MBT-4000B

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ISO9001 / AS9100
Registered Company

Multi-Band Transceiver System
Installation and Operation Manual

Part Number MN/MBT4000B.IOM
Revision 2
June 7, 2022

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding this product. Product specifications are subject to change without prior notice.

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Revision History

Rev	Date	Description
1	---	Initial Release.
2	5/18/2022	- Updated Chapter 3, Sections 3.2 and 3.2.1.1 - Updated company name, logo, base font and format throughout.

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Units of Measurement

Unit / Symbol	Definition
Ω	Ohm
A	Ampere
AC	Alternating Current
bps	bits per second
˚C	Celsius (degrees)
DC	Direct Current
Hz	Hertz
kHz	kiloHertz
dB	decibel
dBc	Decibels relative to the carrier
dBm	Decibel-milliwatts
˚F	Fahrenheit (degrees)
Kbps	Kilobit per second
kg	kilogram
ksps	Kilosymbols per second
lbs.	pounds
mA	Milli-amp
Mbps	Megabit per second
MHz	Megahertz
mm	millimeter
ms	millisecond
Msps	Megasymbols per second
mW	milliwatt
in.	inch
Pps	Packets per second
µF	100 micro-farads
W	Watt
V	Volt

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PREFACE

About this Manual

This manual provides installation and operation information for the Comtech Satellite Network Technologies, Inc (Comtech) MBT-4000 Multi-Band Transceiver System. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the MBT-4000.

Disclaimer

This manual (CEFD P/N MN/MBT4000B.IOM) has been revised in its entirety to comply with current Comtech Technical Publications standards and practices.

Comtech has reviewed this manual thoroughly in order to provide 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 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, contact Comtech Product Support.

Conventions and References

Patents and Trademarks

See all of Comtech's Patents and Patents Pending at http://patents.comtechefdata.com.

Warnings, Cautions, and Notes

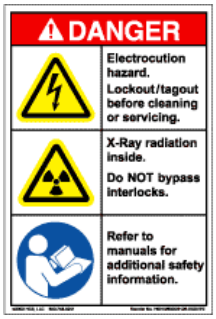
A <u>WARNING</u> informs you about a possible hazard that MAY CAUSE DEATH or SERIOUS INJURY.

A <u>CAUTION</u> informs you about a possible hazard that MAY CAUSE INJURY or PROPERTY DAMAGE.

A <u>NOTE</u> gives you important information about a task or the equipment.

A <u>REFERENCE</u> directs you to additional information about a task or the equipment.

Examples of Multi-Hazard Notices



Recommended Standard Designations

The new designation of the Electronic Industries Association (EIA) supersedes the Recommended Standard (RS) designations. References to the old designations may be shown when depicting actual text (e.g., RS-232). All other references in the manual refer to EIA designations.

The user should carefully review the following information:

Safety and Compliance

Electrical Safety and Compliance

The unit complies with the **EN 60950 Safety of Information Technology Equipment (Including Electrical Business Machines)** safety standard.

IF THE UNIT IS OPERATED IN A VEHICLE OR MOVABLE INSTALLATION, MAKE SURE THE UNIT IS STABLE. OTHERWISE, EN 60950 SAFETY IS NOT GUARANTEED.

Electrical Installation

CONNECT THE UNIT TO A POWER SYSTEM THAT HAS SEPARATE GROUND, LINE AND NEUTRAL CONDUCTORS. DO NOT CONNECT THE UNIT WITHOUT A DIRECT CONNECTION TO GROUND.

Operating Environment

DO NOT OPERATE THE UNIT IN ANY OF THESE EXTREME OPERATING CONDITIONS:

- ***AMBIENT TEMPERATURES LESS THAN -40° C (-40° F) OR MORE THAN 50° C (122° F).***
- ***PRECIPITATION, CONDENSATION, OR HUMID ATMOSPHERES OF MORE THAN 95% RELATIVE HUMIDITY.***
- ***UNPRESSURIZED ALTITUDES OF MORE THAN 3048 METRES (10,000 FEET).***
- ***EXCESSIVE DUST.***
- ***FLAMMABLE GASES.***
- ***CORROSIVE OR EXPLOSIVE ATMOSPHERES.***

European Union Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive (1999/5/EC) and EN 301 489-1

Independent testing verifies that the unit complies with the European Union R&TTE Directive, its reference to EN 301 489-1 (***E****lectromagnetic compatibility and* ***R****adio spectrum* ***M****atters [ERM];* ***E****lectro****m****agnetic* ***C****ompatibility [EMC] standard for radio equipment and services, Part 1: Common technical requirements)*, and the Declarations of Conformity for the applicable directives, standards, and practices that follow:

European Union Electromagnetic Compatibility (EMC) Directive (2004/108/EC)

- **Emissions: EN 55022 Class A** – Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.
- **Immunity: EN 55024** – Information Technology Equipment: Immunity Characteristics, Limits, and Methods of Measurement.
- **EN 61000-3-2** – Harmonic Currents Emission
- **EN 61000-3-3** – Voltage Fluctuations and Flicker.
- **Federal Communications Commission Federal Code of Regulation FCC Part 15, Subpart B.**

TO ENSURE THAT THE UNIT COMPLIES WITH THESE STANDARDS, OBEY THESE INSTRUCTIONS:

- To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.
- Operate the unit with its cover on at all times.

European Union Low Voltage Directive (LVD) (2006/95/EC)

Symbol	Description
<HAR>	Type of power cord required for use in the European Community.
	**CAUTION:** Double-pole/Neutral Fusing **ACHTUNG:** Zweipolige bzw. Neutralleiter-Sicherung

International Symbols			
Symbol	**Definition**	**Symbol**	**Definition**
	Alternating Current		Protective Earth
	Fuse		Chassis Ground

For additional symbols, refer to Warnings, Cautions and Notes listed earlier in this Preface.

European Union RoHS Directive (2002/95/EC)

This unit satisfies (with exemptions) the requirements specified in the European Union Directive on the Restriction of Hazardous Substances in Electrical and Electronic Equipment (EU RoHS, Directive 2002/95/EC).

European Union Telecommunications Terminal Equipment Directive (91/263/EEC)

In accordance with the European Union Telecommunications Terminal Equipment Directive 91/263/EEC, the unit should not be directly connected to the Public Telecommunications Network.

CE Mark

Comtech declares that the unit meets the necessary requirements for the CE Mark.

Product Support

For all product support, please call:

+1.240.243.1880

+1.866.472.3963 (toll free USA)

Comtech Headquarters

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Warranty Policy

Comtech products are warranted against defects in material and workmanship for a specific period from the date of shipment, and this period varies by product. In most cases, the warranty period is two years. During the warranty period, Comtech will, at its option, repair or replace products that prove to be defective. Repairs are warranted for the remainder of the original warranty or a 90 day extended warranty, whichever is longer. Contact Comtech for the warranty period specific to the product purchased.

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

All equipment returned for warranty repair must have a valid RMA number issued prior to return and be marked clearly on the return packaging. Comtech strongly recommends all equipment be returned in its original packaging.

Comtech Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

Limitations of Warranty

The warranty does not apply to any part of a product that has been installed, altered, repaired, or misused in any way that, in the opinion of Comtech, would affect the reliability or detracts from the performance of any part of the product, or is damaged as the result of use in a way or with equipment that had not been previously approved by Comtech.

The warranty does not apply to any product or parts thereof where the serial number or the serial number of any of its parts has been altered, defaced, or removed.

The warranty does not cover damage or loss incurred in transportation of the product.

The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech Corporation, such as lightning or other natural and weather-related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

The warranty excludes any responsibility by Comtech for incidental or consequential damages arising from the use of the equipment or products, or for any inability to use them either separate from or in combination with any other equipment or products.

A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

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

Notes:

Chapter 1. INTRODUCTION

1.1 Overview

Comtech Satellite Network Technologies, Inc (Comtech) MBT-4000B Multi-Band RF Transceiver (**Figure 1-1**) is designed to perform C-, X-, or Ku-Band RF to L-Band down conversion and L-Band to C-, X-, Ku-, or Ka-Band RF up conversion.

Figure 1-1. MBT-4000B Multi-Band RF Transceiver

1.2 Functional Description

The MBT-4000B is designed to perform the following functions:

- LNB support for C-, X-, or Ku-Band RF to L-Band down conversion
- L-Band to C-, X-, or Ku-Band RF up conversion
- RF Band switching in minimal time without requiring tools
- Easy expansion for providing a redundant system or other frequency bands
- System status verification via LEDs located behind a removable cover

1.3 System Overview

Figure 1-2 depicts the operation schematic for a typical MBT-4000B application. The MBT-4000B Multi-Band Tranceiver System is constructed in a modular configuration. **Figure 1-2** illustrates the key components of this configuration. The transceiver is constructed in a modular configuration. Common to the configuration for any frequency band of operation is a base module, which provides the M&C, Power Supply, and Reference function. A band-specific BUC module is mounted to the base module with clip-type fasteners. An internal bias tee provides a 10 MHz reference and bias voltage for an external LNB.

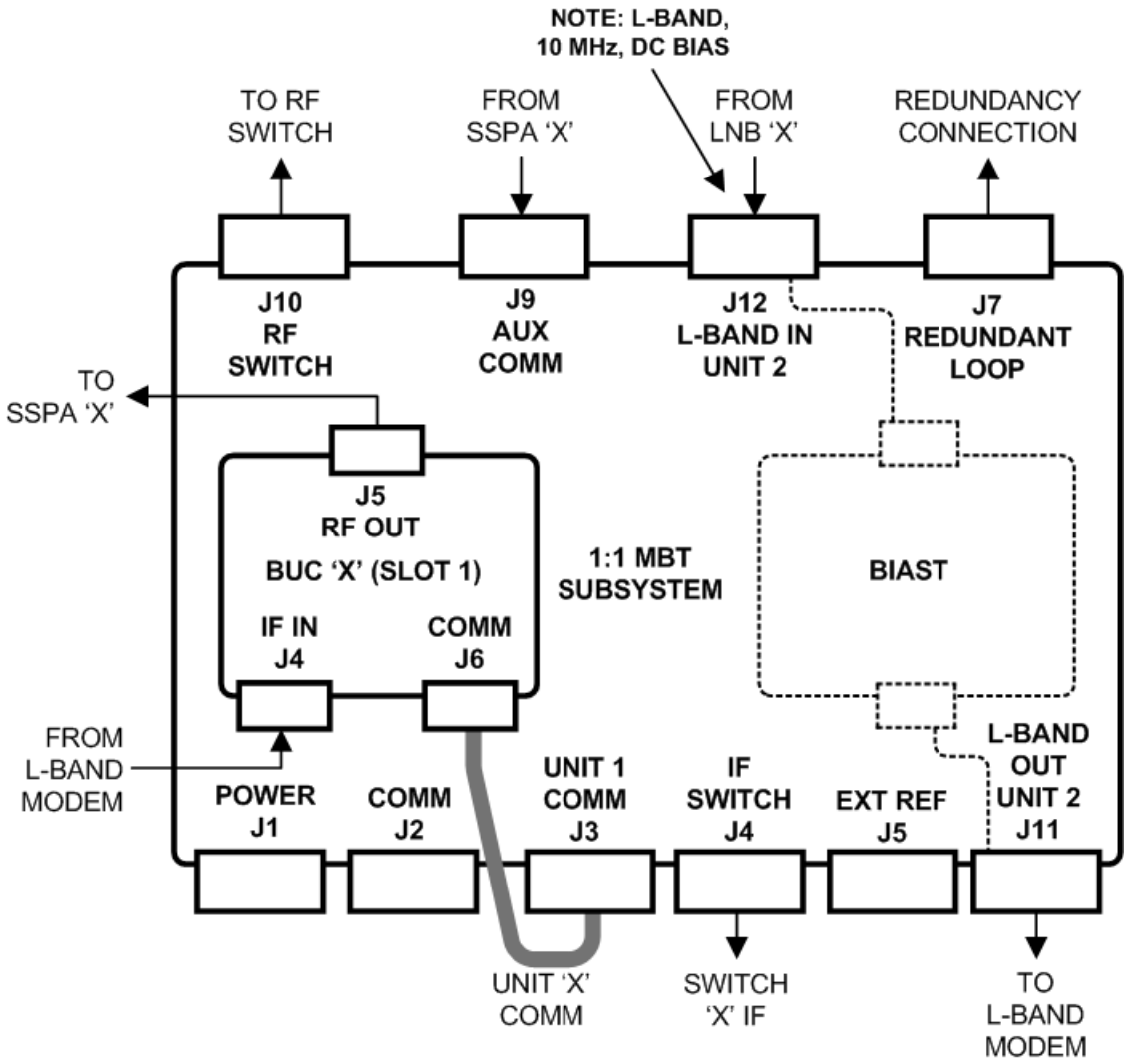


Figure 1-2. MBT-4000B Typical Application Schematic

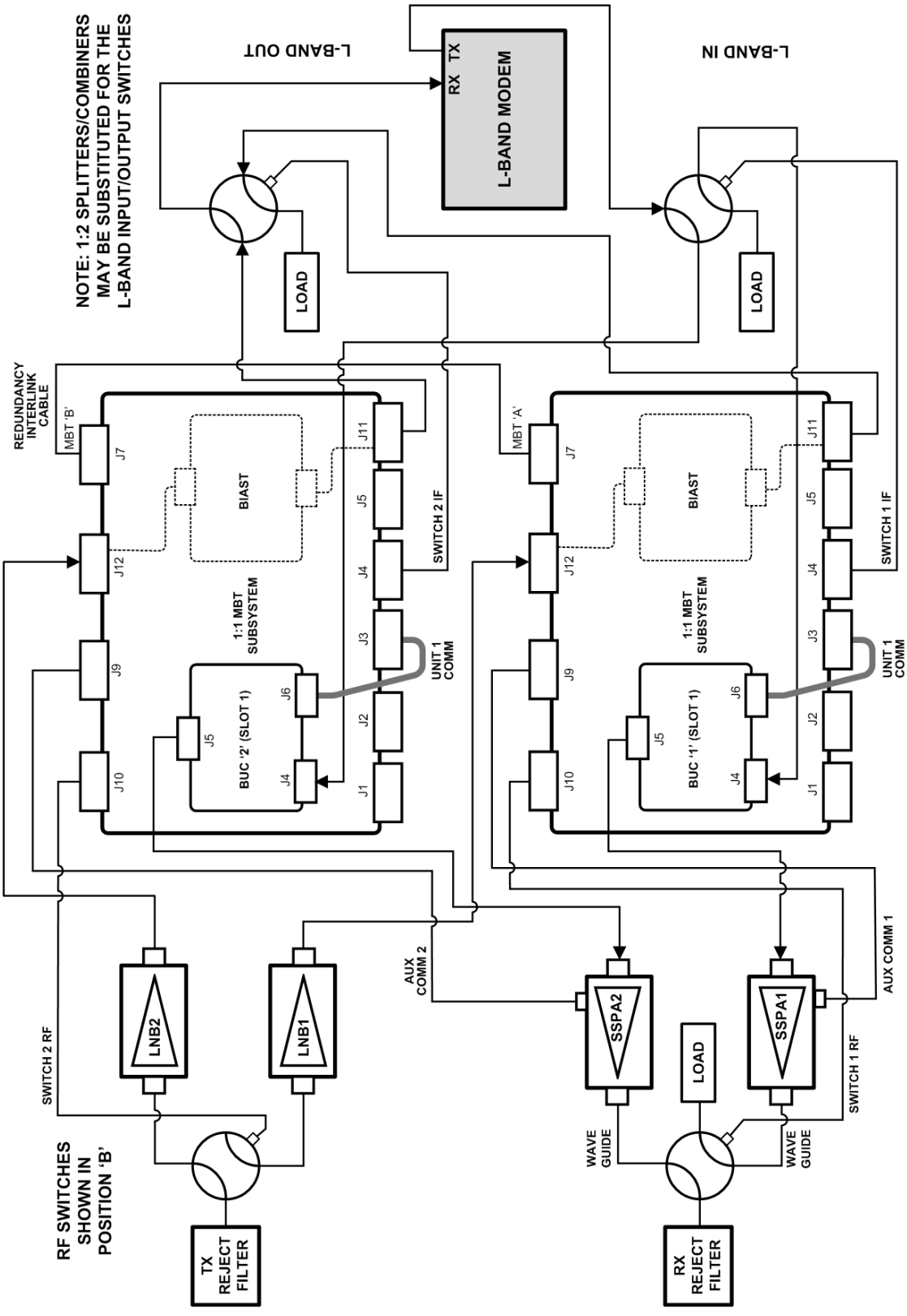


Figure 1-3. Operational Diagram for Typical Chain Switched Redundancy

1.4 Summary of Specifications

1.4.1 Environmental & Physical

Temperature ODU: BUC-4000	Operating	-40º to 122ºF (-40º to 50ºC)
	Non-operating	-58º to 167ºF (-50º to 75ºC)
Operational Humidity		5 to 95% non-condensing
Operational Altitude		10,000 ft above sea level
Prime Power ODU: MBT-4000B		90 to 260 VAC, 47 to 63 Hz
Dimensions (excluding connectors)		See Figure 1-4

