LBC-4000

L-Band Up/Down Converter System
Installation and Operation Manual

Comtech EF Data is an
AS9100 Rev B / ISO9001:2000
Registered Company

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.

Part Number MN/LBC4000.IOM Revision 3

Errata A

Comtech EF Data Documentation Update

LBC-4000

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Part Number MN/LBC4000.IOM
Revision 3
July 2, 2009

Subject: Add SPI Command/Query to **Appendix A. REMOTE CONTROL**

Date: December 4, 2009

Original Manual Part Number/Rev: MN/LBC4000.IOM Rev 3

Errata Number/ Agile Document ID: ER-MN_LBC4000.EA3

Agile CO Number: CO 10232

Comments: *This information will be incorporated into the manual on the next revision pass.*

Add the following Command/Query to **Appendix A. REMOTE CONTROL** (for use in Firmware Ver. 1.1.12 and later):

Spectrum Inversion	SPI_	5 bytes	Command or Query. Used to set or query the Converter spectrum inversion setting, in the form SPI_x_yyy where: x = 'A' (Converter A) or 'B' (Converter B) yyy = NRM (normal spectrum) or INV (inverted spectrum). **Example:** SPI_A_INV (Converter A set to inverted spectrum) **Note:** This command is only valid for down converters.	Same as command	SPI_x_	SPI_x_ (see Description of Arguments for details)

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Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, 480.333.2200, FAX: 480.333.2161

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PREFACE

About this Manual

This manual provides installation and operation information for the Comtech EF Data LBC-4000 L-Band Up/Down Converter System. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the LBC-4000, L-Band Up/Down Converter System.

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Technical Publications Department:

TechnicalPublications@comtechefdata.com.

Conventions and References

Cautions and Warnings

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

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

IMPORTANT ***or*** **NOTE** ***indicates information critical for proper equipment function.***

Metric Conversion

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

Recommended Standard Designations

Recommended Standard (RS) Designations are equivalent to the Electronic Industries Association (EIA). Comtech EF Data references the RS designator throughout this manual.

Trademarks

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

EMC Compliance

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

EN55022 Compliance

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined in EN55022.

EN50082-1 Compliance

This equipment meets the electromagnetic compatibility/generic immunity standard as defined in EN50082-1.

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.

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.

Safety Compliance

EN 60950

Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.

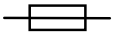
This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

Low Voltage Directive (LVD)

The following information is applicable for the European Low Voltage Directive (EN60950):

<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
~	Alternating Current
	Fuse

Symbol	Definition
	Protective Earth
	Chassis Ground

Note: For additional symbols, refer to “Cautions and Warnings” listed earlier in this preface.

RoHS Compliancy

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

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.

Customer Support

Contact the Comtech EF Data Customer Support Department for:

- Product support or training
- Reporting comments or suggestions concerning manuals
- Information on upgrading or returning a product

A Customer Support representative may be reached at:

Comtech EF Data
Attention: Customer Support Department
2114 West 7th Street
Tempe, Arizona 85281 USA
480.333.2200 (Main Comtech EF Data number)
480.333.4357 (Customer Support Desk)
480.333.2161 FAX

To return a Comtech EF Data product (in-warranty and out-of-warranty) for repair or replacement:

- **Contact** the Comtech EF Data Customer Support Department. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.
- **Request** a Return Material Authorization (RMA) number from the Comtech EF Data Customer Support representative.
- **Pack** the product in its original shipping carton/packaging to ensure that the product is not damaged during shipping.
- **Ship** the product back to Comtech EF Data. (Shipping charges should be prepaid.)

Online Customer Support

An **RMA number request** can be requested electronically by contacting the Customer Support Department through the online support page at **www.comtechefdata.com/support.asp**:

- **Click** on the "Service" hyperlink, then read the "Return Material Authorization" section for detailed instructions on our return procedures.
- **Click** on the "RMA Request Form" hyperlink, then fill out the form completely before sending.
- **Send e-mail** to the Customer Support Department at **service@comtechefdata.com**.

For information regarding this product's warranty policy, refer to the Warranty Policy, p. xii.

Chapter 1. INTRODUCTION

1.1 Overview

Comtech EF Data's LBC-4000 L-Band Up/Down Converter System is designed to interface legacy 70 MHz or 140 MHz equipment to tri-band or quad-band block converters.

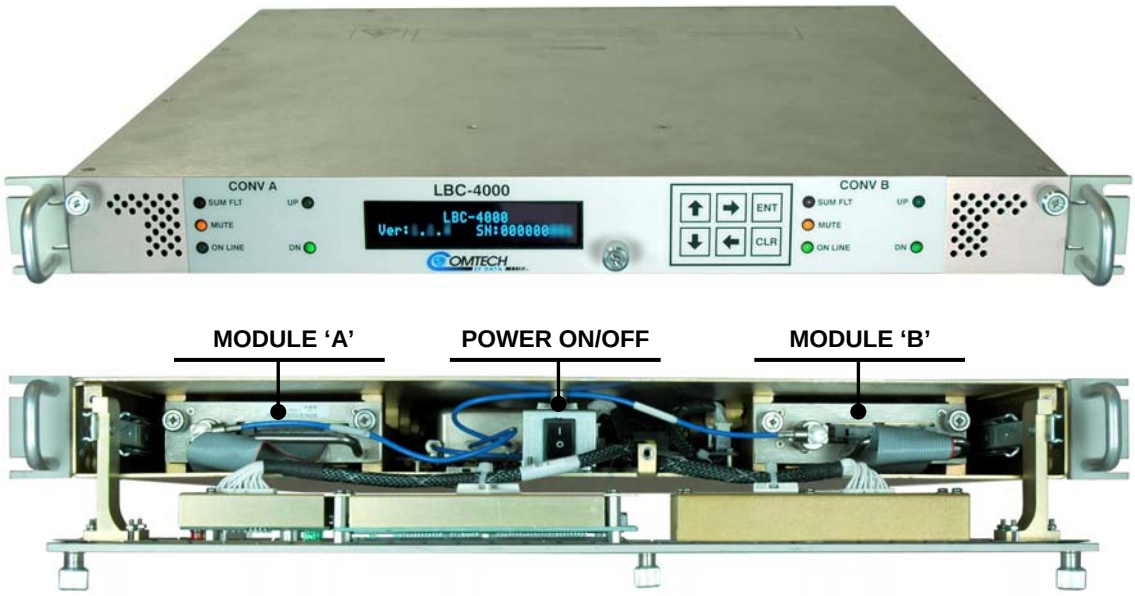


Figure 1-1. Comtech EF Data LBC-4000 L-Band Up/Down Converter

1.2 Functional Description

The LBC-4000, shown in **Figure 1-1**, features a drop-down front panel providing access to the ON/OFF switch and two upconverter modules, or two downconverter modules, or one of each.

All operator controls, indicators and displays for local and remote operation are located on the front panel of the LBC-4000.

The LBC-4000's 1RU-high, 19-inch wide chassis is designed for rack mounting into a standard 19-inch equipment rack. Handles installed on the front panel facilitate ease of installation into and removal from the equipment rack.

External interface connectors are located on the rear panel of the LBC-4000 chassis. External equipment, e.g., a modem, is connected to each internal converter module via a standard, off-the-shelf coaxial cable. A coaxial cable is also used to connect the output for each module to RF equipment either at the same location or at the antenna location.

When configured with the redundancy option, the system may contain two diode "OR-ed" internal power supplies for increased reliability, and microprocessor-based Monitor and Control (M&C) functions. **Figure 1-2** depicts the block diagram for a typical LBC-4000 L-Band Up/ Downconverter System application.

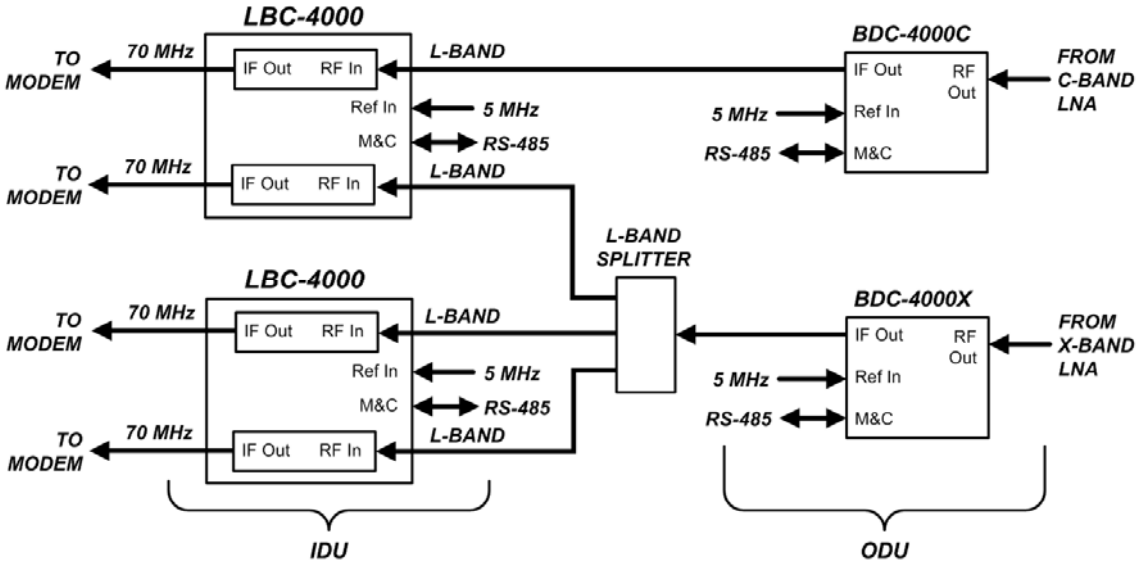


Figure 1-2. LBC-4000 Typical Application Block Diagram

1.3 Features

- Meets or exceeds MIL-STD-188-164A
- Low phase noise
- 1 kHz step size
- No spectral inversion
- 50 dB gain adjustment
- 70 MHz ±18 MHz IF (140 MHz ±36 MHz optional)
- Flexible configuration
- Auto band sensing capability
- 1:1 redundancy available

