MBT-4000

Multi-Band Transceiver System

Installation and Operation Manual

Part Number MN/MBT4000.IOM
Revision 5
July 29, 2016

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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PREFACE

Product Support

For all product support, please call:

+1.240.243.1880

+1.866.472.3963 (toll free USA)

About this Manual

This manual gives installation and operation information for the Comtech EF Data MBT-4000 Multi-Band Transceiver System. Anyone who installs or operates the unit must read this manual.

Cautions and Warnings

IMPORTANT or NOTE indicates information critical for proper equipment function.

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

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

Patents and Trademarks

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

Comtech EF Data acknowledges that all trademarks are the property of the trademark owners.

Copyright

Regulatory Compliance

Electromagnetic Compatibility (EMC) Compliance

This is a Class A product. In a domestic environment, it may cause radio interference that requires the user to take adequate protection measures.

EN 55022 –1998 Compliance

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined per EN 55022 1998.

EN 55082-1 – 1997 Compliance

This equipment meets the EMC/generic immunity standard as defined per EN 55082-1 1997.

EN 60950 – 1997 Compliance

Applicable testing is performed routinely as a condition of manufacturing on all units to ensure compliance with safety requirements of the European Union Low Voltage Directive (EN 60950). This equipment meets the Safety of Information Technology Equipment specification as defined in EN 60950.

Low Voltage Directive (LVD)

This information is applicable for EN 60950:

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

Class I Pluggable Equipment Type A-Protective Earthing

The cable distribution system/telecommunication network of this product relies on protective earthing and the integrity of the protective earthing must be insured.

In Finland:

"Laite on liitettävä suojakoskettimilla varustettuun pistorasiaan"

In Norway:

“Apparatet må tilkoples jordet stikkontakt”

In Sweden:

“Apparaten skall anslutas till jordat uttag”

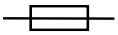
Galvanic Isolator Use

Utrustning som är kopplad till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i visa fall medföra risk för brand. För att undvika detta skall vid anslutning av utrustningen till kabel-TV nät galvanisk isolator finnas mellan utrustningen och kabel-TV nätet

Restricted Access Location

In Nordic Countries, equipotential bonding should be applied using the permanently connected ground stud by a qualified service person

International Symbols

Symbol	Definition
~	Alternating Current
	Fuse

Symbol	Definition
	Protective Earth
	Chassis Ground

Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Correctly shielded cables for DATA I/O must be used. These cables must be shielded from end to end, ensuring a continuous shield.

Comtech EF Data Headquarters

http://www.comtechefdata.com

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Warranty Policy

Comtech EF Data 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 EF Data 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 EF Data for the warranty period specific to the product purchased.

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

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 EF Data strongly recommends all equipment be returned in its original packaging.

Comtech EF Data 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 EF Data Corporation, 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 EF Data Corporation.

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 EF Data 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 EF Data Corporation 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 EF Data Corporation cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech EF Data Corporation'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 EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation 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 EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Chapter 1. INTRODUCTION

1.1 Overview

Comtech EF Data's MBT-4000 Multi-Band RF Transceiver, shown in **Figure 1-1**, is designed to perform C-, X-, or Ku-Band RF to L-Band down conversion and L-Band to C-, X-, or Ku- or Ka-Band RF up conversion.

Figure 1-1. Comtech EF Data MBT-4000 Multi-Band RF Transceiver

1.2 Functional Description

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

- 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
- Automatic band identification for the Block Up converter (BUC), Block Down Converter (BDC), and antenna feed (if the feeds provide an identifying connector)

- System status verification via LEDs located behind a removable cover
- Flexible configuration:
    - 2 Ups
    - 2 Downs
    - 1Up / 1 Down

Figure 1-2 depicts the operation schematic for a typical MBT-4000 application.

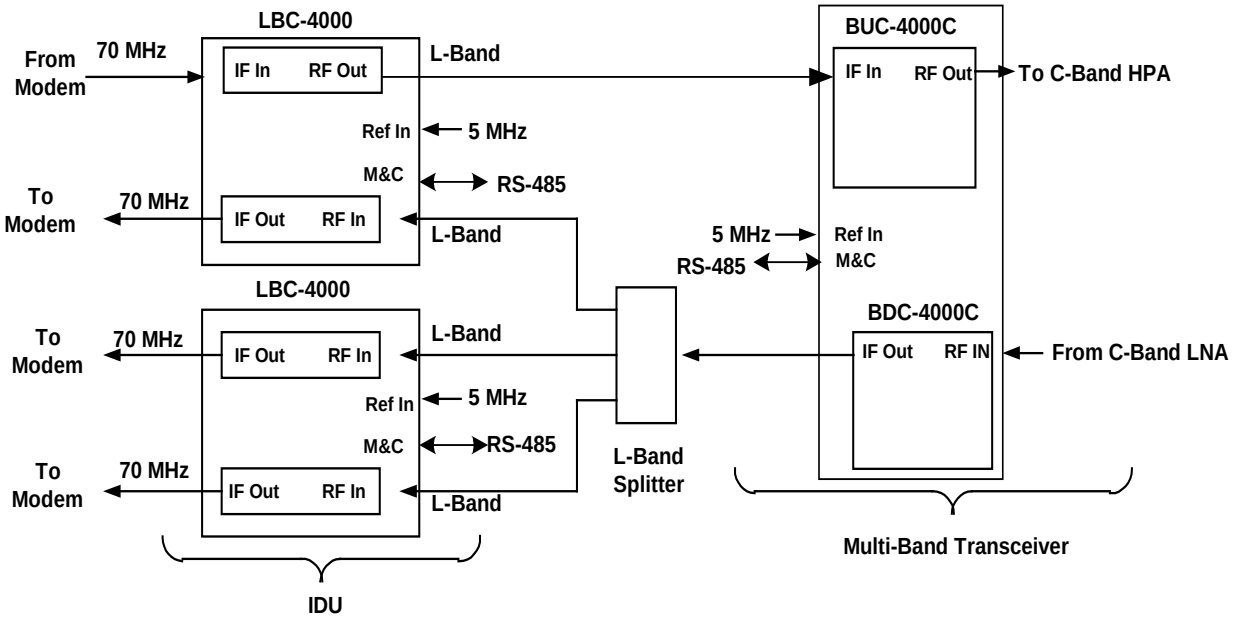


Figure 1-2. MBT-4000 Operational Schematic

1.3 Common Features

- Meets or exceeds MIL-STD-188-164A
- Low phase noise
- Auto band sensing capability
- Functions in 1 MHz step sizes

1.4 Options

- Functions in 1 kHz step sizes
- Dual-Base (Chain) Redundancy Operation (see **Figure 1-3**)

1.5 System Overview

The MBT-4000 Multi-Band Tranceiver System is constructed in a modular configuration. **Figure 1-3** illustrates the key components of this configuration.

Common to the configuration for any frequency band of operation is a base module, which provides the Monitor and Control (M&C), Power Supply, and Reference function.

Band-specific BUC and BDC modules can be mounted to the base module with clip-type fasteners. BUC and BDC modules for other bands and spares for all modules are stored in a transit case until needed.

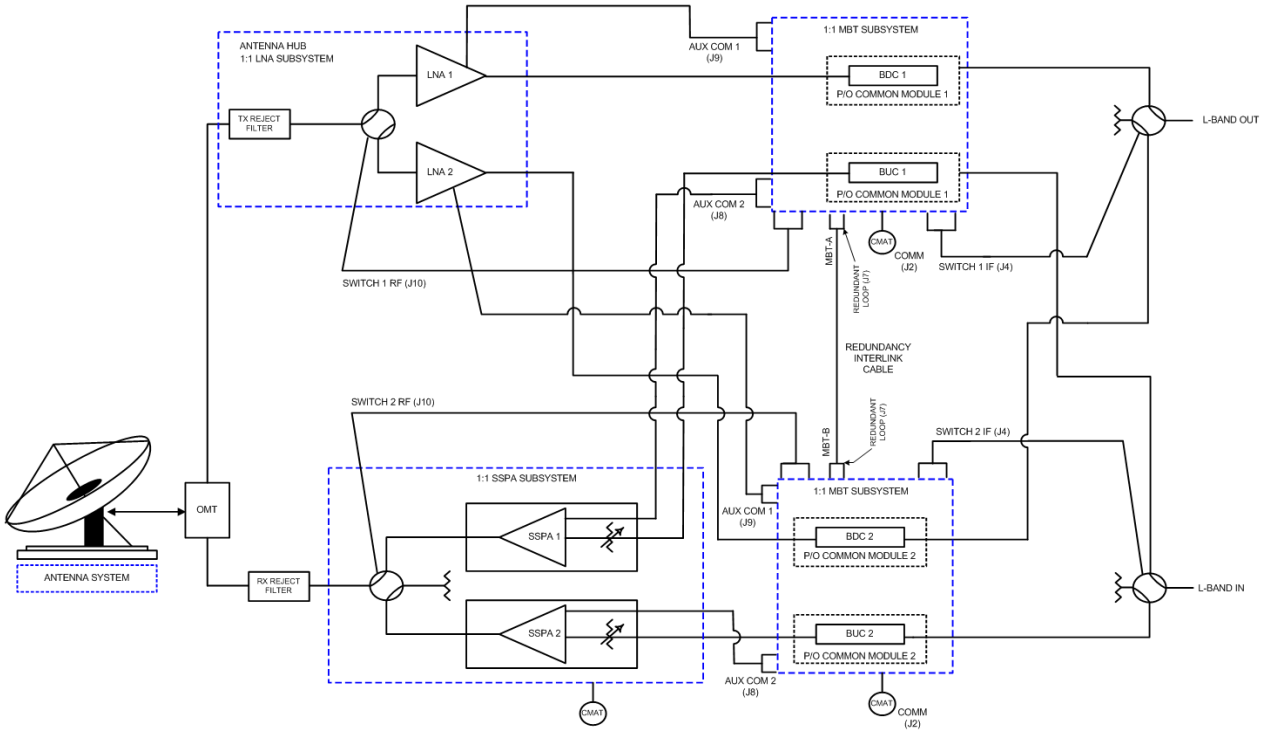


Figure 1-3. Operational Diagram for Dual-Base (Chain) Redundancy Option

1.6 Summary of Specifications

1.6.1 Environmental & Physical

Dimensions (excluding connectors)			See Figure 1-4
Temperature	**Operating**	**ODU: BUC-4000**	-40º – 122ºF (-40º to 50ºC)
		IDU: LBC-4000	14º – 122ºF (-10º to 50ºC)
	Non-operating	**ODU: MBT-4000**	-58º – 160ºF (-50º to 71ºC)
Operational Humidity			5 – 95 non-condensing
Operational Altitude			10,000 ft above sea level
Prime Power			90 – 260 VAC, 47-63 Hz
External Reference Input			Either 5 MHz or 10 MHz ±5 dBm optional
Frequency Stability	**Over time**		$1x10^{-9}$/day, $1x10^{-7}$/year
	Over temperature		40º – 55ºC, $1x10^{-8}$

