CST-5005

C-Band Satellite Terminal
Installation and Operation Manual

Part Number MN/CST5005.IOM **Revision 1**

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Installation and Operation Manual

Comtech EFData is an ISO 9001
Registered Company.

Part Number MN/CST5005.IOM
Revision 1
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Comtech EFData, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

Customer Support

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Attention: Customer Support Department
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5. Ship the product back to Comtech EFData. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, see Warranty Policy, p. ix.

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Overview of Changes to Previous Edition

A summary of the changes made to Rev. 1 includes:

- Cosmetic (non-technical) changes (e.g., formatting, spelling)
- Corrected metric equivalents in Chapter 2
- Updated kits in Chapters 2 and 3
- Deleted Appendix B (refer to *Comtech EFData Monitor and Control Software for Comtech EFData Satellite Terminals User's Guide*)
- Updated VSWR, gain variation, and gain adjustment range specifications in Chapter 1

About this Manual

This manual provides installation and operation information for the CST-5005 C-band satellite terminal. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CST-5005.

Related Documents

The following documents are referenced in this manual:

- *Comtech EFData Specification SP/4450*
- *RSU-503 Redundancy Switch Unit Installation and Operation Manual*
- *KP-10 External Keypad Installation and Operation Manual*
- *Comtech EFData Monitor and Control Software for Comtech EFData Satellite Terminals User's Guide*

Conventions and References

Cautions and Warnings

CAUTION indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Recommended Standard Designations

Recommended Standard (RS) Designations have been superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations are shown only when depicting actual text displayed on the screen of the unit (RS-232, RS-485, etc.). All other references in the manual will be shown with the EIA designations (EIA-232, EIA-485, etc.) only.

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Product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

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Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EFData Customer Support Department.

Warranty Policy

This Comtech EFData product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Comtech EFData will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to Comtech EFData and all related custom, taxes, tariffs, insurance, etc. Comtech EFData is responsible for the freight charges **only** for return of the equipment from the factory to the customer. Comtech EFData will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EFData.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EFData.

No other warranty is expressed or implied. Comtech EFData specifically disclaims the implied warranties of merchantability and fitness for particular purpose.

Exclusive Remedies

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EFData shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Disclaimer

Comtech EFData has reviewed this manual thoroughly in order that it will be an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EFData reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

If you have any questions regarding your equipment or the information in this manual, please contact the Comtech EFData Customer Support Department.

Chapter 1. INTRODUCTION

This chapter describes the CST-5005 C-band satellite terminal, referred to in this manual as "the CST-5005."

1.1 Description

As a single thread system, the CST-5005 is comprised of the following assemblies (Figure 1-1):

- Outdoor enclosure assembly (RFT-505)
- Low Noise Amplifier (LNA)

As a redundant system, the CST-5005 is comprised of the following assemblies:

- Two outdoor enclosure assemblies (RFT-505s)
- Redundant LNA plate (Figure 1-2)
- RSU-503 (Figure 1-3)

For more information on the RSU-503, refer to the *Comtech Comtech EFData RSU-503 Redundancy Switch Unit Installation and Operation Manual.*

Refer to Figure 1-4 for a block diagram of the CST-5005.

The CST-5005 meets all requirements for operation on both private and regional domestic C-band satellite networks.

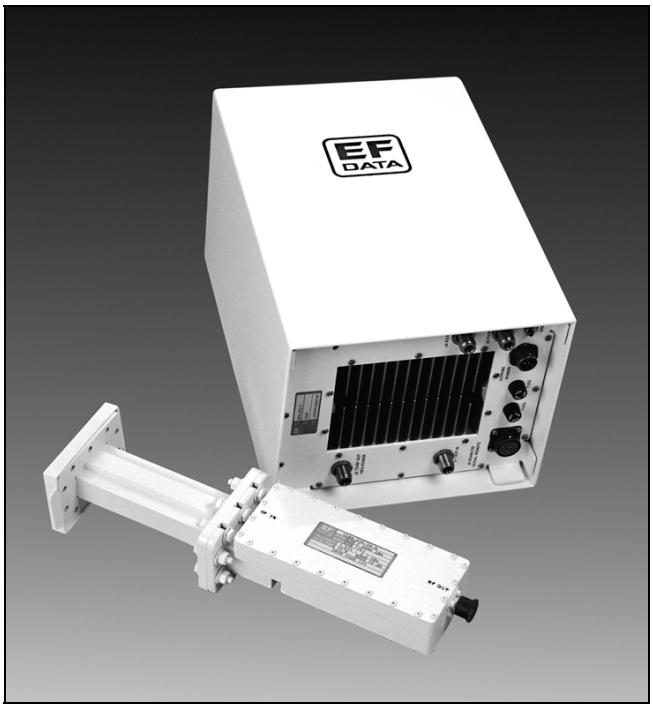


Figure 1-1. CST-5005 Single Thread System

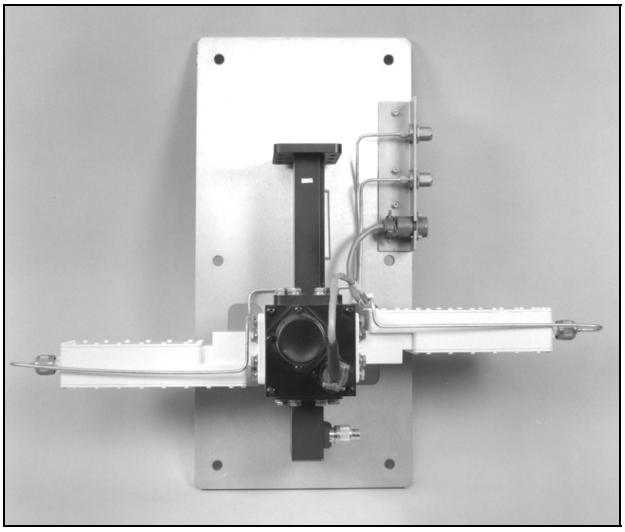


Figure 1-2. Redundant LNA Plate

Note: Pictured above are typical LNAs. Other LNAs are available, and can be ordered from an *Comtech EFData* marketing representative.

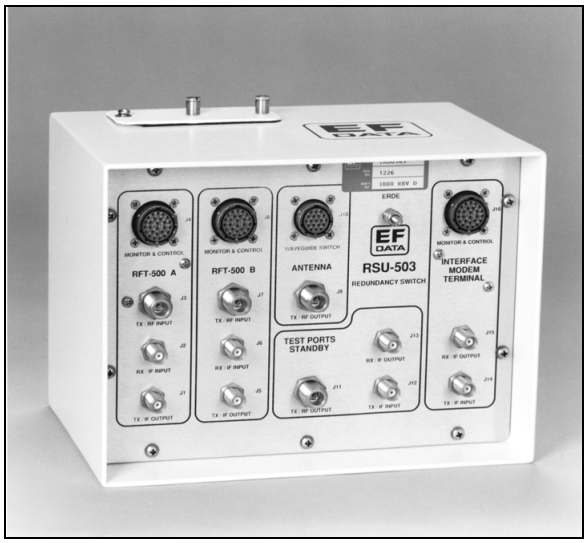


Figure 1-3. RSU-503

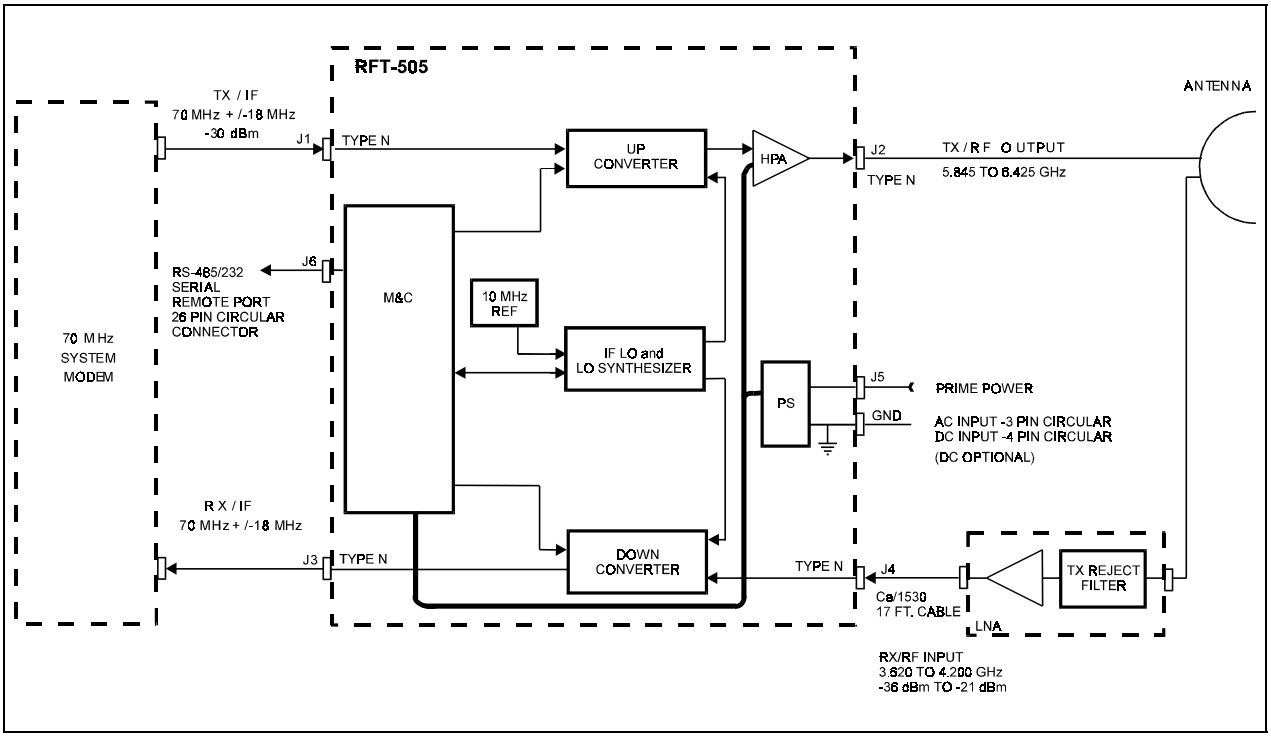


Figure 1-4. CST-5005 Block Diagram

1.1.1 Applications

When used in conjunction with Comtech EFData modems, the CST-5005 is ideal for:

- Single digit carriers up to 2.048 Mbit/s
- Multiple carrier operation over a 36 MHz bandwidth

Because the CST-5005 has a 70 MHz IF, it can also be used for other analog and digital applications.

Small-to-medium size earth stations are easily constructed and commissioned with the CST-5005.

When used with a high-gain antenna, the CST-5005 can also be used as the Radio Frequency (RF) electronics of a central hub in point-to-multipoint applications, as well as serve as the terminal for the end points of the network.

1.1.2 Monitor and Control

An on-board microcomputer monitors and controls all operational parameters and system status of the CST-5005. This powerful M&C system enables the user to locally or remotely control functions such as:

- Output power
- Transmit/receive channel frequencies

The system also reports terminal configuration status, as well as fault status of all CST-5005 components.

The CST-5005 can be initially configured using a connection of a common ASCII/RS-232-C terminal connected to the serial port.

A simple command set allows total configuration control and retrieval of status information.

If the indoor unit is a more sophisticated station M&C computer, the serial port can be set to RS-485 for bus operation.

For more information on the M&C board, refer to Chapter 5.

1.1.3 Low Noise Amplifier (LNA)

The feed assembly consists of an LNA and a wave guide transmit reject filter.

The transmit reject filter provides receive system protection from transmit energy fed back through the antenna feed system.

The LNA standard noise temperature is 65°K, with optional upgrades down to 33°K, depending upon gain over temperature (G/T) requirements.

1.1.4 Outdoor Enclosure

The RFT-505 is a weatherproof enclosure housing the following:

- Solid State Power Amplifier (SSPA)
- Up and down converters
- M&C microprocessor
- Power supply and cables which interface with an antenna subsystem

In the transmit (uplink) direction, the RFT-505 accepts a 70 MHz IF signal, and transmits it in the 5.845 to 6.425 GHz frequency band.

In the receive (downlink) direction, the terminal accepts an RF signal in the 3.620 to 4.200 GHz band, and converts the signal to 70 MHz IF output.

Power levels range from +8 dBm (for driving an external TWT) to 10W, depending upon Equivalent Isotropically Radiated Power (EIRP) requirements.

The up and down converters are dual conversion, with individual synthesizers for independent transmit and receive transponder selection.

The microprocessor provides:

- Online loop monitoring
- Dynamic control functions
- Configuration control
- Fault/status monitoring
- Serial computer/terminal interface

1.2 Options

1.2.1 Configurations

The CST-5005 can be ordered with various configurations, including:

- Output power levels
- Input power (AC/DC)
- LNA gain
- Redundant LNA mounting plates
- Custom logos

Contact an Comtech EFData marketing representative for more information.

1.2.2 Equipment

The following item is available:

- KP-10 hand-held keypad. The KP-10 provides portable, external access for controlling the RFT. For information, refer to the *Comtech EFData KP-10 External Keypad Installation and Operation Manual*.

Contact an *Comtech EFData* marketing representative for more information.

1.3 Specifications

Table 1-1 lists the specifications for the CST-5005, Table 1-2 lists the specifications for the RFT-505, and Table 1-3 lists the specifications for the LNA.

Notes:

1. For specifications on the RSU-503, refer to the *Comtech EFData RSU-503 Redundancy Switch Unit Installation and Operation Manual*.
2. For more information pertaining to CST-5005 specifications, refer to *Comtech EFData Specification SP/4450*.

Table 1-1. CST-5005 System Specifications

Prime Power	95 to 230 VAC, 47 to 63 Hz, or 48 VDC
Power Consumption: +8 dBm output 5W output 10W	 70W 125W 175W
Size	15.1" H x 10.5" W x 8.9" D 17.1" H x 10.5" W x 8.9" D (10W system)
Weight	39 lbs (typical)
Sealing	Weatherproof
Ground Attach	#10 AWG ground lug
Environmental: Temperature Humidity Altitude	 -40 to +55°C operational -50 to +80°C storage 0 to 100% RH 0 to 15,000 ft operational 0 to 50,000 ft storage

Table 1-2. RFT-505 Specifications

Transmit	
Output Frequency (No inversion)	5.845 to 6.425 GHz
Input Frequency	70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz)
Output Power: at 1 dB compression	 +8 dBm or 5W (+37 dBm) or 10W (+40 dBm)
Third Order Intercept	+18 dBm (for +8 dBm) or +46 dBm (for 5W) or +49 dBm (for 10W)
Nominal Small Signal Gain	26 dB (for +8 dBm) or 68 dB (for 5W) or +71 dBm (for 10W)
Gain Adjust Range (from nominal)	± 11 dB min
Gain Variation: Over 36 MHz Over 36 MHz, temperature, and aging	 ± 1 dB max 4 dB max variation
Noise Figure: Maximum attenuation Minimum attenuation	 23 dB max 15 dB max
Group Delay, Total Variation in Passband	10 ns max
Synthesizer Step Size	125 kHz
Synthesizer Phase Noise	-60 dBc/Hz at 100 Hz -70 dBc/Hz at 1 kHz -80 dBc/Hz at 10 kHz -90 dBc/Hz at 100 kHz
Frequency Stability: At shipment Daily at 23°C Annual at 23°C Over temperature After 30 minutes warm-up Electrical adjustment	 $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-7}$ $\pm 1 \times 10^{-8}$ (-40 to +55°C) $\pm 1 \times 10^{-8}$ 0.5×10^{-7}
Isolation on Fault Shutdown	-60 dBc
Spurious: signal related ≤ 250 kHz carrier offset > 250 kHz carrier offset non-signal related	 -35 dBc max -50 dBc max < -15 dBm/44 kHz max
HPA Harmonics	-50 dBc max
RF Output VSWR	1.35:1 at 50Ω
RF Output Connector	Type N female
IF Input VSWR	1.5:1 at 50Ω
IF Input Connector	Type N female

Receive	
Input Frequency (No inversion)	3.620 to 4.2 GHz
Output Frequency	70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz)
Output Power at 1 dB Comp	+15 dBm
Gain Adjust Range (with LNA)	74 to 95 dB
Gain Variation (with LNA): Over 36 MHz Over 36 MHz, temperature, and aging	 ± 1.5 dB max ± 4 dB max
Noise Temperature (with LNA)	LNA specification
Group Delay, Total Variation in Passband	10 ns max
Synthesizer Step Size	125 kHz
Synthesizer Phase Noise	-60 dBc/Hz at 100 Hz -70 dBc/Hz at 1 kHz -80 dBc/Hz at 10 kHz -90 dBc/Hz at 100 kHz
Frequency Stability: At shipment Daily at 23°C Annual at 23°C Over temperature After 30 minutes warm-up Electrical adjustment	 $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-7}$ $\pm 1 \times 10^{-8}$ (-40 to +55°C) $\pm 1 \times 10^{-8}$ 0.5×10^{-7}
Spurious In Band	-60 dBc max
Image Rejection (all conversions)	> 50 dB
Linearity	Intermods < -35 dBc for two tones at -89 dBm at +95 dB gain
RF Input VSWR (with LNA)	1.35:1 at 50Ω
RF Input Connector	Type N female
IF Output VSWR	1.5:1 at 50Ω
IF Output Connector	Type N female

Monitor and Control		
Control Interface	RS-232-C, RS-485	
Control Functions	SELECT RF OUTPT U/C FREQ D/C FREQ U/C ATTN D/C ATTN PROGRAM BAUD ADDRESS	PARITY LNA PWR LNA FLT CALIB. LNA REF ADJ XFLT ENABLE RSW MODE LOCK MODE
Monitor Functions	U/C TEMP D/C TEMP HPA TEMP	
Fault Detect Functions	5V PWR D/C_FLT U/C_FLT 2nd_SYN_LD RESET_FLT 12V PWR LNA_FLT	HPA_FLT OSC_FLT SYN_LOCK_DET XFE_FLT IFLO_LD UL_FLT DL_FLT

Table 1-3. LNA Specifications

LNA Dimensions	Refer to Figures 1-5 or 1-6
Frequency	3.620 to 4.200 GHz
Noise Temperature (with TRF)	65°K max (lower temperatures optional)
Gain	50 dB minimum, 54 dB nominal
Gain Flatness	± 1 dB/575 MHz
Gain vs. Temperature	± 3 dB max
1 dB Compression Point	+12 dBm min
Third Order Intercept	+22 dBm min
Group Delay: Linear Parabolic Ripple	 ± 0.01 ns/MHz max 0.001 ns/MHz^2 max 0.1 ns P-P
Input VSWR	1.25:1
Output VSWR	1.25:1
Input Connector	CPR229G (hold pressure to .5PSIG)
Output Connector	Type N
Spurious	Below thermal noise/100 kHz
TRF Rejection	60 dB