1.4.2 BUC-4000 Block Up Converter ODU

Input Frequency Range		950 to 2000 MHz, 125 kHz steps 1 kHz (optional)
Output Frequency (by model)	BUC-4000C	5860 to 6650 MHz
	BUC-4000X	7900 to 8400 MHz
	BUC-4000Ku	13.75 to 14.50 GHz
	BUC-4000Ka	30.00 to 31.00 GHz 27.50 to 28.50 GHz (optional) 28.50 to 29.50 GHz (optional) 29.50 to 30.10 GHz (optional)
Input/Output Impedance		50Ω
Input Return Loss		15 dB minimum
Output Return Loss		18 dB minimum
Input Connector		Type 'N' Female
Output Connector		Type 'N' Female (C-, X-, and Ku-Band)
Gain		15 dB nominal at minimum attenuation
User Attenuation Range		0 to 10 dB
Output Power, P1dB		+10 dBm minimum
Third Order Intercept		+20 dBm minimum
Spurious	Carrier Related	-60 dBc
	Non-Carrier Related	-60 dBm
External Reference		Input, either 5 MHz or 10 MHz ±5 dBm (optional)

1.5 Dimensional Envelope

All dimensions are in inches. Bracketed dimensions, where shown, are in metric units (mm).

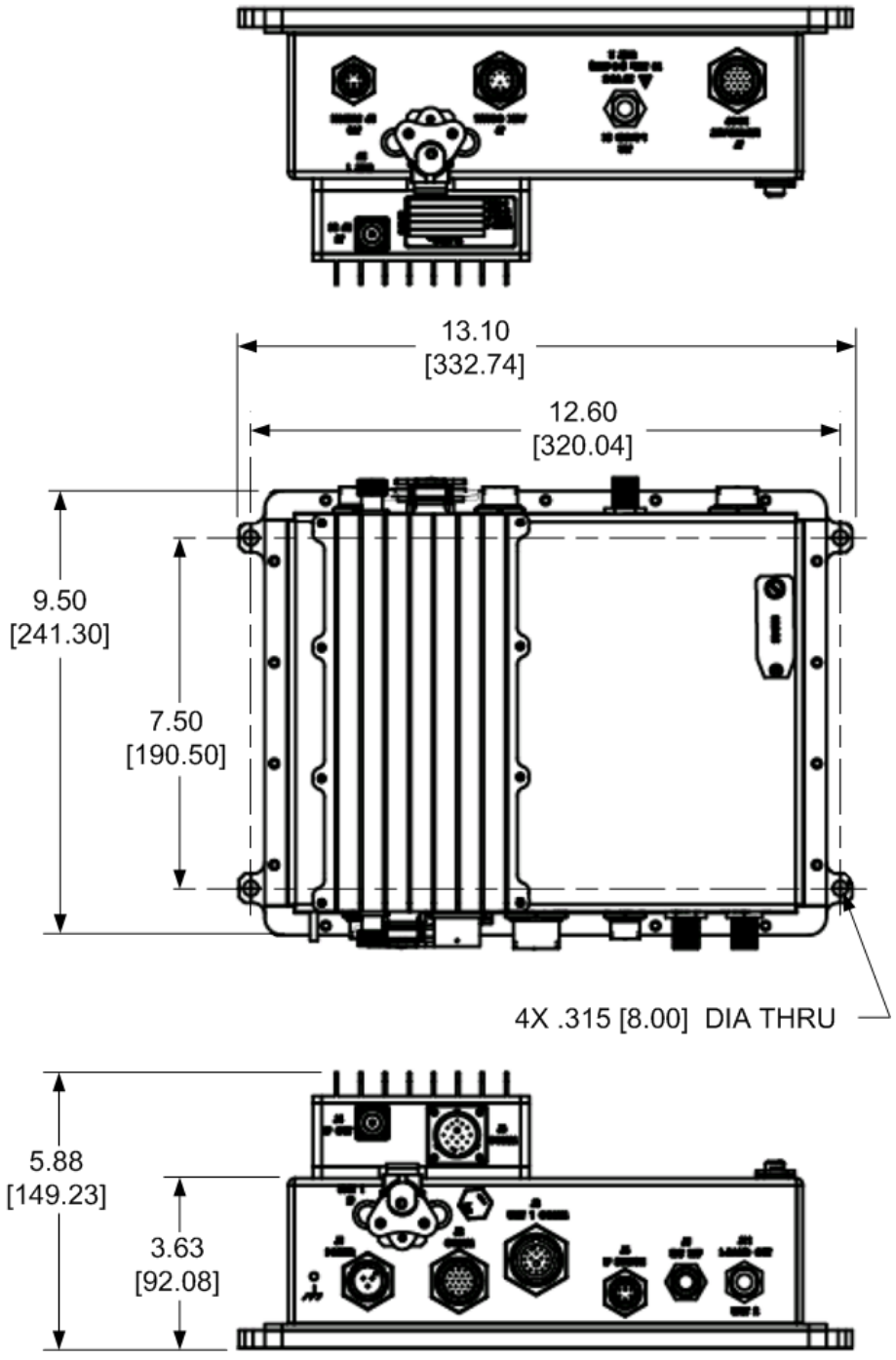


Figure 1-4. MBT-4000B Dimensional Envelope

Notes:

Chapter 2. INSTALLATION

2.1 Unpacking and Inspecting the Shipment

The MBT-4000B Multi-Band Transceiver System and its Installation and Operation Manual were packaged and shipped in a reusable cardboard carton containing protective foam spacing.

Once opened, inspect the shipment:

Step	Task
1	Keep all shipping materials for storage or reshipment.
2	Check the packing list to ensure the shipment is complete.
3	Inspect the equipment for any possible damage incurred during shipment. Contact the carrier and Comtech immediately to submit a damage report if damage is evident.
4	***Review this* MBT-4000B Multi-Band Transceiver System Installation and Operation Manual *carefully to become familiar with operation.***

2.2 Installing the MBT-4000B

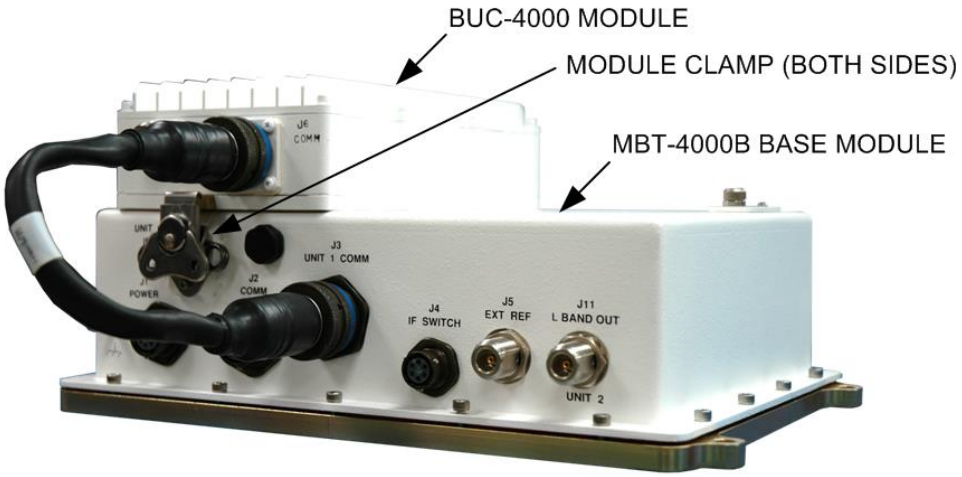


Figure 2-1. MBT-4000B Multi-Band Transceiver System Components

The MBT-4000B Base Module provides the M&C, Power Supply, and Reference interfaces. It may be located near or on the antenna. Guide pins and mechanical clamps keeps the band-specific BUC-4000 Module in place on top of the Base Module.

Cables to the antenna and Base Module complete the installation. For complete information on the MBT-4000B's connectors, including the pinout tables, see **Chapter 3. EXTERNAL CONNECTORS**.

2.3 Operation

To change the band of operation, first disconnect the BUC Module cables and unlatch the module from the MBT-4000B Base Module. Then, remove the BUC module and replace it with the appropriate band-specific module.

Once all pertinent connections have been made between the MBT-4000B and other equipment, see **Chapter 4. SYSTEM OPERATING PARAMETERS** for further information.

Chapter 3. EXTERNAL CONNECTORS

3.1 External Connectors Overview

Connectors on the MBT-4000B Multi-Band Transceiver System (**Figure 3-1**) provide all necessary external connections between the transceiver and other equipment.

(TOP) IF Side
(BOTTOM) RF Side – Cable Loop Removed for Clarity

Figure 3-1. MBT-4000B External Connectors

3.2 MBT-4000B External Connectors

Table 3-1 summarizes the external connections and identifies the chapter sections providing connector pinout information.

Table 3-1. MBT-4000B External Connectors

Signal Side (Sect.)	Module	Ref Des	Name	Sect.	Function
IF (3.2.1)	MBT-4000B Base Module	N/A	N/A	3.2.1.1	#10-32 Ground stud
		J1	POWER	3.2.1.2	AC Power
		J2	COMM	3.2.1.3	Serial communication and Summary Fault
		J3	UNIT 1 COMM	3.2.1.4	Communicate with BUC
		J4	IF SWITCH	3.2.1.5	Monitor & Control IF Switch
		J5	EXT REF	3.2.1.6	External 5 or 10 MHz Reference Input
		J11	L-BAND OUT UNIT 2	3.2.1.7	IF Output to Modem
	BUC-4000 Module	J4	IF IN	3.2.1.8	IF Input from Modem
		J6	COMM	3.2.1.9	Communicate with Base Module
RF (3.2.2)	MBT-4000B Base Module	J7	REDUNDANT LOOP	3.2.2.1	Connect for dual base redundant operation
		J12	L-BAND IN	3.2.2.2	L-Band Input from LNB
		J9	AUX COMM	3.2.2.3	External Equipment Monitoring
		J10	RF SWITCH	3.2.2.4	Monitor and Control RF Switch
	BUC-4000 Module	J5	RF OUT	3.2.2.5	RF Output to SSPA

3.2.1 IF Signal Side Connections

(Cable Loop Removed for Clarity)

Figure 3-2. MBT-4000B External Connectors – IF Signal Side

3.2.1.1 Ground Connector

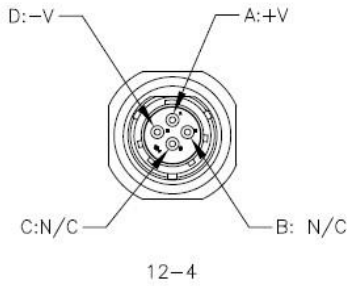
Use this #10-32 stud to connect a common chassis ground among equipment.

3.2.1.2 J1 | POWER

Table 3-2. J1 | POWER Connector Pinouts

AC Power	
Pin	Signal
A	LINE
B	NEUTRAL
C	GND

NOTE – Mating Connector:
COMTECH P/N CN/MS-STPG03F02
(ITT Cannon KPT06B-12-3S)



DC Power	
	Signal
A	+V
B, C	No Connect
D	-V

NOTE - Mating Connectors:
COMTECH P/N CN-0021155
(Amphenol PT06A-12-4S(476))

3.2.1.3 J2 | COMM

Use the **J2 | COMM** 19-pin circular connector for serial-based remote monitor and control of the MBT-4000B Multi-Band Transceiver System.

Table 3-3. J2 | COMM Connector Pinouts

Pin	Signal
A	EIA-485 Rx+
B	EIA-485 Rx-
C	EIA-485 Tx+
D	EIA-485 Tx-
E	EIA-232 RD
F	NC
G	EIA-232 TD
H	NC
J	NC
K	SUM FLT COMM
L	SUM FLT NO
M	SUM FLT NC
N	NC
P	NC
R	NC
S	NC
T	GND
U	GND
V	NC

NOTE – Mating Connector:
COMTECH P/N CN/MS3116J14-19P
(Cannon MS3116J14-19P)

3.2.1.4 J3 | UNIT 1 COMM

Use the **J3 | UNIT 1 COMM** connector to connect the MBT-4000B Base Module Unit 1 section to the BUC-4000 Block Up Converter Module **J6 | COMM** connector via the 15-15 Power & Signal Harness (CEFD P/N CA/WR10963-1), shown in **Figure 3-3**.

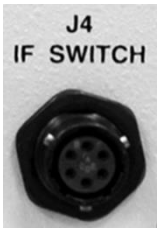
Table 3-4. J3 | UNIT 1 COMM Connector Pinouts

Pin	Signal
A	SUM FLT
M	RxD BXC
C	Tx+ BXC
D	GND
E	+7.5V
F	+7.5V
G	+15V
H	GND
J	Rx+ BXC
K	Rx- BXC
L	Tx- BXC
B	TxD BXC
N	SPARE
P	10 MHz REF
R	SPARE

NOTE – Mating Connector:
COMTECH P/N CN/8LT5-15B15PN
(Souriau 8LT5-15B15PN / Amphenol MS27467T15B15P)

Figure 3-3. J6 | COMM (BUC Module) to J3 | Unit 1 COMM (Base Module) Connection

3.2.1.5 J4 | IF SWITCH



Use the J4 | IF SWITCH 6-pin circular connector to connect an IF switch in a 1:1 configuration to the MBT-4000B Base Module to

Table 3-5. J4 | IF SWITCH Connector Pinouts

Pin	Signal
A	POS 1 IF
B	GND
C	POS 2 IF
D	POS 1 IND IF
E	GND
F	POS 2 IND IF

NOTE – Mating Connector:
COMTECH P/N CN/MS3116J10-6P
(Cannon MS3116J10-6P)

3.2.1.6 J5 | EXT REF (External Reference)

Use the **J5 | EXT REF** Type 'N' female connector to connect a 5 MHz or 10MHz External Reference Input to the MBT-4000B Base Module.