1.6.2 BUC-4000 Block Up Converter ODU

Input Frequency Range		950 – 2000 MHz
Output Frequency (by model)	**BUC-4000C**	5860 – 6650 MHz
	BUC-4000X	7900 – 8400 MHz
	BUC-4000Ku	13.75 – 14.50 GHz
	BUC-4000Ka	30.00 – 31.00 GHz 27.50 – 28.50 GHz (optional) 28.50 – 29.50 GHz (optional) 29.50 – 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 (18 dB for Ku-Band BUC)
User Attenuation Range		0 – 10 dB
Output Power, P1dB		+10 dBm minimum
Third Order Intercept		+20 dBm minimum
Spurious	**Carrier Related**	-60 dBc
	Non-Carrier Related	-60 dBm

1.6.3 BDC-4000 Block Down Converter ODU

Output Frequency Range		950 – 2000 MHz
Input Frequency (by model)	**BUC-4000C**	3400 – 4200 MHz
	BUC-4000X	7250 – 7750 MHz
	BUC-4000Ku	10.95 – 12.75 GHz
	BUC-4000Ka	20.20 – 21.20 GHz 17.70 – 18.70 GHz (optional band) 18.70 – 19.20 GHz (optional band) 19.20 – 20.20 GHz (optional band)
Input/Output Impedance		50Ω
Input Return Loss		18 dB minimum
Output Return Loss		15 dB minimum
Input Connector		Type ‘N’ Female (C-, X-, and Ku-Band)
Output Connector		Type ‘N’ Female
Gain		15 dB nominal at minimum attenuation
User Attenuation Range		0 – 10 dB, in 0.25 dB steps (0.1 dB optional)
Output Power, P1dB		+12 dBm minimum
Third Order Intercept		+22 dBm minimum
Spurious (Carrier Related)		-60 dBc
Noise Figure		15 dB maximum @ 0 dB attenuation

1.7 Dimensional Envelope

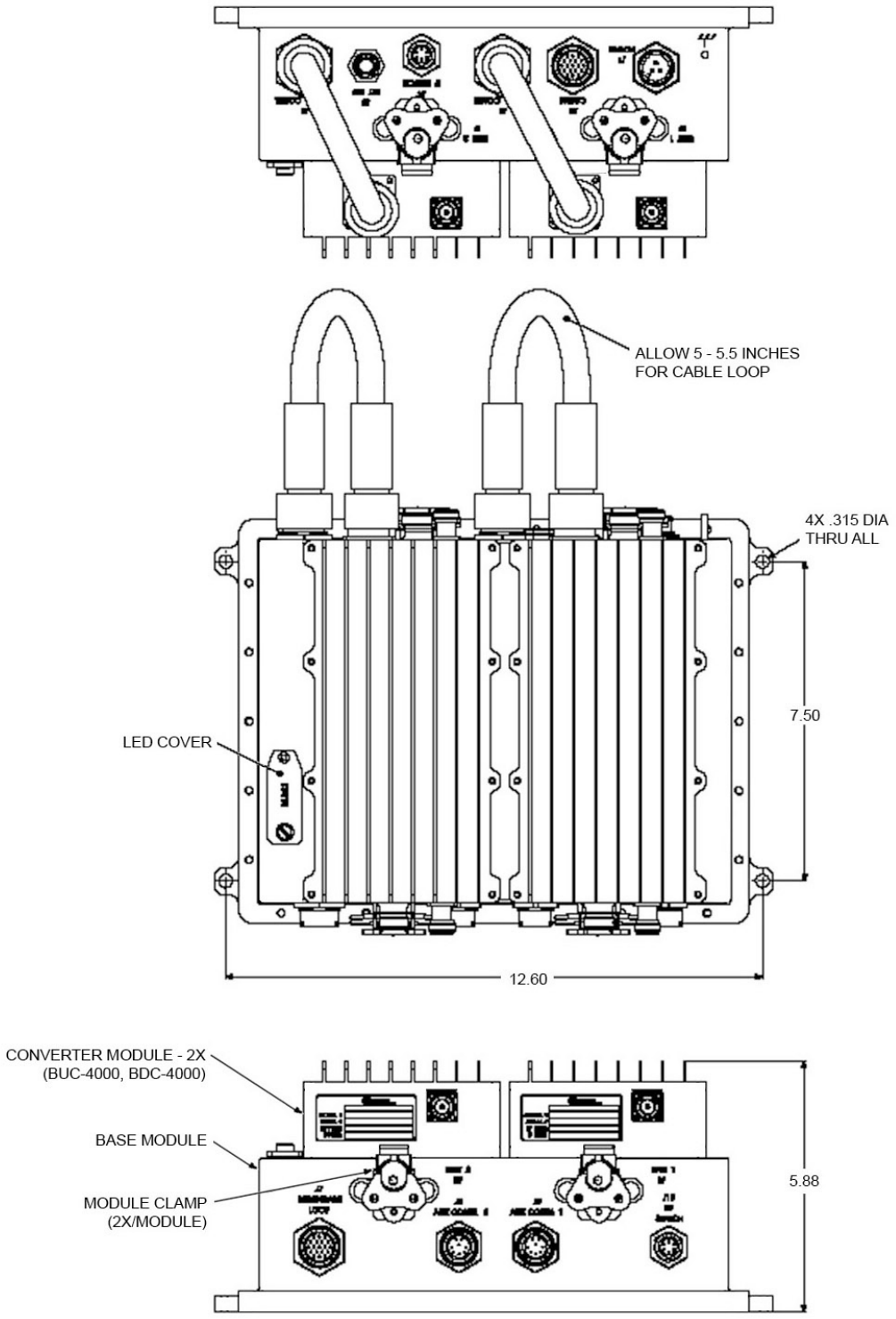


Figure 1-4. MBT-4000 Dimensional Envelope

Chapter 2. INSTALLATION

2.1 Unpacking and Inspection

Inspect shipping containers for damage. If shipping containers are damaged, keep them until the contents of the shipment have been carefully inspected and checked for normal operation.

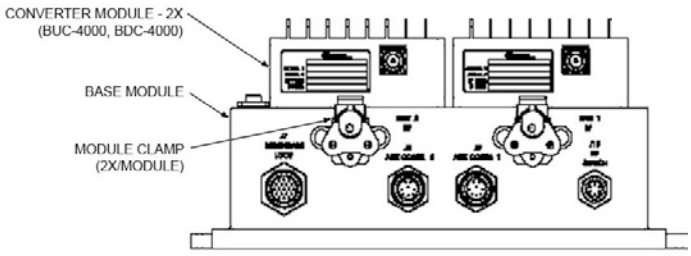
The MBT-5003 L-Band Up/Down Converter System and its Installation and Operation Manual are packaged and shipped in a pre-formed, reusable cardboard carton containing foam spacing for maximum shipping protection.

Do not use any cutting tool that will extend more than 1" into the container and cause damage to the transceiver.

Unpack and inspect the MBT-4000 as follows:

Step	Procedure
1	**Cut** the tape at the top of the carton indicated by OPEN THIS END.
2	**Remove** the cardboard/foam space covering the MBT-4000.
3	**Remove** the MBT-4000 and manual from the carton.
4	**Save** the packing material for storage or reshipment purposes.
5	**Inspect** the equipment for any possible damage incurred during shipment.
6	**Check** the equipment against the packing list to ensure the shipment is correct.
7	**Refer** to the next section (Section 2.2) for installation instructions.

2.2 Installation



The Base Module for the MBT-4000 system – which provides the M&C, Power Supply, and Reference interfaces – may be located near or on the antenna. Guide pins and mechanical clamps keep the band-specific BUC and BDC modules in place on top of the Base Module.

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

To change the band of operation, the cables to the BUC/BDC modules are disconnected and the modules are unlatched from the Base unit, allowing removal and replacement of the existing modules with appropriate band-specific modules.

2.3 Operation

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

Chapter 3. EXTERNAL CONNECTORS

3.1 External Connectors Overview

As shown in **Figure 3-1**, connectors provided on the MBT4000 Multi-Band Transceiver System provide all necessary external connections between the the transceiver and other equipment.

Note: This figure depicts an MBT-4000 configuration with (1) BUC-4000 Block Up Converter Module and (1) BDC-4000 Block Down Converter Module installed.

RF Side

IF Side
(Cable Loops removed for clarity)

Figure 3-1. MBT-4000 External Connectors

3.2 MBT-4000 External Connectors

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

Table 3-1. MBT-4000 External Connectors

Signal Side (Sect.)	Module	Ref Des	Name	Sect.	Function
IF (3.2.1)	MBT-4000 Base	J1	POWER	3.2.1.1	AC Power
		J2	COMM	3.2.1.2	Serial communication and Summary Fault
		J3	UNIT 1 COMM	3.2.1.3	Communicate to BxC Unit 1
		J4	IF SWITCH	3.2.1.4	Monitor & Control IF Switch
		J5	EXT REF	3.2.1.5	External 10 MHz Reference Input
		J6	UNIT 2 COMM	3.2.1.6	Communicate to BxC Unit 2
		N/A	N/A	3.2.1.7	#10-32 Ground stud
	BUC-4000	J4	IF IN	3.2.1.8	IF Input
		J6	COMM	3.2.1.9	Communicate to Base Unit
	BDC-4000	J4	IF OUT	3.2.1.10	IF Input
		J6	COMM	3.2.1.9	Communicate to Base Unit
RF (3.2.2)	MBT-4000 Base	J7	REDUNDANT LOOP	3.2.2.1	Connected for dual base redundant operation
		J8	AUX COMM 2	3.2.2.2	External Equipment Monitoring
		J9	AUX COMM 1	3.2.2.3	
		J10	RF SWITCH	3.2.2.4	Monitor and Control RF Switch
	BUC-4000	J5	RF OUT	3.2.2.5	RF Output
	BDC-4000	J5	RF IN	3.2.2.6	RF Input

3.2.1 IF Signal Side Connectors

3.2.1.1 POWER (J1)

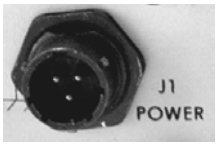


Table 3-2. POWER (J1) Pin Connections

Pin	Signal
A	LINE
B	NEUTRAL
C	GND

NOTE - Mating Connectors:
CEFD P/N CN/MS-STPG03F02
(ITT Cannon KPT06B-12-3S)

3.2.1.2 COMM (J2)

Table 3-3. COMM (J2) Connector Pinouts

Pin	Signal
A	RS 485 Rx+
B	RS 485 Rx-
C	RS 485 Tx+
D	RS 485 Tx-
E	RS 232 RD
F	NC
G	RS 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 Connectors:
CEFD P/N CN/MS3116J14-19P
(Cannon MS3116J14-19P)

3.2.1.3 UNIT 1 COMM (J3)

The **J3 UNIT 1 COMM** connector is used for connecting the MBT-4000 Base Module Unit 1 section to the **J6 COMM** connector featured on both the BUC-4000 Block Up Converter and BDC-4000 Block Down Converter Modules via the 15-15 Power & Signal Harness (CEFD P/N CA/WR10963-1), as shown in **Figure 3-2.**

Table 3-4. UNIT 1 COMM (J3) 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:
CEFD P/N CN/8LT5-15B15PN

Figure 3-2. Unit 1 Base Module to Converter Module Connection

3.2.1.4 IF Switch (J4)

Table 3-5. IF Switch (J4) 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 Connectors:
CEFD P/N CN/MS3116J10-6P
(Cannon MS3116J10-6P)

3.2.1.5 Ext Ref (External Reference) (J5)

The **J5 EXT REF** connector is a Type 'N' female connector, used to provide an External 10MHz Reference Input.

