11880	981	11930	1031	11980	1081	12030	1131	12080	1181	12130
932	11881	982	11931	1032	11981	1082	12031	1132	12081	1182	12131
933	11882	983	11932	1033	11982	1083	12032	1133	12082	1183	12132
934	11883	984	11933	1034	11983	1084	12033	1134	12083	1184	12133
935	11884	985	11934	1035	11984	1085	12034	1135	12084	1185	12134
936	11885	986	11935	1036	11985	1086	12035	1136	12085	1186	12135
937	11886	987	11936	1037	11986	1087	12036	1137	12086	1187	12136
938	11887	988	11937	1038	11987	1088	12037	1138	12087	1188	12137
939	11888	989	11938	1039	11988	1089	12038	1139	12088	1189	12138
940	11889	990	11939	1040	11989	1090	12039	1140	12089	1190	12139
941	11890	991	11940	1041	11990	1091	12040	1141	12090	1191	12140
942	11891	992	11941	1042	11991	1092	12041	1142	12091	1192	12141
943	11892	993	11942	1043	11992	1093	12042	1143	12092	1193	12142
944	11893	994	11943	1044	11993	1094	12043	1144	12093	1194	12143
945	11894	995	11944	1045	11994	1095	12044	1145	12094	1195	12144
946	11895	996	11945	1046	11995	1096	12045	1146	12095	1196	12145
947	11896	997	11946	1047	11996	1097	12046	1147	12096	1197	12146
948	11897	998	11947	1048	11997	1098	12047	1148	12097	1198	12147
949	11898	999	11948	1049	11998	1099	12048	1149	12098	1199	12148
950	11899	1000	11949	1050	11999	1100	12049	1150	12099	1200	12149

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
1201	12150	1251	12200	1301	12250	1351	12300	1401	12350	1451	12400
1202	12151	1252	12201	1302	12251	1352	12301	1402	12351	1452	12401
1203	12152	1253	12202	1303	12252	1353	12302	1403	12352	1453	12402
1204	12153	1254	12203	1304	12253	1354	12303	1404	12353	1454	12403
1205	12154	1255	12204	1305	12254	1355	12304	1405	12354	1455	12404
1206	12155	1256	12205	1306	12255	1356	12305	1406	12355	1456	12405
1207	12156	1257	12206	1307	12256	1357	12306	1407	12356	1457	12406
1208	12157	1258	12207	1308	12257	1358	12307	1408	12357	1458	12407
1209	12158	1259	12208	1309	12258	1359	12308	1409	12358	1459	12408
1210	12159	1260	12209	1310	12259	1360	12309	1410	12359	1460	12409
1211	12160	1261	12210	1311	12260	1361	12310	1411	12360	1461	12410
1212	12161	1262	12211	1312	12261	1362	12311	1412	12361	1462	12411
1213	12162	1263	12212	1313	12262	1363	12312	1413	12362	1463	12412
1214	12163	1264	12213	1314	12263	1364	12313	1414	12363	1464	12413
1215	12164	1265	12214	1315	12264	1365	12314	1415	12364	1465	12414
1216	12165	1266	12215	1316	12265	1366	12315	1416	12365	1466	12415
1217	12166	1267	12216	1317	12266	1367	12316	1417	12366	1467	12416
1218	12167	1268	12217	1318	12267	1368	12317	1418	12367	1468	12417
1219	12168	1269	12218	1319	12268	1369	12318	1419	12368	1469	12418
1220	12169	1270	12219	1320	12269	1370	12319	1420	12369	1470	12419
1221	12170	1271	12220	1321	12270	1371	12320	1421	12370	1471	12420
1222	12171	1272	12221	1322	12271	1372	12321	1422	12371	1472	12421
1223	12172	1273	12222	1323	12272	1373	12322	1423	12372	1473	12422
1224	12173	1274	12223	1324	12273	1374	12323	1424	12373	1474	12423
1225	12174	1275	12224	1325	12274	1375	12324	1425	12374	1475	12424
1226	12175	1276	12225	1326	12275	1376	12325	1426	12375	1476	12425
1227	12176	1277	12226	1327	12276	1377	12326	1427	12376	1477	12426
1228	12177	1278	12227	1328	12277	1378	12327	1428	12377	1478	12427
1229	12178	1279	12228	1329	12278	1379	12328	1429	12378	1479	12428
1230	12179	1280	12229	1330	12279	1380	12329	1430	12379	1480	12429
1231	12180	1281	12230	1331	12280	1381	12330	1431	12380	1481	12430
1232	12181	1282	12231	1332	12281	1382	12331	1432	12381	1482	12431
1233	12182	1283	12232	1333	12282	1383	12332	1433	12382	1483	12432
1234	12183	1284	12233	1334	12283	1384	12333	1434	12383	1484	12433
1235	12184	1285	12234	1335	12284	1385	12334	1435	12384	1485	12434
1236	12185	1286	12235	1336	12285	1386	12335	1436	12385	1486	12435
1237	12186	1287	12236	1337	12286	1387	12336	1437	12386	1487	12436
1238	12187	1288	12237	1338	12287	1388	12337	1438	12387	1488	12437
1239	12188	1289	12238	1339	12288	1389	12338	1439	12388	1489	12438
1240	12189	1290	12239	1340	12289	1390	12339	1440	12389	1490	12439
1241	12190	1291	12240	1341	12290	1391	12340	1441	12390	1491	12440
1242	12191	1292	12241	1342	12291	1392	12341	1442	12391	1492	12441
1243	12192	1293	12242	1343	12292	1393	12342	1443	12392	1493	12442
1244	12193	1294	12243	1344	12293	1394	12343	1444	12393	1494	12443
1245	12194	1295	12244	1345	12294	1395	12344	1445	12394	1495	12444
1246	12195	1296	12245	1346	12295	1396	12345	1446	12395	1496	12445
1247	12196	1297	12246	1347	12296	1397	12346	1447	12396	1497	12446
1248	12197	1298	12247	1348	12297	1398	12347	1448	12397	1498	12447
1249	12198	1299	12248	1349	12298	1399	12348	1449	12398	1499	12448
1250	12199	1300	12249	1350	12299	1400	12349	1450	12399	1500	12449