3.2.1.7 J11 | L-BAND OUT UNIT 2

Use the **J11 | L-BAND OUT UNIT 2** Type 'N' female connector to connect the MBT-4000B Base Module L-Band output signal output either to the modem Rx, or the Rx IF switch or 1:2 splitter/combiner in a 1:1 configuration.

3.2.1.8 J4 | IF IN (BUC-4000 ONLY)

Use the **J4 | IF IN** Type 'N' female connector, located on the BUC-4000 Block Up Converter Module, to connect the BUC either to the L-Band input signal from the modem Tx, or the Tx IF switch or 1:2 splitter/combiner in a 1:1 configuration.

3.2.1.9 J6 | COMM (BUC-4000 ONLY)

Use the **J6 | COMM** 15-pin circular connector, located on the BUC-4000 Block Up Converter Module, to connect the module, via the 15-15 Power & Signal Harness (CEFD P/N CA/WR10963-1), to the MBT-4000B Base Module **J3 | UNIT 1 COMM** connector. See **Figure 3-3**.

Table 3-6. J6 | COMM (J6) Connector Pinouts

Pin	Signal
A	SUM FLT
B	TxD BXC
C	Tx+ BXC
D	GND
E	+7.5V
F	+7.5V
G	+15V
H	GND
J	Rx+ BXC
K	Rx- BXC
L	Tx- BXC
M	RxD BXC
N	SPARE
P	10 MHz REF
R	SPARE

NOTE – Mating Connector:
COMTECH P/N CN/8LT5-15B15PN
(Souriau 8LT5-15B15PN / Amphenol MS27467T15B15P)

3.2.2 RF Signal Side Connectors

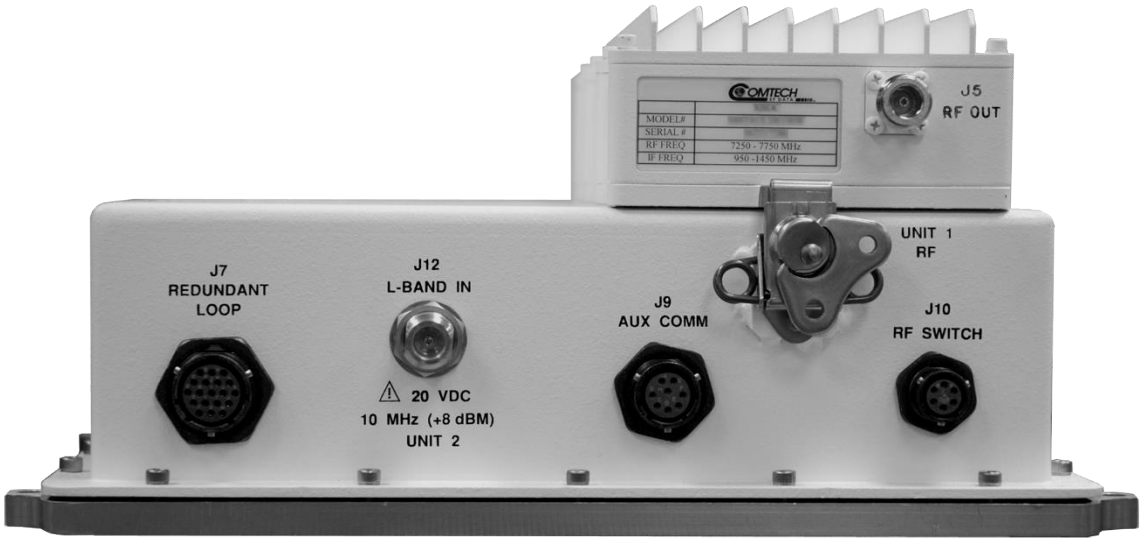


Figure 3-4. MBT-4000B External Connectors – RF Signal Side

3.2.2.1 J7 | REDUNDANT LOOP

Use the **J7 | REDUNDANT LOOP** 19-pin circular connector to connect the MBT-4000B Base Module, via the Redundant Loop Bus Cable (CEFD P/N CA/WR11224), to another MBT-4000B Base Module in a 1:1 Redundancy configuration.

Table 3-7. J7 | REDUNDANT LOOP Connector Pinouts

Pin	Signal
A	SW POS 2 DRIVE OUT
B	GND
C	SW POS 2 DRIVE OUT
D	RF SW IND OUT
E	IF SW IND OUT
F	SW POS 1 DRIVE IN
G	SW POS 2 DRIVE IN
H	RF SW IND IN
J	IF SW IND IN
K	MBT 'A' IND

Pin	Signal
L	MBT 'B' IND
M	NC
N	BXC 1 FLT OUT
P	BXC 2 FLT OUT
R	BXC 1 FLT IN
S	BXC 2 FLT IN
T	NC
U	TX
V	RX

NOTE – Mating Connector:
COMTECH P/N CA/WR11224
Redundant Loop Bus Cable

3.2.2.2 J12 | L-BAND IN

Use the **J12 | L-BAND IN** Type 'N' female connector to provide the down converted IF Input (via a low-noise block down converter (LNB)) to the MBT-4000B Base Module.

3.2.2.3 J9 | AUX COMM

Use the **J9 | AUX COMM** 8-pin circular connector to connect a Solid-State Power Amplifier (SSPA) to the MBT-4000B Base Module.

Table 3-8. J9 | AUX COMM Connector Pinouts

Pin	Signal
A	AUX Rx (+)A
B	AUX Rx (–)A
C	AUX Tx (+)A
D	AUX Tx (-)A
E	+12.6V LNA A
F	IO1 A / Fault (Note 2)
G	IO1 B (Note 3)
H	GND

NOTES:

1. Mating Connector:
   COMTECH P/N CN/MS3116J12-8P
   (Cannon MS3116J12-8P)

2. Input from external amplifier.

3. Normally an input; when programmed as an output, this pin indicates Unit 1 Online/Offline status.

3.2.2.4 J10 | RF SWITCH

Use the **J10 | RF SWITCH** 6-pin circular connector to connect an RF Switch in a 1:1 configuration (e.g., connecting to two LNBs or SSPAs) to the MBT-4000B Base Module.

Table 3-9. J10 | RF SWITCH Connector Pinouts

Pin	Signal
A	POS 1 RF
B	GND
C	POS 2 RF
D	POS 1 IND RF
E	GND
F	POS 2 IND RF

NOTE – Mating Connector:
COMTECH P/N CN/MS3116J10-6P
(Cannon MS3116J10-6P

3.2.2.5 J5 | RF OUT (BUC-4000 ONLY)

Use the **J5 | RF OUT** Type 'N' female connector, located on the BUC-4000 Block Up Converter Module, to provide the upconverted RF Output to an SSPA.

Notes:

Chapter 4. SYSTEM OPERATING PARAMETERS

4.1 Overview

An introduction to the Monitoring and Control (M&C) features of the MBT-4000B Multi-Band Transceiver, as well as the operating parameters for the BUC-4000 Block Up Converter, are provided in this chapter.

4.2 Description

The MBT- 4000B supports Low Noise Block Down Converters (LNBs) for Rx down conversion. It outputs +17VDC nominal and 10 MHz on the **J12 | L-BAND IN** connector. The LNB amplifies the input RF signal and down converts it to L-Band in the range of 950 to 1750 MHz (there may be instances that the L-Band range = 950 to 1450 MHz). The choice of which downlink frequency band is determined by the selection of a frequency range, usually from one of LNBs in the following bands:

Band	Range
C-Band	3.625 to 4.2 GHz 4.50 to 4.80 GHz
Ku-Band	10.95 to 11.70 GHz 11.70 to 12.20 GHz 12.25 to 12.75 GHz

LNBs are available that are either externally referenced (EXT REF) or internally referenced (INT REF). DC power is supplied to the LNB through the IFL cable from the MBT-4000B for both types.

The standard LNB noise temperature is < 35°K for C-Band, and < 65°K for Ku-Band.

4.3 Remote Configuration, Monitoring and Control

Remote monitoring and control (M&C) of the MBT-4000B is possible via use of a remotely-connected PC or dumb terminal. From this location, the user may issue commands and queries to configure, control, and monitor one or more MBT-4000B systems.

Complete information for these features is provided in **Chapter 5. SERIAL-BASED REMOTE PRODUCT MANAGEMENT.**

4.4 Monitoring Operations via the LED Indicators

The MBT-4000B Multi-Band Transceiver System features two Light-Emitting Diode (LED) indicators – one for each operational unit (module). Each LED provides the user with visual cues to the operational, online, and offline status of the sytem.

Figure 4-1 illustrates the location of the LED Indicators. Located on the top of the MBT-4000B Base Module under a pivoting protective plate.

To view the LEDs: First, loosen the thumbscrew that secures the plate, and then swing the plate away to reveal the LED display window.

See **Appendix B. FAULTS/EVENTS for** complete details for interpreting the LED Indicators.

Figure 4-1. MBT-4000B Multi-Band Transceiver LED Indicators

4.5 Block Up Converter Module (BUC-4000) Operating Parameters

The BUC-4000 translates an L-Band output carrier to the desired output frequency (C-, X-, Ku,- or Ka-Band) with an output level capable of driving a High-Power Amplifier (HPA).

Table 4-1. BUC-4000 C-, X-, Ku-, and Ka-Band Operating Parameters

Band	Frequency	LO Frequency	Inverting
C-Band	5850 to 6650 MHz	4900 MHz	No
X-Band	7900 to 8400 MHz	6950 MHz	No
Ku-Band-W	13.75 to 14.50 GHz	12.800 GHz	No
Ka-Band	30.00 to 31.00 GHz		

Notes:
1. No spectral inversion.
2. 10dB gain adjustment.

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4.6 LNB LO, Mix, and Spectrum Settings

4.6.1 C-Band

Table 4-2. LO and MIX Information for Demodulator and LNB for C-Band

LNB Part No.	Description	LO (Offset) Frequency (MHz)	MIX (+/-)	Min LNB Satellite Frequency (MHz)	Max LNB Satellite Frequency (MHz)	L-Band Frequency at LNB Min (MHz)	L-Band Frequency at LNB Max (MHz)	Demod Spectrum (Utility Demod Menu)	Operating Voltage, V	RF Connector
RF/LNB-C-55-35N	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type N
RF/LNB3.6-4.2FE	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type F
RF/LNB3.6-4.2F03	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type F
XXXXXXXXXXXX	3.400 – 4.200 GHz	5,150.00	-	3,400.00	4,200.00	1,525.00	950.00	Invert	18	Type F
XXXXXXXXXXXX	4.500 – 4.800 GHz	5,760.00	-	4,500.00	4,500.00	1,525.00	950.00	Invert	18	Type F

4.6.2 Ku-Band

Table 4-3. For Ku-Band: LO and MIX Information for Demodulator and LNB for Ku-Band

LNB Part No.	Description	LO (Offset) Frequency (MHz)	MIX (+/-)	Min LNB Satellite Frequency (MHz)	Max LNB Satellite Frequency (MHz)	L-Band Frequency at LNB Min (MHz)	L-Band Frequency at LNB Max (MHz)	Demod Spectrum (Utility Demod Menu)	Operating Voltage, V	RF Connector
RF/LNB-10.9-11.7FE	10.95 – 11.7 GHz Ext Ref	10,000.00	+	10,950.00	11,700.00	950.00	1700.00	Normal	18	Type F
RF/LNB-11.7-12.2FE	11.7 – 12.2 GHz Ext Ref	10,750.00	+	11,700.00	12,200.00	950.00	1450.00	Normal	18	Type F
RF/LNB-12.2-12.7FE	12.25 - 12.75 GHz Ext Ref	11,300.00	+	12,250.00	12,750.00	950.00	1450.00	Normal	18	Type F
RF/LNB-10.9-11.7F03	10.95 – 11.7 GHz ± 3 ppm	10,000.00	+	11,200.00	11,700.00	950.00	1450.00	Normal	18	Type F
RF/LNB-11.7-12.2F03	11.7 – 12.2 GHz ± 3 ppm	10,750.00	+	10,950.00	11,700.00	950.00	1700.00	Normal	18	Type F
RF/LNB-12.2-12.7F03	12.25 - 12.75 GHz ± 3 ppm	11,300.00	+	12,250.00	12,750.00	950.00	1450.00	Normal	18	Type F

Notes:

Chapter 5. UPDATING FIRMWARE

5.1 Introduction

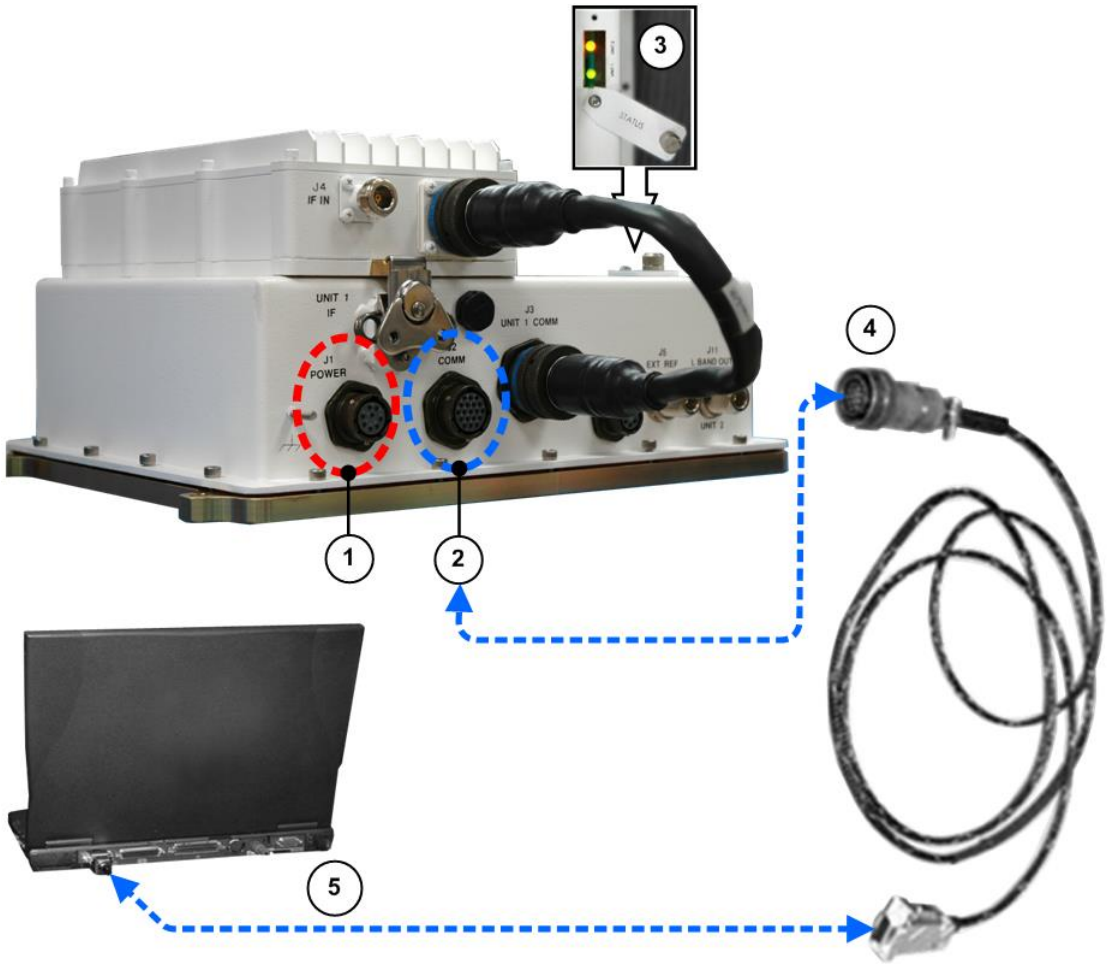
TO ENSURE OPTIMAL PERFORMANCE, IT IS IMPORTANT TO OPERATE THE MBT-4000B WITH ITS LATEST AVAILABLE FIRMWARE.