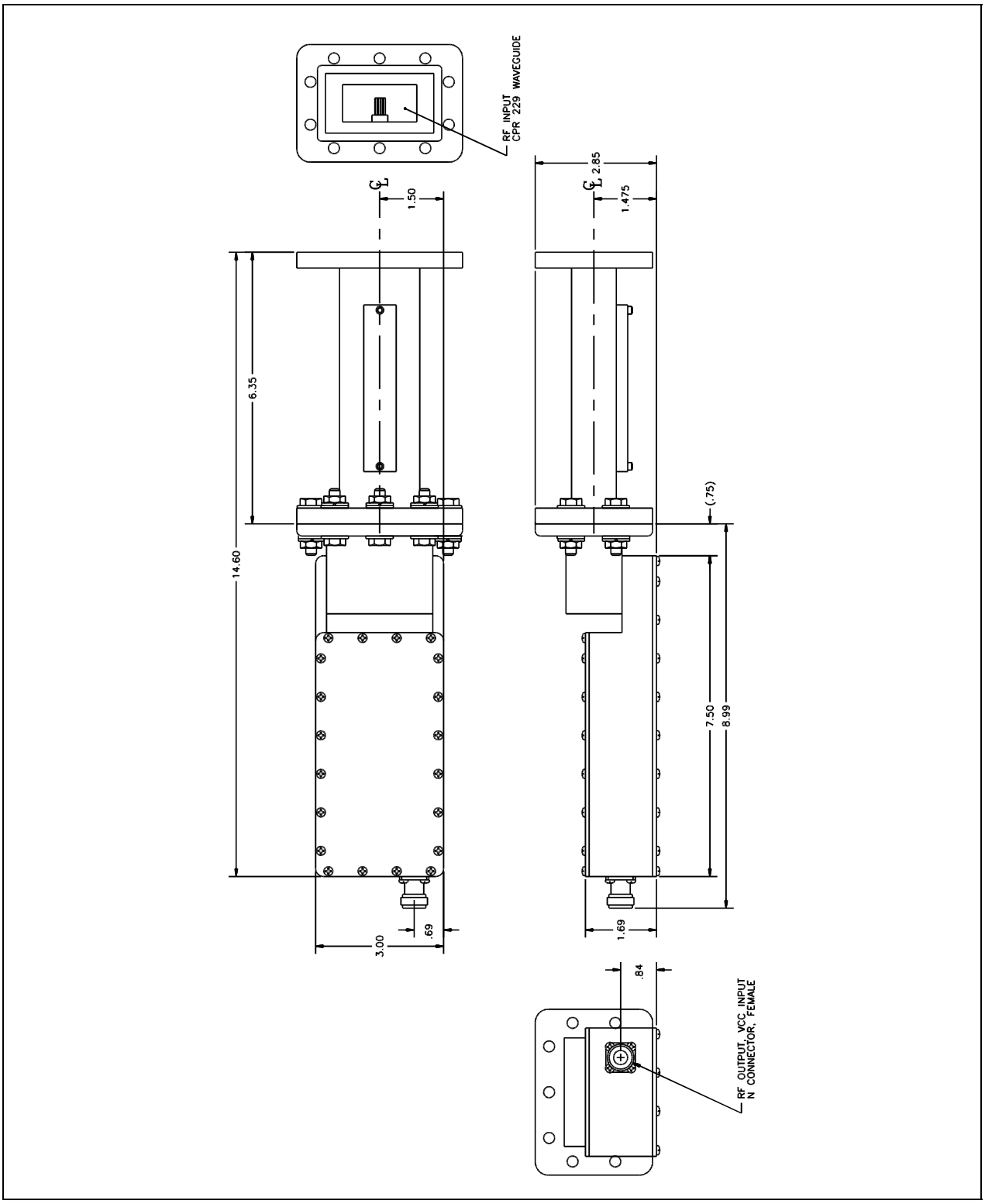


Figure 1-5. Dimensions for a Single Thread LNA

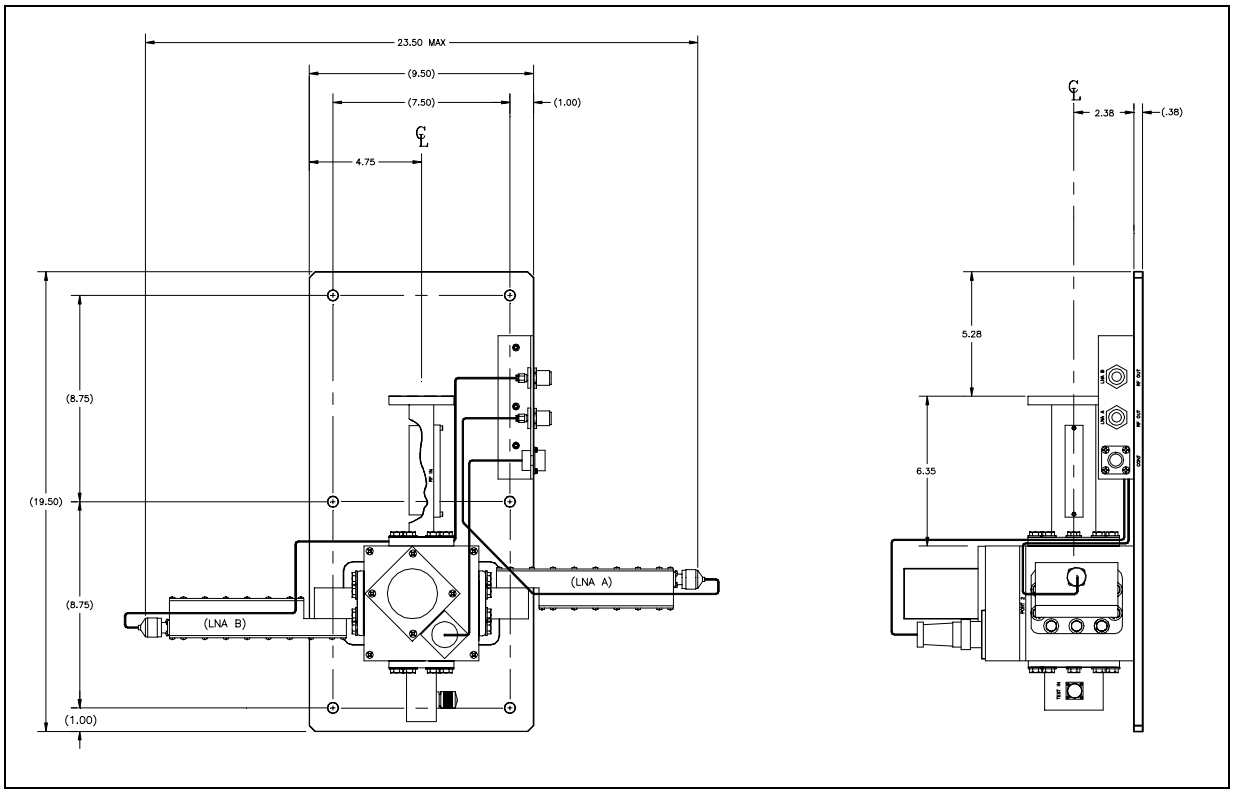


Figure 1-6. Dimensions for 1:1 Redundant LNA Plate

Chapter 2. SINGLE THREAD SYSTEM INSTALLATION

This chapter provides installation information for single thread systems, including:

- Unpacking and inspecting the parts
- Installing the RFT
- Installing the LNA
- External connections

For redundant systems, refer to Chapter 3.

2.1 Unpacking

The CST-5005 is packaged in preformed, reusable foam inside a cardboard carton.

Before unpacking the carton components, ensure that there is plenty of room around the carton for workspace. A large table is recommended.

To remove the parts:

1. Cut the tape at the top of the carton where it is indicated OPEN THIS END.
2. Lift out the cardboard/foam spacer covering the unit.
3. Remove each part from the carton. Refer to Section 2.2.1 for a parts breakdown.

Because the RFT is heavy, assistance may be necessary to remove the unit from the box.

Note: Save the packing material for reshipment.

2.2 Inspecting the Equipment

1. Carefully check the equipment for damage incurred during shipment.

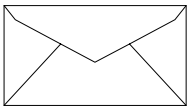
2. Carefully check the equipment against the packing list shipped with the equipment to ensure that the shipment is complete. Refer to the following paragraphs.

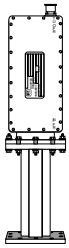
2.2.1 Included Parts

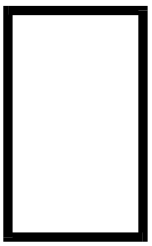
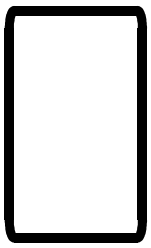
A typical single thread CST-5005 configuration contains the following components.

Notes:

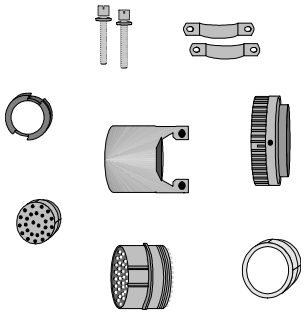
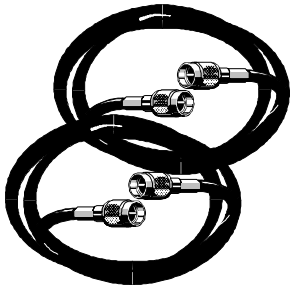
1. Parts are not drawn to scale.
2. Because each system can be custom ordered, it is beyond the scope of this manual to provide the unlimited configuration possibilities.
3. This chapter does not describe the installation procedures for amplifiers, high performance LNAs, phase-locked LNBs, LNBs, and phase-locked block converters.

Qty.	Description
1	RFT outdoor unit. 
1	Envelope containing the test data sheet. 

Qty.	Description
1	Feed assembly.  **Note:** Pictured is a typical LNA. Other LNAs are available, and can be ordered from an EFData marketing representative.
1	CST-5005 installation and operation manual. 
1	Monitor and Control Software for EFData Satellite Terminals User's Guide. 

1	**LNA connector kit (EFData Part # KT/2721), which includes:**			
Qty.	**Description**		**Qty.**	**Description**
1	Gasket — thick.  *EFData Part # 32P1040.*		1	Gasket — thin.  *EFData Part # 32D1002.*
10	1/4-20 x 5/8” bolt.  *EFData Part # 03P1079.*		20	1/4” flat washer.  *EFData Part # O4P1022.*
10	1/4-20 nut.  *EFData Part # HW/1/4HEXNUT.*		10	1/4” split lockwasher.  *EFData Part # HW/1/4-SPLIT.*

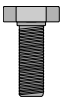
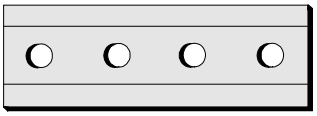
1	Kit KT/3272-x (where x = 1 for AC power, and 2 for DC power), which includes:

Qty.	Description
1	Connector kit.  *EFData Part # CN/STPG26M01.* *Used to connect customer's cable to the RFT 26-pin J6 (REMOTE). For remote control and status monitoring (by using M&C system monitor software).*
2	17' Heliax cable.  *EFData Part # CA/1530.* *Used for RF input and RF output.*

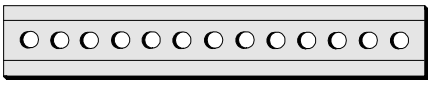
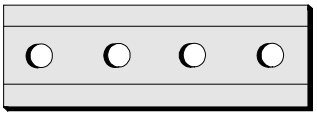
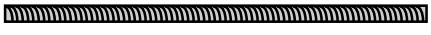
Qty.	Description
1	**Note:** Either the AC or DC cable is provided, depending upon the product ordering code. Assembly, 15' AC prime power cable. *EFData Part # PL/2754.* Assembly, 15' DC prime power cable. *EFData Part # PL/4157.* 

Note: If an RFT for a spar mount is ordered, EFData will provide a spar mount kit (KT/4061). Otherwise, the universal installation kit (KT/3576) will be provided.

1	**Kit KT/4061, which includes:**

Qty.	Description
2	Spar support bracket.  *EFData Part # FP/3175.* *Used for spar mount only.*
8	1/4-20 x 5/8” bolt.  *EFData Part # HW/1/4-20X5/8BT.* *Used to attach 8” or 14” unistruts to RFT.*
8	1/4” flat washer.  *EFData Part # HW/1/4-FLT.* *Used to attach 8” unistruts to RFT.*
8	1/4” split lockwasher.  *EFData Part # HW/1/4-SPLIT.* *Used to attach 8” unistruts to RFT.*
2	Unistrut — 8” long.  *EFData Part # FP/3481.* *Attaches directly to RFT.*

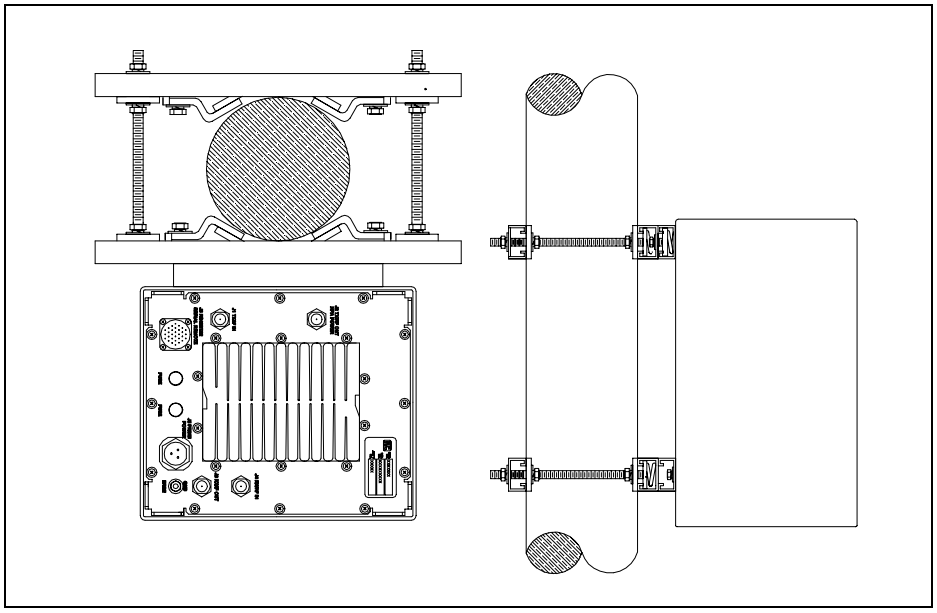
Qty.	Description
4	5/16-18 x 1” bolt.  *EFData Part # HW/5/16-18X1BLT.* *Used to attach spar support bracket to 8” unistrut.*
4	5/16” split lockwasher.  *EFData Part # HW/5/16-SPLIT.* *Used to attach spar support bracket to 8” unistrut.*
4	5/16” flat washer.  *EFData Part # HW/5/16-FLT.* *Used to attach spar support bracket to 8” unistrut.*
4	5/16-18 spring nut.  *EFData Part # HW/5/16-18SPNUT.* *Used to attach spar support bracket to 8” unistrut.*

1	**Kit KT/3576, which includes:**			
Qty.	**Description**		**Qty.**	**Description**
2	Spar support bracket.  *EFData Part # FP/3175.* *Used for spar mount only.*		12	5/16-18 x 1” bolt.  *EFData Part # HW/5/16-18X1BLT.*
4	Unistrut — 14” long.  *EFData Part # FP/3595.* *Used for round and square pole mount only.*		24	5/16” split lockwasher.  *EFData Part # HW/5/16-SPLIT.*
2	Unistrut — 8” long.  *EFData Part # FP/3481.* *Attaches directly to RFT.*		24	5/16” flat washer.  *EFData Part # HW/5/16-FLT.*
8	1/4-20 x 5/8” bolt.  *EFData Part # HW/1/4-20X5/8BT.* *Used to attach 8” or 14” unistruts to RFT.*		12	5/16-18 hex nut.  *EFData Part # HW/5/16-18HEXNT.*
8	1/4” flat washer.  *EFData Part # HW/1/4-FLT.* *Used to attach 8” or 14” unistruts to RFT.*		16	5/16-18 spring nut.  *EFData Part # HW/5/16-18SPNUT.*
8	1/4” split lockwasher.  *EFData Part # HW/1/4-SPLIT.* *Used to attach 8” unistruts to RFT.*		8	Flat fitting plate, 5/16”.  *EFData Part # HW/FIT-PLT-5/16.*
8	Pipe block.  *EFData Part # HW/BLK-PIPE2-8.* *Used for round pole mount only.*		4	Threaded rod, 5/16-18 x 14”.  *EFData Part # HW/RD5/16-18X14.* *Used for round and square pole mount only.*

2.3 RFT Installation

At the customer's discretion, the RFT can be installed anywhere on or near the antenna. The supplied hardware allows the installer a wide range of installation alternatives, including:

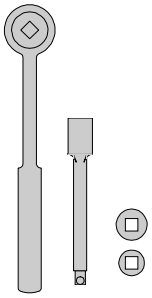
- Vertical pole (e.g., mast) (either square or round). This is the most typical installation.



- Within the hub of a large antenna.
- Spar (i.e., square bar) on the antenna structure.

EFData recommends that the RFT be mounted vertically, with the connections facing the ground.

2.3.1 Tools Required

Qty.	Description
1 1 1 1	3/8” drive ratchet. 3” x 3/8” drive extension. 7/16” x 3/8” drive socket. *(Metric equivalent: 12mm, 6 pt.)* 1/2” x 3/8” drive socket. *(Metric equivalent: 13mm, 6 pt.)* 
1	1/2” combination wrench. *(Metric equivalent: 13mm combination wrench with a 6 pt. box end.)* 

2.3.2 Vertical Pole Installation

2.3.2.1 Round Pole

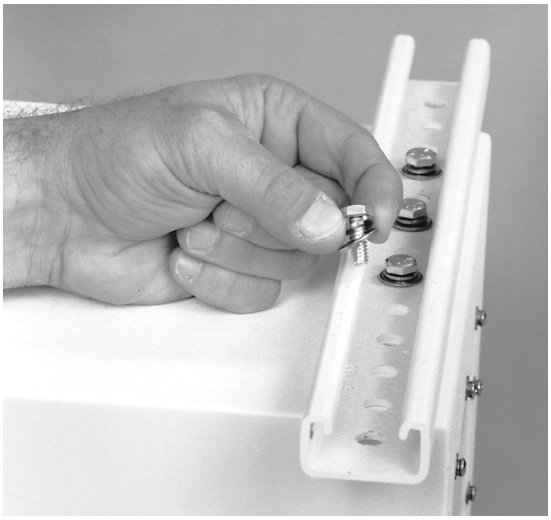
Note: The following process is for a typical installation. Custom systems may be ordered, and are beyond the scope of this manual.

To install the RFT to a round vertical pole:

1. Set the unit on its side, with the mounting holes facing up.

2. Install the two 14” unistruts as follows:

   a. Position a 14” unistrut (with the open side facing up) over one set of the mounting holes on the RFT.

   b. Using four 1/4-20 bolts, 1/4” split lockwashers, and 1/4” flat washers, attach the 14” unistrut to the RFT.

   Tighten the bolts firmly.

   c. Repeat Steps 2.a. and 2.b. for the second 14” unistrut.

3. Install the pipe blocks as follows:

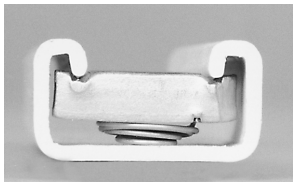
   a. Install two spring nuts in each of four 14” unistruts (the two just mounted on the RFT, and two additional).

      Be sure to position the spring nuts in the unistruts wide enough apart so that when the pipe blocks are installed, they will clear the pole when the unit is lifted into place for installation.

   b. Install each spring nut as follows:

      (1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

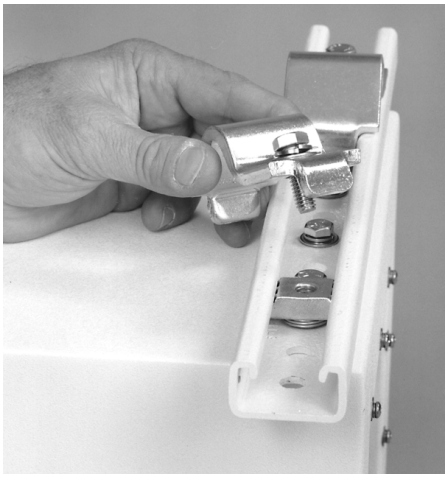
      (2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).



      (3) Release pressure on the spring nut.

      (4) Repeat Steps 3.b.(1) through 3.b.(3) for each spring nut.

   c. Using four 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, loosely secure the pipe blocks to the spring nuts.

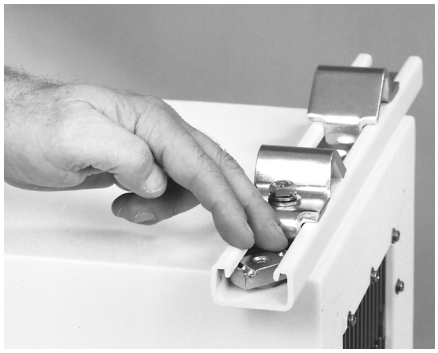


      Ensure the pipe blocks are installed with the long angle facing inward, toward the pipe, as illustrated.

      DO NOT tighten the pipe block bolts until after mounting the RFT on the vertical pole. (See Step 5.e.)