1.4 Summary of Specifications

1.4.1 Physical & Environmental

Weight		25 lbs. (11.34 kg) Maximum
Dimensions (excluding connectors)		19"W x 1.75"H (1RU) x 22"D (482.6 x 44.45 x 559.0 mm) (See Figure 1-3)
Temperature	**Operating**	32º to 122ºF (0º to 50ºC)
	Non-operating (Storage)	-58º to 160ºF (-50º to 71ºC)
Operational Altitude		10,000 ft above sea level
Operational Humidity		5 to 95% non-condensing
Shock		Normal commercial shipping and handling

1.4.2 Prime Power

Voltage	90 to 260 VAC
Frequency	47 to 63 Hz
Dissipation	35 Watts total, two up/downconverters

1.4.3 External Reference

Input Frequency	5 or 10 MHz, Auto detect BNC Female connector
Input Level	±5 dBm
Input Impedance	50Ω

1.4.4 Monitor & Control

Serial M&C Interface	TIA/EIA-232, TIA/EIA-485, 4-wire DB-9F connector
Alarm	Form C, DB-9F connector
Redundant Switch Connections	SMA Female

1.4.5 LBC-4000 L-Band Downconverter IDU

Input Frequency Range		950 MHz to 2000 MHz, 1 kHz steps
Output Frequency		70 MHz ±18 MHz (140 MHz ±36 MHz optional)
Input/Output Impedance		50Ω
Input Return Loss		15 dB minimum
Output Return Loss		20 dB minimum
Input connector		Type 'N' female
Output connector		Type 'BNC' female
Gain		35 dB nominal at minimum attenuation
Ripple		• ±.5 dB over any ±18 MHz for 70 MHz IF units • ±.5 dB over any ±36 MHz for 140 MHz IF units
Slope		0.5 dB/MHz
User Attenuation Range		0 to 40 dB, in 0.25 dB steps (0.1 dB optional)
Output Power, P1dB		+13 dBm minimum
Third Order Intercept		+23 dBm minimum
Carrier Spurious		-60 dBc
Non-Carrier Spurious		-60 dBm
Stability	**Over Time**	±1 X 10^{-9}/Day
	Over Temp	±1 x 10^{-8} 32º to 122ºF (0º to 50ºC)

1.4.6 LBC-4000 L-Band Upconverter IDU

Input Frequency		70 MHz ±18 MHz (140 MHz ±36 MHz optional)
Output Frequency		950 MHz to 2000 MHz, 1 kHz steps
Input/Output Impedance		50Ω
Input Return Loss		18 dB minimum
Output Return Loss		15 dB minimum
Input connector		Type 'BNC' female
Output connector		Type 'N' female
Gain		25 dB ±1 dB nominal at minimum attenuation
Ripple		• ±.5 dB over any ±18 MHz for 70 MHz IF units • ±.5 dB over any ±36 MHz for 140 MHz IF units
Slope		0.5 dB/MHz
User Attenuation Range		0 to 40 dB, in 0.25 dB steps (0.1 dB optional)
Input Power Level		To ±10 dBm maximum
Output Power, P1dB		+10 dBm minimum
Third Order Intercept		+20 dBm minimum
Carrier Spurious		-60 dBc
Non-Carrier Spurious		-75 dBm
Transmit Phase Noise		Exceeds MIL-STD-188-164A
Stability	**Over Time**	±1 X 10^{-9}/Day
	Over Temp	±1 x 10^{-8} 32º to 122ºF (0º to 50ºC)

1.5 Dimensional Envelope

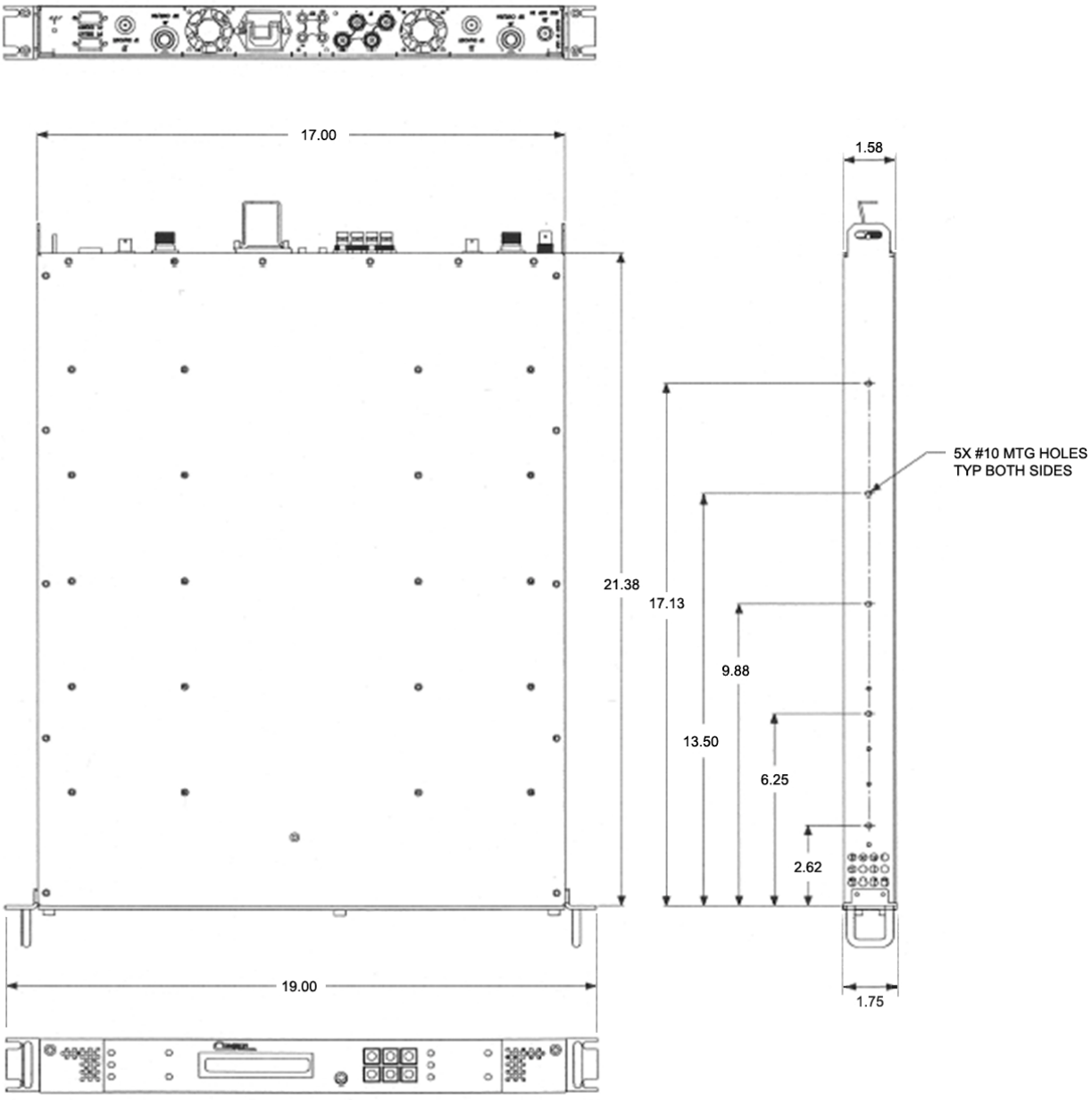


Figure 1-3. LBC-4000 Dimensional Envelope

Notes:

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 LBC-4000 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 converter.

Unpack and inspect the LBC-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 LBC-4000.
3	**Remove** the LBC-4000, manual, and power cord 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.

The equipment contains parts and assemblies sensitive to damage by Electrostatic Discharge (ESD). Use ESD precautionary procedures when touching, removing, or inserting the up/down converter modules.

2.2 Installation

2.2.1 Standard Rack Mount Installation

The LBC-4000 is designed for installation in a standard 19-inch (48.26 cm) rack cabinet or enclosure. **Figure 2-1** provides a "cut-away" side view of a typical LBC-4000 rack configuration.

The converter chassis requires 1-3/4 inches of panel height space. Adequate air ventilation should be provided on both sides of the rack-mounted equipment. In rack systems where there is high heat dissipation, forced air cooling must be provided by top or bottom mounted fans or blowers. Under no circumstance should the highest internal rack temperature be allowed to exceed 50°C (122°F).