Comtech's MBT-4000B Multi-band Transceiver System is factory-shipped with the latest version of operating firmware. Firmware updates may be applied to an MBT-4000B without having to remove it from operation. If you need to update the firmware, you can acquire the download from Comtech Product Support via e-mail or on CD by standard mail delivery.

The MBT-4000B Firmware Update process is as follows:

- Download the firmware update archive file to a user-supplied Microsoft Windows®-compatible PC.
- Use an adapter cable to connect the MBT-4000B to the serial port of a user-supplied Microsoft Windows®-compatible PC that is used for Monitor and Control (M&C) of the MBT-4000B system.
- Extract the firmware update files from the archive download file. The File Transfer Protocol (FTP) update process is then executed, and the files are transferred from the User PC to the MBT-4000B, via use of a utility program, FLSHCSAT.exe.

5.2 Getting Started: Preparing for the Firmware Download



Item	Description
1	J1 | Power Connection
2	J2 | COMM Connection
3	LED Indicators
4	Optional Comtech System Programming Cable (CEFD P/N CA/WR12243-1)
5	User PC with available serial port

Figure 5-1. MBT-4000B Firmware Update – Minimum Requirements

1. **First, identify the firmware number and its version number.**

   A. User-supplied items needed* (Figure 5-1)*:

   - A Microsoft Windows-based PC equipped with an available serial port and a terminal emulator program (e.g., Tera Term or HyperTerminal) if needed.

   - A 9-pin to 19-pin serial adapter cable, such as the optional Comtech System Programming Cable (CEFD P/N CA/WR12243-1).

B. On the PC – Configure the terminal emulator program if applicable.

Refer to your terminal emulator program HELP feature or user guide for operating and configuration instructions.

Configure the utility program serial port communication and terminal display operation:

- 38400 bps (Baud Rate)
- 8 Data Bits
- 1 Stop Bit
- Parity = NO
- Port Flow Control = NONE
- Display New line Rx/Tx: CR
- Local Echo = ON

C. On the MBT-4000B – Power up the unit. Your power connection varies depending on your ordered unit.

See Sect. 3.2.1.2 J1 | POWER *in this manual for your specific power connectors.*

D. Obtain the firmware information using serial-based remote product management:

- *Remote Query:* **<0/FRW?** *(returns complete Boot, Bulk1 and Bulk2 information)*

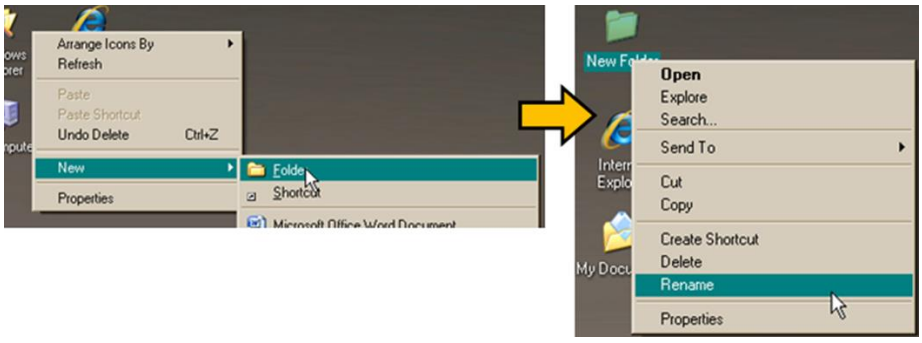
See* Chapter 6. SERIAL-BASED REMOTE PRODUCT MANAGEMENT** ***for more information on using remote commands/queries.

2. Next, create a temporary folder (subdirectory) on the User PC for the firmware archive download.

- ***Drive letter 'c:' is used in these examples. Any valid, writable drive letter can be used.***
- ***Typical for all tasks: Type the command <u>without quotes</u>, and then press Enter to execute.***

There are several ways the user may use create a temporary folder on a Windows-based PC:

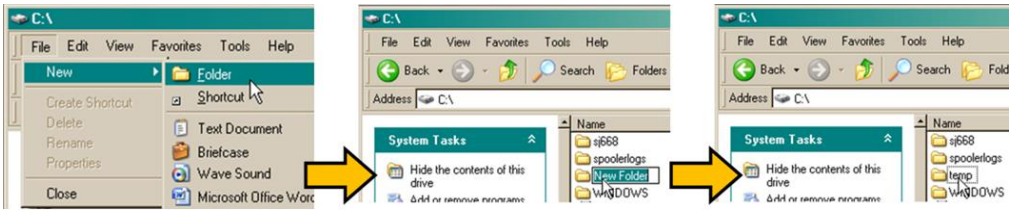
A. Use the Windows Desktop to create and rename the temporary folder.



- Right-click anywhere on the desktop to open the popup submenu, and then select **New > Folder** to create the new, temporary folder on the desktop.

- Right-click on the new folder and then select '**Rename**' from the popup submenu. Rename this folder to "**temp**" or some other convenient, unused name.

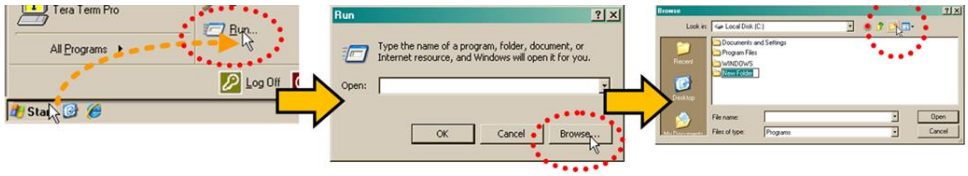
B. Use Windows Explorer to create and rename the temporary folder.



- Select **File > New > Folder** to create the new, temporary folder in the active location.

- Right-click the '**New Folder**' folder name, and then rename this folder to "**temp**" or some other convenient, unused name.

C. Use the 'Run' and 'Browse' windows to create and rename the temporary folder.



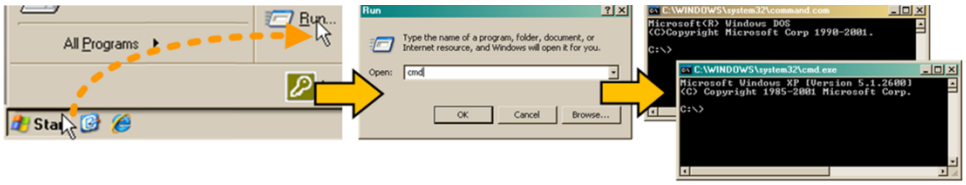
- Select **[Start]** on the Windows taskbar and then click the **Run...** icon. The '**Run**' window will open.

- Click **[Browse]** in the '**Run**' window. The '**Browse**' window will open.

- Click the **Create New Folder** icon in the '**Browse**' window to create the new folder in the active location.

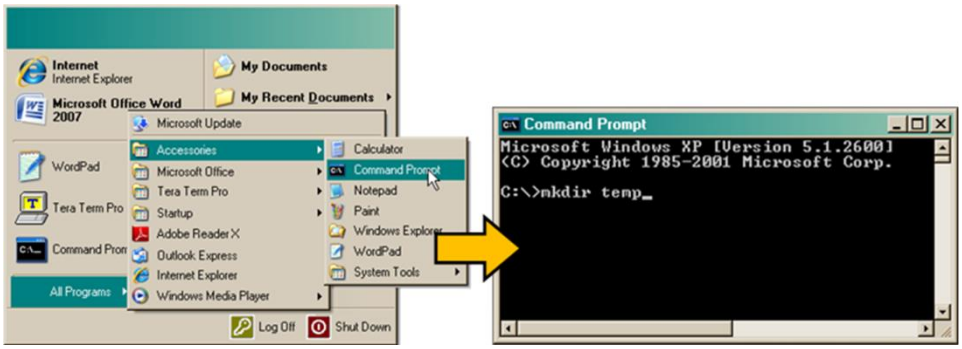
- Right-click the '**New Folder**' folder name, and then rename this folder to "**temp"** or some other convenient, unused name.

D. Use Windows Command-line to create the temporary folder.



- **First,** click **[Start]** on the Windows taskbar, and then click the '**Run...**' icon (or, depending on Windows OS versions *prior* to Windows 95, click the '**MS-DOS Prompt**' icon from the Main Menu).

- **Next,** open a **Command-line** window…



  - For Windows 95 or Windows 98 – Type "**command**".
  - For any Windows OS versions later than Windows 98 – Type "**cmd**" or "**command**".
  - Alternately, from **[Start]**, select **All Programs** > **Accessories** > **Command Prompt**.
  - Finally, from the Command-line '**c:\>**' prompt, type "**mkdir temp**" or "**md temp**" (*mkdir* and *md* stand for *make directory*), and then click **[OK]**.

There should now be a 'temp' folder created and available for placement of the firmware file download.

5.3 Downloading and Extracting the Firmware Update

1. **First, download the firmware update file from the Comtech Web site:**

   A. Go online to www.comtechefdata.com.

   B. On the *Main* page – Under **Support Information** or the **Support** tab, select the **Software Downloads** hyperlink.

   C. On the *Software Downloads* page – Click **Download Flash and Software Update Files**.

   D. On the *Flash Updates Index* page – Select the **(Select a Product Line) Transceivers** hyperlink.

   E. On the *Transceivers* product page – Select the **MBT4000/B** product hyperlink.

   F. Select the appropriate firmware archive EXE or ZIP file download hyperlink.

   - **About Firmware Numbers, File Versions, and Formats:** The Comtech Web site catalogues its firmware update files by product type (e.g., router, modem, etc.), the specific model, and optional hardware configurations.

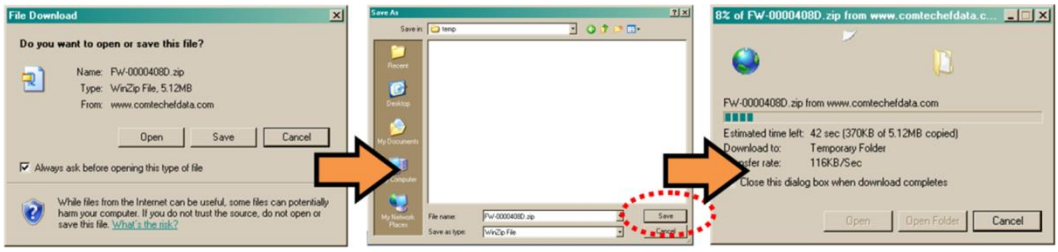
     The MBT-4000B firmware download hyperlink appears as **F12357X_V###**, where '**X**' denotes the revision letter, and '**###**' represents the firmware version number (e.g., V115 = Version 1.1.5).

   - **About File Archive Formats:** Comtech provides its downloadable files in two compressed archive formats: ***.exe** (self-extracting) and ***.zip** (compressed).

     The ***.exe** file does not require a file archiver and compression utility program such as *PKZIP for Windows*, *WinZip*, *ZipCentral*, etc. (*PKZIP for DOS* is not supported due to file naming conventions). **Comtech does not provide this utility program.**

     Some firewalls do not allow the download of *.exe files. Download the *.zip file instead, and extract the firmware files from the archive download with a user-supplied utility program. For detailed information on handling archived files, refer to the utility program Help documentation.

G. Download the archive file to the temporary folder.



- Once the **EXE** or **ZIP** hyperlink is selected the '**File Download'** window opens and prompts selection of **[Open]** or **[Save]**:
  - Click **[Open]** to turn over file extraction to the user-supplied utility program. Be sure to extract the firmware files to the '**temp**' folder created earlier.
  - Click **[Save]** to open the '**Save As'** window. Be sure to select and **[Save]** the archive ***.exe** or ***.zip** file to the '**temp**' folder created earlier.

    Otherwise, click **[Cancel]** to quit and exit the file download process.

2. Next, extract the firmware files from the archive file.

- (If not already done with **File Download > [Open]**) Extract the firmware files from the downloaded ***.exe** or ***.zip** archive file with the user-supplied utility program:
  - Double-click on the archive file name, and then follow the prompts provided by the user-supplied utility program. Extract, at a minimum, four files:
    - **FW12357X.CCC** – The Firmware Bulk image file (where 'x' denotes the revision letter).
    - **MBT4000B_ReleaseNotes_v#-#-#.pdf** – The Firmware Release Notes PDF file (where '#-#-#' denotes the firmware version number).
    - **FLSHCSAT.EXE** – CEFD Flash Upload Utility Program.
    - **CCCflash.hlp** – FLSHCSAT Help File.

3. Confirm availability of the firmware files in the temporary folder.

There are several ways the user may view the contents of the temporary folder on a Windows-based PC:

A. From the Windows Desktop:

- Double-left-click the '**temp'** folder saved to the Windows Desktop.
- Use **Windows Explorer** to locate, and then double-left-click the '**temp**' folder.
- Use the '**Browse'** window (**[Start] > ...Run > [Browse]**) to locate, and then double-click the '**c:\temp**' folder.

B. Using Command-line:

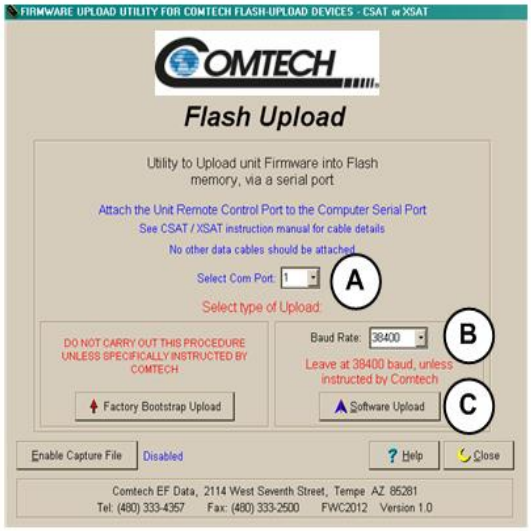
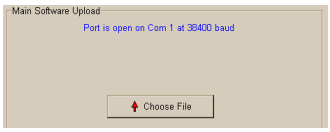
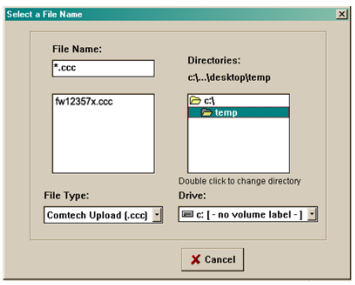
- Type "**cd c:\temp**" at the Command-line prompt to change to the temporary directory created earlier using Command-line.
- Type "**dir**" to list the files extracted to the temporary directory from the downloaded archive file.