4. Install the threaded rods as follows:

   a. Install two spring nuts in both 14” unistruts mounted on the RFT.

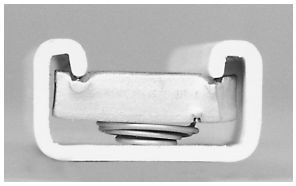
   

   Note: Ensure the spring nuts are positioned over the outer holes in the 14” unistruts, as illustrated.

   b. To install each spring nut:

      (1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

      (2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).

      (3) Release pressure on the spring nut.

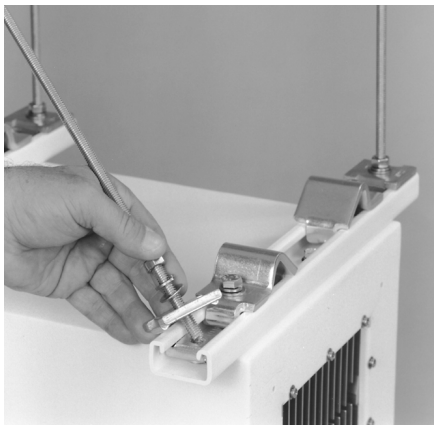
      (4) Repeat Steps 4.b.(1) through 4.b.(3) for each spring nut.

   c. Thread a 5/16-18 nut approximately 1-1/2” onto each threaded rod. (This will ensure that the threaded rods will extend beyond the spring nuts when installed.)

   d. Place a 5/16” split lockwasher, 5/16” flat washer, and flat fitting plate over each threaded rod.

e. One threaded rod at a time, hold the washers and plate in place on the rod, and screw the rod into a spring nut, as illustrated.



Notes:

1. Be sure to position the flanges of the flat fitting plates in the grooves of the unistruts.
2. Before tightening the nuts on the threaded rods, ensure that the end of each rod is screwed in until it is flush with the backside of the unistruts. This ensures the rods are threaded completely through the spring nuts.

Tighten each nut firmly.

f. Thread a 5/16-18 nut about 2” onto the end of each threaded rod.

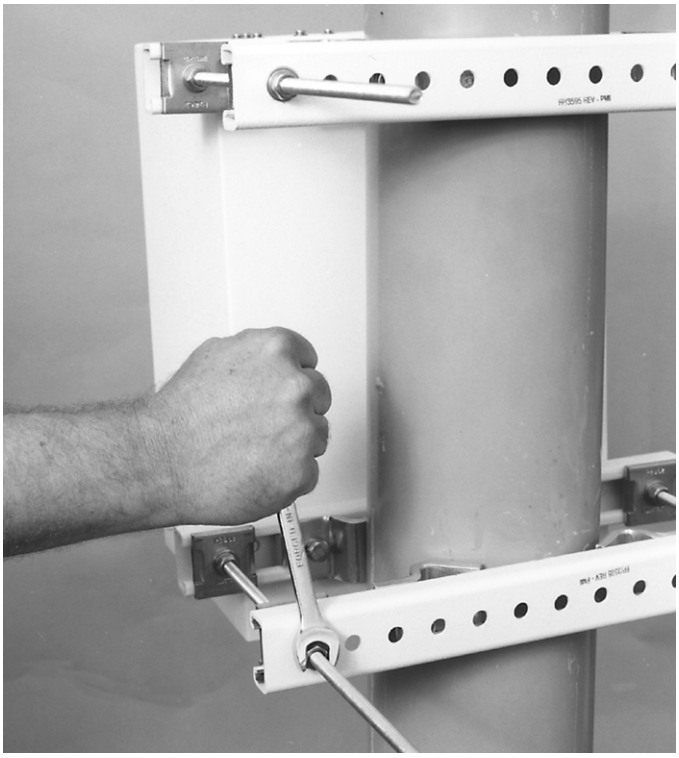
g. Slip a 5/16” split lockwasher, 5/16” flat washer, and flat fitting plate (in that order) onto each threaded rod.

5. Mount the RFT as follows:

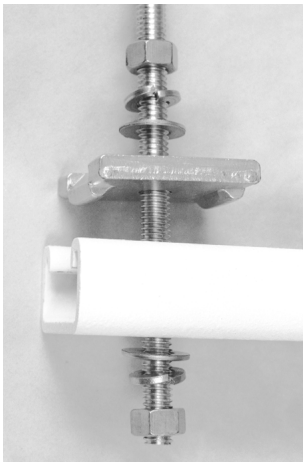
   a. Lift the RFT into position on the vertical pole.

   b. Slip a 14” unistrut over each of pair of threaded rods (upper and lower).

      Note: Install the 14” unistruts with the open face toward the pole as illustrated below.

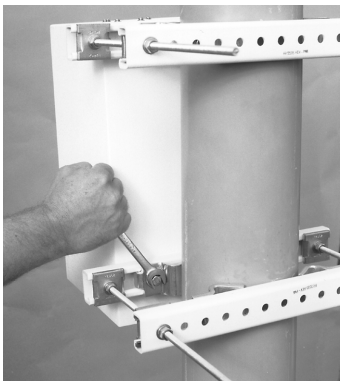


c. Install a 5/16” flat washer, 5/16” split lockwasher, and 5/16-18 nut on each threaded rod.



d. Position the RFT as desired, and tighten the 5/16-18 nuts installed in Step 5.c.

e. Slide the pipe blocks inward until they contact the vertical pole, then firmly tighten the 5/16-18 bolts.



2.3.2.2 Square Pole

For square vertical pole installation, follow the steps in Section 2.3.2.1, with the following exceptions:

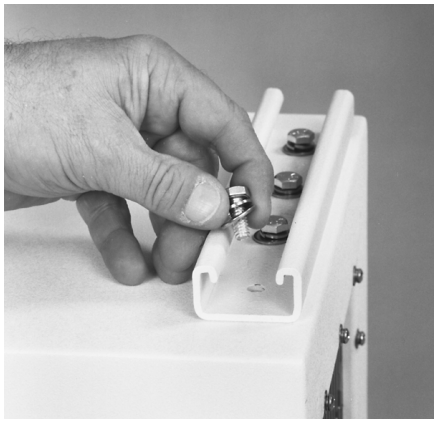
- Do not perform Step 3.
- Do not perform Step 5.e.

2.3.3 Spar Installation

Note: The following process is for a typical installation. Custom systems may be ordered, and are beyond the scope of this manual.

To install the RFT to a spar:

1. Set the unit on its side, with the mounting holes facing up.
2. Install the 8” unistruts as follows:
   a. Position an 8” unistrut (with the open side facing up) over one set of the mounting holes on the RFT.



   b. Using four 1/4-20 bolts, 1/4” split lockwashers, and 1/4” flat washers, attach an 8” unistrut to the RFT.

      Tighten the bolts firmly.

   c. Repeat Steps 2.a. and 2.b. for the second 8” unistrut.

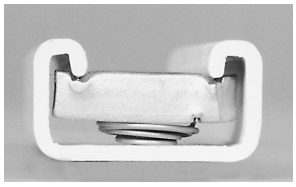
3. Mount the RFT as follows:

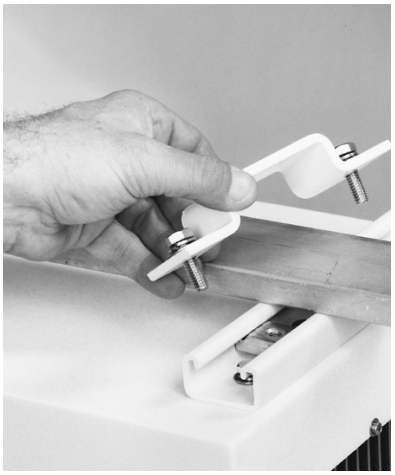
   a. Position a spring nut between the inner and outer bolts on both sides of each 8” unistrut, as illustrated.

   b. Install each spring nut as follows:

      (1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

      (2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).





      (3) Release pressure on the spring nut.

      (4) Repeat Steps 3.b.(1) through 3.b.(3) for each spring nut.

   c. Lift the RFT into position.

   d. Using four 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, bolt the two spar support brackets in place.

      Tighten the bolts firmly.

2.4 LNA Installation

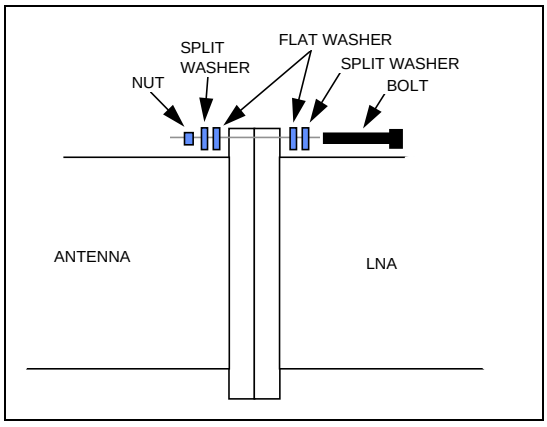
Refer to Section 2.2.1 for included parts.

To install a single LNA to an antenna:

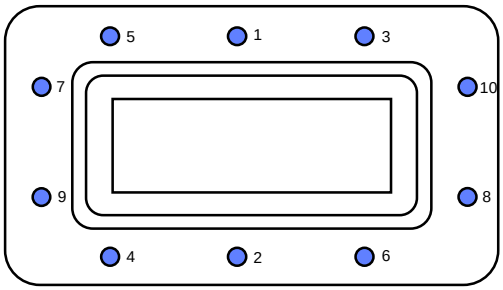
1. Remove the protective cover from the antenna mount location (if installed).
2. Remove the plastic cover from the antenna end (RF IN) of the LNA.
3. Remove the plastic cover from the RF OUT end of the LNA.

After removing the protective cover(s), ensure that no foreign material or moisture enters the antenna waveguide or LNA.

4. Install the appropriate gasket on the antenna end of the LNA:
   a. If the LNA has a groove, and the antenna flange does not, the thin gasket should be used.
   b. If both the LNA and antenna flanges have grooves, the thick gasket should be used.
5. Position the LNA in place on the antenna, and install the 1/4-20 bolts, washers, and nuts. Do not tighten at this time.



6. After all the bolts, washers, and nuts have been installed, tighten them according to the following illustrated sequence.



2.5 External Connections

Connections between the RFT and other equipment are made through six connectors. These connectors are listed in Table 2-1, and their locations are shown in Figure 2-1.

The use of each connector is described in the following paragraphs.

Table 2-1. Front Panel Connectors

Name	Ref. Design.	Connector Type	Function
TX/IF IN	J1	Type N	TX IF INPUT (70 MHz)
TX/RF OUT	J2	Type N	5.845 to 6.425 GHz Out
RX/IF OUT	J3	Type N	RX IF OUT (70 MHz)
RX/RF IN	J4	Type N	3.620 to 4.200 GHz Input
PRIME PWR	J5	Standard	Prime Power Input
REMOTE	J6	26-pin CIR	Remote Interface
GND	ERDE GND	#10-32 Stud	Chassis Ground

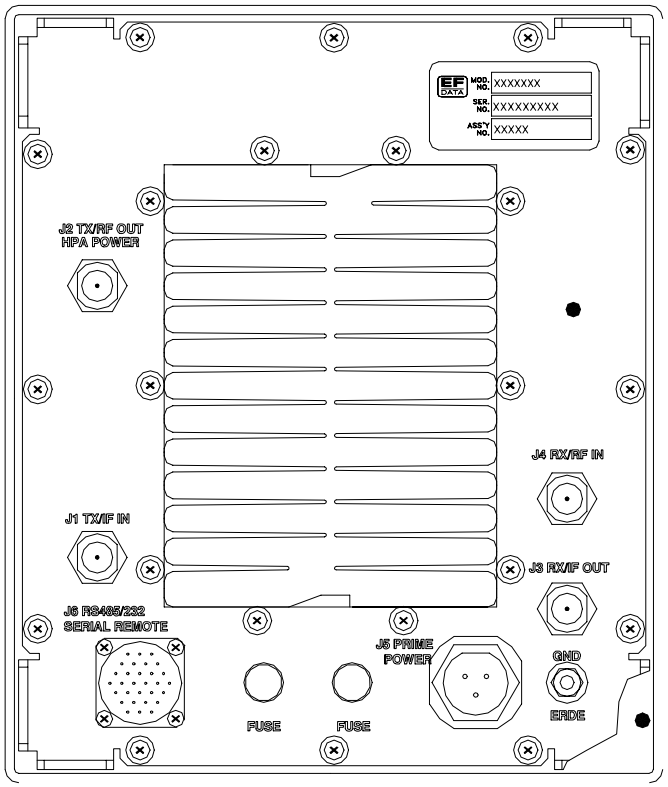


Figure 2-1. RFT-505 External Connections

2.5.1 TX/IF Input (J1)

The TX/IF input is from the indoor unit, and utilizes a type N connector.

The input impedance is 50Ω, and the frequency is 70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz).

The typical power level is from -43 to -19 dBm, depending on the configuration and application.

2.5.2 TX/RF Output (J2)

The TX/RF output has an output impedance of 50Ω, and utilizes a type N connector.

The output frequency range is from 5.845 to 6.425 GHz. The output power level ranges from +8 dBm to 10W (+40 dBm), depending on the power option ordered.

2.5.3 RX/IF Output (J3)

The RX/IF output goes to the indoor unit, and utilizes a type N connector.

The output impedance is 50Ω, and the frequency is 70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz).

The 1 dB output compression point is +15 dBm minimum.

Nominal output power operation is +9 dBm (-6 dB from 1 dB compression) to -27 dBm, depending on system gain requirements.

The down converter has 24 to 45 dB of gain, and is adjustable by the customer from 0 to 21 dB of attenuation.

The typical system gain includes a 50 dB LNA, making the total system gain 74 to 95 dB.

Note: A 60 dB LNA is only used when there are extremely long cables from the LNA to the down converter.

2.5.4 RX/RF Input (J4)

The RX/RF input comes from the LNA, and utilizes a type N connector.

The input impedance is 50Ω, and the input frequency range is from 3.620 to 4.200 GHz.

The input signal level ranges between -53 dBm and -30 dBm, depending on LNA and antenna gain.

The input level should be set to give the required signal level at J3, the RX/IF Output (refer to Section 2.5.3).

2.5.5 Prime Power (J5)

The AC power is supplied to the terminal by a 3-pin power connector.

Normal input voltage is 90 to 260 VAC, 47 to 63 Hz. Maximum power consumption is as follows:

Power Output	Maximum Power Consumption
+8 dBm	70W
5W (+37 dBm)	125W
10W (+40 dBm)	175W

The AC pinout is as follows:

Pin #	Name	Function	Wire Color
A	HI	Line	Brown
B	LO	Neutral	Blue
C	GND	Ground	Green/Yellow

A circular 4-pin power connector is used for the DC (48 VDC) option.

The DC pinout is as follows:

Pin #	Name
A	+ INPUT
B	CHASSIS GROUND
C	- INPUT
D	N/C

2.5.6 Serial Remote Control (J6)

The remote connector on the RFT is used to interface the M&C functions to a remote location. This interface can be either RS-232-C or RS-485.

When using an RS-485 interface, the transmit and receive signals are able to accommodate either type of remote equipment pinouts. As long as the polarities of the remote equipment TX and RX signals are correct, this remote interface will be completely compatible.

Refer to Table 2-2 for a list of pinouts for the J6 connector.

For standard RS-232-C or RS-485 applications, an adapter cable must be used to connect the 26-pin connector (J6) to a standard 9-pin D.

Refer to Figure 2-2 for an illustration of the adapter cable with its pinouts.

Table 2-2. RFT Remote Control Connector, J6

Pin #	Name		Description
	RS-232-C	RS-485	
A	GND	-RX/TX	RX/TX Data
B		-RX/TX	RX/TX Data
C		+RX/TX	RX/TX Data
D	CTS	+RX/TX	Clear to send *(see Note 1)*
E	RD/RX		Receive data
F	RTS		Ready to send *(see Note 1)*
G	TD/TX		Transmit Data
H	DSR		Data Set Ready
J		GND	Ground (green)
K	LNA_PWR		Output, 10V for powering LNA *(see Note 2)*
L	EXT_PWR		Output voltage, 11V, to power RSU-503 and KP-10
M	EXT TWT FLT		Input, logic 0 or 5V, 5V = FLT, 0V = normal *(see Note 3)*
N	EXT IN_1		Input, logic 0 or 5V, spare *(see Note 3)*
P	SPARE		N/C
R	GND		Ground (green)
S	GND		Ground, Signal
T	SPARE		N/C
U	UL_NC		Uplink fault relay, connects to uplink COM with fault
V	UL_COM		Uplink fault relay, COMMON
W	UL_NO		Uplink fault relay, opens with fault
X	DL_NC		Downlink fault relay, connects to downlink COM with fault
Y	DL_COM		Downlink fault relay, COMMON
Z	DL_NO		Downlink fault relay, opens with fault
a	LNA PWR RTN		Return for LNA Power *(see Note 2)*
b	EXT IN_2		Input, 0 to 5V Logic
c	SPARE		N/C

Notes:

1. In RS-232-C mode, CTS is tied to RTS (and vice versa).
2. LNA can be powered from these pins instead of up through the RF cable.
3. 5V is a floating level.

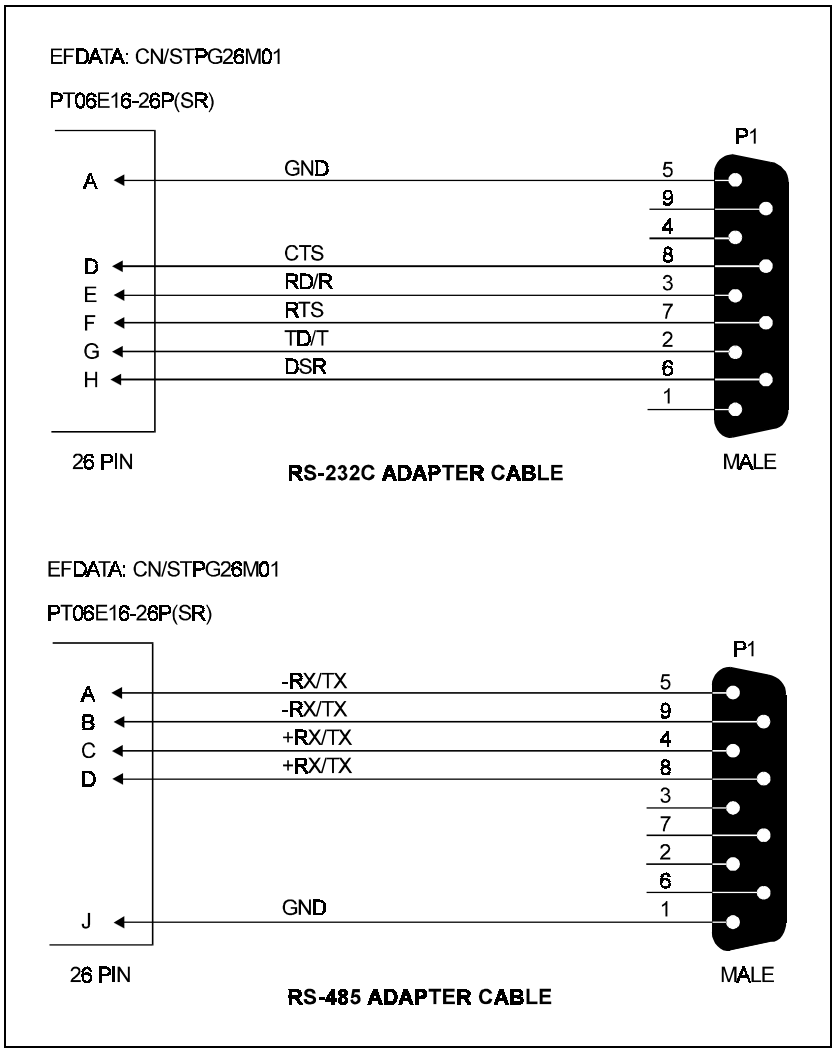


Figure 2-2. Serial Adapter Cables

2.5.7 GND

A #10-32 stud is available on the rear for the purpose of connecting a common chassis ground between all of the equipment.