3.2.1.6 UNIT 2 COMM (J6)

The **J6 UNIT 2 COMM** connector is used for connecting the MBT-4000 Base Module Unit 2 section to the **J6 COMM** connector featured on both the BUC-4000 Block Up Converter and BDC-4000 Block Down Converter Modules, via the 15-15 Power & Signal Harness (CEFD P/N CA/WR10963-1), as shown in **Figure 3-3**.

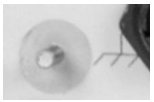
Table 3-6. UNIT 2 COMM (J6) Connector Pinouts

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
CEFD P/N CN/8LT5-15B15PN

Figure 3-3. Unit 2 Base Module to Converter Module Connection

3.2.1.7 Ground Connector



A #10-32 stud is used for connecting a common chassis ground among equipment.

3.2.1.8 IF IN (J4, BUC-4000 ONLY)

The **J4 IF IN** connector, located on the BUC-4000 Block Up Converter Module, is a Type 'N' female connector, used to provide the IF Input signal for the upconverter.

3.2.1.9 COMM (J6, BUC-/BDC-4000)

The **J6 COMM** connector, featured on both the BUC-4000 Block Up Converter and BDC-4000 Block Down Converter Modules, is used for connecting the module to the MBT-4000 Base Module **J3 UNIT 1 COMM** or **J6 UNIT 2 COMM** connectors via the 15-15 Power & Signal Harness (CEFD P/N CA/WR10963-1), as shown in **Figure 3-2** and **Figure 3-3.**

Table 3-7. UNIT 2 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:
CEFD P/N CN/8LT5-15B15SN

3.2.1.10 IF OUT (J4, BDC-4000 ONLY)

The **J4 IF OUT** connector, located on the BDC-4000 Block Down Converter Module, is a Type 'N' female connector, used to provide the downcoverted IF Output signal.

3.2.2 RF Signal Side Connectors

3.2.2.1 REDUNDANT LOOP (J7)

The **J7 REDUNDANT LOOP** connector is used to connect the MBT-4000 Base Module, via the Redundant Loop Bus Cable (CEFD P/N CA/WR11224), to another base unit for a dual base (redundant) setup.

Table 3-8. REDUNDANT LOOP (J7) 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
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

3.2.2.2 AUX COMM 2 (J8)

Table 3-9. AUX COMM 2 (J8) Connector Pinouts

Pin	Signal
A	AUX Rx + B
B	AUX Rx – B
C	AUX Tx + B
D	AUX Tx – B
E	+12.6V LNA B
F	I02 A/Fault
G	I02 B
H	GND

NOTE - Mating Connectors:
CEFD P/N CN/MS3116J12-8P
(Cannon MS3116J12-8P)

3.2.2.3 AUX COMM 1 (J9)

Table 3-10. AUX COMM 1 (J9) 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
G	IO1 B
H	GND

NOTE - Mating Connectors:
CEFD P/N CN/MS3116J12-8P
(Cannon MS3116J12-8P)

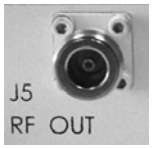
3.2.2.4 RF SWITCH (J10)

Table 3-11. RF Switch (J10) 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 Connectors:
CEFD P/N CN/MS3116J10-6P
(Cannon MS3116J10-6P)

3.2.2.5 RF OUT (J5, BUC-4000 ONLY)



The **J5 RF OUT** connector, located on the BUC-4000 Block Up Converter Module, is a Type 'N' female connector, used to provide the upconverted RF Output.

3.2.2.6 RF IN (J5, BDC-4000 ONLY)

The **J5 RF IN** connector, located on the BDC-4000 Block Down Converter Module, is a Type 'N' female connector, used to provide RF Input for the downcoverter.

Chapter 4. SYSTEM OPERATING PARAMETERS

4.1 Overview

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

4.2 Remote Configuration, Monitoring and Control

Remote monitoring and control (M&C) of the MBT-4000 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-4000 systems.

Complete information for these features is provided in **Appendix A. REMOTE CONTROL**.

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

The BUC-4000 translates the MBT-4000 L-Band output carrier to the desired output frequency (C, X-, or 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 – 6650 MHz	4900 MHz	No
X-Band	7900 – 8400 MHz	6950 MHz	No
Ku-Band-W	13.75 – 14.50 GHz	12.800 GHz	No
Ka-Band	30.00 – 31.00 GHz		

Notes:

1. No spectral inversion.

2. 10dB gain adjustment.

4.4 Block Down Converter Module (BDC-4000) Operating Parameters

The BDC-4000 translates a band-specific input frequency block (C-, X-, or Ku- or Ka-Band) from the LNA down to L-Band (950 to 2000 MHz).

Table 4-2. BDC-4000 C-, X-, KU-, and Ka-Band Operating Parameters

Band	Frequency	LO Frequency	Inverting
C-Band	3625 – 4200 MHz	2300 MHz	No
X-Band	7250 – 7750 MHz	6300 MHz	No
Ku-Band-W (Single module containing three LOs)	10.95 – 11.70 GHz 11.7 – 12.20 GHz 12.250 – 12.75 GHz	10.00 GHz 10.75 GHz 11.30 GHz	No
Ka-Band	20.20 – 21.20 GHz		

Notes:

1. No spectral inversion, selectable inversion for inverted Block Down Converter.

2. 10 dB gain adjustment.

4.5 Monitoring Operations via the LED Indicators

The MBT-4000 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-4000's Base Module under a pivoting protective plate, the LEDs may be viewed by loosening the thumbscrew that keeps the plate in place; the user can then swing the plate away to reveal the LED display window.

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

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

Chapter 5. FLASH UPGRADING

5.1 Overview

This chapter provides procedural information for upgrading the firmware for the Base Module of the Comtech EF Data MBT-4000 Multi-Band Transceiver System. This is a technical document intended for users – i.e., earth station engineers, technicians, and operators – responsible for the operation and maintenance of the MBT-4000. This chapter also assumes that the user has familiarity with Microsoft Windows-based operating systems.

5.2 Flash Updating via Internet

The MBT-4000 uses 'Flash memory' technology internally; this makes firmware upgrading very simple, and updates can now be sent via the Internet (**Figure 5-1**), via E-mail, or on CD.

This chapter outlines the complete upgrading process as follows:

- New firmware update for upgrading the MBT-4000 Base Unit is transferred to a user provided PC intended for Monitor and Control (M&C) of the MBT-4000 system.
- By simply connecting the MBT-4000 to an available serial port on the user-provided PC, the upgrade can then be performed without opening the MBT-4000 base unit. (**Note:** The block up and down converter modules are factory-serviced items, and are not updated during this procedure.)
- Once the firmware update is extracted from the transferred archive file, the upgrade process is executed via use of a utility program, **FLSHCSAT.exe**.

Figure 5-1. Flash Update via Internet

5.2.1 Firmware File Transfer Procedure

1. **Identify the reflashable product, firmware number, and version for download**:

   Using serial remote control, the current MBT-4000 firmware revision can be determined with the following query: **<0/FRW?** (*detailed*).

2. **Create a temporary directory** (folder) on a user-provided external PC.

   Windows: Select **File > New > Folder**, then, rename the New Folder to "temp" or another convenient, unused name. Assuming "temp" works, a "*c:\temp*" folder should now be created.

   Note: The **c:** is the drive letter used in this example. Any valid writable drive letter can be used.

   CMD Prompt: At the command prompt (c:\>), type "**mkdir temp**" or "**MD temp**" without quotes (**mkdir** and **MD** stand for *make directory*). This is the same as creating a new folder from Windows. There should now be a "*c:\temp*" subdirectory created (where **c:** is the drive letter used in the example).

3. **Download the correct firmware file t**o this temporary folder.

   Access the download server with the flash firmware data files link as shown in **Figure** 5-1:

   a. **Go online** to: www.comtechefdata.com;
   b. **Click on: *Support*** tab;
   c. **Click on: *Software Downloads*** drop-down *or* hyperlink from ***Support*** page;
   d. **Click on: *Download Flash and Software Update Files*** icon;
   e. **Click on: *(Select a Product Line) Satellite Modems*** hyperlink;
   f. **Select** the ***(Select a Product Line) Transceivers*** hyperlink;
   g. **Select** the appropriate firmware hyperlink from the roster of displayed MBT-4000 products/components.

   About Firmware Numbers, File Versions, and Formats: The flashable files on the download server are organized by product prefix; Depending on the product for which it is intended, the file name may designate the firmware number (verify that the correct firmware number is known – see Step 1); revision letter, if applicable; release version; and release date.

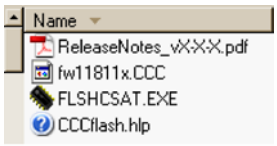
   The naming convention for the MBT-4000 Base Unit firmware is **FW11811*.CCC** (where the asterisk signifies the firmware revision letter).

   Note: The current version firmware release is provided. If applicable, a minimum of one version prior to the current release is also available. *Be sure to identify and download the desired version.*

   The downloadable files are stored in two formats: *.exe (self-extracting) and *.zip (compressed). Some firewalls will not allow the downloading of *.exe files. In this case, download the *.zip file instead.