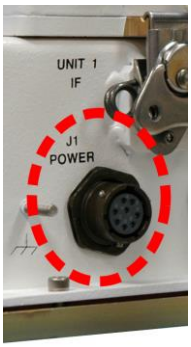
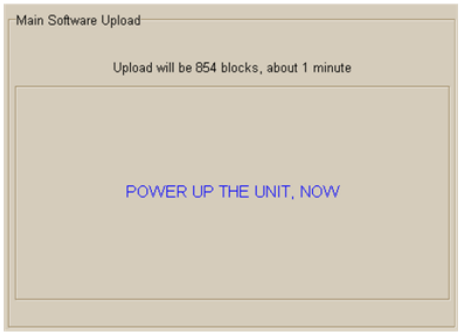
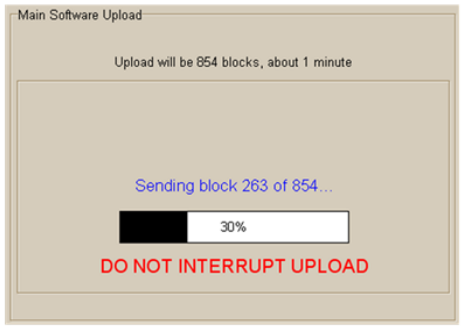
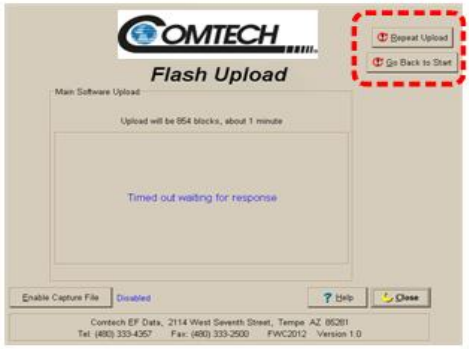
The firmware files have been successfully downloaded and are now available for transfer to the MBT-4000B.

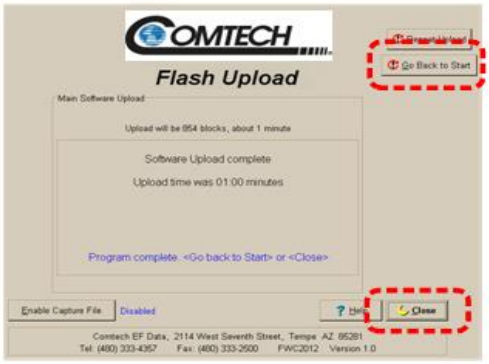
5.4 Performing the FTP Upload Procedure

To proceed with the firmware update procedure, assumptions are made that:

- ***The MBT-4000B is connected to a user-supplied, Windows-based PC:***
  - ***The PC serial port is connected to the MBT4000B's 'J2 \|COMM' port using the appropriate adaptive cabling.***
  - ***The PC is running a terminal emulation program (for operation of the MBT-4000B Serial Interface).***
- ***The latest firmware files have been downloaded or otherwise received from Comtech and are available on the User PC in an accessible temporary folder.***

Step	Task	
1	Double-click FLSHCSAT.EXE (filename or icon) to execute the FTP upload utility.	
2	From the FLSHCSAT window, select the pertinent serial port used for communication between the User PC and the MBT-4000B (Item 'A' in this example shows that COM1 has been selected)	
3	Do not select a baud rate (Item 'B') other than the default selection of 38400, unless otherwise instructed by Comtech Technical Support.	
4	Click [Software Upload] (Item 'C')	
5	You are prompted to select a file to upload. Click [Choose File]. Then, from the dialogue window that opens, use the drop-down list to select the drive (if needed), and then navigate to the temporary folder created earlier. Finally, double-click on the firmware file from the window to the left.	 

Step	Task		
6	Before proceeding, the MBT-4000B system must be powered off. Disconnect the power cable from the Base Module, and then click [Start Upload] to resume the upload process.		
7	When prompted, reconnect the power cable to the Base Module.		
8	Once the User PC establishes communication with the MBT-4000B, the upload takes place – *do not interrupt this upload process.*		
	Note: If the upload is not successful for any reason – e.g., the communications cable is disconnected, the wrong COM port is specified, the upload was inadvertently interrupted, etc. – you may troubleshoot the setup as needed, and then click [Repeat Upload] or [Go Back to Start] to resume or retry the process.		

Step	Task	
9	Upon successful completion of the upload, you may click [Go Back to Start] (if, for example, more than one MBT-4000B System requires update), or click [Close] to exit the FLSHCSAT program.	
10	If needed, disconnect the System Programming Cable (CEFD P/N CA/WR12243-1) and reconnect the original system communication cable.	
11	The LEDs on the MBT-4000B Base Module will illuminate GREEN (unmuted) or YELLOW (muted) to indicate the current status of the unit. Note: If either LED illuminates RED, refer to Appendix B. FAULTS/EVENTS for further information.	 

The MBT-4000B is now operating with its latest firmware. The firmware update process is now complete.

Notes:

Chapter 6. SERIAL-BASED REMOTE PRODUCT MANAGEMENT

6.1 Overview

Serial-based remote product management of Comtech's MBT-4000B Multi-band Transceiver System is available using the MBT-4000B's **'J2 | COMM'** port. This chapter describes the protocol and message command set for remote monitor and control of the MBT-4000B Multi-Band Transceiver System.

To proceed with this chapter, assumptions are made that:

- ***The MBT-4000B is connected to a user-supplied, Windows-based PC:***
  - ***The PC serial port is connected to the MBT4000B's 'J2 \|COMM' port using the appropriate adaptive cabling.***
  - ***The PC is running a terminal emulation program (for operation of the MBT-4000B Serial Interface).***
- ***The MBT-4000B is running its latest firmware file revision.***

6.2 Remote Control Protocol and Structure

The electrical interface is either an EIA-485 multi-drop bus (for the control of many devices) or an EIA-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets, of variable length, in accordance with the structure and protocol defined in later sections.

6.2.1 EIA-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire) EIA-485 is preferred. Half-duplex (2-wire) EIA-485 is possible, but *is not preferred*.

In full-duplex EIA-485 communication there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions. It is assumed that there is a

'Controller' device (a PC or dumb terminal), which transmits data, in a broadcast mode, via one of the pairs. Many 'Target' devices are connected to this pair, which all simultaneously receive data from the Controller. The Controller is the only device with a line-driver connected to this pair – the Target devices only have line-receivers connected.

In the other direction, on the other pair, each Target has a Tri-Stateable line driver connected, and the Controller has a line-receiver connected. All the line drivers are held in high-impedance mode until one (and only one) Target transmits back to the Controller.

Each Target has a unique address, and each time the Controller transmits, in a framed 'packet' of data, the address of the intended recipient Target is included. All of the Targets receive the packet, but only one (the intended) will reply. The Target enables its output line driver, and transmits its return data packet back to the Controller, in the other direction, on the physically separate pair.

EIA-485 (Full Duplex) Summary:	
Two differential pairs	One pair for Controller to Target, one pair for Target to Controller.
Controller-to-Target pair	Pair has one line driver (Controller), and all Targets have line-receivers.
Target-to-Controller pair	Pair has one line receiver (Controller), and all Targets have Tri-State drivers.

6.2.2 EIA-232

This is a much simpler configuration in which the Controller device is connected directly to the Target via a two-wire-plus-ground connection. Controller-to-Target data is carried, via EIA-232 electrical levels, on one conductor, and Target-to-Controller data is carried in the other direction on the other conductor.

6.2.3 Basic Protocol

Whether in EIA-232 or EIA-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. The character format should be 8N1 (8 data bits, no parity, 1 stop bit). The baud rate may vary from 2400 to 38400 baud.

All data is transmitted in framed packets. The Controller is assumed to be a PC or ASCII dumb terminal, which is in charge of the process of monitor and control. The Controller is the only device that is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the Controller.

All bytes within a packet are printable ASCII characters, less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

All messages from Controller-to-Target require a response – with one exception. This will be either to return data that has been requested by the Controller, or to acknowledge reception of an instruction to change the configuration of the Target. The exception to this is when the Controller broadcasts a message (such as Set time/date) using Address 0, when the Target is set to EIA-485 mode.

6.2.4 Packet Structure

Controller-to-Target						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	0-9 ASCII codes 48-57 (4 characters)	/ ASCII code 47 (1 character)	A-Z, a-z ASCII codes 65-90, 97-122 (3 characters)	= *or* ? ASCII codes 61 or 63 (1 character)	(n characters)	Carriage Return ASCII code 13 (1 character)

Example: <0412/MUT=1{CR}

Target-to-Controller						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	0-9 ASCII codes 48-57 (4 characters)	/ ASCII code 47 (1 character)	A-Z, a-z ASCII codes 65-90, 97-122 (3 characters)	=, ?, !, *or* * ASCII codes 61,63,33 or 42 (1 character)	(From 0 to n characters)	Carriage Return, Line Feed ASCII codes 13,10 (2 characters)

Example: >0412/MUT=1{CR}{LF}

6.2.4.1 Start of Packet

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message:

- **Controller-to-Target:** This is 'less-than' the character '<' (ASCII code 60).
- **Target-to-Controller:** This is the 'greater-than' character '>' (ASCII code 62).

6.2.4.2 Target Address

Up to 9,999 devices can be uniquely addressed. In both EIA-232 and EIA-485 applications, the permissible range of values is 1 to 9999.

The BUC sub-device may also be addressed by appending the corresponding sub-device address. The sub-device address for the BUC is 'A1'. For example, a mute command addressed to the BUC attached to an MBT-4000B at address 0412 will be: **<0412A1/MUT=1{CR}**

The format of the response will be: **>0412A1/MUT={CR}{LF}**

The Controller sends a packet with the address of a Target – the destination of the packet. When the Target responds, the address used is the same address, to indicate to the Controller the source of the packet. The Controller does not have its own address.

6.2.4.3 Address Delimiter

This is the 'forward slash' character ' / ' (ASCII code 47).

6.2.4.4 Instruction Code

This is a three-character alphabetic sequence that identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance.

For Example: MUT for **MUT**e. This aids in the readability of the message, should it be displayed in its raw ASCII form.

Both upper case and lower case alphabetic characters may be used (A-Z *and* a-z, ASCII codes 65-90 *and* 97-122).

6.2.4.5 Instruction Code Qualifier

This single character further qualifies the preceding instruction code. Code Qualifiers obey the following rules:

1. From Controller-to-Target, the only permitted values are:

= (ASCII code 61	This character is used as the assignment operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) that follow it. For Example: In a message from Controller-to-Target, MUT=1 would mean 'enable the Mute function'.
? (ASCII code 63)	This character is used as the query operator, and is used to indicate that the Target should return the current value of the parameter defined by the preceding byte. For Example: In a message from Controller-to-Target, MUT? would mean 'return the current state of the Mute function'.

2. From Target-to-Controller, the only permitted values are:

= (ASCII code 61)	This character is used in two ways: First, if the Controller has sent a query code to a Target (for Example: MUT?, meaning '*is the Mute enabled or disabled?*'), the Target would respond with MUT=x, where x represents the state in question: 1 being 'enable' and 0 being 'disable'. Second, if the Controller sends an instruction to set a parameter to a particular value, and if the value sent in the argument is valid, then the Target will acknowledge the message by replying with MUT= (with no message arguments).
? (ASCII code 63)	This character is used only if the Controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the Target will acknowledge the message by replying, for example, with MUT? (with no message arguments). This indicates that there was an error in the message sent by the Controller.
! (ASCII code 33)	This character is used only if the Controller sends an instruction code which the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character. Example: XYZ!
* (ASCII code 42)	This character is used only if the Controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is valid, BUT the Target is in the wrong mode (e.g., standby mode in redundancy configuration) and will not permit that particular parameter to be changed at that time, the Target will acknowledge the message by replying, for example, with MUT* (with no message arguments).
# (ASCII code 35)	This character is used only if the Controller sends an instruction code which the Target cannot currently perform because of hardware resource issues, then the Target will acknowledge the message by echoing the invalid instruction, followed by the # character.

6.2.4.6 Optional Message Arguments

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII codes 48 to 57), period (ASCII code 46) and comma (ASCII code 44).

6.2.4.7 End of Packet

- **Controller-to-Target**: This is the 'carriage return' character (ASCII code 13).
- **Target-to-Controller**: This is the two-character sequence 'carriage return' (ASCII code 13), and 'line feed' (ASCII code 10).

Both indicate the valid termination of a packet.

6.3 Remote Commands and Queries

Any command or query not accepted by the MBT-4000B Base Module must be addressed to BUC or BDC sub-units

Column 'C'=Command; **Column 'Q'**=Query; columns marked '**X**' designate instruction code as *Command only*, *Query only*, or *Command/Query*.