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3 Chapter 3. REDUNDANT SYSTEM INSTALLATION

This chapter provides installation information for redundant systems, including:

- Unpacking and inspecting the parts
- Installing the RFTs
- Installing the 1:1 redundant plate
- External connections

For RSU-503 installation information, refer to the *EFData RSU-503 Redundancy Switch Unit Installation and Operation Manual.*

For single thread systems, refer to Chapter 2.

If the RFTs are to be mounted individually, refer to Chapter 2 for installation information.

3.1 Unpacking

The CST-5005 redundant system is shipped in two cartons (one RFT each) and one crate.

To remove the parts:

1. Cut the tape at the top of each carton where it is indicated OPEN THIS END.
2. Lift out the cardboard/foam spacer covering the units.
3. Remove the parts from the cartons. Refer to Section 3.2.1 for a parts breakdown.

Because the RFTs are heavy, assistance may be necessary to remove the units from the boxes.

4. Remove the screws from the lid of the wooden crate, and remove the lid.
5. Unbolt the redundant LNA plate and remove it from the crate.
6. Remove the remainder of the parts from the crate. Refer to Section 3.2.1 for a parts breakdown.

Note: Save the packing material for reshipment.

3.2 Inspecting the Equipment

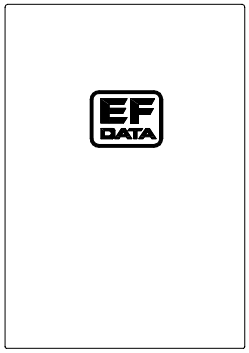
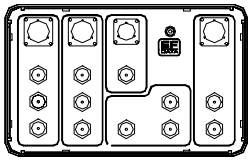
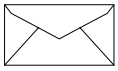
1. Carefully check the equipment for damage incurred during shipment.
2. Carefully check the equipment against the packing list shipped with the equipment to ensure that the shipment is complete. Refer to the following paragraphs.

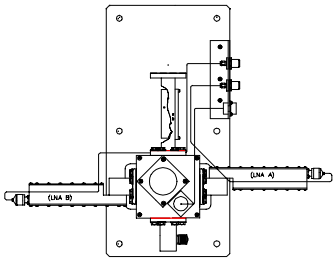
3.2.1 Included Parts

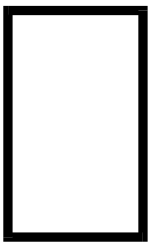
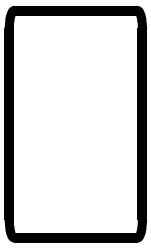
A typical redundant CST-5005 configuration contains the following components.

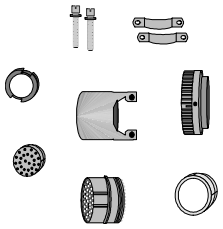
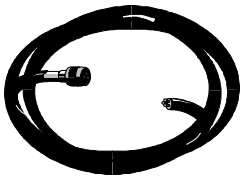
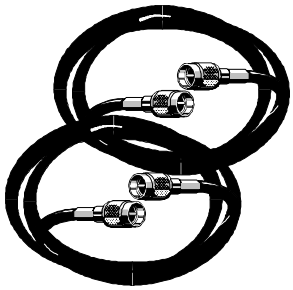
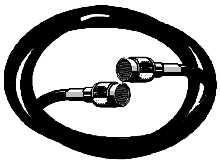
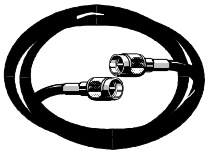
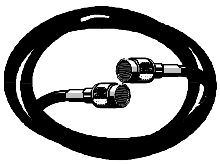
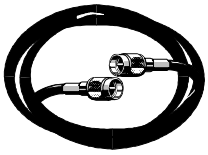
Notes:

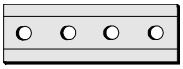
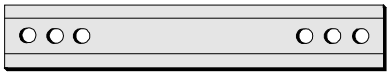
1. Parts are not drawn to scale.
2. Because each system can be custom ordered, it is beyond the scope of this manual to provide the unlimited configuration possibilities.
3. This chapter does not describe the installation procedures for amplifiers, high performance LNAs, phase-locked LNBs, LNBs, or phase-locked block converters.

Qty.	Description
2	RFT outdoor unit. 
1	RSU-503. 
1	Envelope containing the test data sheet. 

Qty.	Description
1	Redundant LNA plate.  **Note:** Pictured is a typical LNA plate. Other LNA plates are available, and can be ordered from an EFData marketing representative.
1	CST-5005 installation and operation manual. 
1	RSU-503 installation and operation manual. 
1	Monitor and Control Software for EFData Satellite Terminals User's Guide. 

1	**LNA connector kit (EFData Part # KT/2721), which includes:**			
Qty.	**Description**		**Qty.**	**Description**
1	Gasket — thick.  *EFData Part # 32P1040.*		1	Gasket — thin.  *EFData Part # 32D1002.*
10	1/4-20 x 5/8” bolt.  *EFData Part # 03P1079.*		20	1/4” flat washer.  *EFData Part # O4P1022.*
10	1/4” split lockwasher.  *EFData Part # HW/1/4-SPLIT.*		10	1/4-20 nut.  *EFData Part # HW/1/4HEXNUT.*

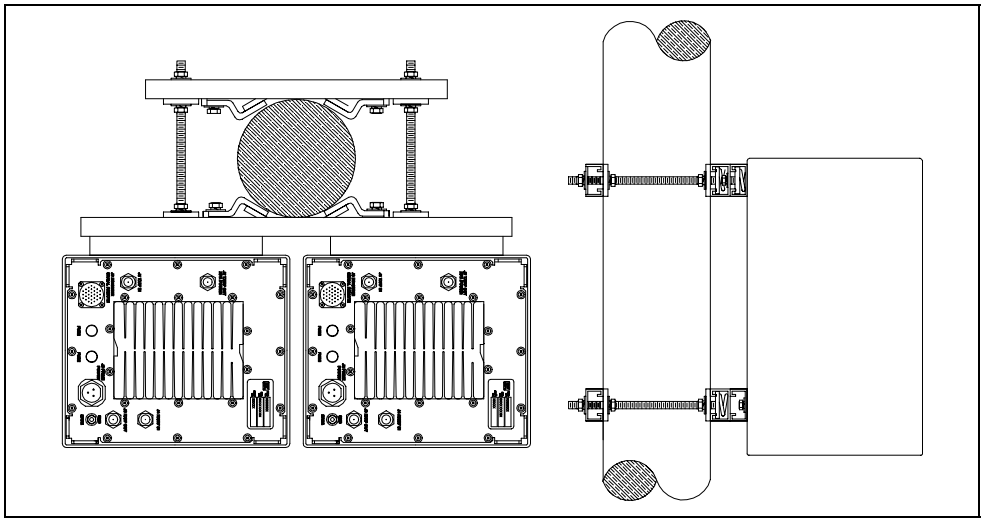
1	Kit KT/3107-x (where x = 5 for AC power, and 6 for DC power), which includes:		
Qty.	**Description**	**Qty.**	**Description**
3	Connector kit.  *EFData Part # CN/STPG26M01.* *Used to connect customer's cable to the RFT 26-pin J6 (REMOTE). For remote control and status monitoring (by using M&C system monitor software).*	2	**Note:** Either the AC or DC cable is provided, depending upon the product ordering code. Assembly, 15' AC prime power cable. *EFData Part # PL/2754.* Assembly, 15' DC prime power cable. *EFData Part # PL/4157.* 
3	17' Heliax cable.  *EFData Part # CA/1530.* *Used for RF input and RF output.*	2	4' M&C Redundancy Assy.  *EFData Part # PL/3003.* *Used for communications from RFTs A and B to RSU.*
4	TNC to N, 50Ω, 4' cable.  *EFData Part # PL/5143.* *IF Tx and Rx cables from RFT to RSU.*	1	17' Cable, RSU-503 to redundant LNA plate.  *EFData Part # PL/3006.* *Communications from RSU to redundant LNA plate.*
2	Cable, N-Male, LDF4-50A, 3', Heliax C-band.  *EFData Part # CA/3230-1.* *Used for CST-5000 terminal system only.*		

2	**Kit KT/3576, which includes:**			
Qty.	**Description**		**Qty.**	**Description**
5	Spar support bracket.  *EFData Part # FP/3175.* *Used for spar mount only.*		58	5/16” flat washer.  *EFData Part # HW/5/16-FLT.*
30	5/16-18 hex nut.  *EFData Part # HW/5/16-18HEXNT.*		58	5/16” split lockwasher.  *EFData Part # HW/5/16-SPLIT.*
38	5/16-18 spring nut.  *EFData Part # HW/5/16-18SPNUT.*		20	Pipe block.  *EFData Part # HW/BLK-PIPE2-8.* *Used for round pole mount only.*
4	Unitstrut — 8” long.  *EFData Part # FP/3481.* *Attaches directly to RFTs.*		20	Flat fitting plate, 5/16”.  *EFData Part # HW/FIT-PLT-5/16.*
28	5/16-18 x 1” bolt.  *EFData Part # HW/5/16-18X1BLT.*		10	Threaded rod, 5/16-18 x 14”.  *EFData Part # HW/RD5/16-18X14.* *Used for round and square pole mount only.*
2	Unistrut, modified, 20” long.  *EFData Part #FP/3482.* *Used for round and square pole mount only.*		19	1/4” flat washer.  *EFData Part # HW/1/4-FLT.* *Used to attach short unistruts to RFT.*
19	1/4-20 x 5/8” bolt.  *EFData Part # HW/1/4-20X5/8BT.* *Used to attach short unistruts to RFTs.*		19	1/4” split lockwasher.  *EFData Part # HW/1/4-SPLIT.* *Used to attach short unistruts to RFT.*

3.3 RFT Installation

At the customer's discretion, the RFTs can be installed anywhere on or near the antenna. The supplied hardware allows the installer a wide range of installation alternatives, including:

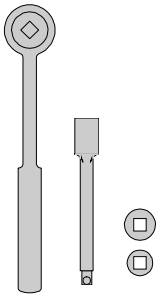
- Vertical pole (e.g., mast) (either square or round). This is the most typical installation.



- Within the hub of a large antenna.
- Spar (i.e., rectangular bar) on the antenna structure.

EFData recommends that the RFTs be mounted vertically, with the air inlets facing the ground.

3.3.1 Tools Required

Qty.	Description
1 1 1 1	3/8” drive ratchet. 3” x 3/8” drive extension. 7/16” x 3/8” drive socket. *(Metric equivalent: 12mm, 6 pt.)* 1/2” x 3/8” drive socket. *(Metric equivalent: 13mm, 6 pt.)* 
1	1/2” combination wrench. *(Metric equivalent: 13mm combination wrench with a 6 pt. box end.)* 

3.3.2 Vertical Pole Installation

3.3.2.1 Round Pole

The following process is for a typical installation. Custom systems may be ordered, and are beyond the scope of this manual.

To install the RFTs to a round vertical pole:

1. Set the units on their sides, with the mounting holes facing up.

2. Install the 8” unistruts as follows:

   a. Position an 8” unistrut (with the open side facing up) over one set of the mounting holes on the RFT.

   b. Using four 1/4-20 bolts, 1/4” split lockwashers, and 1/4” flat washers, attach an 8” unistrut to the RFT.

   Tighten the bolts firmly.

   c. Repeat Steps 2.a. and 2.b. for each of the remaining 8” unistruts (for a total of four).

3. Install the 20” unistruts as follows:

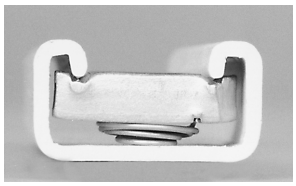
   Note: The placement of the pipe blocks may interfere with the inner or center unistrut attaching bolts. Be sure to determine the pipe block placement locations before bolting the 20” unistruts in place. It may be necessary to eliminate the center or inner 20” unistrut mounting spring nuts and bolts.

   a. Insert a spring nut between the unistrut mounting bolts on both RFTs, as illustrated.

   b. To install each spring nut:

      (1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

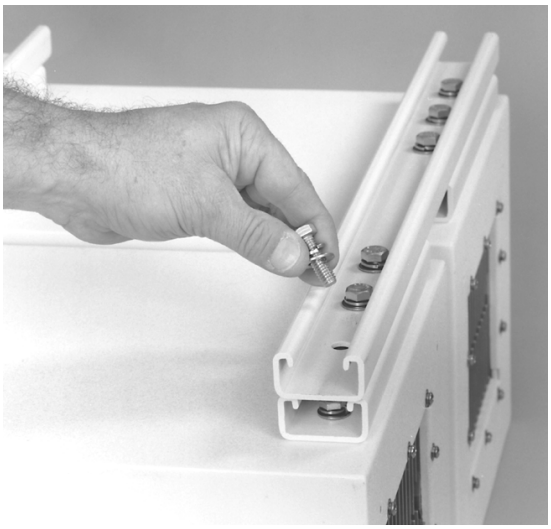
      (2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).



      (3) Release pressure on the spring nut.

      (4) Repeat Steps 3.b.(1) through 3.b.(3) for each spring nut.

c. With the RFTs side-by side, position a 20” unistrut (open side facing up) in place over one pair of 8” unistruts.



Ensure the long unistrut is centered over the RFTs.

d. Using two or three 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, attach the 20” unistrut to the 8” unistruts.

Tighten the bolts firmly.

e. Attach the second 20” unistrut to the second set of 8” unistruts by repeating Steps 3.a. through 3.d.

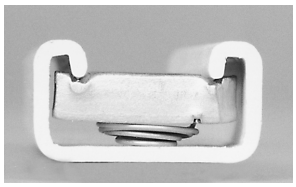
4. Install the pipe blocks as follows:

a. Install two spring nuts in each of the two 20” long unistruts and two 14” long unistruts (centered in the unistruts, and wide enough apart so the pipe blocks will clear the pole when the unit is installed).

b. Install each spring nut as follows:

(1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

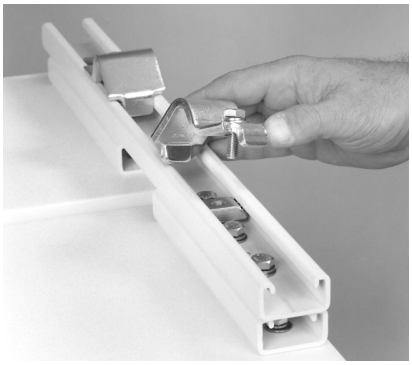
(2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).



(3) Release pressure on the spring nut.

(4) Repeat Steps 4.b.(1) through 4.b.(3) for each spring nut.

c. Using eight 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, loosely secure the pipe blocks to the spring nuts.



Ensure the pipe blocks are installed with the long angle face inward, toward the pipe, as illustrated.

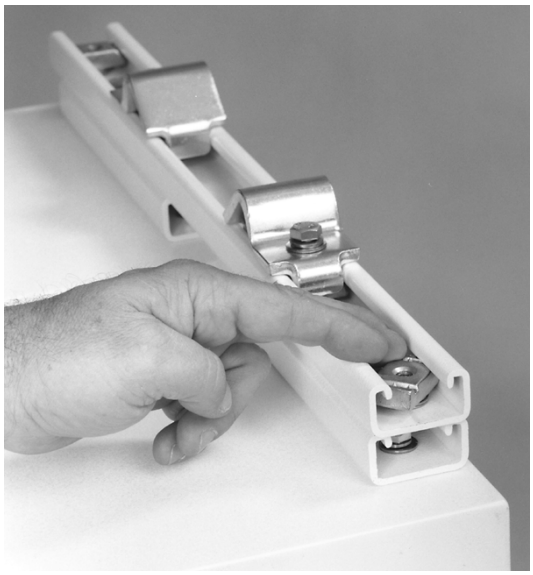
DO NOT tighten the pipe block bolts until after mounting the RFTs on the vertical pole. (See Step 6.e.)

5. Install the threaded rods as follows:

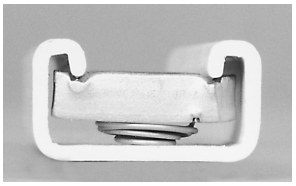
a. Install two spring nuts in both 20” unistruts mounted on the RFTs.

b. Install each spring nut as follows:

(1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.



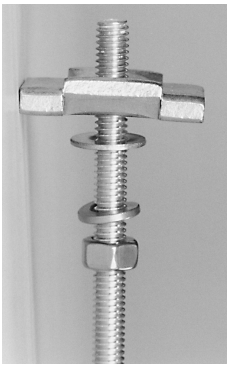
(2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).



(3) Release pressure on the spring nut.

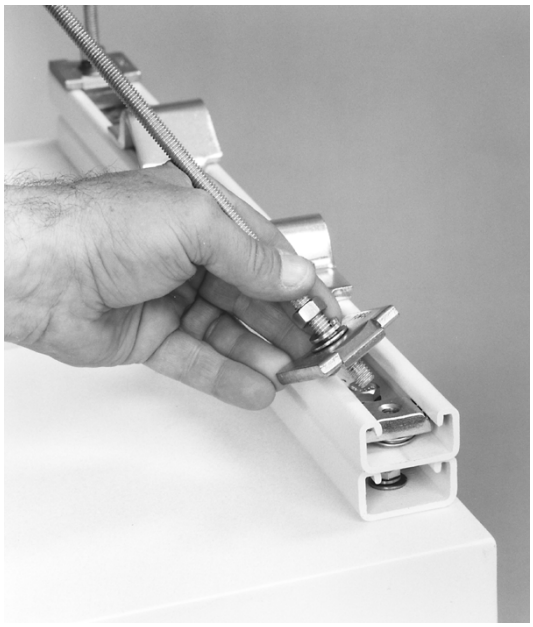
(4) Repeat Steps 5.b.(1) through 5.b.(3) for each spring nut.

c. Thread a 5/16-18 nut approximately 1-1/2” onto each threaded rod. (This will ensure that the threaded rods will extend beyond the spring nuts when installed.)



d. Place a 5/16” split lockwasher, 5/16” flat washer, and flat fitting plate over each threaded rod.

e. One threaded rod at a time, hold the washers and plate in place on the threaded rod and screw it into a spring nut, as illustrated.



Notes:

1. Be sure to position the flanges of the flat fitting plates in the grooves of the unistruts.
2. Before tightening the nuts on the threaded rods, ensure that the end of each rod is screwed in until it contacts the unistrut. This ensures the rods are threaded completely through the spring nuts.

Tighten each nut firmly.

f. Thread a 5/16-18 nut about 2” onto the end of each threaded rod.

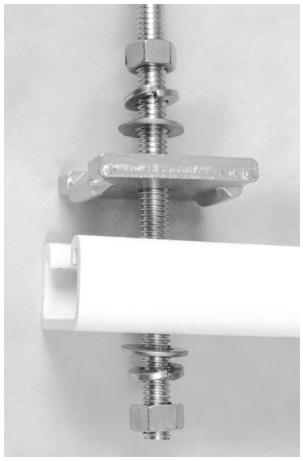
g. Slip a 5/16” split lockwasher, 5/16” flat washer, and flat fitting plate (in that order) onto each threaded rod.

6. Mount the RFTs as follows:

   a. Lift the RFT into position on the vertical pole.

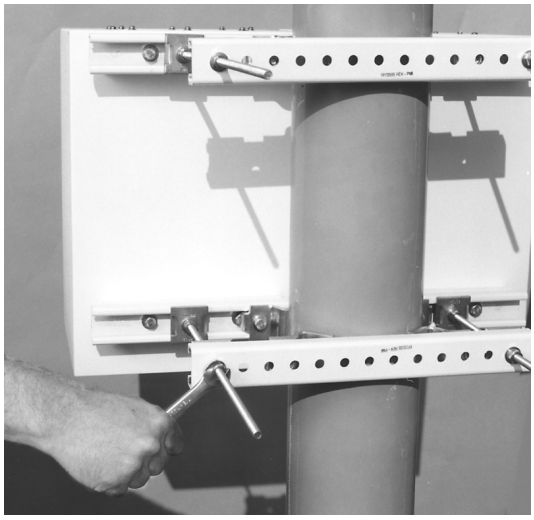
   b. Slip a 14” unistrut over each of pair of threaded rods (upper and lower).