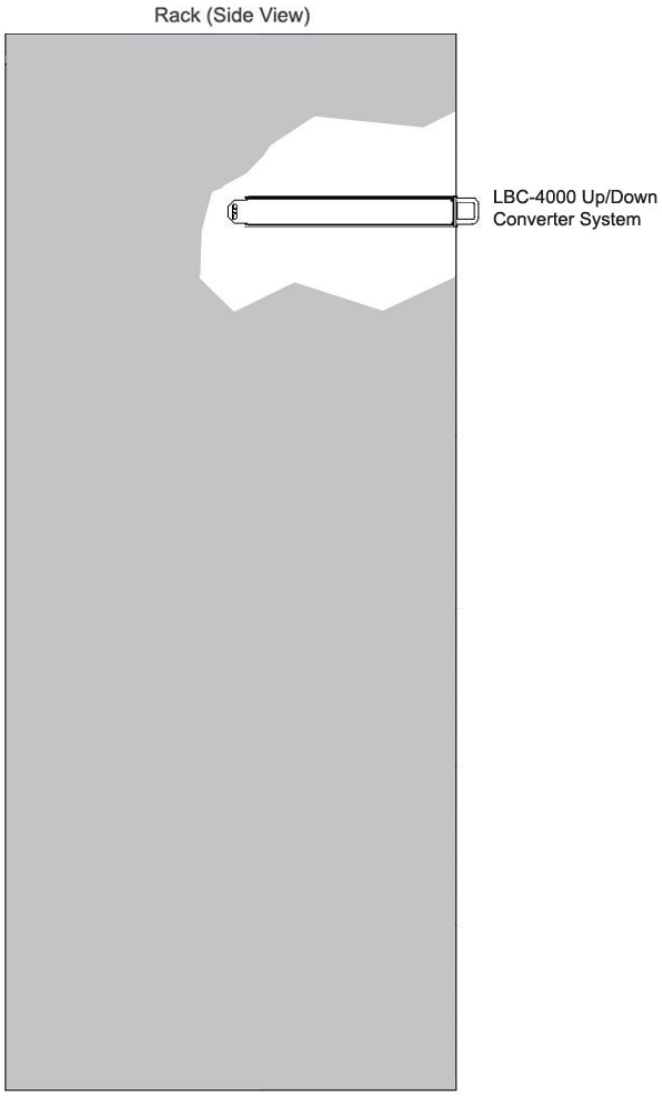


Figure 2-1. LBC-4000 Standard Rack Cabinet Installation

2.2.2 Installation via Optional Side-Railings

If the converter is to be mounted on slides, install the optional side-railing set FP/SL0006, with customer-furnished standard shop hardware:

Quantity	CEFD Part Number	Description
1	FP/SL0006	Bearingless Rack Slide Set

The slides are installed as illustrated in **Figure 2-2** via the following procedure:

Step	Procedure
1	Mount the slides on the sides of the converter chassis with the mounting hardware provided.
2	Install the slide rails in the rack cabinet enclosure.
3	Mount the unit into the equipment rack, ensuring that the shoulders of the #10 shoulder screws properly engage into the rear support bracket slots.
4	Slide the converter into the front of the rack cabinet until the rear of the front panel contacts the mounting surface of the cabinet.
5	Secure the converter to the rack cabinet with four screws inserted through the slots on the converter's front panel

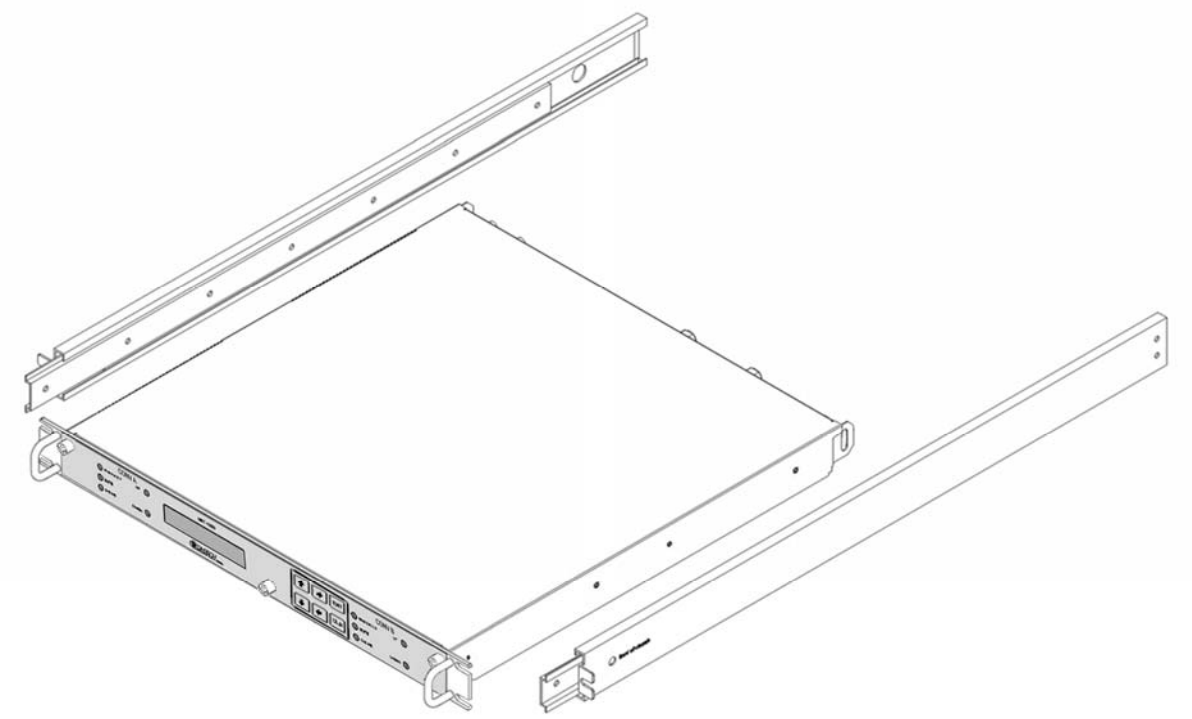


Figure 2-2. LBC-4000 Optional Side-Railings Installation (FP/SL0006)

2.2.3 Installation via Optional Rear-Mounting Support Brackets

Install optional rear-mounting support brackets using mounting kit KT/6228-2:

Quantity	CEFD Part Number	Description
2	HW/10-32SHLDR	Screw, #10 Shoulder
4	HW/10-32FLT	Washer, #10 Flat
2	HW/10-32SPLIT	Washer, #10 Split
2	HW/10-32HEXNUT	Nut, #10 Hex
2	FP/6138-1	Bracket, Rear Support
4	HW/10-32x1/2RK	Bolt, #10 Rack Bracket

The tools required for this installation are a **medium Phillips™ screwdriver** and a **5/32-inch SAE Allen™ Wrench.** The kit is installed as illustrated in **Figure 2-3** via the following procedure:

Step	Procedure
1	Secure the #10 shoulder screws to the unit chassis through the rear right and left side mounting slots, using the #10 flat washers, #10 split washers, and #10 hex nuts as shown.
2	Install the rear support brackets onto the equipment rack threaded rear mounting rails, using the #10 rack bracket bolts.
3	Mount the unit into the equipment rack, ensuring that the shoulders of the #10 shoulder screws properly engage into the rear support bracket slots.

2.3 Prime Power Connection

The detachable power cord mates with the AC Prime power receptacle on the rear of the converter chassis. A power cord for connection to 90 to 125VAC, or 205 to 240VAC, power sources is provided with the converter.

2.4 Connect External Cables

Proceed to connect all external cables to the connectors outlined in the next chapter (**Chapter 3. REAR PANEL CONNECTORS**). Should difficulties occur, call Comtech EF Data Customer Support for assistance.

2.5 Module Removal / Installation

The LBC-4000 comes preassembled as ordered for the specific customer application. In the event removal or replacement of the up/downconverter modules is required, complete instructions are provided in **Appendix B. MODULE REMOVAL / INSTALLATION**.