CODE	C	Q	PAGE
AFR	X	X	6-8
ATT	X	X	6-8
CAA	X		6-8
CAI		X	6-8
CAS		X	6-9
CCS		X	6-10
CID	X	X	6-9
CLC	X	X	6-10
CMS		X	6-11
CUS		X	6-12
DAT	X	X	6-12
EAM	X	X	6-12
EOM	X	X	6-12
FRE	X	X	6-13
FRW		X	6-13

CODE	C	Q	PAGE
IOM	X	X	6-12
LCM	X	X	6-13
LCS	X	X	6-13
LCW	X	X	6-13
LFL	X	X	6-14
LNA		X	6-14
MSP	X	X	6-14
MUT	X	X	6-14
OFM	X	X	6-15
ONL	X	X	6-16
RAI		X	6-16
RAM		X	6-16
RAS		X	6-17
RCS		X	6-18
RED	X	X	6-18

CODE	C	Q	PAGE
REF	X	X	6-19
RET		X	6-19
RMS		X	6-20
RSN		X	6-21
RUS		X	6-21
SBR	X	X	6-21
SFS		X	6-21
SPA	X	X	6-21
SSA	X	X	6-21
SSW	X		6-21
TIM	X	X	6-22
TNA		X	6-22
TSC	X	X	6-22
XRF	X	X	6-22

CODE	C	Q	PAGE

Note: The following codes are used in the 'Response to Command' column:	
CODE	MEANING
=	Message OK
?	Received OK, but invalid arguments found
*	Message OK, but not permitted in current mode
#	Target cannot perform command due to hardware resource issues
!	Command not accepted by unit. It must be addressed to its paired unit (e.g., MBT *not* BUC/BDC, or BUC/BDC *not* MBT)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Automatic Fault Recovery State	AFR=x	All	1 byte	Command or Query. Sets or returns Automatic Fault Recovery on a BUC in the form x, where: x=0 (Disabled) or 1 (Enabled) Example: AFR=1	AFR= AFR? AFR*	AFR?	AFR=x (same format as command arguments)
Attenuation	ATT=xx.xx	BUC	5 bytes, numeric	Command or Query. Sets or returns a valid attenuation level, in dB, at 0.25dB step size as factory default. Example: ATT=08.25	ATT= ATT? ATT* ATT!		
Clear All Stored Alarms	CAA=	All	None	Command only. Instructs the slave to clear all Stored Events. This command takes no arguments.	CAA=	N/A	N/A
Concise AUX COMM I/O	N/A	MBT	5 bytes, numeric	Query only. Returns the Concise AUX COMM I/O of the MBT-4000B base unit, in the form nabcd where: n=1 (AUX COMM) a=12V (0=Off, 1=On) b=IOA (O=logic low [voltage input < 0.5], 1=logic high [voltage input > 2.7 vdc) c=IOB (O=logic low [voltage input < 0.5], 1=logic high [voltage input >2.7 vdc] d=Reserved (Always zero) Example: <0001/CAI?n{cr} >0001?CAI=nabcd{cr}{lf}	CAI= CAI? CAI*	CAI?n	CAI=nabcd (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Concise Alarm Status	N/A	All	20 bytes, numeric	Query only. Returns the alarm status of the unit in the form abcdefghijkl where: a through l=0 (OK) or 1 (FLT) All: a=+15V Power Supply b=+7.5V Power Supply c=+5.0V Power Supply MBT-4000B: d=+28V Power Supply e=Ref Oscillator Lock Detect f=Intermodule Communications g=Max current on LNA power supply AUX COMM h=Max current on LNB power supply Bias Tee i=Current window LNA power supply AUX COMM j=Current window LNB power supply Bias Tee k=Fault input AUX COMM (Conn J9, Pin F) l=Not used BUC/BDC: d=X (reserved for future use) e=Synthesizer Lock Detect f=Heat-sink Temperature g= LNA current (BDC only, reserved on BUC) h=Reserved, always zero i-l=Not sent. Example: <0001/CAS?{cr} >0001/CAS=abcdefghijkl{cr}{lf}	N/A	CAS?	CAS=x…X (see Description of Arguments for details)
Circuit Identification	CID=	All	24 bytes, alphanumeric	Command or Query. Sets or returns name for the unit or station. First line is limited to 24 characters. Example: CID={cr} -Earth Station 1-- ---Converter #1---	CID= CID?	CID?	CID=x…x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Concise Configuration Status	N/A	All	32 bytes (MBT), 48 bytes (BDC), 41 bytes (BUC), alphanumeric	Query only. Returns the summarized version of RCS. Example for MBT-04000 base unit: <0001/CCS?{cr} >0001/CCS=aa,bb,cc,dd,e,ff,g,h{cr}{lf} Where: aa=Frequency band for Unit 1 BXC ('C", 'X", 'Ka', 'Ku', or 'NA') bb=NA cc=Direction for Unit 1 BXC ('DN'=BDC, 'UP'=BUC, 'NA'=None) dd=NA e=Redundancy mode (0, 1, or 2) ff=Automatic mode g=Redundancy loop cable address N=No Cable A=MBT-A B=MBT-B h=External reference lock (1=locked, 0=Not locked) Example BUC/BDC: <0001A1/CCS?{cr}{lf} >0001A1/CCS=aaaaa,bb.bb,c,d.d,e,ff,g,hhhh,i,j,{CR}{lf} Where: aaaaa=Frequency in MHz bb.bb=Attenuation in dB c=mute state, 0=unmated, 1=muted d.d=slope adjust e=LNA current source (BDC only, BUC=X) ff=LNA current window (BDC only, BUC=XX) g=LNA fault logic (BDC only, BUC=X) hhhh=XXXX (reserved for future use) i=X (reserved for future use) j=Fault recovery, 0=Manual, 1=Auto	N/A	CCS?	CCS=x….x (see Description of Arguments for details)
Calibrate LNA Current	CLC=s	MBT BDC	1 byte, numeric	Command only. Sets the calibration point for the LNA/LNB current alarm feature in the form s, where: s (Source)=1 (LNA A (AUX COMM)) or 2 (LNB Bias Tee) Example: CLC=2 would record the current measured for the LNB bias tee	CLC= CLC? CLC* CLC!	N/A	N/A

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Concise Maintenance Status	N/A	All	40 bytes alphanumeric	Query only. Returns the maintenance status of the unit in concise format. Response is comma delimited as follows: Example: <0001/CMS?{cr} >0001/CMS=aaa.a,bbb.b,ccc.c,ddd.d,eee.e,fff.f,ggg.g,h,I,j,k{cr} {lf} All: aaa.a=+15V power supply bbb.b=+7.5V power supply ccc.c=+5V power supply MBT-4000B Base Unit: ddd.d=+28V power supply eee.e=Ref oscillator tuning voltage fff.f= LNA current in mA for LNA A (AUX COMM) ggg.g= LNB current in mA for the Bias Tee h=Local RF switch position (A, B, or N) i=Local IF switch position (A, B, or N) j=Remote RF switch position (A or B) k=Remote IF switch position (A or B) Notes: 1. It is not possible to detect the absence of a remote switch. 2. N= Not present. BUC: ddd.d=+28V power supply eee.e=Ref oscillator tuning voltage fff.f=LNA current in mA for LNA A (AUX COMM) ggg.g= LNB current in mA for the bias tee h=local RF switch position (A, B, or N) i=Local IF switch position (A, B, or N) j=Remote RF switch position (A or B) k=Remote IF switch position (A or B) BDC: ddd.d=XXX.X (reserved for future use) eee.e=Synthesizer tuning voltage fff.f=LNA current in mA. ggg.g= Unit temperature in °C. h – k= Not present	N/A	CMS?	CMS=… (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Concise Utility Status	N/A	MBT	21 bytes alphanumeric	Query only. Returns the utility status of the MBT-4000B Base Unit, response is comma delimited, in the form aaaa,bbbb where: aaaa=Physical Address bbbb=Remote Baud Rate Example: <0001/CUS? >0001/CUS=aaaa,bbbb{cr}{lf}	N/A	CUS?	CUS=x…x (see Description of Arguments for details)
Set RTC (Real-Time-Clock) Date	DAT=mmddyy	All	6 bytes, numeric	Command or Query. Sets or returns the date in the form mmddyy, where; dd=day of the month, from 01 to 31 mm=month of the year, from 01 to 12 yy=year, from 00 to 96 (2000 to 2096) Example: DAT=042503 would be April 24, 2003.	DAT= DAT? DAT*	DAT?	DAT=mmddyy (same format as command arguments)
Enable Aux Com Fault Input Monitoring	EAM=nm	MBT	n=1 AUX COMM 2=AUX COMM2 m=0 (disabled), 1 (monitoring enabled)	Command or Query. EAM controls monitoring of external fault logic inputs to Aux Comm connectors (Conn J9 Pin F). If enabled and external fault input is at Logic 1 (>2.6 vdc) a fault will be reported. This fault is reported has the LNA I1 or LNA I2 status in the RAS? query Note: The inputs may be driven by a contact closure relay. They have an internal pull-up resistor (4.7k) to +5 vdc. Example: EAM=21	EAM= EAM?	EAM?n	EAM=nm (same format as command arguments)
Enable Online/offline indicator line	EOM=um	MBT	2 bytes, alphanumeric	Command or Query. Used to establish Pin G of J9 | AUX COMM to provide Online/Offline indication in the form um, where: u=1 (Unit 1) or 2 (Unit 2) m=O (Letter 'O')=Pin G of J9 | AUX COMM defined as an Output, or I (Letter 'I')=Pin G of J9 | AUX COMM defined as an Input	EOM= EOM?	EOM?	EOM=um (see Description of Arguments for details)
Invert EOM	IOM=um	MBT	1 byte	Command or Query. This command established the logic level associated with the Online/Offline indication in the form um, where: u=1 (Unit 1) or 2 (Unit 2) m=1 (Invert) or 2 (No invert)	IOM= IOM?	IOM?	IOM=um (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Operating RF Frequency	FRE=xxxxx.xxx	BDC BUC	9 bytes, numeric	Command or Query Sets or returns valid Operating RF frequency, in MHz. For Ku BDCs: FRE values: 10950-11700 MHz an LO of 10000 MHz is activated FRE values: 11701-12250 MHz an LO of 10700 MHz is activated FRE values: 12251-12750 MHz an LO of 11300 MHz is activated Example: FRE=11300.000	FRE= FRE? FRE* FRE!	FRE?	FRE=xxxxx.xxx (see Description of Arguments for details)
Retreive Firmware Number	N/A	All		Query only Returns the Firmware Number of the unit. Example: FRW=FW12357'cr''lf'	N/A	FRW?	FRW=FWxxxxx
Monitor LNA Current	N/A	MBT BDC	6 bytes, numeric	Query only. Returns the LNA/LNB Current Source Level in mA in the form s_xxx.x, where: s=1 (LNA A) or 2 (Bias Tee) xxx.x= LNA Current Source Level in mA Example: <0001/LCM?2 >0001/LCM=2_045.3{cr}{lf}	LCM= LCM? LCM!	LCM?s	LCM=s_xxx.x
LNA Current Source	LCS=sx	MBT BDC	2 bytes, numeric	Command or Query. Sets or returns LNA Current Source Enable in the form sx, where: s=1 (LNA A AUX COMM) or 2 (LNB Bias Tee) x=0 (Disable) or 1 (Enable) Example: LCS=20 (turns off the LNB Bias Tee current)	LCS= LCS?) LCS* LCS!	LCS?s	LCS=sx (same format as command arguments)
LNA Current Window	LCW=sxx	MBT BDC	3 bytes, numeric	Command or Query. This command allows the user to set the alarm window in ± % of the calibrated LNA/LNB Bias Current in the form sxx, where: s=1 (LNA A AUX COMM) or 2 (LNB Bias Tee) xx=Valid inputs are 20 to 50 in increments of 1%. Setting the value to 99 disables the alarm function. Default is Disabled. Example: LCW=230 sets alarm window for LNB Bias Tee to ± 30%.	LCW= LCW? LCW* LCW!	LCW?s	LCW=sxx (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
LNA Fault Logic	LFL=sx	MBT BDC	2 bytes, numeric	Command or Query. Sets or returns LNA/LNB Fault Logic as a contribution to the summary fault relay, in the form sx where: s (Source)=1 (LNA A AUX COMM) or 2 (LNB Bias Tee) x=0 (Disable) or 2 (Enable) Example: LFL=21 generates a fault if the measured current for the bias tee varies from the calibrated operating point stored by the CLC=2 command over the % allowed by the LCW=2xx command	LFL= LFL? LCS* LFL!	LFL?s	LFL=sx (same format as command arguments)
Retrieve next 5 unread Stored Alarms	N/A	All	145 bytes	Query only. Returns the oldest 5 Stored Events which have not yet been read over the remote control. Reply format: Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body=YYYYYYYYYY ZZ hhmmss mmddyy: YYYYYYYYYY=being the fault description. ZZ= being the alarm type. FT=Fault OK=Clear IF=Information If there are no new events, the unit replies with LNA* Note: See Appendix B for a description of possible Alarm/Events that may be found in the Alarm queue.	N/A	LNA?	LNA=YY..ss (see Description of Arguments for details)
Bias Tee Mute State	MSP=x	MBT	1 byte, numeric	Command or Query. Sets or returns mute of the unit in the form x, where: x= 0 (Disabled) or 1 (Enabled) Example: MSP=1 would mute the LNB bias tee	MSP= MSP?) MSP* MSP!	MSP?	MSP=x (same format as command arguments)
Mute State	MUT=x	BDC BUC	1 byte, numeric	Command or Query. Sets or returns mute of the unit in the form x, where: x=0 (Disabled) or 1 (Enabled) Example: MUT=1	MUT= MUT? MUT* MUT!	MUT?	MUT=x (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Mute offline	OFM=um	MBT	2 bytes, numeric	Command or Query. Sets or returns muting for offline unit when in redundancy mode in the form um, where: u=1 (Unit 1) or 2 (Unit 2) m=0 (Manual) or (Automatic) Note: The offline unit must start out as online for this command. Where: OFM=10 would be existing behavior for the block in Slot 1. OFM=11 would force a mute of the block in slot one if Slot 1 is offline as indicated by the switch position(blinking yellow or red LED). It would force an "un- mute" of the block in Slot 1 if slot one is online and not faulted as indicated by the switch position(steady green LED). OFM=20 would be existing behavior for the block in Slot 2. OFM=21 would force a mute of the block in Slot 1 if Slot 2 is offline as indicated by the switch position(blinking yellow or red LED). It would force an "un- mute" of the block in slot two if Slot 2 is online and not faulted as indicated by the switch position(steady green LED). These settings would be kept in NVRAM and would come from the factory as "OFM=10" and "OFM=20" Also, the offline unit must not be muted during this time. The offline unit has to be set for online, otherwise the OFM command won't work properly.	OFM= OFM? OFM!	OFM?u	OFM=um (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Online Status	N/A	MBT	N/A	Query only. Returns the online status of the unit (useful in redundant configurations) in the form x. Return position of corresponding RF switch. Example for MBT-4000B base unit: <0001/ONL?{cr} >0001/ONL={cr}{lf} ON1=ON ,{cr} ON2=ON , {cr}{lf} Example for BDC: <0001A1/ONL?{cr} >0001A1/ONL=1{cr}{lf} Example for BUC: <0001A2/ONL?{cr} >0001A2/ONL=1{cr}{lf}	ONL= ONL?	ONL?	ONL=x
Retrieve AUX COMM I/O	N/A	MBT	1 byte, numeric	Query only. Used to Retrieve AUX COMM I/O of the MBT-4000B base unit, in the form n, where: n=1 (AUX COMM) Example: <0001/RAI?1 Returns: >0001/RAI= 12V1=On IO1A=0 IO1B=1 RSVD=0 Note: 0=Logic low or input voltage < 0.5 vdc. 1=Logic level 1 or input voltage > 2.7 vdc.	RAI= RAI? RAI*	RAI?n	RAI=x (see Description of Arguments for details)
Redundancy Mode	RAM=um	MBT	2 bytes, numeric	Command or Query. Sets or returns redundancy mode in the form um, where: u=1 (Unit 1) or 2 (Unit 2) m=0 (Manual Mode) or 1 (Automatic Mode) Example: RAM=11	RAM= RAM?) RAM*	RAM?u	RAM=um (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Retrieve Alarm Status	N/A	All	92 bytes (MBT), 74 bytes (BDC), 64 bytes (BUC), alphanumeric	Query only. Returns the Query the Alarm status of the unit Example for MBT-4000B base: <0001/RAS?{cr} >0001/RAS={cr} 15VT1=OK{cr} 7V5T1=OK{cr} 5VLT1=OK{cr} 28VT1=OK{cr} REFLD=OK{cr} IICST=OK{cr} LNAC1=OK{cr} (Note 2) LNAC2=OK{cr} (Note 2) LNAW1=OK{cr} (Note 3) LNAW2=OK{cr} (Note 3) LNAI1=OK{cr} (Note 4) LNAI2=OK{cr}{lf} (Note 5) Example for BUC/BDC: <0001A1/RAS?{cr} >0001A1/RAS={cr} 15VLT=OK{cr} 7V5LT=OK{cr} 5VOLT=OK{cr} REFLD=XX {cr} (reserved for future use) SYNLD=OK{cr} HSTMP=OK{cr} LNACR=OK{cr}{lf} (Note 1) Notes: 1. LNACR will only appear for BDC. 2. FT reported if MAX current exceeded. 3. FT reported if LCW window current exceeded. 4. FT reported if EAM = 11 & Pin F of J9 High. 5. FT reported if EAM = 21 & Pin F of J8 High, not applicable to MBT-4000B.	N/A	RAS?	RAS=x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Retrieve Configuration Status	N/A	All	65 bytes (MBT), 98 bytes (BDC), 76 bytes (BUC), alphanumeric	Query only. Returns the configuration status of the unit Example for MBT-4000B base: <0001/RCS?{cr} >0001/RCS={cr} BF1=X {cr} BF2=X {cr} BT1=DN{cr} BT2=UP{cr} RED=0{cr} RAM=00{cr} MBT=N, A, or B EXT=0{cr}{lf} Example for BUC/BDC: <0001A1/RCS?{cr} >0001A1/RCS={cr} FLO=06300{cr} ATT=01.00{cr} MUT=1{cr} SLP=0.3{cr} LCS=0{cr} LCW=99{cr} LFL=1{cr} REF=XXXX{cr} (reserved for future use) XRE=X{cr} (reserved for future use) AFR=0{cr}{lf} Note: For BUC – LCS, LCW, & LFL will not be shown.	N/A	RCS?	RCS=x….x (see Description of Arguments for details)
Redundancy State	RED=x	MBT	1 byte	Command or Query. Controls redundancy state in the form x, where: x=0 (Off), 1 (Enables redundancy using single base unit), or 2 (Enables redundancy using dual base units) Example: RED=1	RED= RED? RED*	RED?	RED=x (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Reference Oscillator Adjust	REF=xxxx	MBT	4 bytes, numeric	Command or Query. Sets or returns Ref Osc Adjust in the form xxxx, where: xxxx=value from 0000 to 0255, resolution=0001. Example: REF=0197 Note: REF cannot be adjusted when the unit is locked to an external reference source.	REF= REF? REF*	REF?	REF=xxxx (same format as command arguments)
Retrieve Equipment Type	N/A	All	22 bytes, alphanumeric	Query only. Unit returns a string indicating the Model Number and the software version installed Example: RET=BUC-4000 VER:1.0.3	N/A	RET?	RET=x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Retrieve Maintenance Status	N/A	All	103 bytes (MBT), 98 bytes (BDC), 98 bytes (BUC), alphanumeric	Query only. Used to Query the maintenance status of the unit. Example for MBT-4000B base: >0001/RMS={cr}{lf} 15VT1=015.1{cr} 7V5T1=007.7{cr} 5VLT1=005.0{cr} 28VT1=027.2{cr} REFVT=001.3{cr} LNA_1=000.0{cr} LNA_2=000.0{cr} RFSWP=B{cr} IFSWP=N{cr} RRFSW=B{cr} RIFSW=B{cr}{lf} Example for BUC: <0001A2/RMS={cr} >0001A2/RMS={cr}{lf} 15VT=015.1{cr} 7V5T=007.6{cr} 5VLT=005.2{cr} REFV=XXX.X{cr} (reserved for future use) SYNT=007.2{cr} POUT=XXX.X{cr} (reserved for future use) TEMP=+25.0{cr}{lf} Example for BDC: <0001A1/RMS={cr} >0001A1/RMS={cr}{lf} 15VT=015.1{cr} 7V5T=007.6{cr} 5VLT=005.2{cr} REFV=XXX.X{cr} (reserved for future use) SYNT=007.2{cr} LNAC=255.0{cr} TEMP=+25.0{cr}{lf} Note: “REFV” will show tuning voltage of reference OSC for standalone. Otherwise REFV=xxx.x which means Not Applicable.	N/A	RMS?	RMS=x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Serial Number	N/A	All	9 bytes, numeric	Query only. Returns the unit's 9 digit serial number. Slave returns its S/N, in the form xxxxxxxxx. Example: RSN=000000165	N/A	RSN?	RSN= x….x (see Description of Arguments for details)
Retrieve Utility Status	N/A	MBT	24 bytes, alphanumeric	Query only. Returns the utility status of the MBT-4000B base unit.. Example: <0001/RUS={cr} >0001/RUS={cr}{lf} ADR=0001{cr} BDR=9600{cr}{lf}	N/A	RUS?	RUS=x….x (see Description of Arguments for details)
Remote Baud Rate	SBR=xxxx	MBT	4 bytes,	Command or Query. Sets or returns the remote baud rate as follows: in the form xxxx, where: 9600=9600 baud 19K2=19200 baud	SBR= SBR? SBR!	SBR?	SBR=xxxx (same format as command arguments)
Summary Fault Status	N/A	All	N/A	Query only. Returns the status of the Summary Fault Relay in the form x, where: x=0 (OK) or 1 (FLT) Example: SFS?	N/A	SFS?	SFS=x (see Description of Arguments for details)
Remote Address	SPA=xxxx	MBT	4 byte, numeric	Command or Query. Sets or returns the Physical Address of the MBT-4000B base unit in the form xxxx, where: xxxx=an address from 0001 to 9999, resolution=0001 Example: SPA=0412	SPA= SPA? SPA!	SPA?	SPA=xxxx (same format as command arguments)
Slope Adjust	SSA=x.x	BDC BUC	3 bytes, numeric	Command or Query. Sets or returns the Slope adjust level in the form x.x, where: x.x=valid number from 0.0 to 1.0, resolution=0.1 Example: SSA=0.3	SSA= SSA? SSA* SSA!	SSA?	SSA=x.x (same format as command arguments)
Set Redundancy Switch	SSW=xy	MBT	2 bytes, alphanumeric	Command only. Sets the switches dedicated to Slot 1 or 2, and sets them to either Port A or Port B in the form xy, where: x =1 (Slot 1) or 2 (Slot 2) y=A (Switched to Converter on MBT_A) or B (Switched to Converter on MBT_B)	SSW= SSW=xy	N/A	SSW=xy (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT or BUC/BDC	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57)	Response to Command (Target to Controller)	Query (Instruction Code and qualifier)	Response to Query (Target to Controller)
Set RTC Time	TIM=hhmmss	All	6 bytes, numeric	Command or Query. Sets or returns the time, indicating the time from midnight, in the form hhmmss where: hh=hours, between 00 and 23 mm=minutes, between 00 and 59 ss=seconds, between 00 and 59 Example: TIM=231259 would be 23 hours, 12 minutes and 59 seconds from midnight.	TIM= TIM? TIM *	TIM?	TIM=hhmmss (same format as command arguments)
Retrieve Number of unread Stored Alarms	N/A	All	2 bytes, numeric	Query only. Returns the number of Stored Events that remain unread, in the form xx. Example reply: TNA=18	N/A	TNA?	TNA=xx (see Description of Arguments for details)
Terminal Status Change	N/A	All	1 byte, numeric	Query only. Returns the status of the Terminal Status in the form x, where: x=0 (no change in status) or 1 (change in status) Example: TSC=0	N/A	TSC?	TSC=x (see Description of Arguments for details)
External Reference Fault Logic	XRF=x	MBT	1 byte, numeric	Command or Query. Sets or returns enabling/disabling the software monitoring of the external reference source in the form x, where: x=0 (Ext Reference not monitored) or 1 (Ext Reference is monitored and the lock state reported) Note: If enabled and no source is present, a fault will be reported. Example: XRF=1	XRF= XRF?	XRF?	XRF=x (see Description of Arguments for details)