      Note: Install the 14” unistruts with the open face toward the pole, as illustrated.



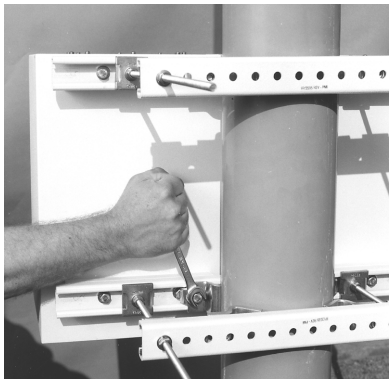
   c. Install a 5/16” flat washer, 5/16” split lockwasher, and 5/16-18 nut on each threaded rod.

   d. Position the RFT, as desired, and tighten the 5/16-18 nuts installed in Step 6.c.



   e. Slide the pipe blocks in until they contact the vertical pole.

      Then, firmly tighten the 5/16-18 bolts.



3.3.2.2 Square Pole

For square vertical pole installation, follow the steps in Section 3.3.2.1, with the following exceptions:

- Do not perform Step 4.
- Do not perform Step 6.e.

3.3.3 Spar Installation

Note: The following process is for a typical installation. Custom kits may be ordered and are beyond the scope of this manual.

To install the RFTs to a spar:

1. Set the units on their side, with the mounting holes facing up.

2. Install the 8” unistruts as follows:

   a. Position an 8” unistrut (with the open side facing up) over one set of the mounting holes on an RFT.

   b. Using four 1/4-20 bolts, 1/4” split lockwashers, and 1/4” flat washers, attach an 8” unistrut to the RFT.

   Tighten the bolts firmly.

   c. Repeat Steps 2.a. and 2.b. for the remaining 8” unistruts (for a total of four).

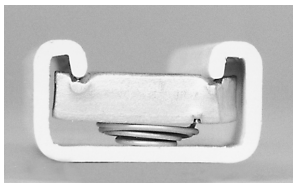
3. Install the 20” unistruts as follows:

   a. Position a spring nut between the 1/4-20 bolts in each 8” unistrut, as illustrated below:

   b. Install each spring nut as follows:

      (1) Place the spring nut in the unistrut channel, spring side down, with its wide side parallel with the unistrut channel.

      (2) Press down on the spring nut to compress the spring, and rotate the nut 90° (i.e., perpendicular to the unistrut).

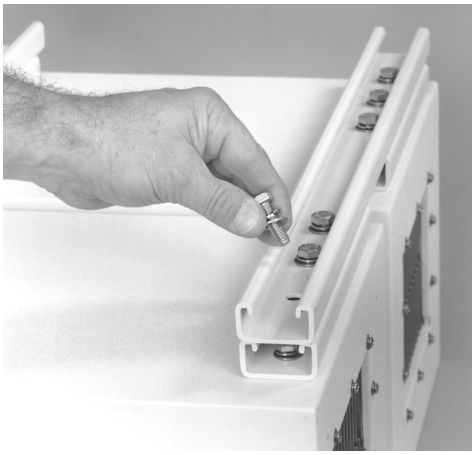


      (3) Release pressure on the spring nut.

      (4) Repeat Steps 3.b.(1) through 3.b.(3) for each spring nut.

   c. With the RFTs side by side, position a 20” unistrut in place over one pair of 8” unistruts (open side up).

d. Using four 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, bolt the 20” unistrut to the 8” unistruts.



e. Tighten the bolts firmly.

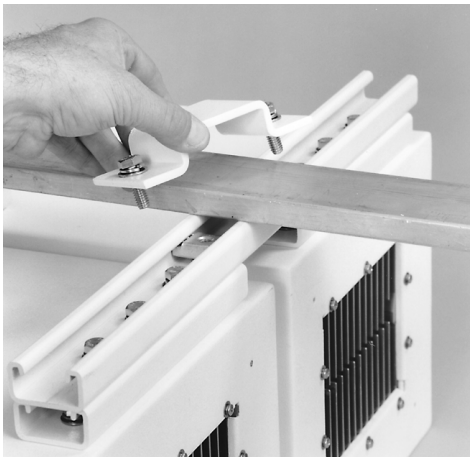
f. Repeat Steps 3.c. through 3.e. for the second 20” unistrut.

4. Mount the RFTs as follows:

a. Lift the RFTs into position.

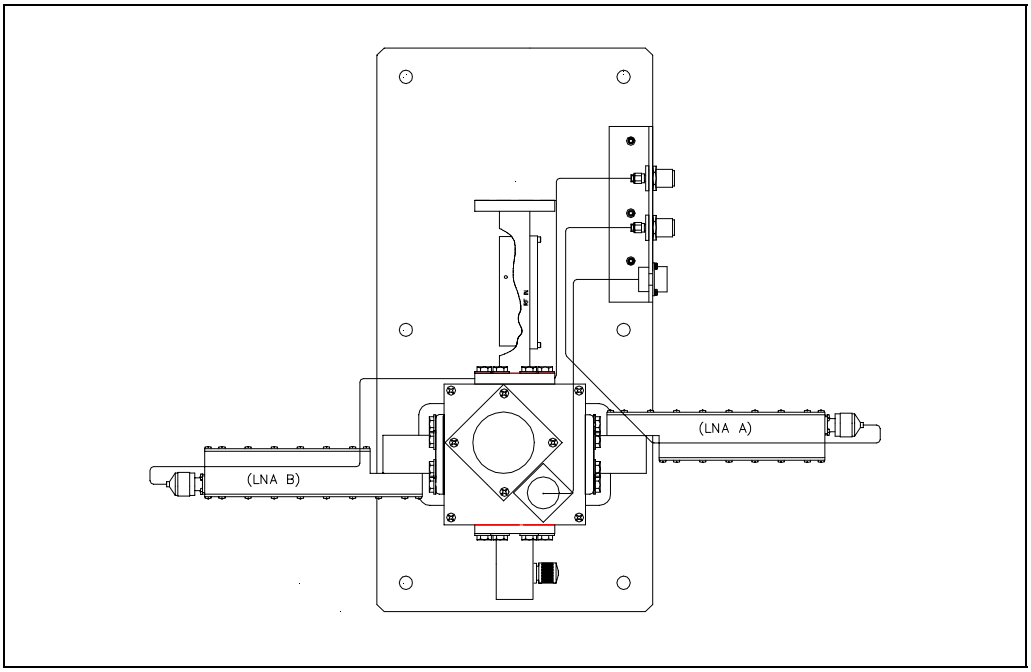
b. Using four 5/16-18 bolts, 5/16” split lockwashers, and 5/16” flat washers, bolt the two spar support brackets in place.

Tighten the bolts firmly.



3.3.4 1:1 Redundant Plate Installation

A typical 1:1 redundant plate is shown below. Refer to Section 3.2.1 for included parts.



To install the 1:1 redundant plate:

1. Mount the 1:1 redundant plate to the antenna.

   Note: The type of mounting is determined by the brand of antenna on which the equipment will be installed.

2. Remove the plastic cover from the RF IN connector of the redundant plate.

   CAUTION

   After removing the protective cover, ensure that no foreign material or moisture enters the 1:1 redundant plate's waveguide.

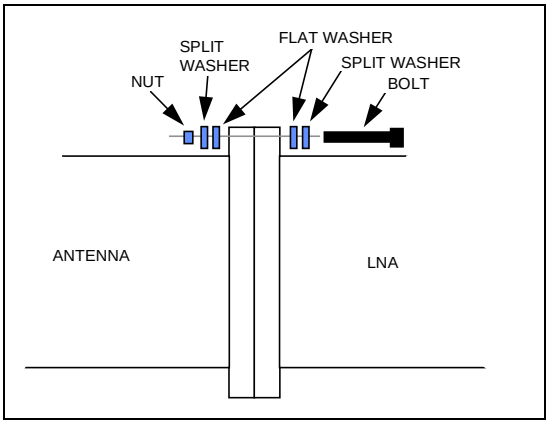
3. Install the appropriate gasket on the RF IN connector of the redundant plate:

   a. If the LNA has a groove, and the antenna flange does not, the thin gasket should be used.

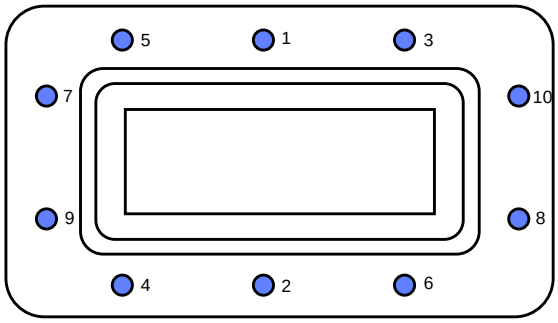
   b. If both the LNA and the antenna flange have grooves, the thick gasket should be used.

4. Position the antenna waveguide in place on the RF IN connector, and install the 1/4-20 bolts, 1/4” split lockwashers, 1/4” flat washers, and 1/4-20 nuts.

   Do not tighten the bolts at this time.



5. After all the bolts, washers, and nuts have been installed, tighten them according to the following illustrated sequence.



6. Remove the plastic covers from all the connectors, and attach the appropriate cables.

3.4 RSU-503 Installation

Refer to the *EFData RSU-503 Redundancy Switch Unit Installation and Operation Manual.*

3.5 External Connections

Refer to Section 2.5 for external connections information.

Chapter 4. OPERATION

This chapter provides operation information for the RFT-505.

4.1 System Operation

There are two methods of operating the RFT-505:

- Connect a PC running DOS to the RS-232-C/485 remote control port, and run the M&C system monitor software. This software is DOS-based and provides an interface to the remote commands.

  For more information on the M&C system monitor program, refer to the *Monitor and Control Software for EFData Satellite Terminals User's Guide*.

- Connect the optional KP-10 hand-held keypad. For more information, refer to the *KP-10 External Keypad Installation and Operation Manual*.

4.2 Remote Control

Refer to Appendix A.

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Chapter 5. THEORY OF OPERATION

This chapter provides the basic theory of operation for the Monitor and Control (M&C) board, high stability oscillator, IFLO synthesizer, and the up and down converters.

5.1 Monitor and Control

The RFT-505 uses a sophisticated microcontroller module to perform the M&C functions of the terminal. This board (refer to Figure 5-1) is located inside of the RFT-505, on top of the other assemblies.

The M&C monitors the RFT-505 and provides configuration updates to other modules within the terminal when necessary.

Terminal configuration parameters are maintained in EEPROM, which provides for total recovery after a power-down situation.

Fault monitoring and status gathering are also provided.

All RFT-505 functions are accessible through the remote communications interface.

Note: For more information on the M&C board, refer to Chapter 1.

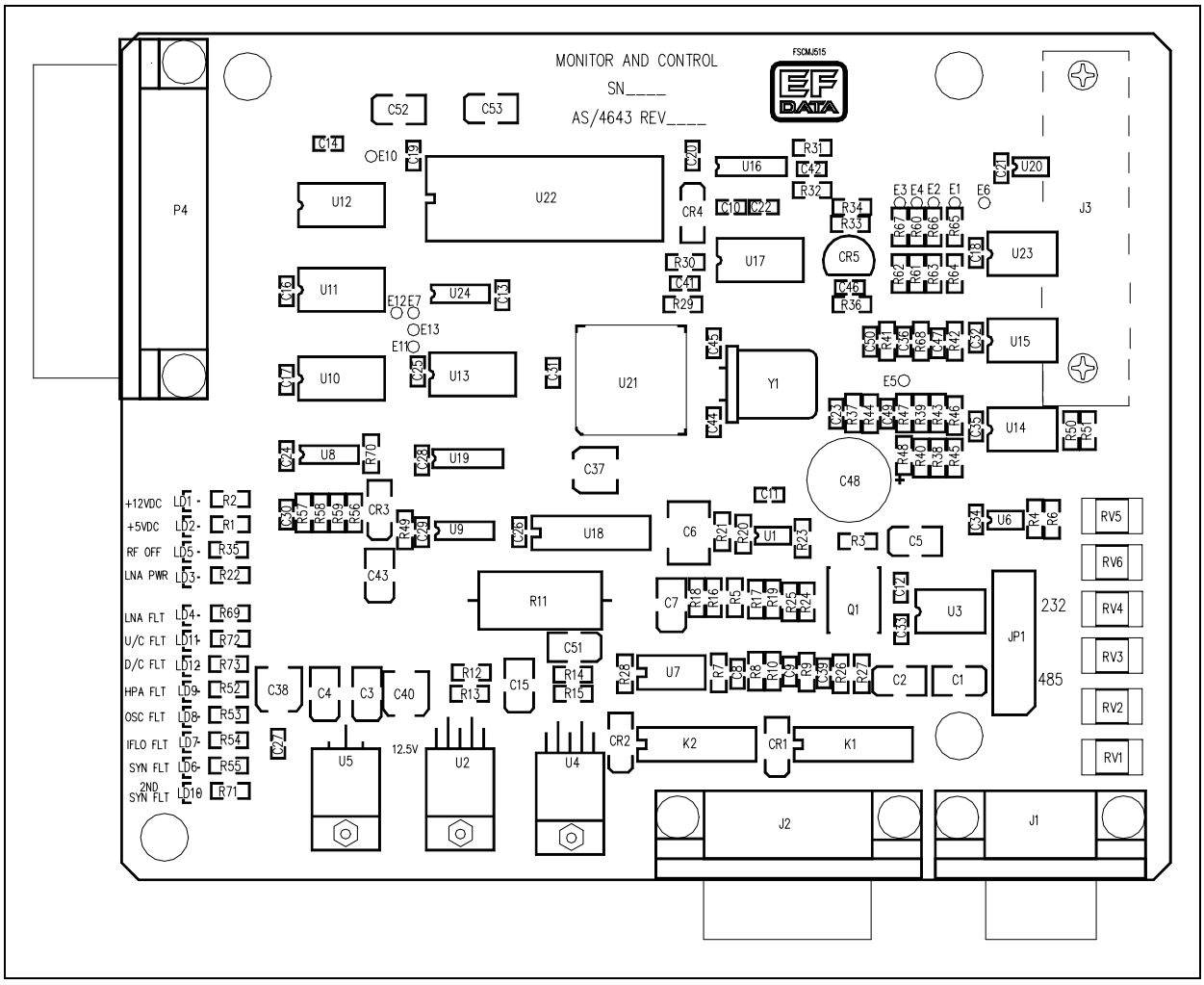

Figure 5-1. M&C Board

5.1.1 EEPROM Memory

EEPROM memory on the M&C module allows it to retain configuration information without prime power for at least one year. If the terminal has been powered down, the following power-up sequence will be carried out by the M&C microcontroller when power is reapplied:

1. The microcontroller checks the EEPROM's Random Access Memory (RAM) to see if valid data has been retained. If valid data has been retained, the terminal is reconfigured to the configuration maintained in EEPROM.

2. If EEPROM memory fails the valid data test, a default configuration from Read Only Memory (ROM) is loaded into the system.

5.1.2 Remote Interface

The functions of the RFT-505 can be remotely controlled and monitored via an RS-485 or RS 232-C communications link. The M&C module must be hardware configured to one of the two interfaces.

The RS-485 interface makes it possible to operate 255 terminals on a common communications link.

The RS-232-C interface is used to communicate with a single terminal.

Refer to Figure 5-2 for the jumper placement at JP3.

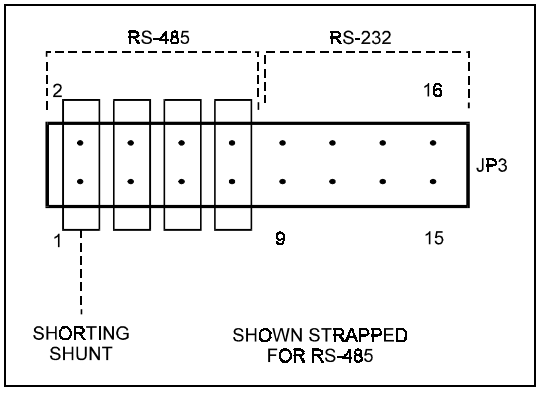

Figure 5-2. M&C Jumper Placement at JP3

5.1.2.1 Remote Interface Specification

Refer to Appendix A.

5.1.3 Terminal Default Conditions

On initial power-up, the unit will default to the following parameters:

Parameter	Default
Baud Rate	9600
Parity	Even
Device Address	1
U/C Gain	Max gain/or min attenuation
D/C Gain	Max gain/or min attenuation
RF Output	OFF
U/C Frequency	6135.00 MHz
D/C Frequency	3925.00 MHz

5.1.4 Theory of Operation

Refer to Figure 5-3 for a functional block diagram of the M&C.

The M&C board performs the following operations:

- Receives the desired frequency from either the remote RS-232-C/485 or KP-10 keypad, and after converting it to a synthesizer setting, stores it to the applicable synthesizer output latch.
- Reads the thermistors located in the up converter, down converter, and high-power amplifier, and converts them to temperatures for display.
- Reads the characterization EEPROMs in the up converter, down converter, and high-power amplifier, and calculates an Automatic Gain Control (AGC) voltage based on frequency and temperature to linearize the respective module.
- Receives fault inputs from all modules, and presents them to the remote RS-232-C/485 and the optional KP-10 keypad display.
- Performs an initial current sense on the LNA, and stores the reading in EEPROM. Subsequent current sense readings are taken and compared to the initial reading to determine a fault.

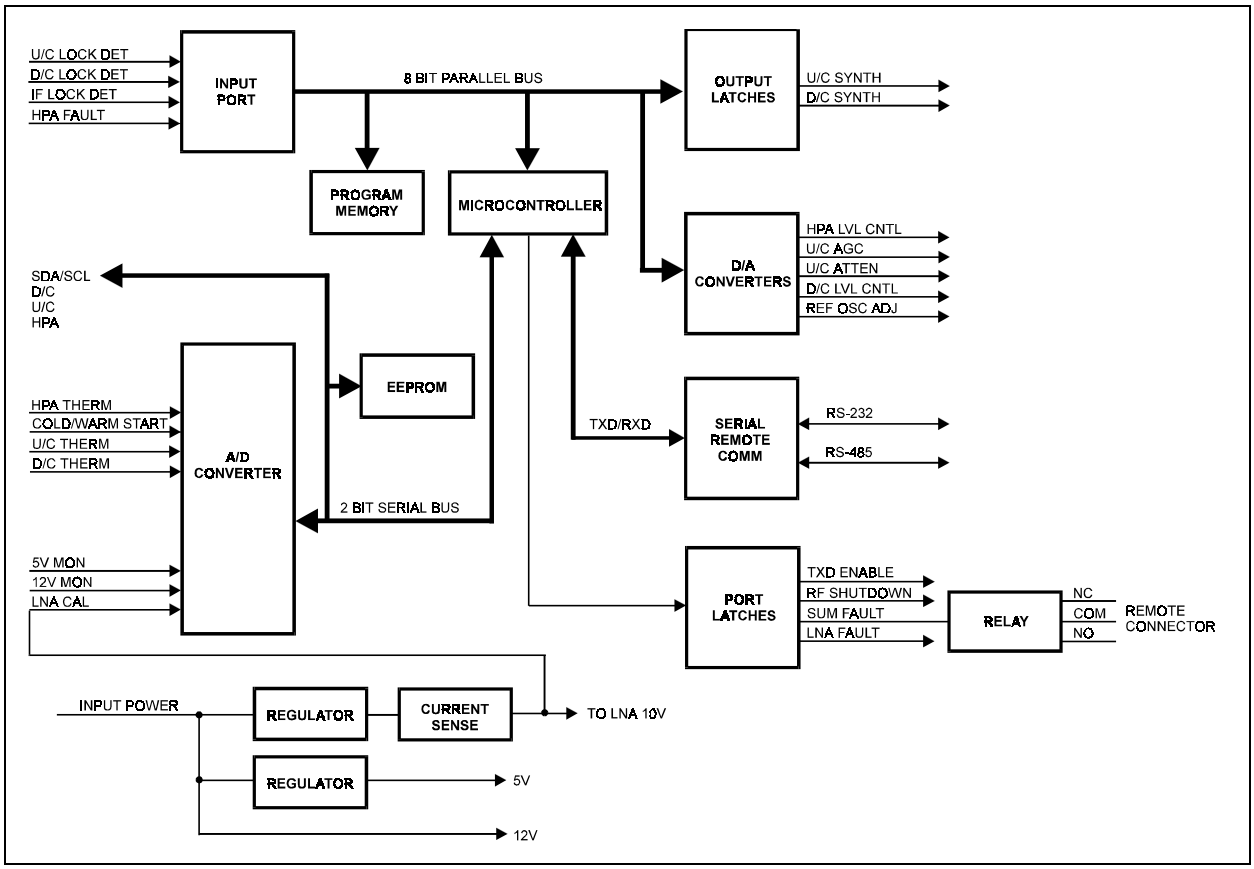

Figure 5-3. M&C Functional Block Diagram

5.1.5 M&C Board Connector Pinouts

5.1.5.1 RS-232-C/485 Remote Control (J1)

The remote interface is provided on a 9-pin male D connector. Screw locks are provided for mechanical security of the mating connector. The remote connector is a Data Circuit Terminating Equipment (DCE) interface.