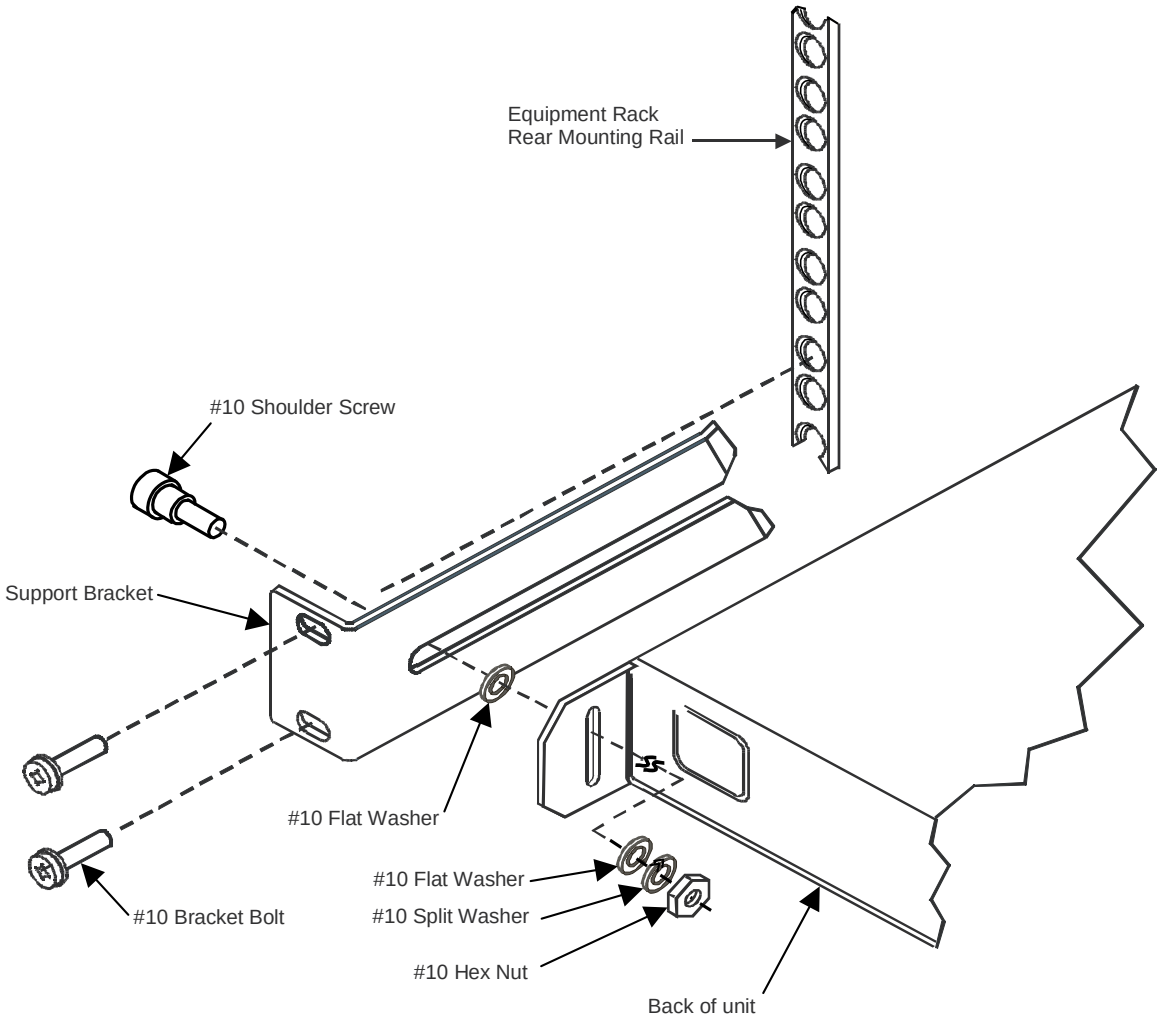


Figure 2-3. Optional Rear-Mounting Support Bracket Kit Installation

Notes:

Chapter 3. REAR PANEL CONNECTORS

3.1 Rear Panel Overview

The connectors accessible from the LBC-4000 rear panel (**Figure 3-1**) provide all necessary external connections between the converter and other equipment.

Table 3-1 summarizes these connections and identifies the chapter sections providing more detailed information.

Figure 3-1. LBC-4000 Rear Panel (Redundant Unit Shown)

3.2 LBC-4000 External Connectors

Table 3-1. LBC-4000 Rear Panel External Connections

Ref Des	Name	Sect	Connector Type	Function
J2	EXT REF IN	3.2.1	Type 'BNC' female	External10 MHz Reference input
J4	RF OUT/IN	3.2.2	Type 'N' female	Unit B Module RF output/input
J5	IF IN/OUT	3.2.3	Type ' BNC ' female	Unit B Module IF input/output
IF	B SEC	3.2.4	Type 'BNC' female	Opt. Redun (top): To J4 IF In/Out
				Opt. Redun (bot): To Modem
	A PRI			Opt. Redun (top): To Termination
				Opt. Redun (bot): To J6 IF In/Out
RF	B SEC	3.2.5	Type 'SMA' female	Opt. Redun (top): To J5 RF In/Out
				Opt. Redun (bot): To PA or LNA
	A PRI			Opt. Redun (top): To Termination
				Opt. Redun (bot): To J7 RF In/Out
J6	RF OUT/IN	3.2.6	Type 'N' female	Unit A Module RF output/input
J7	IF IN/OUT	3.2.7	Type 'BNC' female	Unit A Module IF input/output
P1	RELAY	3.2.8	9-Pin Type 'D' female	Form C Unit Alarm
J1	COM 1	3.2.9	9-Pin Type 'D' male	Serial Remote Control Interface
N/A	Prime Power AC Plug	3.2.10	IEC	Converter Power
N/A	GND	3.2.11	#10-32 Stud	Grounding

3.2.1 J2 External Reference Input Connector, Type 'BNC' Female

The **J2 External Reference Input** is used to supply a master reference to the entire chassis. The input signal supplied here by the user is used for phase-locking the internal 10MHz reference oscillator to a customer-provided 5 or 10 MHz station clock. The impedance is matched for 50/75Ω, and requires a level in the range 0.5V-4.0Vpp square or sine wave.

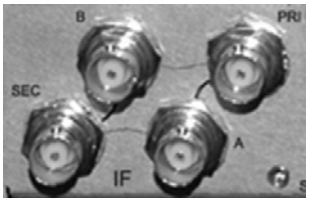
3.2.2 J4 RF OUT/IN Unit B Connector, Type 'N' Female

The **J4 RF OUT/IN** connector is a Type 'N' female connector that provides either an L-Band output signal interface (with the Downconverter IDU installed), or an L-Band input signal interface (with the Upconverter IDU installed).

3.2.3 J5 IF IN/OUT Unit B Connector, Type ‘BNC’ Female

The **J5 IF IN/OUT** connector is a Type 'BNC' female connector that provides either a downconverted IF input signal (with the Downconverter IDU installed), or an upconverted IF output signal (with the Upconverter IDU installed).

3.2.4 Optional IF Connectors, Type ‘BNC’ Female



The **IF Primary A / Secondary B** connector pairs are Type 'BNC' female connectors that provide the IF “baseball” switch for optional redundant operations. Refer to **Figure C-2** in **Appendix C. LBC-4000 REDUNDANCY OPERATION** for interconnection between these connectors to others located on the LBC-4000 rear panel and on other external equipment.

3.2.5 Optional RF Connectors, Type ‘SMA’ Female

The **RF Primary A / Secondary B** connector pairs are Type 'SMA' female connectors that provide the RF “baseball” switch for optional redundant operations. Refer to **Figure C-2** in **Appendix C. LBC-4000 REDUNDANCY OPERATION** for interconnection between these connectors to others located on the LBC-4000 rear panel and on other external equipment.

3.2.6 J6 RF OUT/IN Unit A Connector, Type ‘N’ Female

The **J6 RF OUT/IN** connector is a Type 'N' female connector that provides either an L-Band output signal interface (with the Downconverter IDU installed), or an L-Band input signal interface (with the Upconverter IDU installed).

3.2.7 J7 IF IN/OUT Unit A Connector, Type ‘BNC’ Female

The **J7 IF IN/OUT** connector is a Type 'BNC' female connector that provides either a downconverted IF input signal (with the Downconverter IDU installed), or an upconverted IF output signal (with the Upconverter IDU installed).

3.2.8 P1 RELAY (Summary Fault Output) Connector, DB-9F

The summary fault output connector, P1, is 9-pin Type "D" female (DB-9F) connector. The mating connector is a DB-9M connector. The pinout specifications are provided in **Table 3-2**.

Table 3-2. P1 Summary Fault Connector Pinout

Pin #	Description
1	SUMFLT1_NC
2	SUMFLT1_NO
3	SUMFLT2_NC
4	SUMFLT2_NO
5	GND
6	SUMFLT1_COM
7	NC
8	SUMFLT2_COM
9	NC

Notes – For Normal Fault Relay Logic:
1. Pin 1 to Pin 6: OK – No Fault
2. Pin 2 to Pin 6: Fault

3.2.9 J1 COM1 (RS-485/232 Interface) Connector, DB-9F

The RS-485/RS-232 Interface connector, J1, is a 9-pin Type "D" female (DB-9F) connector. The mating connector is a DB-9M connector. The pinout specifications for RS-485 are provided in **Table 3-3** and **Table 3-4**; the specification for RS-232 is provided in **Table 3-5**.

Table 3-3. J1 2-Wire RS-485 Interface Pinout

Pin #	Description
1	GND; Ground
2	
3	
4	+RX/TX; Signal
5	-RX/TX; Signal Complement
6	
7	
8	+RX/TX; Signal
9	-RX/TX; Signal Complement

Note: Pins 8 & 9 are the loop to the next converter.

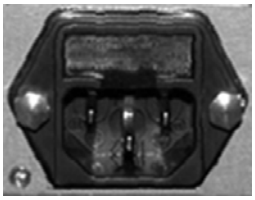
Table 3-4. J1 4-Wire RS-485 Interface Pinout

Pin #	Description
1	GND; Ground
2	
3	
4	+TX; Signal
5	-TX; Signal Complement
6	
7	
8	+RX; Signal
9	-RX; Signal Complement

Table 3-5. J1 RS-232C Interface Pinout

Pin #	Description
1	
2	TD; Transmit Data
3	RD; Receive Data
4	
5	GND; Ground
6	DSR; Unit Ready – always high
7	RTS; Request to Send. Looped to CTS
8	CTS; Clear to Send
9	

3.2.10 Prime Power Connector



The detachable power cord mates with the Alternating Current (AC) Prime power receptacle (shown here). A power cord for connection to 90 to 125 VAC, or 205 to 240 VAC power sources is provided with the LBC-4000.

3.2.11 Ground Connector

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

Note: The AC power connector provides the safety ground.