Notes:

Appendix A. FAULTS/EVENTS

A.1 LED Status Indicators

The MBT-4000B Multi-Band Transceiver System features two Light-Emitting Diode (LED) indicators. As shown in **Figure A-1**, the LEDs are found on the top of the MBT-4000's base module, under a protective plate. To view the LEDs, loosen the thumbscrew that keeps the plate in place, then swing the plate away to reveal the LED display window.

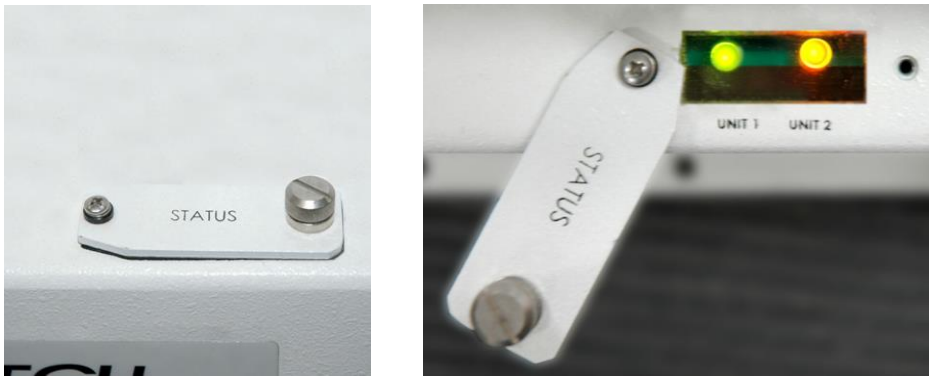


Figure A-1. MBT-4000B LED Indicators

The Unit 1 LED is for the installed BUC (Slot 1). The Unit 2 LED is operational when the presence of an LNB is detected. Each LED provides the user with visual cues to the operational, online, and offline status for the system.

A *steadily-lit* LED indicates that the specified unit is **ONLINE**. A *blinking* LED indicates that the specified unit is **OFFLINE**. The user is presented with MBT-4000B system status as per the following table:

UNIT STATUS	LED COLOR	UNIT STATE
ONLINE	GREEN	**No faults** present; the unit is **not** muted.
	YELLOW	**No faults** present; the unit is **muted**.
	RED	The unit is **faulted**.
OFFLINE	GREEN (blinking)	**No faults** present; the unit is **not** muted.
	YELLOW (blinking)	**No faults** present; the unit is **muted**.
	RED (blinking)	The unit is **faulted**.

A.2 Faults/Events

There are three types of Faults/Events that may occur and be recorded in the event log of the MBT-4000B or BUC-4000:

- **Summary Faults**
- **Configurable Summary Faults**
- **Informational Events**.

Each of these are described in further detail in the next subsections; **Tables B1** through **B6** list possible Fault/Event messages where applicable. An example of a faulted system is shown in **Figure A-2**; here, Unit 2 has faulted.

Figure A-2. Faulted System Example

A.2.1 Summary Faults

Summary Faults indicate improper operation. When a Summary Fault condition occurs, the Summary Fault Relay will be de-energized. If a Summary Fault occurs on a converter, it will mute. If a Summary Fault occurs on the base unit, the converter will be muted according to the specific error. If a Summary Fault occurs on the online unit of a redundant pair, the offline unit will detect the fault and assume online state. In all cases, a corresponding event message will be added to the event log.

Table A-1. MBT-4000B Summary Faults

Mnemonic	Mute	Description
15V PS1	All	The 15 volt power supply is out of tolerance.
28V PS1	All	The 28 volt power supply is out of tolerance.
5VT PS1	All	The 5 volt power supply is out of tolerance.
7V5 PS1	All	The 7.5 volt power supply is out of tolerance.
IIC BUS	All	Unable to communication via the internal high speed communication bus

Table A-2. BUC-4000 Summary Faults

Mnemonic	Description
15V SUP	The 15 volt power supply is out of tolerance.
5VT SUP	The 5 volt power supply is out of tolerance.
7V5 SUP	The 7.5 volt power supply is out of tolerance.
OVR TMP	The maximum operating temperature has been exceeded.
PLL LD	The PLL has lost lock.

A.2.2 Configurable Summary Faults

Configurable Summary Faults operate the same as Summary Faults, except Configurable Summary Faults may be enabled or disabled using remote commands.

Table A-3. MBT-4000B Configurable Summary Faults

Mnemonic	Mute	Description
AUXCOM1	Slot 1	The IO1A/FAULT input (AUX COMM 1) indicates a fault. Monitoring for this fault is enabled using the EAM command.
LNACUR2	Slot 2	The +17 V nominal bias tee provided LNB power supply current has exceeded the maximum limit of 450 mA and has been disabled. The LNB power supply – and thus this fault – is enabled using the LCS command. This fault is cleared by a LCS command or power cycle.
LNAWIN2	Slot 2	The +17 V nominal bias tee provided LNB power supply current is outside the programmed window. (The power supply is not disabled in response to this fault.). LNB current window monitoring is configured and enabled using the LCS, CLC and LCW commands. This fault is cleared by an LCS command, CLC command, LCW command or power cycle.
REF LD	All	The External Reference Monitor has lost lock with the external reference signal. The attached converter has been muted. Monitoring for this fault is enabled using the XRF command. This fault is cleared when lock has been regained.

A.2.3 Informational Events

Informational Events are operation conditions which may be important, but are not considered improper operation and will not cause a converter to mute.

Table A-4. MBT-4000B Informational Events

Mnemonic	Mute	Description
LOG CLR	None	The Event LOG Queue was cleared in response to receipt of a CAA command.
PWR OFF	None	Power off was detected.
PWR ON	None	Power on was detected.

Table A-5. BUC-4000 Informational Events

Mnemonic	Description
LOG CLR	The Event LOG Queue was cleared in response to receiving a CAA command.
PWR OFF	Power off was detected.
PWR ON	Power on was detected.

Appendix B. REDUNDANCY CONFIGURATION / OPERATION

B.1 Overview

The MBT-4000B is designed to operate in both standalone and redundant configurations. Every MBT-4000B base contains the circuitry and logic necessary to perform all the functions of a backup controller in either a single base or dual base configuration.

The Bias Tee side of the MBT-4000B provides the 10 MHz reference and DC voltage for the LNB. This power supply features current monitoring with programmable failure limits. Overcurrent and undercurrent failures can participate in overall fault indication and redundant switchover criteria.

Each MBT-4000B base provides the **"J9 | AUX COMM"** connector. This connector includes a logic input intended to be connected to contact closure fault indications of external equipment. Thus, external equipment failure may participate in overall fault indication and redundant switchover operation. The **"J9 | AUX COMM"** connector also has a user programmable I/O pin. When programmed as an output, this pin indicates the online/offline position of the switch associated with the BUC. This signal can be used to mute the external offline amplifier.

Each MBT-4000B base includes two 'switch drive' connectors. Each connector is intended for driving and monitoring a 28V latching switch. In most installations, one switch drive connector will drive an RF waveguide switch, while the second switch drive connector will drive an IF (L-Band) coaxial switch.

B.2 Single-Base Redundancy Operation

The MBT-4000B does not support Single-Base Redundancy Operation.