ANASAT®-Ku/EKu/SEKu Receive Channels

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
1501	12450	1551	12500	1601	12550	1651	12600	1701	12650	1751	12700
1502	12451	1552	12501	1602	12551	1652	12601	1702	12651	1752	12701
1503	12452	1553	12502	1603	12552	1653	12602	1703	12652	1753	12702
1504	12453	1554	12503	1604	12553	1654	12603	1704	12653	1754	12703
1505	12454	1555	12504	1605	12554	1655	12604	1705	12654	1755	12704
1506	12455	1556	12505	1606	12555	1656	12605	1706	12655	1756	12705
1507	12456	1557	12506	1607	12556	1657	12606	1707	12656	1757	12706
1508	12457	1558	12507	1608	12557	1658	12607	1708	12657	1758	12707
1509	12458	1559	12508	1609	12558	1659	12608	1709	12658	1759	12708
1510	12459	1560	12509	1610	12559	1660	12609	1710	12659	1760	12709
1511	12460	1561	12510	1611	12560	1661	12610	1711	12660	1761	12710
1512	12461	1562	12511	1612	12561	1662	12611	1712	12661	1762	12711
1513	12462	1563	12512	1613	12562	1663	12612	1713	12662	1763	12712
1514	12463	1564	12513	1614	12563	1664	12613	1714	12663	1764	12713
1515	12464	1565	12514	1615	12564	1665	12614	1715	12664	1765	12714
1516	12465	1566	12515	1616	12565	1666	12615	1716	12665	1766	12715
1517	12466	1567	12516	1617	12566	1667	12616	1717	12666	1767	12716
1518	12467	1568	12517	1618	12567	1668	12617	1718	12667	1768	12717
1519	12468	1569	12518	1619	12568	1669	12618	1719	12668	1769	12718
1520	12469	1570	12519	1620	12569	1670	12619	1720	12669	1770	12719
1521	12470	1571	12520	1621	12570	1671	12620	1721	12670	1771	12720
1522	12471	1572	12521	1622	12571	1672	12621	1722	12671	1772	12721
1523	12472	1573	12522	1623	12572	1673	12622	1723	12672	1773	12722
1524	12473	1574	12523	1624	12573	1674	12623	1724	12673	1774	12723
1525	12474	1575	12524	1625	12574	1675	12624	1725	12674	1775	12724
1526	12475	1576	12525	1626	12575	1676	12625	1726	12675	1776	12725
1527	12476	1577	12526	1627	12576	1677	12626	1727	12676	1777	12726
1528	12477	1578	12527	1628	12577	1678	12627	1728	12677	1778	12727
1529	12478	1579	12528	1629	12578	1679	12628	1729	12678	1779	12728
1530	12479	1580	12529	1630	12579	1680	12629	1730	12679	1780	12729
1531	12480	1581	12530	1631	12580	1681	12630	1731	12680	1781	12730
1532	12481	1582	12531	1632	12581	1682	12631	1732	12681	1782	12731
1533	12482	1583	12532	1633	12582	1683	12632	1733	12682	1783	12732
1534	12483	1584	12533	1634	12583	1684	12633	1734	12683	1784	12733
1535	12484	1585	12534	1635	12584	1685	12634	1735	12684	1785	12734
1536	12485	1586	12535	1636	12585	1686	12635	1736	12685	1786	12735
1537	12486	1587	12536	1637	12586	1687	12636	1737	12686	1787	12736
1538	12487	1588	12537	1638	12587	1688	12637	1738	12687	1788	12737
1539	12488	1589	12538	1639	12588	1689	12638	1739	12688	1789	12738
1540	12489	1590	12539	1640	12589	1690	12639	1740	12689	1790	12739
1541	12490	1591	12540	1641	12590	1691	12640	1741	12690	1791	12740
1542	12491	1592	12541	1642	12591	1692	12641	1742	12691	1792	12741
1543	12492	1593	12542	1643	12592	1693	12642	1743	12692	1793	12742
1544	12493	1594	12543	1644	12593	1694	12643	1744	12693	1794	12743
1545	12494	1595	12544	1645	12594	1695	12644	1745	12694	1795	12744
1546	12495	1596	12545	1646	12595	1696	12645	1746	12695	1796	12745
1547	12496	1597	12546	1647	12596	1697	12646	1747	12696	1797	12746
1548	12497	1598	12547	1648	12597	1698	12647	1748	12697	1798	12747
1549	12498	1599	12548	1649	12598	1699	12648	1749	12698	1799	12748
1550	12499	1600	12549	1650	12599	1700	12649	1750	12699	1800	12749
										1801	12750