Pin #	RS-232-C	RS-485	Description
1	GND	GND	Ground
2	TD/TX		Transmit Data
3	RD/RX		Receive Data
4		+RX/TX	Plus Transmit or Receive
5	GND	-RX/TX	Negative Transmit or Receive
6	DSR		Data Set Ready
7	RTS		Ready to Send
8	CTS	+RX/TX	Clear to Send (RS-485 — Plus Transmit or Receive)
9		-RX/TX	Negative Transmit or Receive Data

Notes:

1. Clear to Send (CTS) is tied to Ready to Send (RTS) in RS-232-C mode.
2. The pinout for Data Terminal Equipment (DTE) interface is provided for RS-232-C.

5.1.5.2 Remote Relay Control, J2 DB15-Male

Pin #	Name	Description
1	EXT PWR	Output voltage, 11V, 1A
9	LNA_PWR	10V to LNA
2	DL FLT NO	Summary fault relay A
10	DL FLT COM	Normal operation, common connects to NO
3	DL FLT NC	Fault mode, common connects to NC
11	UL FLT NO	Summary fault relay B
4	UL FLT COM	Normal operation, common connects to NO
12	UL FLT NC	Fault mode, common connects to NC
5	SPARE	
13	EXT INPUT 2	
6	SPARE	
14	LNA_PWR_RTN	Ground Return for LNA
7	EXT INPUT1	Input, logic 0 (normal) or 5V (fault)
15	EXT TWT FLT	Input, logic 0 or 5V, used for TWT.FLT
8	GND	Ground

5.1.5.3 PS, Synthesizer, and D/C, P4 DB25-Male

Pin #	Name	Description
1	HPA 12V	Input, 12.5V power from PS
14	HPA 12V	Input, 12.5V power from PS
2	UC 12V	Input, 12.5V power from PS
15	M&C 12V	Input, 12.5V power from PS
3	SYN DATA	Output CMOS level, Data
16	SYN CLOCK	Output CMOS level, Clock
4	SYN EN1	Output CMOS level, Enable 1
17	SYN EN2	Output CMOS level, Enable 2
5	SYN EN3	Output CMOS level, Enable 3
18	IFLO LD	Input, Open collector, floating = fault
6	SYN LD	Input, Open collector, floating = fault
19	2ND SYN LD	Input, Open collector, floating = fault
7	OSC FLT	Input, Open collector, floating = fault
20	RNG_SW	Output, CMOS level, range select
8	DC THERM	Input, 5K thermistor tied to ground
21	SYN EN 4	Output, CMOS, Enable 4
9	DC GAIN CNTL	Output, 0 to 5V
22	SDA	Bidirectional, CMOS serial data
10	SCL	Output, CMOS serial clock
23	LNA PWR	Output, 11V power to the LNA coax
11	FREQ CNTL	Output, 0 to 10V
24	M&C GND	Ground
12	UC GND	Ground
25	HPA GND	Ground
13	HPA GND	Ground

5.1.5.4 U/C and HPA, J3 DB25-Female

Pin #	Name	Description
1	UC 12V	Output power to UC
14	HPA 12V	Output power to high-power amplifier
2	HPA 12V	Output power to high-power amplifier
15	N/C	
3	HPA GAIN CNTL	Output, 0 to 4V for gain control of high-power amplifier
16	RF OFF	Output, open collector, 0 = OFF
4	N/C	
17	N/C	
5	N/C	
18	HPA FLT NO	Input, Open = Fault
6	HPA FLT COM	Output, ground connection to relay common
19	HPA FLT NC	Input, Open = Normal
7	N/C	
20	HPA THERM	Input, 10K thermistor to ground located in high-power amplifier
8	UC THERM	Input, 10K thermistor to ground located in UC
21	UC GAIN CNTL1	Output, 0 to 4 VDC for gain control of UC
9	UC GAIN CNTL2	Output, 0 to 4 VDC for gain control of UC
22	SDA	Bidirectional, CMOS serial data
10	SCL	Output, CMOS serial clock
23	SPARE	
11	SPARE	
24	SPARE	
12	HPA GND	Ground
25	HPA GND	Ground
13	UC GND	Ground

5.1.6 Test Points and LEDs

Refer to Section 6.1.

5.2 High Stability Oscillator

The high stability oscillator provides a low phase noise frequency-stable 10 MHz source for the RF and IF local oscillator synthesizers.

The internal oven, which is provided for additional stability, operates directly from the 12V power source. The electronic control circuitry is buffered by an active filter.

Refer to Figure 5-4 for a block diagram of the High Stability Oscillator.

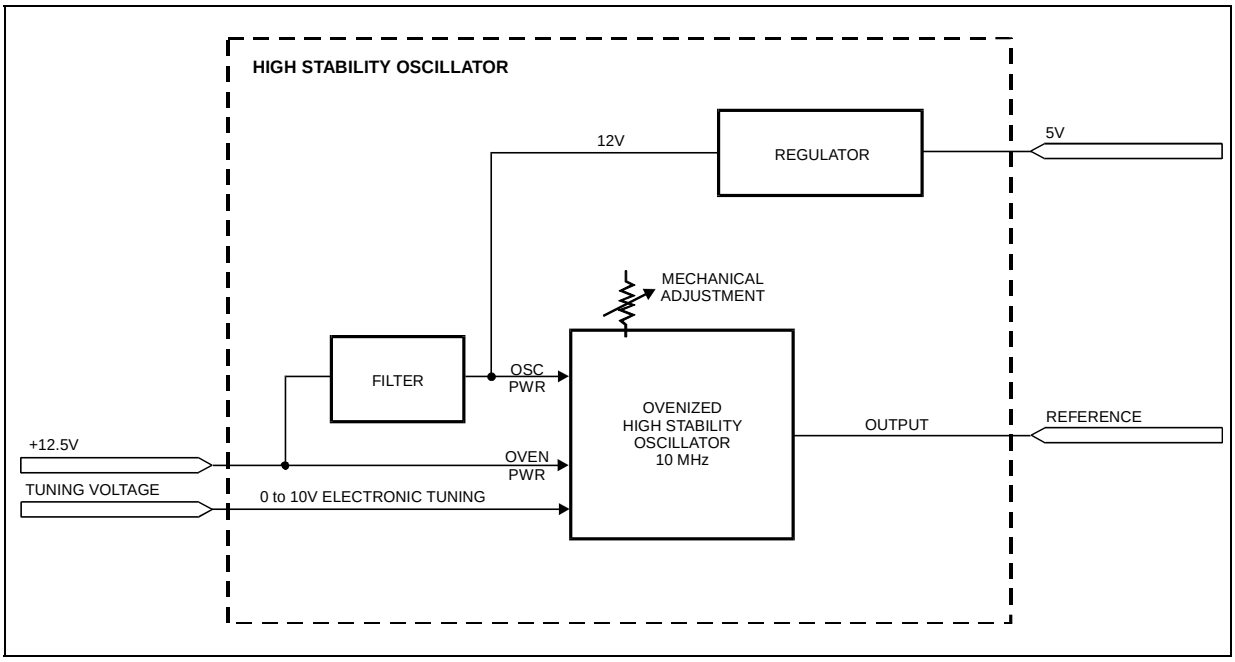

Figure 5-4. High Stability Oscillator Block Diagram

5.2.1 Specifications

Frequency	10 MHz
Frequency Stability	-40 to +70°C
Output Level	+7 dBm typical
Output Waveform	Sinewave
Input Voltage	12.5V
Input Current	600 mA at turn-on, 250 mA after warm-up at +25°C
Warm-up	2.5 minutes to within 1 x 10^{-7} of final frequency at +25°C
Phase Noise (Maximum) 1Hz Measurement bandwidth measured at 10 MHz: 10 Hz 100 Hz 1 KHz 10 KHz	 -120 dBc -150 dBc -160 dBc -165 dBc
Vibrational Sensitivity	1 x 10^{-9}/g
Aging	5 x 10^{-10}/day, 1 x 10^{-1}/year
Frequency Deviation (mechanical)	To compensate for 10 years aging
Frequency Deviation (electrical)	± 2 x 10^{-6} minimum, 0 to 10 VDC

5.3 IF Local Oscillator

The IF local oscillator (IF LO) contains:

- Voltage Controlled Oscillator (VCO)
- Loop filter
- Divide-down chain

The lock detect status is sent to the M&C board, where it is monitored.

Refer to Figure 5-5 for a block diagram of the IF Local oscillator.

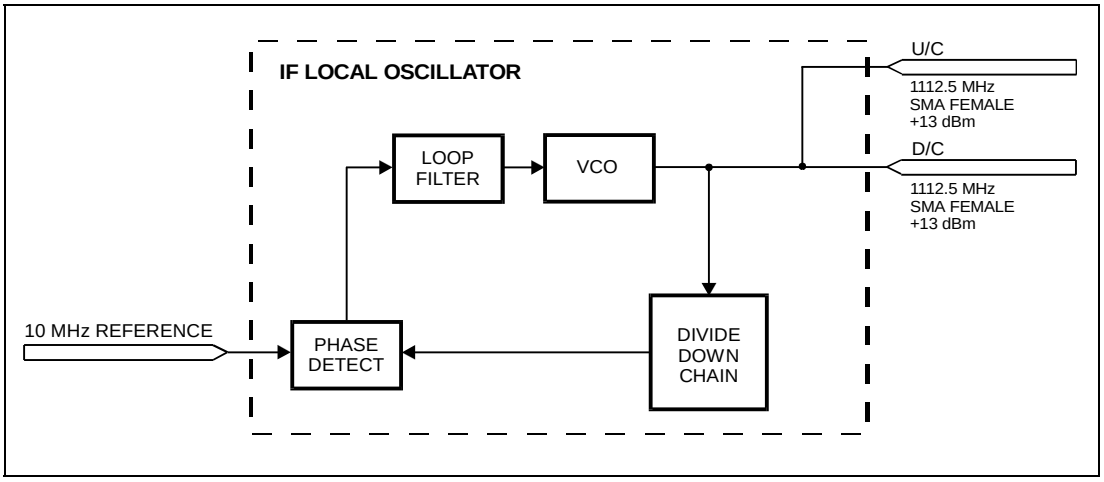

Figure 5-5. IF Local Oscillator Block Diagram

5.3.1 Specifications

Input	10 MHz Square wave, CMOS levels
Output	1112.5 MHz (2 each)
Connectors	SMA
Output Impedance	50Ω
Output Level	+13 dBm

5.4 Synthesizer

The RFT-505 uses a single synthesizer.

The purpose of the synthesizer module is to convert the 10 MHz reference signal to a variable frequency to perform the conversion.

5.4.1 Specifications

RF Inputs:	10 MHz references
Connector Type	SMA
Impedance	50Ω
Input level	+7 dBm
RF Outputs:	4662.5 to 5242.5 MHz
Connector Type	SMA
Impedance	50Ω
Level	+4 dBm

5.4.2 Theory of Operation

The synthesizer module multiplies the 10 MHz reference clock to a variable clock by use of:

- VCOs
- Loop filters
- Phase detectors
- Variable divide-down chain

The divide-down chain is controlled by the M&C board.

Refer to Figure 5-6 for a block diagram of the synthesizer.

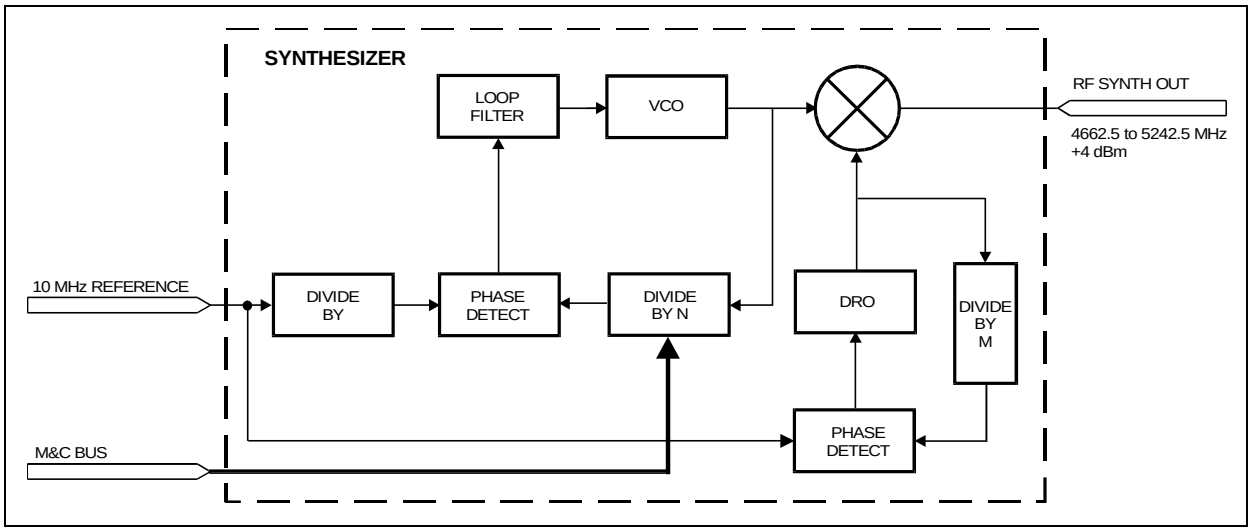

Figure 5-6. Synthesizer Block Diagram

5.5 Down Converter

The function of the down converter is to convert the C-band signal from the LNA to a 70 MHz IF signal for use in the modem.

Refer to Figure 5-7 for a functional block diagram of the down converter.

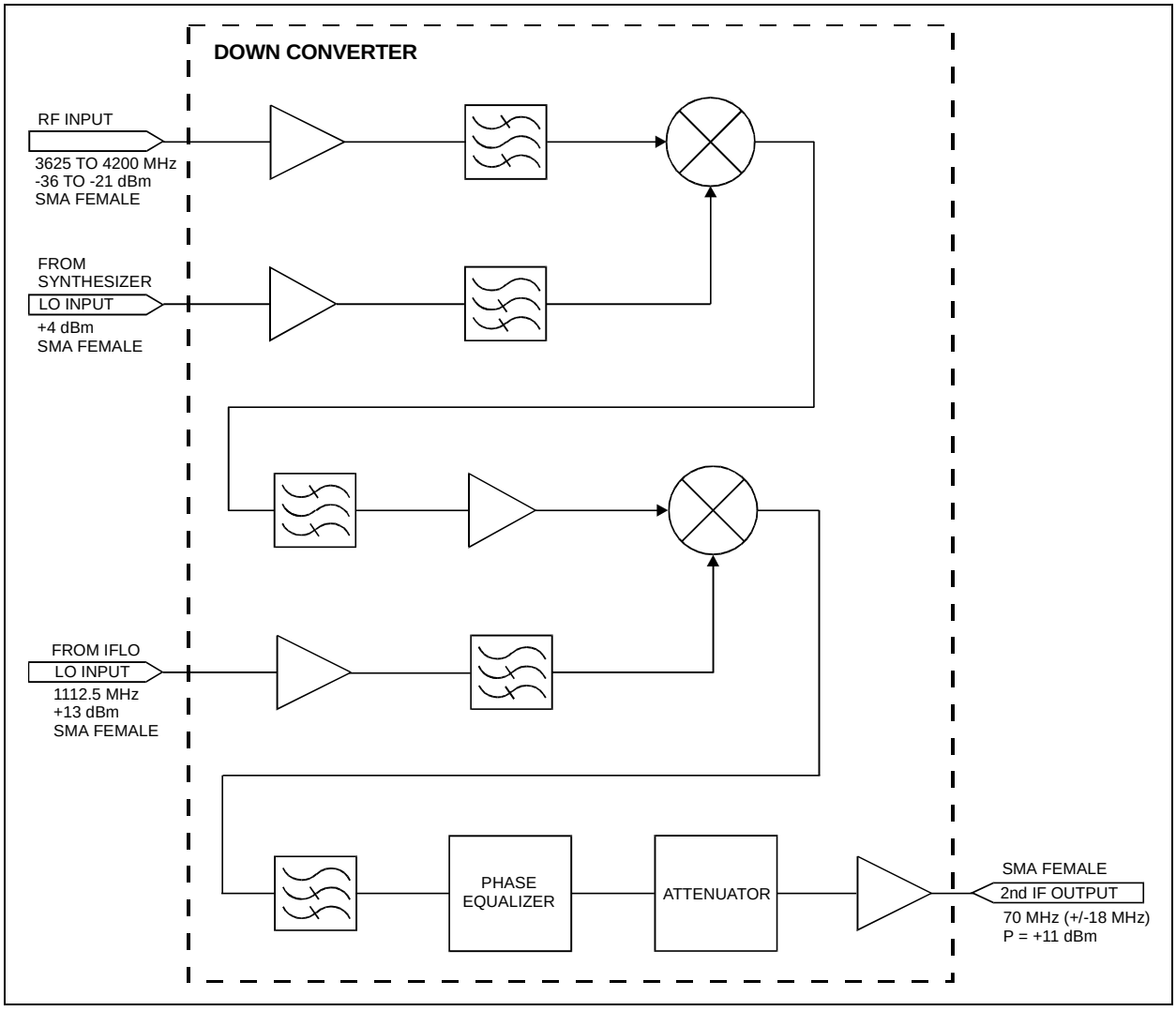

Figure 5-7. Down Converter Block Diagram

5.5.1 Specifications

Input Frequency	3620 to 4200 MHz
Input Connector	SMA Female
Input Impedance	50Ω
Input VSWR	1.5:1
Output Frequency	70 MHz (± 18 MHz)
Output Connector	SMA Female
Output VSWR	1.3:1
1 dB Compression	+17.5 dBm

1st IF Synthesizer Input	
Frequency	4662.5 to 5242.5 MHz, in 125 kHz steps
Level	+8 dBm
Connector	SMA Female
Return Loss	14 dB
Impedance	50Ω

2nd IF Local Oscillator Input	
Frequency	1112.5 MHz
Level	+13 dBm
Connector	SMA Female
Return Loss	14 dB
Impedance	50Ω

5.5.2 Theory of Operation

The RFT-505 down converter utilizes a dual conversion process to convert from an input RF frequency band of 3620 to 4200 MHz, to an output baseband 70 MHz IF signal.

The first conversion requires a down converter synthesizer frequency input to mix with the RF input.

The M&C board controls the frequency selection of the synthesizer.

The synthesizer output frequency band is from 4662.5 to 5242.5 MHz, in 125 kHz steps.

The output of the first mixing process is at a frequency of 1042.5 MHz. The 1042.5 MHz output is applied to the second mixer, which mixes with an IF Local Oscillator frequency input at 1112.5 MHz.

The output of the second mixer is the desired baseband 70 MHz IF signal.

The M&C board interpolates the factory preset compensation data that is stored in an EEPROM inside the down converter. This data allows the M&C board to command and compensate the down converter's output power, ensuring proper output power levels over the entire frequency and temperature range.