   For additional help with "zipped" file types, refer to *PKZIP for Windows*, *WinZip*, or *ZipCentral* help files. *PKZIP for DOS* is not supported due to file naming conventions.

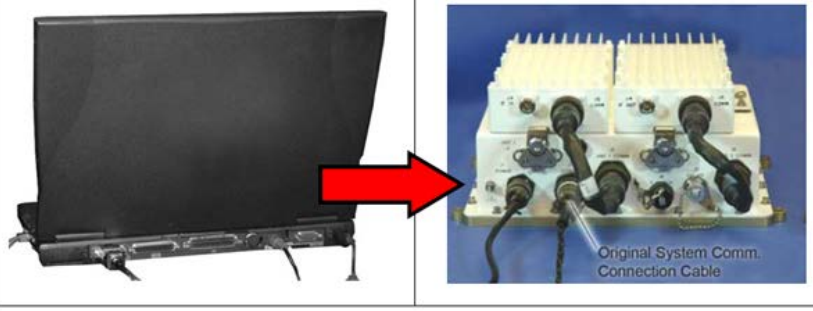
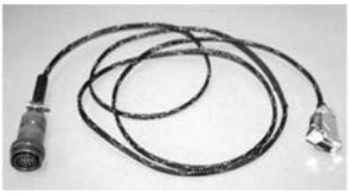
4. **Unzip the files** in the temporary folder on the PC, PC, then, **verify** the success of the file extraction using the ***dir*** command. At least four files should be extracted:

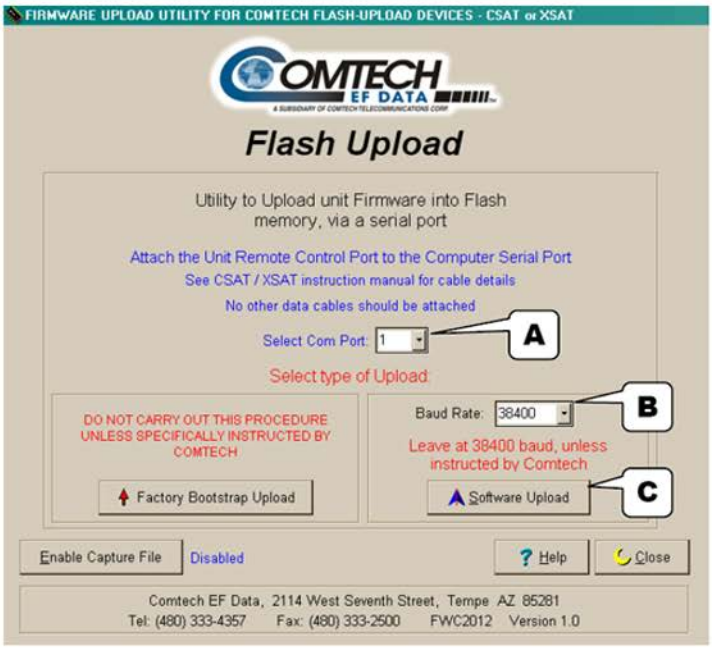


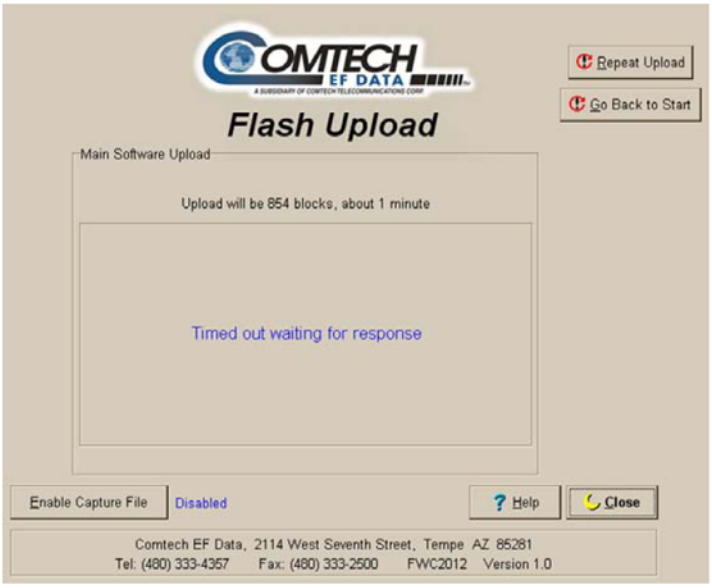
- ReleaseNotes_vX-X-X.pdf, where "X-X-X" denotes the firmware version.
- FW11811x.CCC, where "x" denotes the firmware revision letter.
- FLSHCSAT.EXE: CEFD Flash Upload Utility Program.
- CCCflash.hlp: FLSHCSAT Help File.

If these four files as identified are displayed, proceed to the next section to perform the flash upgrade.

5.3 Flash Upgrade Procedure

Step	Procedure	
1	Locate and Identify the MBT-4000 Multi-Band Transceiver System. The illustration to the right serves to identify key features of a typical system.	
2	Ensure that the MBT-4000 system is connected to a user-provided, Windows-based PC.	
	Note: If needed, the CA/WR12243-1 System Programming Cable is available from Comtech EF Data. Contact CEFD Customer Support for ordering information.	

Step	Procedure	
3	Double-click **FLSHCSAT.EXE** (filename or icon) to execute the flash upload utility.	
4	From the FLSHCSAT window, select the pertinent serial port used for communication between the user-provided PC and the MBT-4000. (In this example, as noted at '**A**', COM1 has been selected.)	
5	Do **not** select a Baud Rate (noted at '**B**') other than the default selection of 38400, unless otherwise instructed by Comtech EF Data Technical Support.	
6	Click on '**Software Upload**', as noted at '**C**'.	
7	The user is prompted to select the firmware file to upload. Click '**Choose File**', then select the file from the temporary folder created earlier by using the box to the right to navigate to the desired folder, then double-clicking on the firmware file using the box to the left.	 
8	Prior to continuing the upload process, the MBT-4000 system must be powered off. Disconnect the power cable from the Base Unit, then click on '**Start Upload**' to resume the upload process.	 

Step	Procedure	
9	When prompted, reconnect the power cable to the Base Unit.	
10	Once communication has been established between the PC and MBT-4000, the upload will take place – ***do not interrupt this upload process.***	
	Note: If the upload is *not* successful for any reason – e.g., the communications cable is not physically connected, the wrong COM port has been specified, the user inadvertently interrupted the upload, etc. – the user may troubleshoot the setup as needed, then click on '**Repeat Upload**' or '**Go Back to Start**' to resume/retry the upload process.	

Step	Procedure	
11	Upon successful completion of the upload, the user may click on '**Go Back to Start**' (if, for example, more than one MBT-4000 system requires upgrade), or '**Close**' (to exit the FLSHCSAT program).	
12	If needed, disconnect the System Programming Cable (CEFD P/N CA/WR12243-1) and reconnect the original System Communications Connection Cable.	
13	The LEDs on the MBT-4000 Base Unit will illuminate GREEN (unmuted) or YELLOW (muted) to indicate the current status of the Unit 1 and Unit 2 modules. (**Note:** If either LED illuminates RED, refer to **Appendix B. FAULTS/EVENTS** for further information.)	

The upgrade process has been successfully completed.

Appendix A. REMOTE CONTROL

A.1 Overview

This appendix describes the protocol and message command set for remote monitor and control of the MBT-4000 Multi-Band Transceiver System (more specifically, the BUC-4000 and BDC-4000 modules).

The electrical interface is either an RS-485 multi-drop bus (for the control of many devices) or an RS-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.

A.2 RS-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire plus ground) RS-485 is preferred. Half-duplex (2-wire plus ground) RS-485 is possible, but is not preferred. In full-duplex RS-485 communications, there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions.

It is assumed that a 'Controller' device (a PC or dumb terminal) transmits data in a broadcast mode via one of the pairs. Many 'Target' devices are connected to this pair, and all simultaneously receive data from the Controller. The Controller is the only device with a line-driver connected to this pair – the Target devices have only 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, the address of the intended recipient Target is included in a framed 'packet' of data. 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.

RS-485 (full duplex) summary:

- Two differential pairs – one pair for Controller-to-Target, one pair for Target-to-Controller.
- Controller-to-Target pair has one line driver (Controller), and all Targets have line-receivers.
- Target-to-Controller pair has one line receiver (Controller), and all Targets have tri-state drivers.

A.3 RS-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 RS-232 electrical levels, on one conductor, and Target-to-Controller data is carried in the other direction on the other conductor.

A.4 Basic Protocol

Whether in RS-232 or RS-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. The asynchronous character is fixed at 8-N-1 (8 data bits, no parity, one stop bit). Only two baud rates are supported: 9600 baud and 19200 baud.

All data is transmitted in framed packets. The Controller is assumed a PC or ASCII dumb terminal that 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 RS-485 mode.

A.5 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)	 (4 or 6 characters)	/ ASCII code 47 (1 character)	 (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)	 (4 or 6 characters)	/ ASCII code 47 (1 character)	 (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={CR}{LF}

A.5.1 Start of Packet

Controller-to-Target: This is the character '<' (ASCII code 60)

Target-to-Controller: This is the character '>' (ASCII code 62)

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.

A.5.2 Target Address

Up to 9,999 devices can be uniquely addressed. In both RS-232 and RS-485 applications, the permissible range of values is 1 to 9999. It is programmed into a target unit using the remote control port.

The BDC and BUC subdevices may also be addressed by appending the corresponding subdevice address. The subdevice address is ‘A1’ for the BUC and ‘A2’ for the BDC. For example, a mute command addressed to a BUC attached to an MBT-4000 at address 0412 will be:

<0412A1/MUT=1{CR}

The format of the response will be:

>0412A1/MUT={CR}{LF}

Subdevice addresses cannot be changed.

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.

A.5.3 Address Delimiter

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

A.5.4 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. This aids in the readability of the message if seen in its raw ASCII form. Upper and lower case alphabetic characters (i.e., A-Z – ASCII codes 65-90, and a-z – ASCII codes 97-122) may be used.

A.5.5 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)**	The **=** code 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: MUT=1** would mean 'enable the Mute function.'
? **(ASCII code 63)**	The **?** (ASCII code 63) 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: MUT?** Would mean 'return the current state of the Mute function.'