Appendix E. Converting dBm to Watts and Watts to dBm

dBm	W	W	dBm
20	0.10	1	30.00
20.5	0.11	2	33.01
21	0.13	3	34.77
21.5	0.14	4	36.02
22	0.16	5	36.99
22.5	0.18	6	37.78
23	0.20	7	38.45
23.5	0.22	8	39.03
24	0.25	9	39.54
24.5	0.28	10	40.00
25	0.32	11	40.41
25.5	0.35	12	40.79
26	0.40	13	41.14
26.5	0.45	14	41.46
27	0.50	15	41.76
27.5	0.56	16	42.04
28	0.63	17	42.30
28.5	0.71	18	42.55
29	0.79	19	42.79
29.5	0.89	20	43.01
30	1.00	21	43.22
30.5	1.12	22	43.42
31	1.26	23	43.61
31.5	1.41	24	43.80
32	1.58	25	43.97
32.5	1.78	26	44.14
33	2.00	27	44.31
33.5	2.24	28	44.47
34	2.51	29	44.62
34.5	2.82	30	44.77
35	3.16	32	45.05
35.5	3.55	34	45.31
36	3.98	36	45.56
36.5	4.47	38	45.8
37	5.01	40	46.02
37.5	5.62	42	46.23
38	6.31	44	46.43
38.5	7.08	46	46.63
39	7.94	48	46.81
39.5	8.91	50	47.00
40	10.00	55	47.40
40.5	11.22	60	42.78
41	12.59	65	48.13
41.5	14.13	70	48.45
42	15.85	75	48.75
42.5	17.78	80	49.05
43	19.95	85	49.29
43.5	22.39	90	49.54
44	25.12	95	49.78
44.5	28.18	100	50.00

Appendix F. Transceivers Weights & Dimensions

Ku, EKu and SEKu

	Dimensions inches	Dimensions mm	Weight lbs	Weight kg
0dBm	21.6"x9.0"x7.0"	549 x 229 x 178	22.0	10.00
2 watts	21.6"x9.0"x7.0"	549 x 229 x 178	26.0	11.80
4 watts	21.6"x9.0"x7.0"	549 x 229 x 178	27.0	12.30
8 watts	21.6"x9.0"x11.6"	549 x 229 x 295	28.0	12.70
16 watts	21.6"x9.0"x13"	549 x 229 x 330	37.0	16.80
20 watts	21.6"x9.0"x13"	549 x 229 x 330	40.0	18.20
23 watts	21.6"x9.0"x13"	549 x 229 x 330	40.0	18.20
25 watts	21.6"x9.0"x13"	549 x 229 x 330	40.0	18.20
40 watts	21.6"x13"x13.6"	549 x 330 x 353	67.1	30.50
50 watts	21.6"x13"x13.6"	550 x 330 x 353	67.1	30.50
60 watts	21.6"x13"x13.6"	550 x 330 x 353	67.1	30.50
80 watts	34"x11.5"x13"	864 x 292 x 330	123.0	55.8
100 watts	34"x11.5"x13"	864 x 292 x 330	123.0	55.8
125 watts	34"x11.5"x13"	864 x 292 x 330	123.0	55.8

Protection Switch

P. S.	8.5"x9.5"x4.0"	216 x 241 x 102	3.0	1.36

LNC

Ku-Band	8.4" x 2.9" x 1.75"	213 x 74 x 44.4	1.75	0.79