The M&C board also supplies the DC power for the LNA, which is subsequently injected into the RF input connector.

5.6 Up Converter

The function of the up converter is to convert the 70 MHz IF signal from the indoor unit modem to a C-band signal to be transmitted.

Refer to Figure 5-8 for a functional block diagram of the up converter.

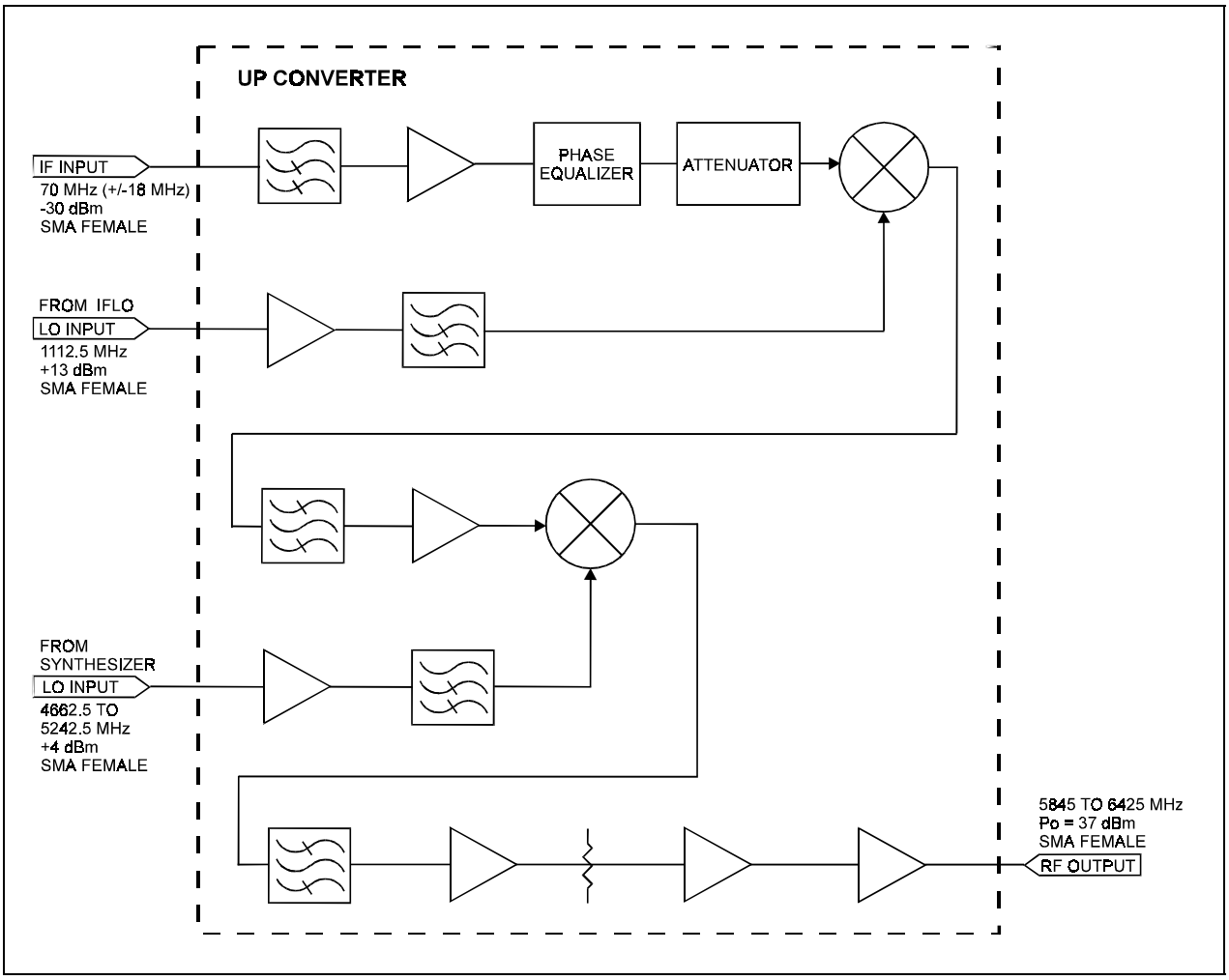

Figure 5-8. 5W Up Converter Block Diagram

5.6.1 Specifications

Input Frequency	70 MHz (± 18 MHz)
Input Connector	SMA Female
Input Impedance	50Ω
Input VSWR	1.3:1
Output Frequency	5845 to 6425 MHz
Output Connector	SMA Female
Output VSWR	1.5:1
1 dB Compression	+37 dBm

1st RF Local Oscillator Input	
Frequency	1112.5 MHz
Level	+13 dBm
Connector	SMA Female
Return Loss	10 dB
Impedance	50Ω

2nd RF Synthesizer Input	
Frequency	4662.5 to 5242.5 MHz, in 125 kHz steps
Level	+4 dBm
Connector	SMA Female
Return Loss	10 dB
Impedance	50Ω

5.6.2 Theory of Operation

The RFT-505 up converter utilizes a dual conversion process to convert from a baseband 70 MHz IF signal to the output RF frequency band. The first conversion requires an IF Local Oscillator frequency input at 1112.5 MHz from the synthesizer module.

The output of the first mixing process is at a frequency of 1182.5 MHz. The 1182.5 MHz output is applied to the second mixer which mixes with the synthesizer frequency input.

The M&C board controls the frequency selection of the synthesizer and the U/C attenuator.

The M&C board also interpolates the factory preset compensation data that is stored in an EEPROM inside the up converter. This data allows the M&C board to command and compensate the up converter's output power, ensuring proper output power levels over the entire frequency and temperature range.

The up converter synthesizer output frequency band is from 4662.5 to 5242.5 MHz, in 125 kHz steps.

The output of the second mixer is the desired RF frequency band of 5845 to 6425 MHz.

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6 Chapter 6. MAINTENANCE

This chapter provides information on how to use test points and LEDs on the M&C board for troubleshooting. In addition, this chapter provides guidelines for troubleshooting faults.

6.1 Test Points and LEDs

Test points and LEDs are included on the M&C board for quick troubleshooting references. LEDs are a visual reference. Test points are used when more troubleshooting is required.

Refer to Table 6-1 for a list of LEDs and their functions. Refer to Table 6-2 for a list of test points on the M&C board.

Table 6-1. M&C LEDs

Name	Color	Description
HPA FLT	Red	Illuminates when the high-power amplifier is faulted or turned off. This fault will cause the transmitter to turn OFF.
IFLO FLT	Red	Illuminates when the IF local oscillator is out of lock. This fault will cause the transmitter to turn OFF.
SYN FLT	Red	Illuminates when synthesizer 1 is out of lock. This fault will cause the transmitter to turn OFF.
2ND SYN FLT	Red	Illuminates when synthesizer 2 (optional) is out of lock. This fault will cause the transmitter to turn OFF.
LNA FLT	Red	Illuminates when the LNA is faulted, or LNA has not been calibrated.
RF ON	Yellow	Illuminates when the high-power amplifier is turned ON.
12.5V	Green	Illuminates when 12.5V is applied to board.
5V	Green	Illuminates when 5V is applied to board.
OSC FLT	Red	Illuminates when reference oscillator fault is detected.
U/C FLT	Red	Illuminates when U/C is not connected, or is faulted.

Name	Color	Description
D/C FLT	Red	Illuminates when D/C is not connected, or is faulted.
LNA PWR	Yellow	Illuminates when LNA power is ON.

6.2 Fault Isolation

Once the terminal has been set up for operation, troubleshooting faults can be accomplished by monitoring the terminal faults remotely, via the optional KP-10 external keypad, or by removing the cover and observing the LEDs on the M&C board.

The following table should be used in isolating a problem and deciding the appropriate action to be taken.

Refer to Figures 6-1 and 6-2 for the locations of the various modules mentioned in this list.

Fault	Possible Problem and Action
+5 VOLT	+5V power supply fault. Indicates the +5V power supply on the M&C board is at a high or a low voltage condition. Allowable level variation is ± 5%. Check for a short on the +5V line, or faulty connection at P4 on the M&C board.
+12 VOLT	+12V supply fault. Indicates the +12V power supply is at a high or low voltage condition. Check for a short on the +12V line, or faulty connections between any of the internal modules.
HPA	High Power Amplifier fault. Verify that the RF output is programmed ON. Check for a loose connection at J3. If acceptable, replace the U/C-HPA module. Once the problem has been corrected, the transmitter must be turned back ON.
OSC	Reference Oscillator fault. Check RF cable from reference oscillator module to synthesizer/IFLO module. Check P4 on M&C and P13 on oscillator module. If acceptable, replace the reference oscillator module.
D/C	Down Converter fault. Indicates either faulty connection of module or missing temperature/frequency compensation. Check P4 (at M&C) and J8 (at U/C). If acceptable, replace D/C module.
U/C	Up Converter fault. Indicates either faulty connection of module or missing temperature/frequency compensation. Check J3 (at M&C) and P12 (at U/C). If acceptable, replace U/C-HPA module.
SYNTH	Synthesizer fault. Indicates that the synthesizer if out of lock. Check the RF cable from reference oscillator module to the synthesizer/IFLO module. Check J9, J8, and P7. If acceptable, replace the synthesizer/IFLO module.
IFLO	IF Local Oscillator fault. Indicates the IFLO is out of lock. Check the connection of the RF cable from reference oscillator module, J9, J8, and P7. If acceptable, replace the synthesizer/IFLO module.
LNA	Low Noise Amplifier fault. Check the RF cable from the LNA to J4 of the RFT-505 terminal. If acceptable, replace the LNA.

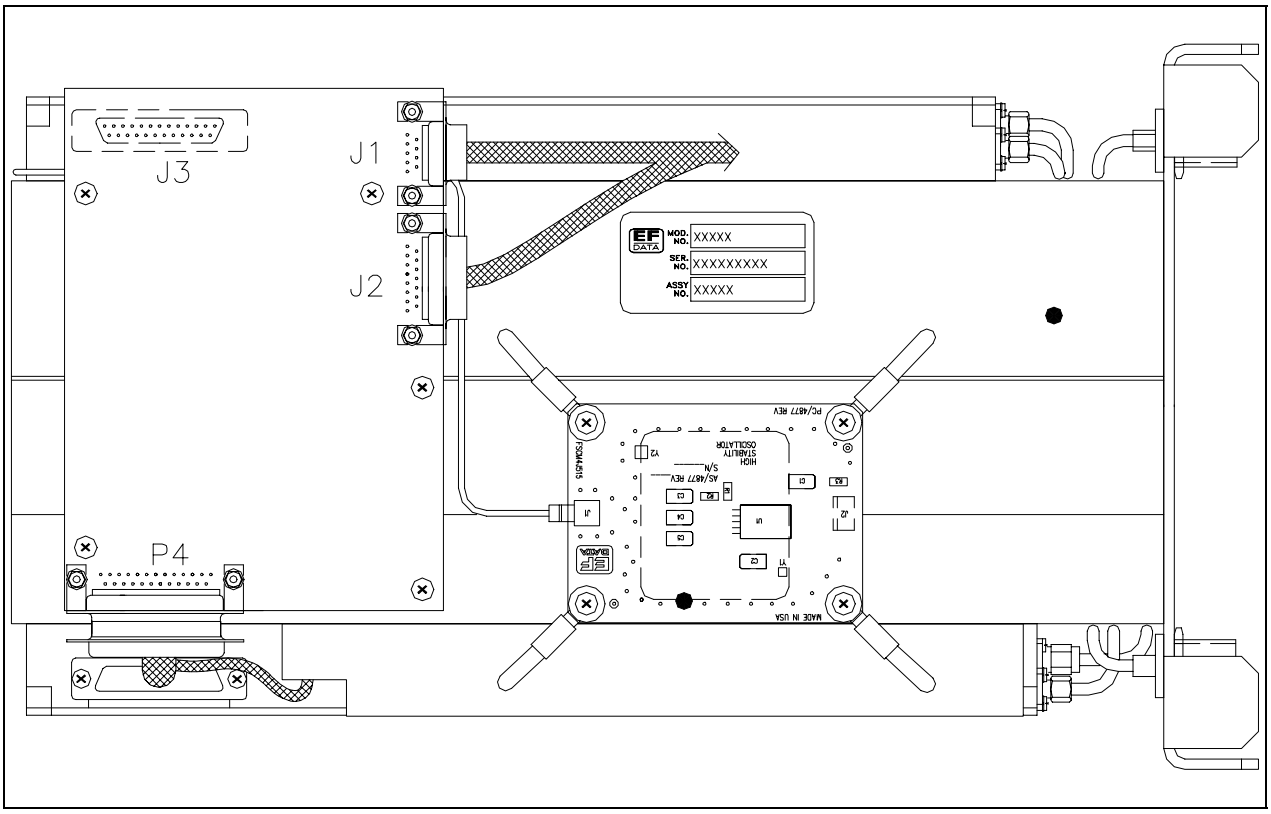

Figure 6-1. RFT-505 Inside Front View

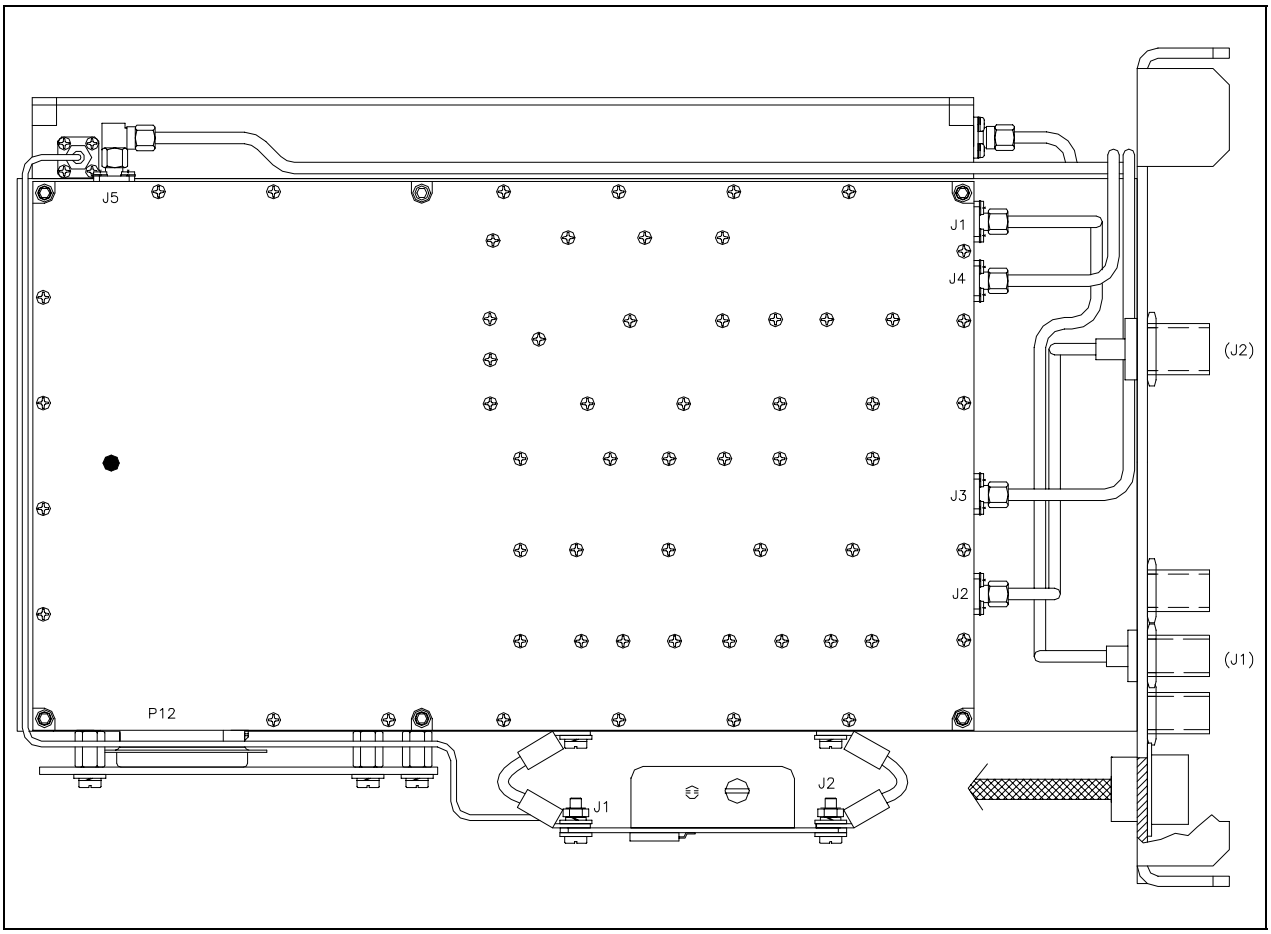

Figure 6-2. RFT-505 Inside Rear View

Appendix A. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the RFT-505.

- Firmware number: FW/4644-1
- Software version: 1.0

A.1 General

Remote controls and status information are transferred via an RS-485 (optional RS-232-C) serial communications link.

Commands and data are transferred on the remote control communications link as US ASCII-encoded character strings.

The remote communications link is operated in a half-duplex mode.

Communications on the remote link are initiated by a remote controller or terminal. The RFT-505 never transmits data on the link unless it is commanded to do so.

A.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits
- 1 parity bit
- 2 stop bits

or:

- 1 start bit
- 8 information bits
- no parity bit
- 2 stop bits

Messages on the remote link fall into the categories of commands and responses.

Commands are messages which are transmitted to an RFT-505, while responses are messages returned by an RFT-505 in response to a command.

The general message structure is as follows:

- Start Character
- Device Address
- Command/Response
- End of Message Character

A.2.1 Start Character

A single character precedes all messages transmitted on the remote link. This character flags the start of a message. This character is:

- "<" for commands
- ">" for responses

A.2.2 Device Address

The device address is the address of the controller which is designated to receive a transmitted command, or which is responding to a command.

Valid device addresses are 1 to 3 characters long, and in the range of 1 to 255. Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link. Devices do not acknowledge global commands.

Each RFT-505 which is connected to a common remote communications link must be assigned its own unique address. Addresses are software selectable and must be in the range of 1 to 255.

Note: Global address "*" is reserved for the external keypad (i.e., the KP-10).

A.2.3 Command/Response

The command/response portion of the message contains a variable length character sequence which conveys command and response data.

If a satellite modem receives a message addressed to it which does not match the established protocol or cannot be implemented, a negative acknowledgment message is sent in response. This message is:

- >add/?ER1_parity error'cr''lf']
  (Error message for EV, OD, or NO parity errors.)
- >add/?ER2_invalid parameter'cr''lf']
  (Error message for a recognized command which cannot be implemented or has parameters which are out of range.)
- >add/?ER3_unrecognizable command'cr''lf']
  (Error message for unrecognizable command or bad command syntax.)
- >add/?ER4_converter in local mode'cr''lf']
  (Controller in lock mode. Must go to enable mode first.)
- >add/?ER5_not supported by hardware'cr''lf']
  (Command is a valid command. However, it is not supported by the current hardware configuration.)

  Note: "add" is used to indicate a valid 1 to 3 character device address in the range between 1 and 255.