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

= **(ASCII code 61)**	The = code is used in two ways: First, if the Controller has sent a query code to a Target (**for example: MUT?** would mean 'return the current state of the Mute function'), the Target would then respond with **MUT=x**, where '**x**' represents the state in question (1 being 'enabled', 2 being 'disabled). Second, if the Controller sends an instruction to set a parameter to a particular value, then, providing the value sent in the argument is valid, the Target will acknowledge the message by replying with **MUT=** (with no message arguments).
? **(ASCII code 63)**	The **?** code is only used as follows: 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 argument of the message sent by the Controller.
! **(ASCII code 33)**	The **!** code is only used as follows: If the Controller sends an instruction code that the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character; for example, **XYZ!**
***** **(ASCII code 42)**	The * code is only used as follows: 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) such that it 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)**	The # code is only used as follows: If the controller sends an instruction code that 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; for example, **MUT#** (with no message arguments).

A.5.6 Optional Message Arguments

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

A.5.7 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', 'Line Feed' (ASCII codes 13 and 10).

Both indicate the valid termination of a packet.

A.6 Remote Commands and Queries

Where Column 'C' = Command; Column 'Q' = Query: Columns marked (X) indicate Command only, Query only, or Command/Query for Instruction Code.

Instr Code	C	Q	Page
AFR	X	X	A-7
ATT	X	X	A-7
CAA	X		A-7
CAI		X	A-7
CAS		X	A-8
CCS		X	A-9
CID	X	X	A-9
CLC	X		A-10
CMS		X	A-11
CUS		X	A-12
DAT	X	X	A-12
EAM	X	X	A-12
FRE	X	X	A-12
FRW		X	A-12
LCM		X	A-13
LCS	X	X	A-13
LCW	X	X	A-13, A-14
LFL	X	X	A-14
LNA		X	A-15
MUT	X	X	A-15
OFM	X	X	A-24
ONL		X	A-15
RAI		X	A-16
RAM	X	X	A-16
RAS		X	A-17
RCS		X	A-18

Instr Code	C	Q	Page
RED	X	X	A-18
REF	X	X	A-19
RET		X	A-19
RMS		X	A-20
RSN		X	A-21
RUS		X	A-21
SBR	X	X	A-21
SFS		X	A-21
SPA	X	X	A-21
SSA	X	X	A-22
SSW	X		A-22
TIM	X	X	A-22
TNA		X	A-22
TSC		X	A-23
XRF	X	X	A-23

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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, value of 0, 1	Command or Query. Enable Automatic Fault Recovery on a BXC, where: 0=Disabled 1=Enabled **Example:** AFR=1	AFR=(message OK) AFR? (received OK, but invalid arguments found) AFR*(message OK, but not permitted in current mode)	AFR?	AFR=x (same format as command arguments)
Attenuation	ATT=xx.xx	BDC BUC	5 bytes, numeric	Command or Query. Valid attenuation level, in dB, at 0.25dB step size as factory default. **Example:** ATT=08.25	ATT=(message OK) ATT? (received OK, but invalid arguments found) ATT*(message OK, but not permitted in current mode) ATT! (Command not accepted by MBT-4000 base unit. It must be addressed to BUC or BDC sub-units)		
Clear All Stored Alarms	CAA=	All	None	Command only. Instructs the slave to clear all Stored Events. This command takes no arguments.	CAA=(message OK)	N/A	N/A
Concise AUX COMM I/O	N/A	MBT	n=Slot 1=AUX COMM 1 2=AUX COMM 2	Query only. Used to Query the Concise AUX COMM I/O of the MBT-4000 base unit, where: n=1 (AUX COMM 1) or 2 (AUX COMM 2) **Example:** <0001/CAI?n{cr} >0001?CAI=nabcd{cr}{lf} **Where:** n=1 or 2 (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)	CAI=(message OK) CAI? (received OK, but invalid arguments found) CAI*(message OK, but not permitted in current mode)	CAI?n	CAI=nabcd (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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. Used to query the alarm status of the unit. **Example:** <0001/CAS?{cr} >0001/CAS=abcdefghijkl{cr}{lf} **Where:** a through l = 0 or 1, 0=OK, 1=FLT **All:** a=+15V Power Supply b=+7.5V Power Supply c=+5.0V Power Supply **MBT-4000:** d=+28V Power Supply e=Ref Oscillator Lock Detect f=Intermodule Communications g=Max current on LNA power supply AUX COMM1 h=Max current on LNA power supply AUX COMM2 i=Current window LNA power supply AUX COMM1 j=Current window LNA power supply AUX COMM2 k=Fault input AUX COMM1 (Pin F, J9) l=Fault input AUX COMM2 (Pin F, J8) **BDC/BUC:** 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.	N/A	CAS?	CAS=x…X (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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	48 bytes (BDC) 41 bytes (BUC) 32 bytes (MBT) 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=Frequency band for Unit 2 BXC ('C', 'X', 'Ka', 'KU', OR 'NA') cc=Direction for Unit 1 BXC ('DN'=BDC, 'UP'=BUC, 'NA'=None) dd=Direction for Unit 2 BXC ('DN'=BDC, 'UP'=BUC, 'NA'=None) e = X (reserved for future use) ff = X (reserved for future use) g = X (reserved for future use) h=External reference lock (1=locked, 0=Not locked) **Example BDC or BUC:** <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 for details of arguments)
Circuit Identification	CID=	All	24 bytes, alphanumeric	Command or Query. Used to identify or name the unit or station. First line is limited to 24 characters. **Example:** CID={cr} -Earth Station 1-- ---Converter #1---	CID=(message OK) CID?(received OK, but invalid arguments found)	CID?	CID=x…x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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)
Calibrate LNA Current	CLC=	BDC	none	Command only. This command is used to set the calibration point for the LNA current alarm feature. **Example:** CLC=	CLC=(message ok) CLC?(received ok, but invalid arguments found) CLC*(message ok, but not permitted in current mode) CLC!(command not accepted by BDC sub-units.)	N/A	N/A
Calibrate LNA Current	CLC=s	MBT	S=1 byte Value of 1 , 2 1=LNA A 2= LNA 2	Command only. This command is used to set the calibration point for the LNA current alarm feature, where s = Source: 1=LNA A (AUX COMM1) 2=LNA B(AUX COMM2) **Example:** CLC=1	CLC=(message ok) CLC?(received ok, but invalid arguments found) CLC*(message ok, but not permitted in current mode) CLC!(command not accepted by BUC or BDC sub-units.)	N/A	N/A

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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. Used to query 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.=+5V power supply **MBT-4000 Base Unit:** ddd.d=+28V power supply eee.e=Ref oscillator tuning voltage fff.f= XXX.X (reserved for future use) ggg.g= LNA current in mA for LNA B (AUX COMM2) 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. **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 **BUC:** ddd.d=XXX.X (reserved for future use) eee.e=Synthesizer tuning voltage fff.f=RF output power in dBm (reserved) ggg.g=Unit temperature in °C h – k= Not present	N/A	CMS?	CMS=… (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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. Used to query the utility status of the MBT-400 Base Unit, response is comma delimited, 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 for details of arguments)
Set RTC (Real-Time-Clock) Date	DAT=mmddyy	All	6 bytes, numeric	Command or Query. A command in the form mmddyy, where; dd = day of the month, between 01 and 31 mm = month of the year, between 01 and 12 yy = year, between 00 and 96 (2000 to 2096) **Example:** DAT=042503 would be April 24, 2003.	DAT= (message OK) DAT? (received OK, but invalid arguments found) DAT* (message OK, but not permitted in current mode)	DAT?	DAT=mmddyy (same format as command arguments)
Enable Aux Com Fault Input Monitoring	EAM=nm	MBT	n=1 AUX COMM1 2=AUX COMM2 m=0 (disabled), 1 (monitoring enabled)	Command or Query. EAM controls monitoring of external fault logic inputs to Aux Comm connectors (J8/J9 pin F). If enabled and external fault input is at Logic 1 (> 2.6 vdc) a fault will be reported. **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=(message OK) EAM?(received OK, but invalid arguments found)	EAM?n	EAM=nm (same format as command arguments)
Operating RF Frequency	FRE=xxxxx.xxx	BDC BUC	9 bytes, numeric	Command or Query 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=(message OK) FRE? (received OK, but invalid arguments found) FRE* (message OK, but not permitted in current mode) FRE! (command not accepted by MBT-4000 base unit. It must be addressed to BUC or BDC sub-units)	FRE?	FRE=xxxxx.xxx (see description of arguments)
Retreive Firmware Number	N/A	All		Query only Gets the Firmware Number of the unit. **Example:** FRW=FW12001'cr''lf'	N/A	FRW?	FRW=FWxxxxx