B.3 Dual-Base (Chain) Redundancy Operation

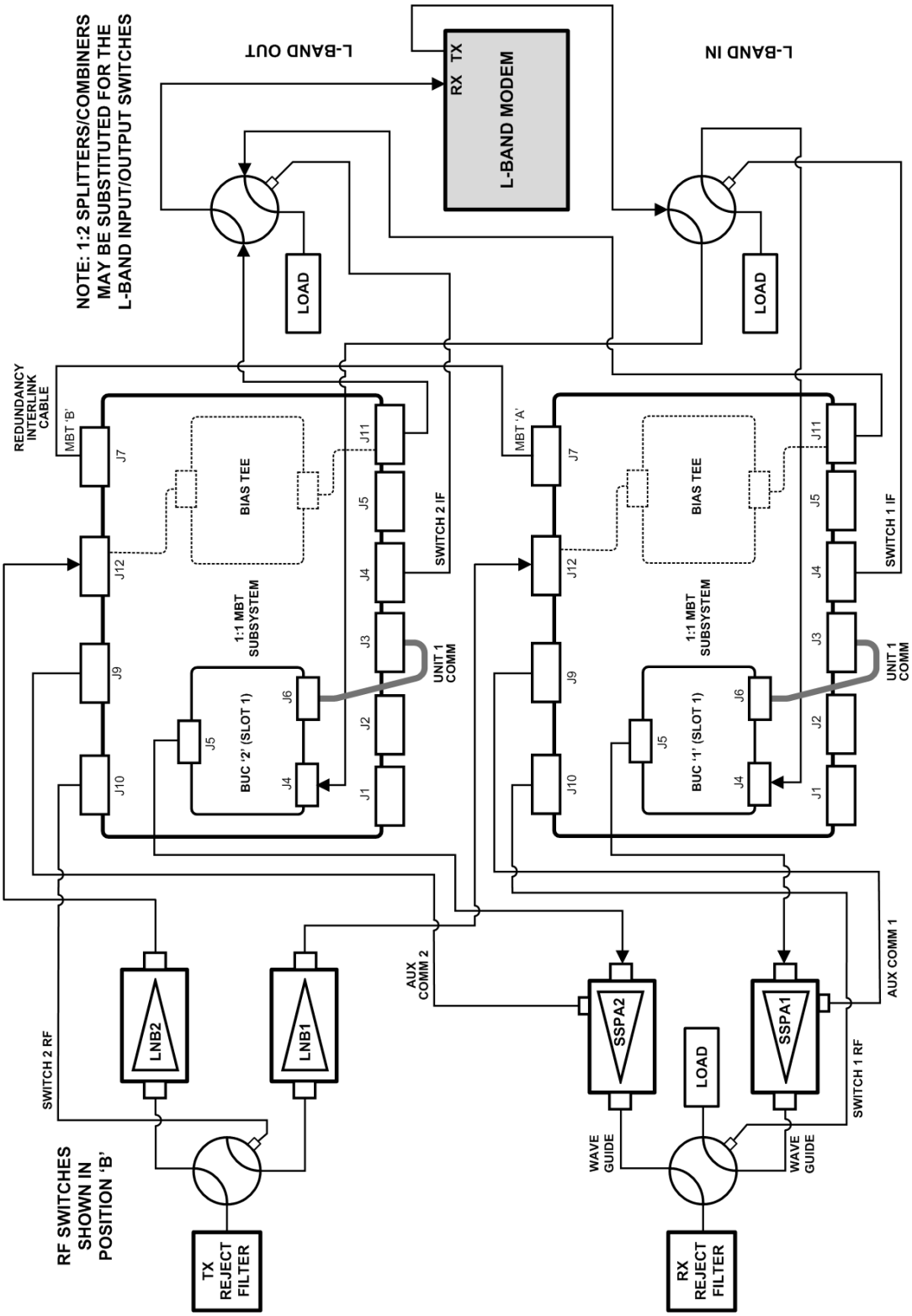


Figure B-1. Dual-Base (Chain) Redundancy Operation

Figure B-1 illustrates a typical Dual-Base (Chain) Redundancy configuration. The two MBT-4000B base units cooperate in monitoring the health of the two BUCs, two external amplifiers, two Low-Noise Block Down Converters (LNBs), and each other. In case of a fault on an online BUC/amplifier or LNB, the MBT-4000B base containing the corresponding standby chain will automatically switch over to the standby chain in accordance with the following rules:

1. In dual-base (chain) redundancy operation, the redundancy is 'slot' based. The corresponding pairs reside in the same 'slot' of the opposite MBT-4000B base, the pair of BUCs connected to the **"J3 | UNIT 1 COMM"** (Slot 1) connector on each base form a redundant pair. The LNBs connected to the **"J12 | L-BAND IN"** connector on each base form the other redundant pair.

2. The corresponding BUCs in a pair must be of the same band type.

3. The Redundancy Interlink Cable (CEFD P/N CA/WR11224-1 or equivalent) must be installed.

4. Base unit identification (**MBT1** or **MBT2**) is driven by the redundancy interlink cable. Hard-wired connections within the cable designate one MBT-4000B base as **MBT1** and the other as **MBT2**. The cable is labeled accordingly.

5. The RF and IF switches connected to **MBT1** correspond to the redundant pair of BUCs installed on the **"J3 | UNIT 1 COMM"** (Slot 1) connector.

6. The RF and IF switches connected to **MBT2** correspond to the redundant pair of LNBs installed on the **"J12 | L-BAND IN"** connectors.

7. When a BUC or LNB attached to **MBT1** is online, the corresponding RF and IF switches will be switched to Position **"**A**"**. When a BUC or LNB attached to **MBT2** is online, the corresponding switches will be switched to Position **"**B**"**.

For a switchover to occur:

1. Both MBT-4000B base units must be set to Redundancy Mode 2. The **RED=2** remote command must have been received by each base.

2. Both chains must be set to Automatic Mode. For example, if the redundant pair is on Slot 2 of the bases, the **RAM=21** remote command must have been received by each base.

3. The corresponding standby chain must not be in faulted state.

B.4 External Fault Monitoring

Each MBT-4000B base includes a logic input on the **"J9 | AUX COMM"** connector that may be connected to contact closure fault indications of external equipment (usually an SSPA or TWTA). Thus, external equipment failure may participate in overall fault indication and redundant switchover operation according to the following rules:

1. An open connection (or 2.7 V min) indicates a fault condition exists.
2. A closed connection (or 0.7 V max) indicates no fault condition exists.
3. Maximum voltage range on fault logic inputs is –12V to +12V.
4. The fault input of **"J9 | AUX COM"** corresponds to the BUC installed as **"BUC1"**.
5. To enable fault input checking, the **EAM=1m** remote command is used (where **m**=**0** for disabled, or **1** for enabled).

B.5 LNB Power Supply Current Monitoring

The bias tee in the MBT-4000B base is used to supply power and the 10 MHz reference to the LNB.

This power supply features current monitoring with programmable failure limits. Overcurrent and undercurrent failures can participate in overall fault indication and redundant switchover criteria.

The following remote commands and rules configure operation of this feature:

1. The power supply provides +18V with a 450 mA current limit.
2. The Bias Tee supply is enabled by issuing the **LCS=2m** remote command (where **m**=**0** (OFF) or **1** (ON)).
3. In case of excessive current (more than 450 mA), the supply will be disabled and a fault will be posted. The **LCS=2m** remote command must be re-sent to re-enable the supply.
4. To enable programmable current monitoring, the following steps are taken:
   a. The desired output is enabled as outlined above.
   b. The nominal current is calibrated using the **CLC=2** remote command.
   c. The programmable current window is specified using the **LCW=2xx** remote command. (Note that **xx**=the allowable percentage of variance from nominal (set by the **CLC=2** remote command). Acceptable percentage values are **20** to **50** in increments of 1%. A value of **99** disables the alarm function.)
   d. If a current is detected outside this window, an LNB current fault will be posted, but the supply will not be disabled.

B.6 Gain Equalization of Redundant Units

Gain equalization in an MBT-4000B system is accomplished by issuing individual attenuation settings to the specific BUCs.

B.7 Redundancy Systems Check

Step	Task
1	Set up two MBT-4000Bs with BUC modules installed in Slot 1.  *The BUCs must match (e.g., C-Band → C-band).*
2	Using a multi-drop EIA-485 connection, use the SPA=xxxx remote command to set the COMM address of the first MBT to "1" (<"current address"/SPA=0001) and the COMM address of the other MBT to "2" (<"current address"/SPA=0002).
3	With both MBTs connected to the multi-drop EIA-485 connection, use the RET? remote query on each base and BUC module to verify communication and software versions.
4	Power down the system.
5	Connect the Redundant Loop Cable (CEFD P/N CA/WR11224-1) between the two MBT base unit "J7 | REDUNDANCY LOOP" connectors..
6	Typical for each MBT base, connect an RF switch to the "J10 | RF Switch" connector. Note the "A" and "B" labels on the ends of the Redundant Loop Cable – the MBT base connected to the "A" cable end will be connected to the RF switch associated with the uplink (BUC/SSPA) path, and is referred to as "MBT1". The MBT connected to the "B" cable end will be connected to the RF switch associated with the downlink (LNB), and is referred to as "MBT2".
7	Power up the system.
8	Enable two-unit redundancy by sending the RED=2 remote command to both MBT base units.
9	Place redundancy in AUTO mode by sending the RAM=xx remote command: RAM=11 to the MBT1 base, and RAM=21 to the MBT2 base.
10	Verify that there are two *solid* LEDs on the "online" unit, and two *flashing* LEDs on the "offline" unit.
11	Unmute the BUCs by sending the MUT=0 remote command to both BUCs: <1A1/MUT=0 to BUC1, and <2A1/MUT=0 to BUC2. Then, unmute the Bias Tee by sending the MSP=0 remote command to both MBT bsee units: <1/MSP=0 to MBT1, and <2/MSP=0 to MBT2.
12	Verify that there are two *solid* green LEDs on the "online" unit, and two *flashing* green LEDs on the "offline" unit.
13	Power down MBT2. This should force both switches to select MBT1.
14	Verify that both LEDs on MBT1 are *solid* green.
15	Power up MBT2.
16	Verify that both LEDs on MBT2 are *flashing* green.
17	Power down MBT1. This should trip both switches to MBT2.
18	Verify that both LEDs on MBT2 are *solid* green
19	Power up MBT1.
20	Verify that both LEDs on MBT2 are *flashing* green.

Step	Task

Steps 21 through 35 comprise the Uplink Test:

21	Fault the BUC (Slot 1) of MBT2 by disconnecting the base-to-BUC cable (15-15 Power & Signal Harness, CEFD P/N CA/WR10963-1).
22	LED 1 on MBT2 should now be *flashing* red.
23	This should have tripped the switch connected to MBT1 to throw.
24	Verify that LED 1 on MBT1 is *solid* green.
25	Clear the fault on Unit 1 of MBT2 by reconnecting the base-to-BUC cable.
26	Verify that LED 1 on MBT2 is now *flashing* green.
27	Fault the block in Slot 1 of MBT2 and confirm proper switch/LED behavior.
28	If the system is being used to monitor external SSPAs to provide chain switching, perform Steps 29 through 34. Otherwise, skip these steps and continue to the "Downlink Test" (Steps 35 through 42).
29	Build the two cables (one per MBT/SSPA) that interface the "J9 | AUX COMM" connector of the MBT to the amplifiers discrete control connector. Note the following: • The MBT is designed to pass EIA-485 communications directly to the amplifier. Pins "A" through "D" are hard-wired to the EIA-485 COMM bus coming into the MBT. If the amplifier is going to share the same EIA-485 bus, it will need to have its own serial COMM address. • Pin "F" of the "J9 | AUX COMM" connector is used to monitor the summary fault relay of the amplifier. This line is internally pulled up and must be grounded to clear a fault condition. The EAM=11 remote command allows this fault to be detected and acted upon by the MBT. • Pin "G" of the "J9 | AUX COMM" connector provides a logic level ONLINE/OFFLINE indication. This can be used to force an offline amplifier to be muted. The amplifier must have a discrete mute-status control line. This pin is set to be an output using the EOM=1O (letter O) remote command. The logic state associated with an online/offline position can be set using the IOM=21 or IOM=20 remote command.
30	Connect the cable between the amplifiers and the "J9 | AUX COMM" connectors on the MBT base units. Terminate the output of the amplifiers and power them up.
31	Enable external fault monitoring by sending the EAM=11 remote command to both MBT base units.
32	Fault the online SSPA by removing its power, and then confirm that LED 1 of the associated MBT is *flashing* red (indicating that a fault is detected and that the switch has thrown and is now offline). Restore the system and repeat for the second amplifier.
33	If the online/offline control line (Pin "G" of the "J9 | AUX COMM" connector) is being used, proper operation can be established by querying the amplifiers mute status. The line must be enabled as an output using the EOM=1O remote command. If the logic levels are opposite of what is required, the IOM=1X remote command can be used.
34	Setting the BUC attenuators independently performs gain balancing. If the BUC/amplifier chain associated with MBT1 has 1 dB more gain than the chain associated with MBT2, add 1 dB of attenuation to the desired setting of the BUC on MBT1.

Steps 35 through 42 comprise the Downlink Test:

35	Ensure redundancy is enabled, and set to AUTO mode as outlined in Step 9.
36	Connect the LNBs.
37	Enable the LNB voltage by sending the LCS=21 remote command to both MBT bases.
38	Verify the LNBs are drawing appropriate current by polling them with the RMS? remote query. Reported current for LNB2 should be in the 200 to 400 mA range.

Step	Task
39	Calibrate the normal operating point of the LNB by sending the CLC=2 remote command to both MBT bases. This records the operating current of the LNB and the MBT will monitor this current.
40	Set the desired current window (outside of which a fault will be declared) using the LCW=2xx remote command (where xx=percentage of the nominal current allowed before a fault is declared – LCW=230 (30%) is a typical setting).
41	Disconnect the online LNB (indicated by the *solid* Unit 2 LED). The LED should now be *flashing* red and the LNB switch should throw. The Unit 2 LED on the other MBT should stop flashing.
42	Restore the first LNB, and then fault the second. The same change in LEDs and switch position should be observed.

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METRIC CONVERSIONS

Units of Length

Unit	Millimeter	Centimeter	Inch	Foot	Yard	Meter	Kilometer	Mile
1 millimeter	1	0.1	0.0394	0.0033	0.0011	0.001	1×10^{-6}	6.214×10^{-7}
1 centimeter	10	1	0.3937	0.0328	0.0109	0.01	1×10^{-5}	6.214×10^{-6}
1 inch	25.4	2.54	1	0.0833	0.0278	0.0254	2.54×10^{-5}	1.578×10^{-5}
1 foot	304.8	30.48	12	1	0.3333	0.3048	3.048×10^{-4}	1.894×10^{-4}
1 yard	914.4	91.44	36	3	1	0.9144	9.144×10^{-4}	5.682×10^{-4}
1 meter	1000	100	39.37	3.2808	1.0936	1	0.001	6.214×10^{-4}
1 kilometer	1×10^{6}	1×10^{5}	3.938×10^{4}	3.281	1093	1000	1	0.6214
1 mile	1.609×10^{6}	1.609×10^{5}	6.336×10^{4}	5280	1760	1609	1.609	1

Temperature Conversions

Temperature	° Fahrenheit	° Centigrade
Water freezes	32	0
Water boils	212	100
Absolute zero	-459.69	-273.16

Formulas
° C = (F - 32) * 0.555
° F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoirdupois	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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