A.2.4 End Character

Each message is ended with a single character which signals the end of the message:

- "cr" Carriage return character for commands
- "]" End bracket for responses

Note: For the external keypad (i.e., the KP10), the end of message character is:

- "cr]" Carriage return and end bracket for commands
- "]" End bracket for responses

A.3 Configuration Commands/Responses

Up Converter Freq Select	Command: Response: Status: Response:	<add/UCF_nnnn.nnn'cr' >add/UCF_nnnn.nnn'cr' RF_OFF'cr''lf'] <add/UCF'cr' >add/UCF_nnnn.nnn'cr''lf']	Where: nnnn.nnn = 5845.0 to 6425.0 MHz, in 2.5 MHz or 125 kHz step size. D/C frequency is 2225 MHz for single synthesizer system.
Down Converter Freq Select	Command: Response: Status: Response:	<add/DCF_nnnn.nnn'cr' >add/DCF_nnnn.nnn'cr''lf'] <add/DCF'cr' >add/DCF_nnnn.nnn'cr''lf']	Where: nnnn.nnn = 3620.0 to 4200.0 MHz, in 2.5 MHz steps or 125 kHz step size. Status only for single synthesizer system.
RF Output	Command: Response: Status: Response:	<add/RF_xxx'cr' >add/RF_xxx'cr''lf'] <add/RF_'cr' >add/RF_xxx'cr''lf']	Where: xxx = ON, WRM, or OFF. The OFF command will keep the RF output turned off under all conditions. The WRM command is a conditional ON command instructing the RF output to come on after the unit is warmed up and meets stability requirements. The ON command is an override, instructing the output to be on and ignoring the warm start. The ON command cannot override faults.
Up Converter Attenuator	Command: Response: Status: Response:	<add/UCA_nn.n'cr' >add/UCA_nn.n'cr''lf'] <add/UCA_'cr' >add/UCA_nn.n'cr''lf']	Where: nn.n = 0 to 25.0 dB, in 0.5 dB steps.
Down Converter Attenuator	Command: Response: Status: Response:	<add/DCA_nn.n'cr' >add/DCA_nn.n'cr''lf'] <add/DCA_'cr' >add/DCA_nn.n'cr''lf']	Where: nn.n = 0 to 21.0 dB, in 0.5 dB steps.
LNA Calibration	Command: Response:	<add/CLNA_'cr' >add/CLNA_'cr''lf']	Performs a current windowing calibration on the LNA. This is only done once during the initial installation.
LNA Fault Enable	Command: Response: Status: Response:	<add/LFE_xxx'cr' >add/LFE_xxx'cr''lf'] <add/LFE_'cr' >add/LFE_xxx'cr''lf']	Where: xxx = ON (the default, enable monitor) or OFF.
Reference Freq Adjust	Command: Response: Status: Response:	<add/RFJ_nnn'cr' >add/RFJ_nnn'cr''lf'] <add/RFJ_'cr' >add/RFJ_nnn'cr''lf']	Where: nnn = DAC setting from 0 to 255. Where: nnn = Current DAC setting.
Lock Mode	Command: Response: Status: Response:	<add/LM_xx'cr' >add/LM_xx'cr''lf'] <add/LM_'cr' >add/LM_xx'cr''lf']	Where: xx = LK (lock) or EN (enable) (the default). Lock mode prevents the current settings from being changed.

External Fault Enable	Command: Response: Status: Response:	<add/XFE_xxx'cr' >add/XFE_xxx'cr''lf'] <add/XFE_'cr' >add/XFE_xxx'cr''lf']	Where: xxx = ON (the default) or OFF.
LNA Power Enable	Command: Response: Status: Response:	<add/LPE_xxx'cr' >add/LPE_xxx'cr''lf'] <add/LPE_'cr' >add/LPE_xxx'cr''lf']	Where: xxx = ON (the default, enable power) or OFF.
Select Preset Config	Command: Response: Status: Response:	<add/SEL_n'cr' >add/SEL_n'cr''lf'] <add/SEL_'cr' >add/SEL_'cr'	Where: n = 1, 2, or 3. 1 UCF_nnnn.nnn'cr' nnnn.nnn = 5845.0 to 6425.0 MHz. DCF_nnnn.nnn nnnn.nnn = 3620.0 to 4200.0 MHz. UCA_nn.n'cr' nn.n = 0.0 to 25.0 dB (UC Fine Adj). DCA_nn.n'cr' nn.n = 0.0 to 21.0 dB (DC Fine Adj). 2 UCF_nnnn.nnn'cr' nnnn.nnn = 5845.0 to 6425.0 MHz. DCF_nnnn.nnn nnnn.nnn = 3620.0 to 4200.0 MHz. UCA_nn'cr' nn.n = 0.0 to 25.0 dB (UC Fine Adj). DCA_nn n'cr' nn.n = 0.0 to 21.0 dB (DC Fine Adj). 3 UCF_nnnn.nnn'cr' nnnn.nnn = 5845.0 to 6425.0 MHz. DCF_nnnn.nnn nnnn.nnn = 3620.0 to 4200.0 MHz. UCA_nn.n'cr' nn.n = 0.0 to 25.0 dB (UC Fine Adj). DCA_nn.n'cr''lf'] nn.n = 0.0 to 21.0 dB (DC Fine Adj). Allows the user to select any one of three 'PreSet' configurations. The users must first program (store) a configuration using the PGM_n command defined below. This command used without the Preset number (n) will provide the current programming of each of the three Presets.
Redundant Switch Mode	Command: Response: Status: Response:	<add/RSW_xxxxx'cr' >add/RSW_xxxxx'cr''lf'] <add/RSW_'cr' >add/RSW_xxxxx'cr''lf']	Where: xxxxx = INDEP (the default) or DEP. Note: For use in redundant system only with RSU-503 switch. (INDEP TX and RX switch independently on fault to backup terminal. DEP switches both TX and RX on fault to backup terminal.)
Program Preset Config	Command: Response: Status: Response:	<add/PGM_n'cr' >add/PGM_n'cr''lf'] <add/PGM_'cr' >add/PGM_'cr'	Where: n = 1, 2, or 3. 1 xxxxxxxxxx'cr' xxxxxxxxxx = 'Programmed' or 'None'. 2 xxxxxxxxxx'cr' 3 xxxxxxxxxx'cr''lf'] Allows the user to store (program) the current frequency and attentuator settings as one of three 'PreSet' selections.

Clear Program Preset Config	Command: Response: Status: Response:	<add/CPGM_n'cr' >add/CPGM_n'cr''lf'] <add/CPGM_'cr' >add/CPGM_'cr'	Where: n = 1, 2, or 3. 1 xxxxxxxxxx'cr' xxxxxxxxxx = 'Programmed' or 'None'. 2 xxxxxxxxxx'cr' 3 xxxxxxxxxx'cr''lf'] Allows the user to clear (unprogram) the frequency and attentuator setting for one of three 'PreSet' selections.
RS-232 Address Select	Command: Response: Status: Response:	<add/AS_xxx'cr' >add/AS_xxx'cr''lf'] <add/AS_'cr' >add/AS_xxx'cr''lf']	Where: add = current address. xxx = new address, 1 to 255. Default address = 1.
RS-232 Baud Rate Select	Command: Response: Status: Response:	<add/BR_xxxxx'cr' >add/BR_xxxxx'cr''lf'] <add/BR_'cr' >add/BR_xxxxx'cr''lf']	Where: xxxxx = 300 to 19200, in standard settings of 300, 600, 1200, 2400, 4800, 9600, and 19200. Default = 9600.
RS-232 Parity Select	Command: Response: Status: Response:	<add/PS_xx'cr' >add/PS_xx'cr''lf'] <add/PS_'cr' >add/PS_xx'cr''lf']	Where: xx = OD (odd), EV (even, the default), or NO (none - 8 bit).

A.4 Status Commands/Responses

Config Status	Command: Response:	<add/OS_'cr' >add/OS_'cr' UCF_nnnn.nnn'cr' DCF_nnnn.nnn'cr' RF_xxx'cr' DCA_nn.n'cr' UCA_nn.n'cr' SEL_n'cr''lf']	nnnn.nnn = 5845.0 to 6425.0 MHz. nnnn.nnn = 3620.0 to 4200.0 MHz. xxx = ON, WRM, or OFF. nn.n = 0.0 to 21.0 dB. DC Fine Adj. nn.n = 0.0 to 25.0 dB. UC Fine Adj. n = 1, 2, 3, or None. The command returns a block of data to be returned by the addressed RFT-505. The block of data reflects the current configuration status.
Fault Status	Command: Response:	<add/FS_'cr' >add/FS_'cr' RST_xxx'cr' UL_xxx'cr' DL_xxx'cr' PS5_xxx'cr' P12_xxx'cr' HPA_xxx'cr' LNA_xxx'cr' SYN_xxx'cr' ILD_xxx'cr' OSC_xxx'cr' UCM_xxx'cr' DCM_xxx'cr' SL2_xxx'cr''lf'] See Note	xxx = OK or FLT. Unit experienced a restart. xxx = OK or FLT. Uplink fault. xxx = OK or FLT. Downlink fault. xxx = OK or FLT. +5V power supply. xxx = OK or FLT. +12V power supply. xxx = OK or FLT. Power amp fault. xxx = OK or FLT. LNA fault. xxx = OK or FLT. Synthesizer1 L0 Lock Detect. xxx = OK or FLT. IF LO Lock Detect. xxx = OK or FLT. 10 MHz REF OSC. xxx = OK or FLT. UC Module fault. xxx = OK or FLT. UC Module fault. xxx = OK, FLT, or NA. Synthesizer2 L0 Lock Detect. This command returns a block of data reflecting the current and logged faults. Logged faults will be reset when receiving this command, while current faults can be read on the second request. Note: Valid only in dual synthesizer systems, else N/A.
Summary Fault Status	Command: Response:	<add/SF_'cr' >add/SF_xxx'cr''lf']	Where: xx = OK or FLT. Returns status of current faults only.
Maintenance Status	Command: Response:	<add/MS_'cr' >add/MS_'cr' UCT_nn'cr' DCT_nn'cr' HPT_nn'cr'	nn = UC temperature in degrees C. nn = DC temperature in degrees C. nn = Power Amp temp in degrees C. This command returns a block of data from the RFT-505 reflecting the status of certain internal parameters for the purpose of troubleshooting.
Equipment Type Status	Command: Response:	<add/ET_'cr' >add/ET_xx'cr''lf']	Where: xx = RFT-505 SW_1.00. This command returns the equipment type polled and software version.

Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
16QAM	16 Quadrature Amplitude Modulation
8PSK	8 Phase Shift Keying
A	Ampere
A/D	Analog to Digital
AC	Alternating Current
ADC	Analog to Digital Converter
ADJ	Adjust
ADMA	Amplitude Domain Multiple Access
ADPCM	Adaptive Differential Pulse Code Modulation
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
AOC	Automatic Offset Control
APM	Amplitude Phase Modulation
ASC	Add-Select-Compare
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying
ASYNC	Asynchronous
AUPC	Automatic Uplink Power Control
AUX 1	Auxiliary 1
AVC	Automatic Volume Control
BB	Baseband
BCD	Binary Coded Decimal
BER	Bit Error Rate
BER CONT	BIT Error Rate Continuous
bit/s	bits per second
BPSK	Bi-Phase Shift Keying
BTU	British Thermal Unit

Acronym/ Abbreviation	Definition
BW	Backward Alarm or Bandwidth
BWR	Bandwidth Ratio
C	Celsius
C/N	Carrier-to-Noise Ratio
C/No	Carrier-to-Noise Density Ratio
CCITT	International Telephone and Telegraph Consultative Committee
CDMA	Code Division Multiple Access
CH	Channel
CHNL	Channel
CIC	Common Interface Circuit
CL	Carrier Loss
CLK	Clock
CLNA	C-band LNA
CLR	Clear
CMOS	Complementary Metal Oxide Semiconductor
Coax	Coaxial
Codec	Coder/Decoder
COM	Common
CPFSK	Continuous-Phase Frequency Shift Keying
CPSK	Coherent Phase Shift Keying
CPU	Central Processing Unit
cr	Carriage Return
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CS	Clear to Send
CSC	Comstream Compatible
CSMA	Carrier Sense Multiple Access
CTS	Clear to Send
CU	Channel Unit
CW	Continuous Wave
D&I	Drop and Insert
D/A	Digital-to-Analog
D/C	Down Converter
DAC	Digital-to-Analog Converter
DAMA	Demand Assignment Multiple Access
dB	Decibels
dB/Hz	Decibels/Hertz (unit of carrier-to-noise density ratio)
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
dBm0	The signal magnitude in dBm referenced to the nominal level at that point
dBW	Decibels referred to 1.0 watt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DCPSK	Differentially Coherent Phase Shift Keying
DDO	Drop Data Output
DDS	Direct Digital Synthesis
Demod	Demodulator
DEMUX	Demultiplexer
DET	Detector
DM	Data Mode
DPCM	Differential Pulse Code Modulation
DPSK	Differential Phase Shift Keying
DSP	Digital Signal Processing
DSR	Data Signal Rate

Acronym/ Abbreviation	Definition
DTE	Data Terminal Equipment
E&M	Ear and Mouth
E_b/N_0	Bit Energy-to-Noise Ratio
ECL	Emitter Coupled Logic
EDP	Electronic Data Processing
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EFD	EFData Compatible
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
EMF	Electromotive Force
EPROM	Erasable Read-Only Memory
ESC	Engineering Service Circuit or Engineering Service Channel
ESD	Electrostatic Discharge
EXC	External Clock
EXT	External Reference Clock
FDC	Fairchild Data Compatible
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FET	Field Effect Transistor
FFSK	Fast Frequency Shift Keying
FIFO	First in/First Out
Flt	Fault
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
FS	Frame Sync
FSK	Frequency Shift Keying
FW	Firmware
GHz	Gigahertz (10^9 hertz)
GND	Ground
HI STAB	High Stability
HPA	High Power Amplifier
Hz	Hertz (cycle per second)
I&Q	In-Phase and Quadrature
I/O	Input/Output
IBS	INTELSAT Business Services
IC	Integrated Circuit
IDI	Insert Data Input
IDR	Intermediate Data Rate
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
ISD	Insert Send Data
k	kilo (10^3)
KΩ	kilo-ohms
kbit/s	Kilobits per second (10^3 bits per second)
kHz	Kilohertz (10^3 Hertz)
ks/s	Kilosymbols Per Second (10^3 symbols per second)
kW	Kilowatt (10^3 Watts)
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
lf	Line Feed
LNA	Low Noise Amplifier
LO	Local Oscillator

Acronym/ Abbreviation	Definition
LSB	Least Significant Bit
LSI	Large Scale Integration (semiconductors)
m	mille (10^{-3})
M&C	Monitor and Control
mA	Milliamperes
Max	Maximum
Mbit/s	Megabits per second
MC	Monitor and Control
MFS	Multiframe Sync
MHz	Megahertz (10^6 Hertz)
Min	Minimum or Minute
Mod	Modulator
MOP	Modulated Output Power
MPC	Microprocessor Controller
ms	Millisecond (10^{-3} second)
Ms/s	Megasymbols per second
MSB	Most Significant Bit
MUX	Multiplexer
n	nano (10^{-9})
N/A	Not Applicable
NACK	Negative Acknowledgment
NC	No Connection or Normally Closed
NO	Normally Open
NRZ	Non-Return to Zero (code)
ns	Nanosecond (10^{-9} second)
OQPSK	Offset Quadrature Phase Shift Keying
OSC	Oscillator
p	pico (10^{-12})
P-P	Peak-to-Peak
P/AR	Peak to Average Ratio
PAL	Programmable Array Logic
PC	Printed Circuit
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PECL	Positive Emitter Coupled Logic
pF	PicoFarads (10^{-12} Farads)
PK	Peak
PLL	Phase-Locked Loop
PN	Pseudo-Noise
PPM	Parts Per Million
PS	Power Supply
PSK	Phase Shift Keying
PWB	Printed Wiring Board
PWR	Power
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
REF	Reference
RF	Radio Frequency
RLSD	Receive Line Signal Detect
RMA	Return Material Authorization
ROM	Read-Only Memory
RR	Receiver Ready
RS	Ready to Send

Acronym/ Abbreviation	Definition
RT	Receive Timing
RTS	Request to Send
RX	Receive (Receiver)
RXCLK	Receive Clock
RXD	Receive Data
RZ	Return-to-Zero
s	Second
S/N	Signal-to-Noise Ratio
SCPC	Single Channel Per Carrier
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SFS	Subframe Sync
SMS	Satellite Multiservice System
SN	Signal-to-Noise Ratio
SSB	Single-sideband
SSPA	Solid State Power Amplifier
ST	Send Timing
SW	Switch
SYNC	Synchronize
TB	Terminal Block
TCXO	Temperature-Compensated Crystal Oscillator
TDMA	Time Division Multiple Access
TEMP	Temperature
TERR	Terrestrial
TP	Test Point
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
TXCLK	Transmit Clock
TXD	Transmit Data
TXO	TX Octet
U/C	Up converter
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-high Frequency
UNK	Unknown
US	United States
UW	Unique Word
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VCXO	Voltage-Controlled Crystal Oscillator
VDC	Volts, Direct Current
VSWR	Voltage Standing Wave Ratio
W	Watt
WG	Waveguide

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Errata A

Comtech EFData Documentation Update

Subject: Changes to Table 1-2 (Gain Adjust Range)

Date: October 24, 1997
Document: CST-5005 C-Band Satellite Terminal Installation and Operation Manual, Rev. 1, dated July 23, 1996
Part Number: MN/CST5005.EA1
Collating Instructions: Attach this page to page 1-1

Comments:

The following changes provide updated information for Table 1-2. This information will be incorporated into the next revision.

Change Specifics:

Table 1-2. RFT-505 Specifications

Transmit	
Output Frequency (No inversion)	5.845 to 6.425 GHz
Input Frequency	70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz)
Output Power: at 1 dB compression	 +8 dBm or 5W (+37 dBm) or 10W (+40 dBm)
Third Order Intercept	+18 dBm (for +8 dBm) or +46 dBm (for 5W) or +49 dBm (for 10W)
Nominal Small Signal Gain	26 dB (for +8 dBm) or 68 dB (for 5W) or +71 dBm (for 10W)
Gain Adjust Range (from nominal)	0 to 25 dB, in 0.5 dB steps
Gain Variation: Over 36 MHz Over 36 MHz, temperature, and aging	 ± 1 dB max 4 dB max variation
Noise Figure: Maximum attenuation Minimum attenuation	 23 dB max 15 dB max
Group Delay, Total Variation in Passband	10 ns max
Synthesizer Step Size	125 kHz

Synthesizer Phase Noise	-60 dBc/Hz at 100 Hz -70 dBc/Hz at 1 kHz -80 dBc/Hz at 10 kHz -90 dBc/Hz at 100 kHz
Frequency Stability: At shipment Daily at 23°C Annual at 23°C Over temperature After 30 minutes warm-up Electrical adjustment	 $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-7}$ $\pm 1 \times 10^{-8}$ (-40 to +55°C) $\pm 1 \times 10^{-8}$ 0.5×10^{-7}
Isolation on Fault Shutdown	-60 dBc
Spurious: signal related ≤ 250 kHz carrier offset > 250 kHz carrier offset non-signal related	 -35 dBc max -50 dBc max < -15 dBm/44 kHz max
HPA Harmonics	-50 dBc max
RF Output VSWR	1.35:1 at 50Ω
RF Output Connector	Type N female
IF Input VSWR	1.5:1 at 50Ω
IF Input Connector	Type N female

Receive	
Input Frequency (No inversion)	3.620 to 4.2 GHz
Output Frequency	70 MHz, ± 18 MHz (optional 140 MHz, ± 36 MHz)
Output Power at 1 dB Comp	+15 dBm
Gain Adjust Range (with LNA)	0 to 21 dB, in 0.5 dB steps
Gain Variation (with LNA): Over 36 MHz Over 36 MHz, temperature, and aging	 ± 1.5 dB max ± 4 dB max
Noise Temperature (with LNA)	LNA specification
Group Delay, Total Variation in Passband	10 ns max
Synthesizer Step Size	125 kHz
Synthesizer Phase Noise	-60 dBc/Hz at 100 Hz -70 dBc/Hz at 1 kHz -80 dBc/Hz at 10 kHz -90 dBc/Hz at 100 kHz
Frequency Stability: At shipment Daily at 23°C Annual at 23°C Over temperature After 30 minutes warm-up Electrical adjustment	 $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-8}$ $\pm 1 \times 10^{-7}$ $\pm 1 \times 10^{-8}$ (-40 to +55°C) $\pm 1 \times 10^{-8}$ 0.5×10^{-7}
Spurious In Band	-60 dBc max
Image Rejection (all conversions)	> 50 dB
Linearity	Intermods < -35 dBc for two tones at -89 dBm at +95 dB gain
RF Input VSWR (with LNA)	1.35:1 at 50Ω
RF Input Connector	Type N female
IF Output VSWR	1.5:1 at 50Ω
IF Output Connector	Type N female