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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)
Monitor LNA Current	N/A	MBT	s_xxx.x, s=1 byte, value of 1, 2 1=LNA A 2=LNA B xxx.x=5 bytes, numeric	Query only. Returns LNA Current Source Level in mA. **Example:** <0001/LCM?2 >0001/LCM=2_045.3{cr}{lf}	LCM= (message ok) LCM? (received ok, but invalid arguments found) LCM! (command not accepted by BUC or BDC sub-units)	LCM?s s=1 byte, value of 1, 2	LCM=s_xxx.x
LNA Current Source	LCS=sx	MBT	s=1 byte, value of 1, 2 1=LNA A 2=LNA B x=1 byte, value of 0, 1 0 = Disable 1 = Enable	Command or Query. LNA Current Source Enable, where: Source: 1=LNA A (Aux Comm 1), (Aux Comm 2) Enable: 0 = Disabled2=LNA B 2=LNB B, 1 = Enabled **Example:** LCS=10	LCS= (message ok) LCS? (received ok, but invalid arguments found) LCS* (message ok, but not permitted in current mode) LCS! (command not accepted by BUC or BDC sub-units)	LCS?s s=1 byte, value of 1, 2	LCS=sx (same format as command arguments)
LNA Current Source	LCS=x	BDC	x=1 byte, value of 0, 1 0 = Disable 1 = Enable	Command or Query. LNA Current Source Enable, where: 0 = Disabled 1 = Enabled **Example:** LCS=0	LCS= (message ok) LCS? (received ok, but invalid arguments found) LCS* (message ok, but not permitted in current mode) LCS! (command not accepted by BUC sub-units)	LCS?	LCS=x (same format as command arguments)
LNA Current Window	LCW=xx	BDC	xx=2 bytes, numeric	Command or Query. This command allows the user to set the alarm window in ± % of the calibrated LNA Current. Valid inputs are 20 to 50 in increments of 1%. In addition, setting the value to 99 disables the alarm function. Default is **Disabled.** **Example:** LCW=30, set alarm window for LNA A (Aux Comm 1) to ± 30%.	LCW= (message ok) LCW? (received ok, but invalid arguments found) LCW* (message ok, but not permitted in current mode) LCW! (command not accepted by BDC sub-units)	LCW?	LCW=xx (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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 Current Window	LCW=sxx	MBT	s=1 byte, value of 1, 2 1=LNA A 2=LNA B xx=2 bytes, numeric	Command or Query. This command allows the user to set the alarm window in ± % of the calibrated LNA Current. Valid inputs are 20 to 50 in increments of 1%. In addition, setting the value to 99 disables the alarm function. Default is **Disabled**. **Example:** LCW=130, set alarm window for LNA A (Aux Comm 1) to ± 30%.	LCW= (message ok) LCW? (received ok, but invalid arguments found) LCW* (message ok, but not permitted in current mode) LCW! (command not accepted by BUC or BDC sub-units)	LCW?s	LCW=sxx (same format as command arguments)
LNA Fault Logic	LFL=sx	MBT	s=1 byte, value of 1, 2 1=LNA A 2=LNA B x=1 byte, Value of 0, 1 0 = Disable 1 = Enable	Command or Query. Allows LNA Fault Logic to contribute to the summary fault relay, where: s = Source: 1=LNA A (Aux Comm 1) 2=LNA B (Aux Comm 2) x = Enable: 0 = Disabled 1 = Enabled **Example:** LFL=11	LFL= (message ok) LFL? (received ok, but invalid arguments found) LCS* (message ok, but not permitted in current mode) LFL! (command not accepted by BUC or BDC sub-units)	LFL?s s=1 byte, Value of 1, 2	LFL=sx (same format as command arguments)
LNA Fault Logic	LFL=x	BDC	x=1 byte, Value of 0, 1 0 = Disable 1 = Enable	Command or Query. Allows LNA Fault Logic to contribute to the summary fault relay as follows: Enable 0 = Disabled 1 = Enabled **Example:** LFL=1	LFL= (message ok) LFL? (received ok, but invalid arguments found) LCS* (message ok, but not permitted in current mode) LFL! (command not accepted by BDC sub-units)	LFL?	LFL=x (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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 next 5 unread Stored Alarms	N/A	All	145 bytes	Query only. The unit 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 will reply 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 for details of arguments)
Mute State	MUT=x	BDC BUC	1 byte, value of 0,1	Command or Query. Mute the unit, where: 0 = Disabled, 1 = Enabled **Example:** MUT=1	MUT= (message OK) MUT? (received OK, but invalid arguments found) MUT* (message OK, but not permitted in current mode) MUT! (command not accepted by MBT-4000 base unit. It must be addressed to BUC or BDC sub-units)	MUT?	MUT=x (same format as command arguments)
Online Status	N/A	MBT	N/A	Query only. Used to query the online status of the unit (useful in redundant configurations). Return position of corresponding RF switch. **Example:** <0001/ONL?{cr} >0001/ONL={cr}{lf} ON1=ON ,{cr} ON2=ON , {cr}{lf}	ONL= (message OK) ONL? (received OK, but invalid arguments found)	ONL?	ONL=x

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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 AUX COMM I/O	N/A	MBT	1 byte, value of n=1 or 2 1=Aux Comm1 2=Aux Comm2	Query only. Used to Retrieve AUX COMM I/O of the MBT-4000 base unit, where: n=1 (Aux Comm 1) or 2 (Aux Comm 2). **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 = (message OK) RAI? (received OK, but invalid arguments found) RAI* (message OK, but not permitted in current mode)	RAI?n	RAI=x….x (see description for details of arguments)
Redundancy Mode	RAM=um	MBT	u=1 byte, value of 1, 2 1=Unit 1 2=Unit 2 m=1 byte, Value of 0, 1 0 = Manual 1 = Automatic	Command or Query. Sets redundancy mode as follows: Unit: 1=Unit 1 2=Unit 2 Mode: 0 = Manual 1 = Automatic **Example:** RAM=11	RAM= (message OK) RAM? (received OK, but invalid arguments found) RAM* (message OK, but not permitted in current mode)	RAM?u u=1 byte, Value of 1, 2	RAM=um (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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-4000 64 bytes (BUC), 74 bytes (BDC), alphanumeric	Query only. Used to Query the Alarm status of the unit **Example for MBT-4000 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} LNAC2=OK{cr} LNAW1=OK{cr} LNAW2=OK{cr} LNAI1=OK{cr} LNAI2=OK{cr}{lf} **Example for BDC or BUC:** <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:** LNACR will only appear for BDC.	N/A	RAS?	RAS=x….x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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-4000) 98 bytes (BDC), 76 bytes (BUC) alphanumeric	Query only. Used to Query the configuration status of the unit **Example for MBT-4000 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 BDC or BUC:** <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 for details of arguments)
Redundancy State	RED=x	MBT	1 byte, value of 0,1, or 2	Command or Query. Controls redundancy state, where: 0=Off 1=Enables redundancy using single base unit 2=Enables redundancy using dual base units **Example:** RED=1	RED= (message OK) RED? (received OK, but invalid arguments found) RED* (message OK, but not permitted in current mode)	RED?	RED=x (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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. Ref Osc Adjust, between 0000 and 0255. Resolution 0001. **Example:** REF=0197 **Note:** REF cannot be adjusted when the unit is locked to an external reference source.	REF= (message OK) REF? (received OK, but invalid arguments found) REF* (message OK, but not permitted in current mode)	REF?	REF=xxxx (same format as command arguments)
Retrieve Equipment Type	N/A	All	22 bytes, alphanumeric	Query only. The unit returns a string indicated the Model Number and the software version installed **Example:** RET=BUC-4000 VER:1.0.3	N/A	RET?	RET=x….x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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	MBT-4000 - 103 bytes, alphanumeric BDC – 98 bytes, alphanumeric BUC – 98 bytes, alphanumeric	Query only. Used to Query the maintenance status of the unit. **Example for MBT-4000 base:** <0001/RMS?{cr} >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 for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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 000000000 to 999999999	Query only. Used to Query the units 9 digit serial number. Slave returns its S/N, in the form xxxxxxxxx. **Example:** RSN=000000165	N/A	RSN?	RSN= x….x (see description for details of arguments)
Retrieve Utility Status	N/A	MBT	24 bytes alphanumeric	Query only. Used to Query the utility status of the MBT-4000 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 for details of arguments)
Remote Baud Rate	SBR=xxxx	MBT	4 bytes,	Command or Query. Set remote baud rate as follows: 9600 = 9600 baud 19K2 = 19200 baud	SBR= (message OK) SBR? (received OK, but invalid arguments found) SBR! (Command not accepted by BUC and BDC sub-units.)	SBR?	SBR=xxxx (same format as command arguments)
Summary Fault Status	N/A	All	N/A	Query only. Used to Query the status of the Summary Fault Relay, where: 0=OK 1=FT **Example:** SFS?	N/A	SFS?	SFS=**x** (see description for details of arguments)
Remote Address	SPA=xxxx	MBT	4 byte, numeric	Command or Query. Set Physical Address-between 0001 to 9999. Resolution 0001 **Example:** SPA=0412	SPA= (message OK) SPA? (received OK, but invalid arguments found) SPA! (Command not accepted by BUC and BDC sub-units.)	SPA?	SPA=xxxx (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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)
Slope Adjust	SSA=x.x	BDC BUC	3 bytes, numeric	Command or Query. Slope adjust level, valid from 0.0 to 1.0 with 0.1 resolution. **Example:** SSA=0.3	SSA= (message OK) SSA? (received OK, but invalid arguments found) SSA* (message OK, but not permitted in current mode) SSA! (command not accepted by MBT-4000 base unit. It must be addressed to BUC or BDC sub-units)	SSA?	SSA=x.x (same format as command arguments)
Set Redundancy Switch	SSW=xy	MBT	2 bytes	Command only. SSW control the switches dedicated to Slot1 or 2, and sets them to either Port A or Port B. **Syntax:** SSW=xy, where: x = 1 or 2 depicting Slot 1 or 2 y = A or B depicting the switch direction. Direction A Switched to Converter on MBT_A B Switched to Converter on MBT_B	SSW=(message OK) SSW=xy	N/A	N/A
Set RTC Time	TIM=hhmmss	All	6 bytes, numeric	Command or Query. A command in the form hhmmss, indicating the time from midnight, 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 = (message OK) TIM? (received OK, but invalid arguments found) TIM * (message OK, but not permitted in current mode)	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 which remain unread, in the form xx. **Example reply:** TNA=18	N/A	TNA?	TNA=**xx** (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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)
Terminal Status change	N/A	All	1 byte, value of 0,1	Query only. Used to Query the status of the Terminal Status. Where: 0=no change in status 1=change in status **Example:** TSC=0	N/A	TSC?	TSC=x (see description for details of arguments)
External Reference Fault Logic	XRF=x	MBT	1 byte, value of 0,1	Command or Query. XRF controls whether or not the Software monitors the external reference source. If enabled and no source is present, a fault will be reported. Where: 0=Ext Reference not monitored 1=Ext Reference is monitored and the lock state reported **Example:** XRF=1	XRF=(message OK) XRF?(received OK, but invalid arguments found)	XRF?	XRF=x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	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	u=1 byte, value of 1, 2 1=Unit 1 2=Unit 2 m=1 byte, Value of 0, 1 0 = Manual 1 = Automatic	Command or Query. This command allows the user to enable muting for offline unit when in redundancy mode. **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 one is offline as indicated by the switch position(blinking yellow or red LED). It would force an "un- mute" of the block in slot one 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 two. OFM=21 would force a mute of the block in slot one if slot two 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 two 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= (message OK) OFM? (received OK, but invalid arguments found) OFM! (command not accepted	RAM?u u=1 byte, Value of 1, 2	RAM=um (same format as command arguments)

Appendix B. FAULTS/EVENTS

B.1 LED Status Indicators

The MBT-4000 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 for the sytem.

As shown in **Figure B-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 B-1. MBT-4000 LED Indicators

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-4000 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**.

B.2 Faults/Events

There are three types of Faults/Events that may occur and be recorded in the event log of an MBT-4000, BDC-4000, 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 B-2**; here, Unit 2 has faulted.