Notes:

Chapter 4. FRONT PANEL OPERATION

4.1 Introduction

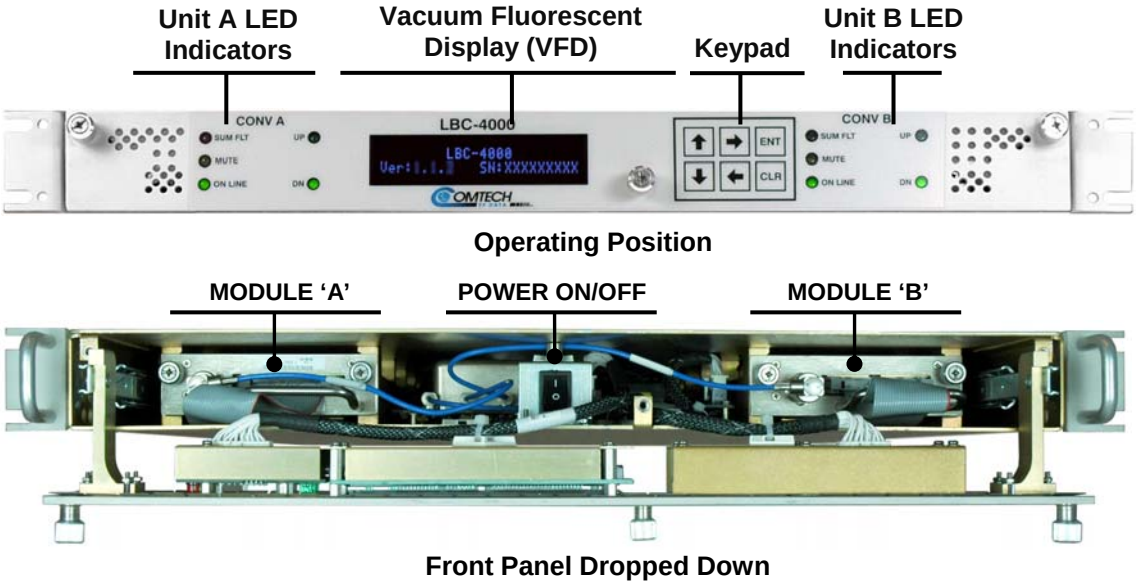


Figure 4-1. LBC-4000 Front Panel Views

Figure 4-1 identifies the key operational features of the front panel of the LBC-4000 L-Band Up/Down Converter System.

Note: The Prime Power Switch is centrally located inside the chassis (behind the front panel).

The front panel features (from left): two sets of five **L**ight-**E**mitting-**D**iode (LED) indicators (one set for each unit); a **V**acuum **F**luorescent **D**isplay (VFD); and a six-switch keypad.

The keypad comprises six individual keyswitches. The user enters data via the keypad, and messages are displayed on the VFD. The LEDs indicate, in a summary fashion, the status of the unit.

The user can fully control and monitor the operation of the LBC-4000 from the front panel using the keypad and display. Nested menus are used, which display all available options and prompt

the user to carry out a required action. The function and behavior of the LED indicators, keypad, and VFD is described in detail in the sections that follow.

4.1.1 Switch Power On

Prior to turning power on to the unit, check to ensure that installation is complete, and verify that the LBC-4000 is connected to the proper prime power source, RF Input, and IF Output.

For more information, refer to **Chapter 2. INSTALLATION** and **Chapter 3. REAR PANEL CONNECTORS**.

Switch on the unit and verify the cooling fans are operational, the LED indicators illuminate as expected, and the Vacuum Fluorescent Display is readable.

4.1.2 Front Panel LED Indicators

The behavior of the two sets of front panel LED indicators (five LEDs each per Converter Units A and B) is as follows:

LED	Color	Condition
SUM FLT	**Red**	Specified unit has active faults.
MUTE	**Yellow**	Specified unit is in Mute Mode.
ON LINE	**Green**	Designates the specified unit is operational when lit.
UP	**Green**	Designates the specified unit is operating as an Upconverter when lit.
DOWN	**Green**	Designates the specified unit is operating as a Downconverter when lit.

4.1.3 Front Panel Keypad

IMPORTANT

The keypad has an auto-repeat feature. If a key is held down for more than 1 second, the key action will repeat, automatically, at the rate of 15 keystrokes per second. This is particularly useful when editing numeric fields, with many digits, such as frequency or data rate.

The keypad comprises six individual keyswitches, mounted directly behind a fully sealed membrane overlay. They have a positive ‘click’ action, which provides tactile feedback. The user enters data via the keypad, and messages are displayed on the VFD.

Typically, the **[←][→]** arrow keys are used to select from the submenu choices shown, and **[ENT]** is then pressed to save or execute the selection.

Some commands permit the user to configure the unit in a step-by-step process, with nested menus available in succession. For example, for menus containing multiple parameters, use the **[←][→]** arrow keys to select the parameter to edit, then use the **[↑][↓]** arrow keys to edit the values (i.e., alphanumeric characters) or options for that parameter as needed.

Pressing **[ENT]** will save or execute the selection, while pressing [**CLR]** permits the user to abort the modification or otherwise discontinue and return back to the top menu.

To summarize, the function of the keypad is as follows:

KEY	FUNCTION
[ENT] (ENTER)	This key is used to select a displayed function or to execute a modem configuration change.
[CLR] (CLEAR)	This key is used to back out of a selection or to cancel a configuration change which has not been executed using **[ENT]**. Pressing **[CLR]** generally returns the display to the previous selection.
[←] [→] (Left, Right)	These arrow keys are used to move between selections or to move the cursor functions. At times, they may also be used to move from one section to another.
[↑] [↓] (Up, Down)	These arrow keys are used primarily to change configuration data (numbers or characters). At times, they may also be used to move from one section to another.

4.2 Front Panel Vacuum Fluroescent Display (VFD)

The LBC-4000 features a **V**acuum **F**luorescent **D**isplay (VFD). The VFD is an active display showing two lines of 24 characters each. It produces a blue light, the brightness of which can be controlled by the user. Compared to a **L**iquid **C**rystal **D**isplay (LCD), it has greatly superior viewing characteristics and does not suffer problems of viewing angle or contrast.

On most menu screens, the user will observe a flashing solid block cursor, which blinks at a once-per-second rate. This indicates the currently selected item, digit, or field. Where this solid block cursor would obscure the item being edited (e.g., a numeric field) the cursor will automatically change to an underline cursor.

If the user were to display the same screen for weeks at a time, the display could become 'burnt' with this image. To prevent this, the unit has a 'screen saver' feature, which will activate after a user-selected timeframe. See **Sect. 4.7.4** to see the screen saver options and behaviors available to the user.

Pressing any key will restore the previous screen.

4.2.1 Opening Screen

```
          LBC-4000
Ver: X.X.X    SN:XXXXXXXXX
```

This screen is displayed whenever power is first applied to the unit. The converter commands are in a tree-structured menu format designed for access and execution of all control functions, and to prevent the execution of an invalid entry by the operator. When the prime power is turned on, the

VFD 'splash' display indicates the converter model number – i.e., 'LBC-4000' – along with the Firmware Version installed, and the serial number assigned for the unit in use.

Figure 4-2 illustrates the hierarchal structure of the front panel menu tree.

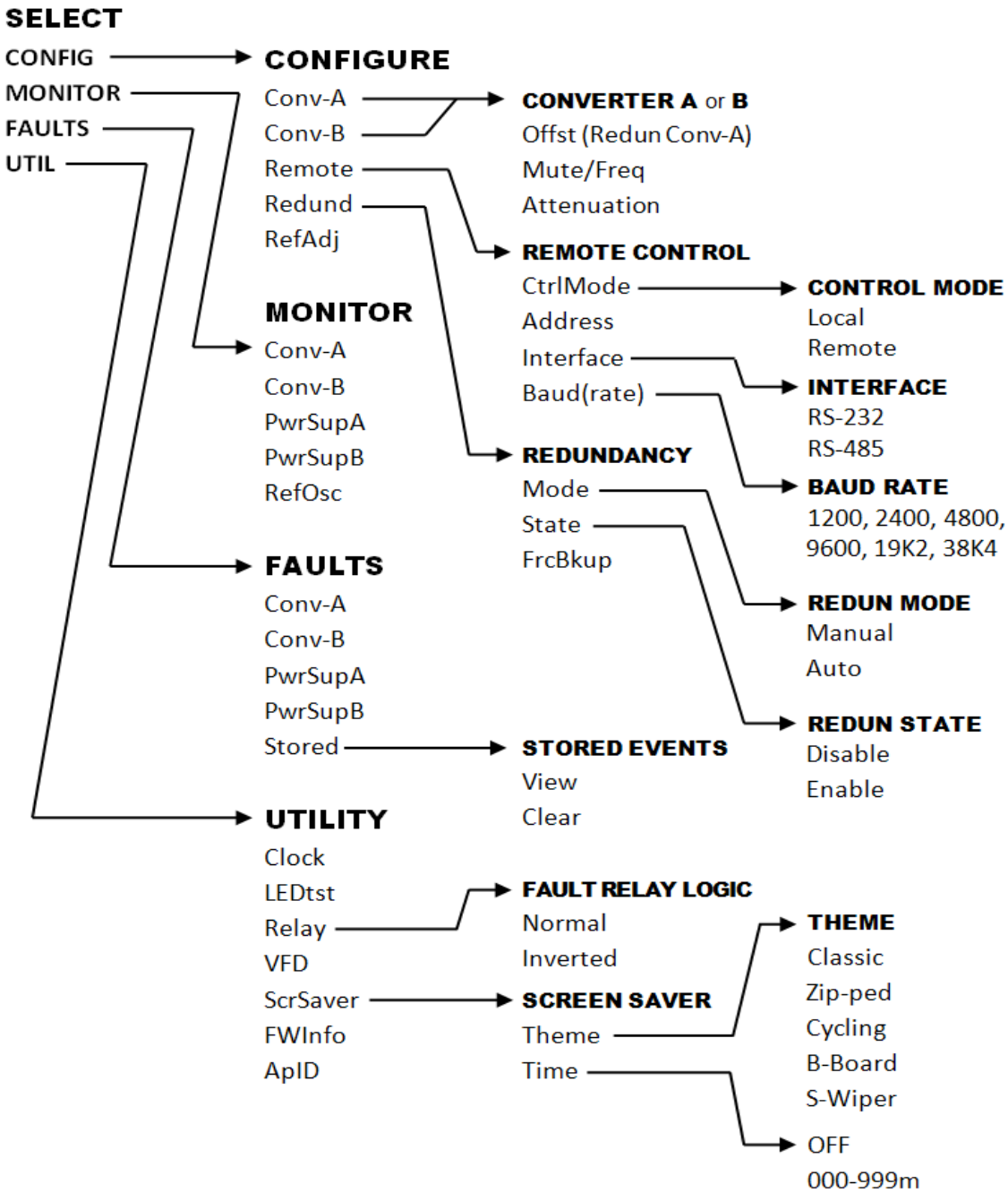


Figure 4-2. LBC-4000 Principal Menu Tree

4.3 SELECT: (Main Menu)

```
SELECT: Config  Monitor
Faults Util
```

Use the **[←][→]** arrow keys to select from the choices shown, then press **[ENT]**. The following table identifies each menu branch available from the **SELECT** (Main) menu, its content section in this chapter, and the functional description of each branch:

Menu Branch	Sect	Description
Config	**4.4**	**(Configuration)** Permits the user to fully configure the LBC-4000.
Monitor	**4.5**	Permits the user to monitor the alarm status of the unit, to view the log of stored events, and to display the Receive Parameters screen.
Faults	**4.6**	Permits the user to view information on the unit, without having to go into configuration screens.
Util	**4.7**	**(Utility)** Permits the user to perform miscellaneous functions, such as setting the Real-time clock, adjusting the display brightness, etc.

4.4 SELECT: Config (CONFIGURATION)

```
CONFIGURE: Conv-A Conv-B
Remote Redund RefAdj
```

Use the **[←][→]** arrow keys to select from the submenu choices shown, then press **[ENT]**. The following table identifies each submenu available from the Configuration menu branch – typical for Converter Unit A or Unit B – its content section in this chapter, and functional description of each submenu:

Submenu	Sect	Functional Description
Conv-A Conv-B	**4.4.1**	**(Converter Unit A** or **B)** Displays the current configuration of the selected converter, including the frequency, attenuation, and slope.
Remote	**4.4.2**	**(Remote Control)** Permits the user to define whether the unit is being controlled locally or remotely, and identifies the unit address, interface type, and rate and format of the baud parameters.
Redund	**4.4.3**	**(Redundancy – overview only)** Permits the user to identify the redundancy state and mode (refer to **Appendix C. LBC-4000 REDUNDANCY OPERATION** for detailed information).
RefAdj	**4.4.4**	**(Ref-Osc Adjust)** Permits the user to adjust the reference oscillator.

4.4.1 CONFIGURE: Conv-A *or* Conv-B (Converter Unit A *or* Converter Unit B)

```
CONFIG CnvX: (IF=YYYMHz)
Freq/Mute Attn/Slope
```

Where *'X'* is the selected converter – **Conv-A** (Converter Unit A) or **Conv-B** (Converter Unit B) – and *'YYY'* indicates its operating frequency (**70** or **140 MHz**), select **Freq/Mute** or **Atten/Slope** using the **[←][→]** arrow keys, then press **[ENT]**.

CONFIG CnvA or CnvB → Freq/Mute

```
CONFIG CnvX: (IF=YYYMHz)
Freq=01980.000MHz Rx=ON
```

Use the **[←][→]** arrow keys to select the parameter to edit – **Freq** or (depending on whether the unit is an Upconverter or Downconverter) **Rx** or **Tx**.

To edit the selected converter's operating frequency, use the **[←][→]** arrow keys to select each digit, then use the **[↑][↓]** arrow keys to edit that digit. Repeat for all digits until the desired frequency has been defined.

To select the Tx/Rx mute status, use the **[←][→]** arrow keys to select the mute parameter, then use the **[↑][↓]** arrow keys to select **ON** or **OFF**.

Press **[ENT]** when done.

CONFIG CnvA or CnvB → Atten/Slope

When **Atten/Slope** is selected for **Conv-A**:

```
CONFIG CnvA: Ofst=+0.0dB
Atten=00.00dB Slope=0.0
```

When **Atten/Slope** is selected for **Conv-B**:

```
CONFIG CnvB:
Atten=00.00dB Slope=0.0
```

For either, use the **[←][→]** arrow keys to select the parameter to edit – **Atten** or **Slope**.

To edit the selected converter's attenuation, use the **[←][→]** arrow keys to select each digit, then use the **[↑][↓]** arrow keys to edit the value of that digit.

To edit the selected converter's slope value, use the **[↑][↓]** arrow keys to select a scrolling value, in 0.1 increments, between 0.0 and 1.0.

Note: For the **Configure: Conv-A → Atten/Slope** menu, the **Ofst** (**Gain Offset)** command is available only if redundancy is enabled. See **Appendix C. LBC-4000 REDUNDANCY OPERATION** for further details on using this command in redundancy applications.

Press **[ENT]** when done.

4.4.2 CONFIGURE: Remote (Remote Control)

```
CONFIG Remote:CtrlMode
Address   Interface Baud
```

Select **CtrlMode**, **Address**, **Interface**, or **Baud** using the **[←][→]** arrow keys, then press **[ENT]**.

CONFIG Remote → CtrlMode (Control Mode)

```
CONFIG Remote:
Control Mode = Local
```

Select **Local** or **Remote** using the **[↑][↓]** arrow keys, then press **[ENT]**.

Note: When **Control Mode** = **Local**, then remote control will be disabled. Remote monitoring is still possible.

CONFIG Remote → Address

```
Remote Address:
Unit Address = 0001
```

The valid range of addresses is from 0001 to 9999. Use the **[←][→]** arrow keys to select the digit to edit, then use the **[↑][↓]** arrow keys to edit the value of the digit, then press **[ENT]**.

CONFIG Remote → Interface

```
CONFIG Remote:
Interface=RS-485
```

Select **RS-232** or **RS-485** using the **[↑][↓]** arrow keys, then press **[ENT]**.

CONFIG Remote → Baud

```
CONFIG Baud Params:
Rate=9600 Format=8N1
```

Use the **[←][→]** arrow keys to select the parameter to edit – the baud **Rate** or the asynchronous character **Format** – then use the **[↑][↓]** arrow keys to select a new value for that parameter:

- **Select** the **Baud** rate of the remote control bus (connected locally to the M&C computer): **1200**, **2400**, **4800**, **9600**, **19K2** (19200), or **38K4** (38400) baud are available.
- **Select** the asynchronous character **Format** using the **[↑][↓]** arrow keys, as follows:

Selection	Description
8N1	8 data bits, no parity, 1 stop bit
7O2	7 data bits, odd parity, 2 stop bits
7E2	7 data bits, even parity , 2 stop bits

Press **[ENT]** when done.

4.4.3 CONFIGURE: Redund (Redundancy)

```
CONFIG Redundancy:
Mode  State  FrcBkup
```

The Redundancy menu identifies the redundancy mode. Refer to **Appendix C. LBC-4000 REDUNDANCY OPERATION** for further information on this operational feature.

4.4.4 CONFIGURE: RefAdj (Reference Oscillator Adjustment)

```
UTIL Ref Osc:
Adjust=087  (◄ ► ▲ ▼ ENT)
```

The reference oscillator adjustment may be manipulated with this menu. Use the **[←][→]** arrow keys to select the character to edit, then the **[↑][↓]** arrow keys to edit the value of the selected character, then press **[ENT]**. The default Reference Frequency tuning adjustment is 087, with allowable values from 0 to 255.

4.5 SELECT: MONITOR

```
MONITOR: Conv-A Conv-B
PwrSupA PwrSupB RefOsc
```

Use the **[←][→]** arrow keys to select from the submenu choices shown, then press **[ENT]**. The following table identifies each ***read-only*** display available from the Monitor menu branch, including a sample screen and a functional description of the display:

Submenu	Example	Description
Conv-A	`MON-A: iLO=04.1 rLO=14.6 Tp=+32`	*For Converter Unit A or B:* The operating parameters for the selected Up/Downconverter IDU are shown, where: **iLO** = IF Lockout **rLO** = RF Lockout **Tp** = Operating Temp (°C)
Conv-B	`MON-B: iLO=04.1 rLO=14.6 Tp=+30`	
PwrSupA	`MON Power SupplyX: 12V=12.3 8V=0.82 5V=5.3`	*Where 'X' denotes Power Supply 'A' or 'B':* The 12V, 8V, and 5V values for the selected power supply are shown.
PwrSupB		
RefOsc	`MON Ref Osc: Vtune=04.7`	The raw voltage of the voltage tuning monitor is shown. **Note:** This display is used for debugging purposes only.

For all ***read-only*** Monitor displays, pressing **[ENT]** or **[CLR]** returns the user back to the previous menu.