Figure B-2. Faulted System Example

B.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 applicable converters (one or both) 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 B-1. MBT-4000 Summary Faults

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

Table B-2. BDC-4000/BUC-4000 Summary Faults

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

B.2.2 Configurable Summary Faults

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

Table B-3. MBT-4000 Configurable Summary Faults

Mnemonic	Type	Mute	Description
AUXCOM1	Configurable Summary Fault	Slot 1	The IO1A/FAULT input (AUX COMM 1) indicates a fault. Monitoring for this fault is enabled using the EAM command.
AUXCOM2	Configurable Summary Fault	Slot 2	The IO2A/FAULT input (AUX COMM 2) indicates a fault. The converter attached to UNIT 2 COMM (J6) has been muted.
LNACUR1	Configurable Summary Fault	Slot 1	The +12.6 V LNA A (AUX COMM 1) power supply current has exceeded the maximum limit of 350 mA and has been disabled. The converter attached to UNIT 1 COMM (J3) has been muted. The LNA power supply—and thus this fault—is enabled using the LCS command. This fault is cleared by a LCS command or power cycle.
LNACUR2	Configurable Summary Fault	Slot 2	The +12.6 V LNA B (AUX COMM 2) power supply current has exceeded the maximum limit of 350 mA and has been disabled. The converter attached to UNIT 2 COMM (J6) has been muted. The LNA power supply—and thus this fault—is enabled using the LCS command. This fault is cleared by a LCS command or power cycle.
LNAWIN1	Configurable Summary Fault	Slot 1	The +12.6 V LNA A (AUX COMM 1) power supply current is outside the programmed window. (The power supply is not disabled in response to this fault.) The converter attached to UNIT 1 COMM (J3) has been muted. LNA current window monitoring is configured and enabled using the LCS, CLC and LCW commands. This fault is cleared by a LCS command, CLC command, LCW command or power cycle.
LNAWIN2	Configurable Summary Fault	Slot 2	The +12.6 V LNA B (AUX COMM 2) power supply current is outside the programmed window. (The power supply is not disabled in response to this fault.) The converter attached to UNIT 2 COMM (J6) has been muted. LNA current window monitoring is configured and enabled using the LCS, CLC and LCW commands. This fault is cleared by a LCS command, CLC command, LCW command or power cycle.
REF LD	Configurable Summary Fault	All	The External Reference Monitor has lost lock with the external reference signal. All attached converters (UNIT 1 and UNIT 2) have been muted. Monitoring for this fault is enabled using the XRF command. This fault is cleared when lock has been regained.
LNAI1	Configurable Summary Fault	Slot 1	The IO1A/FAULT input (AUX COMM 1) indicates a fault. Monitoring for this fault is enabled using the EAM-1X command.
LNAI2	Configurable Summary Fault	Slot 2	The IO2A/FAULT input (AUX COMM 2) indicates a fault. Monitoring for this fault is enabled using the EAM-2X command.

Table B-4. BDC-4000 Configurable Summary Faults

Mnemonic	Type	Description
LNA CUR	Configurable Summary Fault	The +12.6 V LNA power supply current (via center conductor of coax connector) has exceeded the maximum limit of 350 mA and has been disabled. The LNA power supply—and thus this fault—is enabled using the LCS command.
LNA WIN	Configurable Summary Fault	The +12.6 V LNA A power supply current (via center conductor of coax connector) is outside the programmed window. (The power supply is not disabled in response to this fault.) LNA current window monitoring is configured and enabled using the LCS, CLC and LCW commands.

B.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 B-5. MBT-4000 Informational Events

Mnemonic	Type	Mute	Description
BXCTYP1	Informational Event	None	In redundancy mode, the BxC corresponding to slot 1 is not of the same type. Redundancy mode switched to manual (RAM=10).
BXCTYP2	Informational Event	None	In redundancy mode, the BxC corresponding to slot 2 is not of the same type. Redundancy mode switched to manual (RAM=20).
LOG CLR	Informational Event	None	The Event LOG Queue was cleared in response to receipt of a CAA command.
PWR OFF	Informational Event	None	Power off was detected.
PWR ON	Informational Event	None	Power on was detected.

Table B-6. BDC-4000/BUC-4000 Informational Events

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

Appendix C. REDUNDANCY CONFIGURATION / OPERATION

C.1 Overview

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

The BDC-4000 is capable of supplying LNA power over the center conductor of the coaxial cable. 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-4000 base includes two “J9 AUX COMM” connectors. Each of these connectors 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.

Each “J9 AUX COMM” connector also is capable of supplying power to external LNAs (or other devices). 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-4000 base includes two “switch drive” connectors. Each of these connectors 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.

C.2 Single-Base Redundancy Operation

Single-Base Redundancy Operation is not supported in the MBT-4000.

C.3 Dual-Base Redundancy Operation

The MBT-4000 can support three (3) different Dual-Base redundancy configurations as follows:

1. Chain Redundant: Dual-Base, two (2) BxC per Base, external subsystems (SSPA, LNA, etc.) including asscoaited switch assemblies providing two (2) chain switched 1:1 configurations.
2. Single Redundant: Dual-Base, one (1) BxC per Base, one (1) dual coax switch assembly providing one (1) standalone 1:1 configuration.
3. Dual Redundant: Dual-Base, two (2) BxC per Base, two (2) dual coax switch assemblies providing two (2) standalone 1:1 configurations.

Figure C-1 illustrates a typical Dual-Base Chain Redundant configuration.

Figure C-2 illustrates a typical Dual-Base Single Redundant configuration.

Figure C-3 illustrates a typical Dual-Base Dual Redundanct configuration.