4.6 SELECT: FAULTS

```
FAULTS: Conv-A Conv-B
PwrSupA PwrSupB Stored
```

The screens available under this menu branch display the current status of fault conditions for Converter A and Converter B; this includes the converter oscillator faults, converter temperature fault condition, power supply faults, and stored faults.

Select **Conv-A**, **Conv-B**, **PwrSupA**, **PwrSupB**, or **Stored** using the **[←][→]** arrow keys, then press **[ENT]**.

FAULTS: Conv-A *or* Conv-B

Where 'X' denotes whether **Conv-A** or **Conv-B** is selected, the highest fault for the converter will appear. If no converter faults exist, the message "**OK**" is displayed:

```
FAULTS: Cnv-X
ifLO=OK rfLO=OK temp=OK
```

Press **[ENT]** to return to the previous menu.

FAULTS: PwrSupA *or* PwrSupB

Where 'X' denotes whether Power Supply A or Power Supply B is selected, the highest fault for the power supply will appear. If no power supply faults exist, the message "**OK**" is displayed:

```
FAULTS: Pwr Supply X:
12VT=OK 08VT=OK 05VT=OK
```

FAULTS: Stored

```
FAULTS: Stored:
View   Clear
```

Select **View** or **Clear** using the **[←][→]** arrow keys, then press **[ENT]**.

FAULTS: Stored → View

```
Fault No. 06 10:28:53
OK-IFLO_A 08/10/04
```

A total of 100 faults can be stored in memory as they occur, and the faults are date and time stamped. The stored faults remain in memory until a **Clear c**ommand is entered. When the number of faults reaches 100, the 100th fault will display an error (**ER**).

FAULTS: Stored → Clear

```
     Clear all stored
     Faults?        NO
```

When **Clear-All** is selected, the user is prompted to choose **NO** or **YES**. Use the **[↑][↓]** arrow keys, then press **[ENT]**.

If the user selects **YES**, the event log is cleared and the message '**DONE**' is displayed, then the user is taken directly back to the previous menu. However, if there are faults present on the unit at this time, they will be re-time-stamped, and new log entries will be generated.

4.7 SELECT: UTIL (UTILITY)

```
UTIL: Clock LEDtst Relay
VFD ScrSaver FWInfo ApID
```

Use the **[←][→]** arrow keys to select from the submenu choices shown, then press **[ENT]**. The following table identifies each submenu available from the **SELECT: UTIL** menu branch – typical for Converter Unit A or Unit B – its content section in this chapter, and functional description of each submenu:

Submenu	Sect	Functional Description
Clock	**4.7.1**	Edits the date and Real-Time Clock time settings
LEDtst	**4.7.2**	Runs a diagnostic test on each of the two sets of five front panel Light-Emitting Diodes (LEDs).
Relay	**4.7.3**	Selects Fault Relay Logic.
VFD	**4.7.4**	Adjusts the brightness level of the Vacuum Fluorescent Display (VFD).
ScrSaver	**4.7.5**	Allows selection of five screen saver modes, as well as a time setting for activation of the screen saver.
FWInfo	**4.7.6**	Displays the installed internal firmware images.
ApID	**4.7.7**	Allows the user to enter an 48-character Application ID string.

4.7.1 UTIL: Clock

```
UTIL Time/Date:
t=07:32:08 d=08/31/04
```

Edit the time and date settings of the real-time clock by selecting the digit to be edited using the **[←][→]** arrow keys, then changing the value of the digit using the **[↑][↓]** arrow keys.

The time **t=** is entered in military format; that is, in the form hh:mm:ss (00-23 hours:00-59 minutes:00-59 seconds).

The date **d=** is entered in mm/dd/yy format (01-12 month/01-31 day/00-99 year).

Press **[ENT]** when done.

4.7.2 UTIL: LEDtst (Front Panel LED Test)

Once **LEDtst** is selected from the **UTILITY** menu branch by using the**[←][→]** arrow keys then pressing **[ENT],** the LBC-4000 runs a diagnostic pass on the front panel LEDs.

While the test is underway, the following message displays:

```
Testing Front Panel LEDs
      Please Wait
```

During the test, the LED groups for each converter (CONV A and CONV B) illuminate in sequence:

COLOR	LED (CONVA / CONVB)
RED	SUM FLT
YELLOW	MUTE
GREEN	ON LINE
	UP
	DN

4.7.3 UTIL: Relay

```
UTIL: FAULT RELAY LOGIC
Normal          (▲ ▼,ENTER)
```

This submenu allows the user to control the Fault Relay. Select the Fault Relay Logic as **Normal** or **Inverted** using the **[↑][↓]** arrow keys, then press **[ENT]**.

4.7.4 UTIL: VFD (VFD Display Brightness)

```
Display Brightness:
100%            (▲ ▼,ENTER)
```

To edit the display brightness, use the **[↑][↓]** arrow keys. The values of brightness that can be selected are **3** (25%), **2** (50%), **1** (75%), or **0** (100%).

Press **[ENT]** when the brightness is suitable.

4.7.5 UTIL: ScrSaver

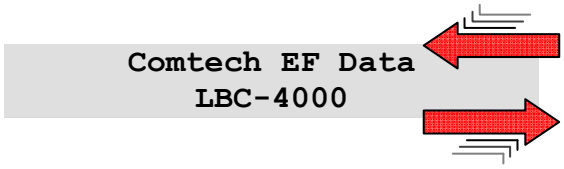
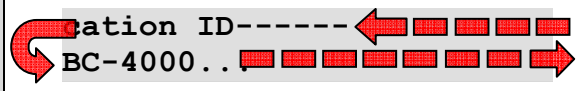
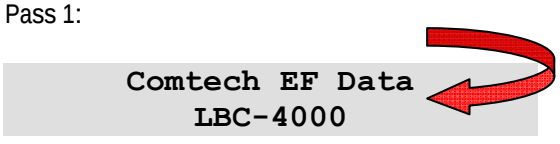
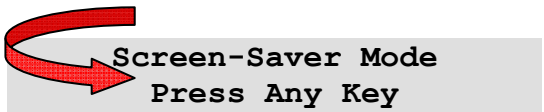
```
UTIL ScreenSaver:
Theme=Classic Time=015m
```

If the user were to display the same screen for weeks at a time, the display could become 'burnt' with this image. To prevent this, the LBC-4000 has a 'screen saver' feature, which will activate after a user-selected timeframe.

Define the screen saver behaviors, using the **[←][→]** arrow keys to select the parameter to edit – **Theme** or **Time** – then changing the value of the parameter setting using the **[↑][↓]** arrow keys. Press **[ENT]** when done.

UTIL: ScrSaver → Theme

The user may choose from five screen saver themes. Each theme establishes a unique behavior for the screen saver, when activated:

Theme Name	Screen Saver Activity Visual	Description
Classic		The top line of the display shows the user-defined "Application ID", and the bottom line shows '**Press any key...**'. The message moves from right to left across the screen, then wraps around.
Zip-ped		This mode features a 'marquee' display: "**Comtech EF Data LBC-4000**" This display 'zips to center' from 'offstage right' then 'zips/exits offstage right.'
Cycling		A single line display comprised of the user-defined "Application ID" and "**LBC-4000**" 'crawls' along from right to left across the top line of the VFD, then wraps around to the bottom line, moving left to right as it 'crawls off' the display.
B-Board		This mode features a 'marquee' display: "**Comtech EF Data LBC-4000**" The display performs a 'slow reveal' from left to right, then performs a 'slow wipe', again from left to right.
S-Wiper	Pass 1:  Pass 2: 	This mode features two separate 'marquee' displays - the first reads, "**Comtech EF Data LBC-4000**" The second 'marquee' reads, "**Screen-Saver Mode Press Any Key**" The screens alternate, with Marquee 1 performing a slow reveal/wipe from left-to-right, then Marquee 2 performs a slow reveal/wipe from right-to-left.

Select the chosen theme using the **[↑][↓]** arrow keys, then press **[ENT]** when done.

Pressing any key will de-activate the screen saver and restore the previous screen.

UTIL: ScrSaver → Time

The time lapse from normal VFD operation to screen saver mode may be adjusted – or disabled outright – using the **[↑][↓]** arrow keys, then press **[ENT]** when done.

- Select **OFF** to disable the screen saver feature, or
- Using the **[↑][↓]** arrow keys, select a time in minutes ranging from 001 to 999.

4.7.6 UTIL: FWInfo

```
Firmwares:   BULK=FW9965X
M&C=FW9966X  FPGA=9967X
```

This *read-only* display permits the user to view information about the LBC-4000 internal firmware. Information is provided for the Bulk, M&C and FPGA firmwares (where 'X' in the example shown denotes the firmware letter revision).

4.7.7 UTIL: ApID (Application ID)

```
--USER APPLICATION ID--
```

This menu allow the user to enter an 48-character Application ID string. Use the **[←][→]** arrow keys to position the cursor on to the character to be edited, then edit the character using **[↑][↓]** arrow keys. The following characters are available:

[*Space*] ( ) * + - , . / 0-9 *and* A-Z.

Note the following restrictions:

- First line is limited to 24 characters.
- Second line is also limited to 24 characters.

Once the Application ID string is composed, press **[ENT]**.

Notes:

Appendix A. REMOTE CONTROL

A.1 Introduction

This appendix describes the protocol and message command set for remote monitor and control of the LBC-4000 L-Band Up/Down Converter System.