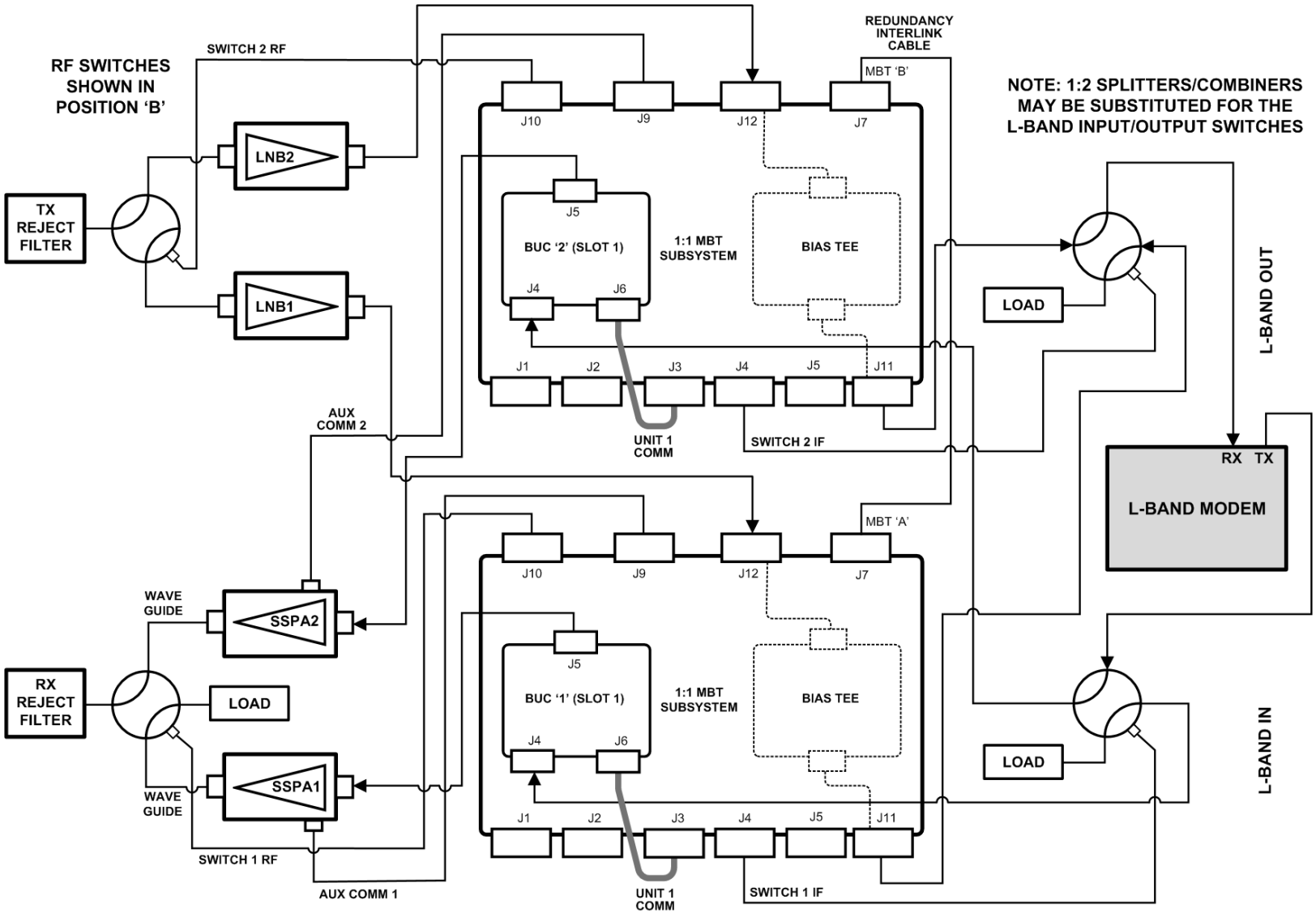


Figure C-1. Dual-Base Chain Redundant Operation

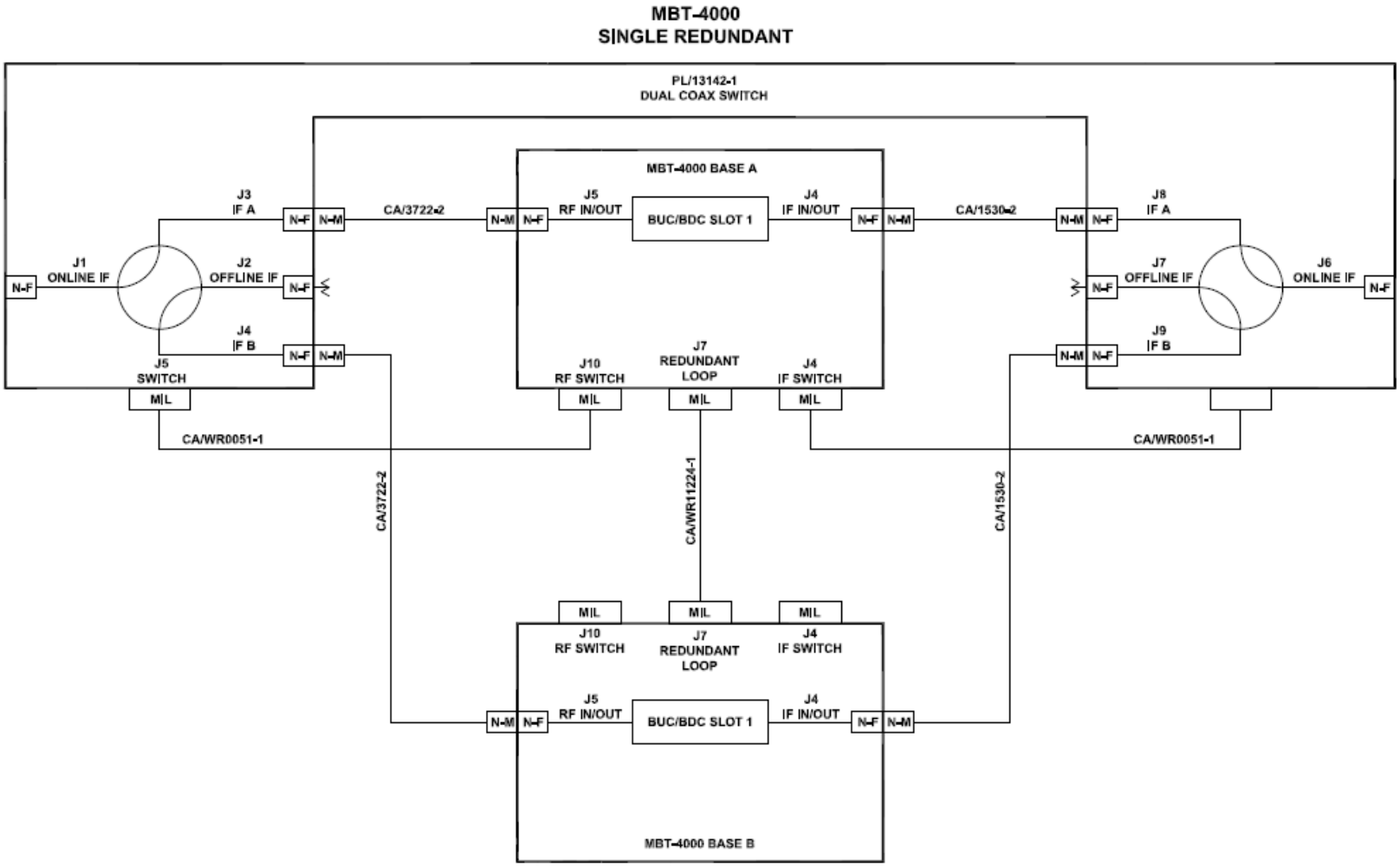


Figure C-2. Dual-Base Single Redundant Operation

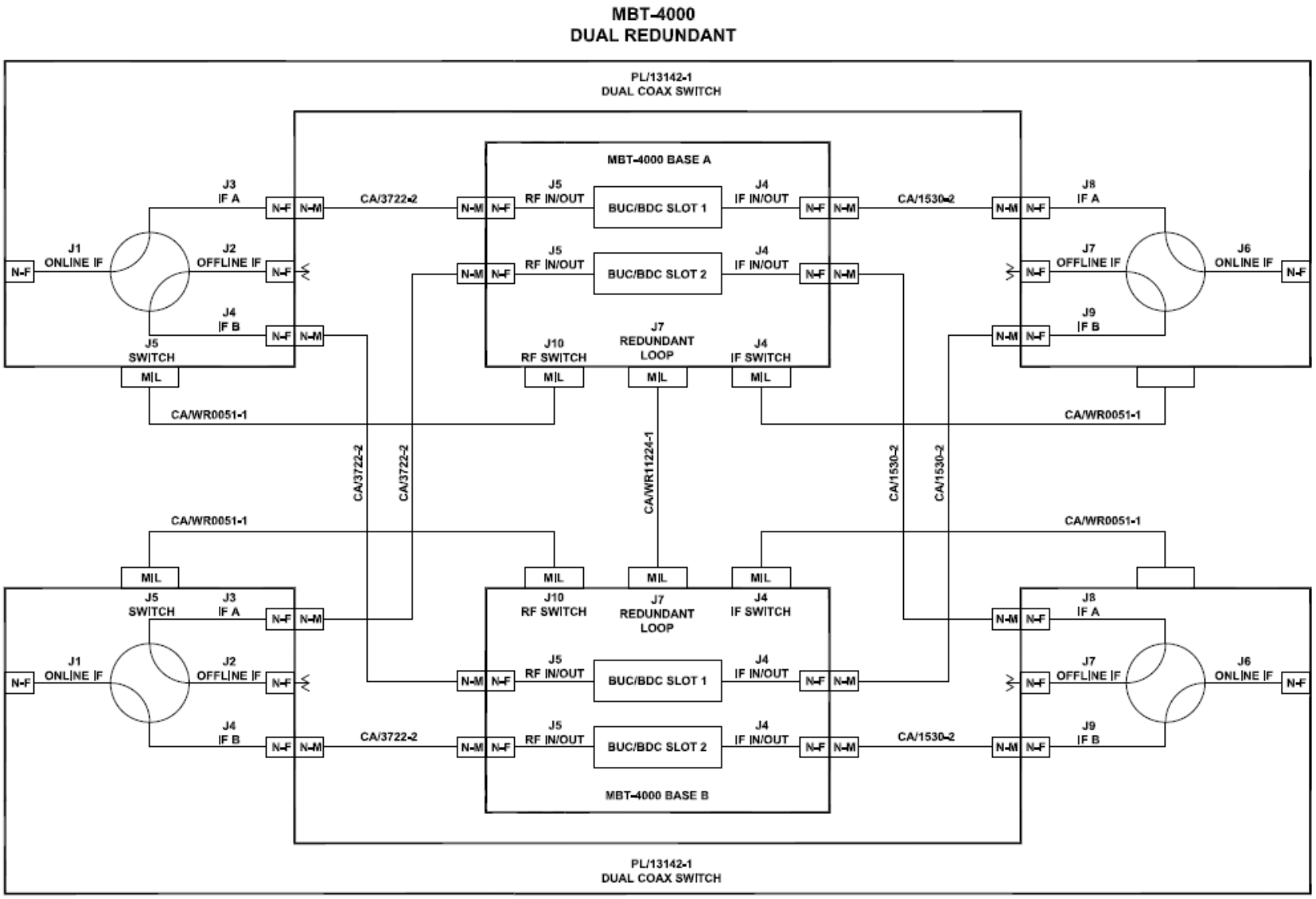


Figure C-3. Dual-Base Dual Redundant Operation

The two MBT-4000 base units cooperate in monitoring the health of the two (2) or four (4) BxCs (and each other) and, when applicable, external amplifiers, LNAs, LNBs, etc. In case of a fault on an online BxC the MBT-4000 base containing the corresponding standby BxC, will automatically switch over to the standby BxC in accordance with the following rules:

1. In dual-base redundancy operation, the redundancy is 'slot' based. The corresponding pairs reside in the same 'slot' of the opposite MBT-4000 base, the pair of BxCs connected to J3 UNIT 1 COMM (Slot 1) on each base form a redundant pair. The BxCs connected to J6 UNIT 2 COMM (Slot 2) on each base form the other redundant pair. Typically, one pair is used for up conversion and the other for downconversion although this is not a requirement.
2. The corresponding BxCs in a pair must be of the same type.
3. The Redundancy Interlink Cable (CEFD P/N CA/WR11224-1 or equivalent) must be installed.
4. Base unit identification (MBT-A or MBT-B) is driven by the redundancy interlink cable. Hard wired connections within the cable designate one MBT-4000 base as MBT-A and the other as MBT-B. The cable is labeled accordingly.
5. The RF and IF switches connected to MBT-A correspond to the redundant pair of BxCs installed on J3 UNIT 1 COMM (Slot 1).
6. The RF and IF switches connected to MBT-B correspond to the redundant pair of BxCs installed on J6 UNIT 2 COMM (Slot 2).
7. When a BxC attached to MBT-A is online, the corresponding RF and IF switches will be switched to position A. When a BxC attached to MBT-B is online, the corresponding switches will be switched to position B.

For a switchover to occur:

1. Both MBT-4000 base units must be set to redundancy mode 2, the RED=2 command must have been received by each base.
2. Both BxCs must be set to automatic mode. For example, if the redundant pair is on Slot 2 of the bases, the command RAM=21 must have been received by each base.
3. The corresponding standby BxC must not be in faulted state.

C.4 External Fault Monitoring

Each MBT-4000 base includes two logic inputs, one per AUX COMM connector, that may be connected to contact closure fault indications of external equipment (usually an SSPA or LNA). 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 inputs correspond to a slot, the fault input of AUX COM 2 corresponds to the BxC installed as UNIT 2. The fault input of AUX COM 1 corresponds to the BxC installed as UNIT 1.
5. To enable fault input checking the EFI=nm command is usedwnput parameter ‘n’ can equal 1for AUX COM 1 input, or 2 for AUX COMM 2 input. The mode parameter ‘m’ can equal 0 for disabled, or 1 for enabled. Each input must be enabled individually.

C.5 LNA Power Supply Current Monitoring

The MBT-4000 base and BDC-4000 are capable of supplying power to external LNAs. The MBT-4000 base supplies the power from a pin in the AUX COMM connectors; the BDC-4000 supplies the power over the center conductor of the coaxial cable. These power supplies feature current monitoring with programmable failure limits. Overcurrent and undercurrent failures can participate in overall fault indication and redundant switchover criteria.

The following commands and rules configure operation of this feature:

1. The power supplies are +12.6V with a 350 mA current limit.
2. No more than two of the four possible supplies should be enabled simultaneously.
3. An individual supply is enabled by issuing the ‘LCS=sm’ command as follows:
   a. ‘s’ is the source. Valid values are 1 or 2 where: 1=AUX COMM 1 supply and 2=AUX COMM 2 supply. The BDC-4000 only has a single current source, so ‘s’ must be set to 1 on a BDC-4000.
   b. ‘m’ is the mode. Valid values are 0=OFF or 1=ON.
4. In case of excessive current (more than 350 mA), the supply will be disabled and a fault will be posted. The ‘LCS=sm’ command must be sent again to re-enable the supply.
5. 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=s command, where ‘s’ is the source as described previously.
   c. The programmable current window is specified using the LCW=sxx command. Where ‘s’ is the source as described previously and ‘xx’ is the allowable percentage of variance from nominal (set by the CLC command). Acceptable values for ‘xx’ are 20 to 50 in increments of 1%. In addition, a value of ‘99’ for ‘xx’ disables the alarm function.

d. If a current is detected outside this window, a LNA current fault will be posted, but the supply will not be disabled.

C.6 Gain Equalization of Redundant Units

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

C.7 Operational Configuration Commands

In automatic redundancy mode, configuration commands (with the exception of attenuation and LNA power supply configuration) sent to the online unit will be mirrored in the offline unit. In auto mode, commands sent to the offline unit will be rejected.

In manual mode, configuration commands are not mirrored. However, upon reverting to “auto” mode, online unit configuration will transfer to the offline unit, again with the exception of attenuation and LNA power supply configuration.

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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