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.

***The Remote Control connector pinout is shown in* Chapter 3.2.9 J1 COM 1 (RS-485/232 Interface) Connector (DB-9F).**

A.2 RS-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (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 communication, 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; 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; 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	• One line driver (Controller) • All Targets have line-receiver
Target-to-Controller pair	• One line receiver (Controller)A • 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 formats are:

Selection	Description
8-N-1	8 data bits, no parity, 1 stop bit
7-O-2	7 data bits, odd parity, 2 stop bits
7-E-2	7 data bits, even parity , 2 stop bits

The supported baud rates are 1200, 2400, 4800, 9600, 19200, and 38400 baud.

All data is transmitted in framed packets. The Controller is assumed to be 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 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_A_ON{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 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_A_ON{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. The address is programmed into a Target unit using the remote control port.

IMPORTANT

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 character '/' (forward slash) (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. For example,

FRE is for *Operating **FRE**quency*,

FBU is for ***F**orce **B**ackup **U**nit*, etc.

This aids in the readability of the message if seen in its raw ASCII form. Upper case and lower case alphabetic characters may be used (A-Z *and* a-z, ASCII codes 65 – 90 *and* 97-172).

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 is '_':

_ **(ASCII code 95)** ***Plus* additional parameters**	The '**_**' code plus additional parameter(s) 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) which follow it. For example, in a message from controller to target, **MUT_A_ON** would mean 'enable the mute function of Converter A'.
_ **(ASCII code 95)** ***Without* additional parameters**	The '**_**' code *without* additional parameter(s) 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_A_** denotes 'return the current state of the mute function of Converter A'.

2. From **Target-to-Controller**, if the message being sent was successful from controller to target, the target will respond with the same message being sent.

   If, however, a converter cannot execute a Command or detects a protocol violation, an error response is generated:

   >DEV?COM ER Error Message{CR}{LF}

   As illustrated by this example (ER Error Message is used for the generic case examples response):

   - An error is flagged by changing the "/" command designator in the response to a "?".
   - Following the "?" error symbol are two characters which are unique error symbols useful for computer analysis.
   - The two error symbols are followed by a text string explaining the error for the convenience of a human operator.

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 to 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 code 13, and ASCII code 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
AID	X	X	A-6
ATO	X	X	A-6
ATT	X	X	A-6
CAA	X		A-6
CAS		X	A-7
CCS		X	A-7
CMM	X	X	A-8
CMS		X	A-8
CUS		X	A-9
DAT	X	X	A-9
FBU	X		A-9
FRE	X	X	A-9
FRL	X	X	A-9
FRW		X	A-9
LAA		X	A-10
MUT	X	X	A-10
ONL		X	A-10

Instr Code	C	Q	Page
RAS		X	A-10
RCS		X	A-11
RED	X	X	A-11
REM	X	X	A-11
RET		X	A-11
RET_x		X	A-11
RMS		X	A-12
RUS		X	A-12
SAM	X	X	A-12
SAS		X	A-12
SBR	X	X	A-13
SPA	X	X	A-13
SRO	X	X	A-13
SSA	X	X	A-13
SSN		X	A-13
TIM	X	X	A-14
VFD	X	X	A-14

A.6.1 LBC-4000 Commands and Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes between 48 and 57)	Response to Command (Target to controller)	Query (Instruction Code and qualifier)	Response to query (Target to controller)
Application Identification	AID_	48 bytes, alphanumeric	Command or Query. Used to identify or name the unit or station, in the form AID_xxx…x where: • First line is limited to 24 characters. • Second line is also limited to 24 characters. • No carriage return between first line and second line. **Example:** AID_ --Earth Station 1— ---Converter #1----	Same as command	AID_	AID_x…x (see Description of Arguments for details)
Attenuation Offset	ATO_A_SY.Z	6 bytes Alphanumeric	Command or Query. Used to control or query attenuation offset, in the form ATO_A_SY.Z <Enter> where: S=Sign (+ or -) Y=Number between 0 and 5 Z=Number between 0 and 9 (cannot be greater than 5.0) **Example:** ATO_A_+2.3 <Enter> = Command **Notes:** 1. **Applicable only on Slot A.** Slot B will return error. 2. If (displayed attenuation + offset) < 0, actual attenuation will be set to 0dB. 3. If (displayed attenuation + offset) > maximum attenuation, actual attenuation will be set to maximum attenuation. 4. Actual attenuation is the sum of Attenuation displayed on front panel and Offset.	ATO_A_SY.Z	ATO_A_<Enter>	(see Description of Arguments for details)
Attenuation	ATT_	7 bytes, alphanumeric	Command or Query. In the form ATT_x_yy.yy where: x = 'A' (Converter A) or 'B' (Converter B) yy.yy = Valid attenuation level, in dB, at 0.1dB step size as factory default. **Example:** ATT_A_12.20 (Converter A is set to 12.20 dB)	Same as command	ATT_x_	ATT_x_yy.yy (see Description of Arguments for details)
Clear All Stored Alarms	CAA_	None	Command only. Instructs the target to clear all Stored Events, in the form CAA_xxx, where: xxx = YES	CAA_CLEARED	N/A	N/A

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric 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	13 bytes numeric	Query only. Used to Query the Alarm Status of the unit, in the form CAS_abcdefghijklm'cr''lf', where: a = 1 if 12VDC #1 Fault, else 0. b = 1 if 8VDC #1 Fault, else 0. c = 1 if 5VDC #1 Fault, else 0. d = 1 if 12VDC #2 Fault, else 0. e = 1 if 8VDC #2 Fault, else 0. f = 1 if 5VDC #2 Fault, else 0. g = 1 if REF LD Fault, else 0. h = 1 if IFLO A Fault, else 0. i = 1 if RFLO A Fault, else 0. j = 1 if TEMP A Fault, else 0. k = 1 if IFLO B Fault, else 0. l = 1 if RFLO B Fault, else 0. m = 1 if TEMP B Fault, else 0.	N/A	CAS_	CAS_x….x (see Description of Arguments for details)
Concise Configuration Status	N/A	52 bytes numeric	Query only. Used to query the summarized version of RCS, in the form CCS_aaaaa.aaabb.bbcd.defffff.fffgg.gghi.ijklmnnnopqqqqrs where: aaaaa.aaa = Conv A frequency in MHz bb.bb = Conv A attenuation in dB c = Conv A mute state, 0 = A–7nmated, 1 = muted d.d = Conv A slope adjust e = Conv A online/offline (redundancy) fffff.fff = Conv B frequency in MHz gg.gg = Conv B attenuation in dB h = Conv B mute state, 0 = unmuted, 1 = muted i.i = Conv B slope adjust j = Conv B online/offline (redundancy) k = Converter redundancy l = auto fault recovery, 1=auto, 0=manual m = external ref present, 0=no ext ref, 1=present nnn = internal ref. Oscillator adjust (000-255) o = remote mode, 1=remote, 0=local p = remote interface, 0=EIA-232, 1=EIA-485 qqqq = remote address (0-9999) r = remote baud rate (0=38400, 1=19200, 2=9600, 3=4800, 4=2400, 5=1200) s = remote data format (0 = 8N1, 1=7E2, 2=7O2)	N/A	CCS_	CCS_ x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes between 48 and 57)	Response to Command (Target to controller)	Query (Instruction Code and qualifier)	Response to query (Target to controller)
Configure Mute Mode	CMM_	5 bytes, alpha	Command or Query. Turns the mute mode ON or OFF. When mute mode is OFF (default), the unit will mute upon changing RF frequency. When mute mode is ON, the unit will remain whatever its mute state upon changing RF frequency: In the form CMM_y_xxx'cr''lf'] where: y = 'A' (Converter A) or 'B' (Converter B) xxx = ON (mute) or OFF (unmute) **Example:** CMM_A_OFF (Unmutes Converter A)	Same as command	CMM_y_	CMM_y_xxx (see Description of Arguments for details)
Concise Maintenance Status	N/A	85 bytes numeric	Query only. Used to Query the Maintenance Status of the unit in concise format, in the form CMS_aaa.abbb.bccc.cddd.deee.efff.fggg.ghhh.hiii.ijjj.jkkk.klll.lmmm.mnnn.nooo.oppp.pqqq.q'cr''lf' where: aaa.a = 12 VDC supply #1 in volts bbb.b = 8 VDC supply #1 in volts ccc.c = 5 VDC supply #1 in volts ddd.d = 12 VDC supply #2 in volts eee.e = 8 VDC supply #2 in volts fff.f= 5 VDC supply #2 in volts ggg.g = Ref Osc tuning voltage in volts hhh.h = Converter A IFLO tuning voltage in volts iii.i= Converter A RFLO tuning voltage in volts jjj.j = Converter A Input Power in dBm (Reserved for future use) kkk.k = Converter A Output Power in dBm (Reserved for future use) lll.l= Converter A temperature in degrees C mmm.m = Converter B IFLO tuning voltage in volts nnn.n= Converter B RFLO tuning voltage in volts ooo.o = Converter B Input Power in dBm (Reserved for future use) ppp.p = Converter B Output Power in dBm (Reserved for future use) qqq.q = Converter B temperature in degrees C	N/A	CMS_	CMS_ x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric 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	43 bytes alphanumeric	Query only. Used to Query the Maintenance status of the unit, in the form CUS_tt:tt:ttdd/dd/ddabcsssfffffffggggggghhhhhhh where: tt:tt:tt = time in hh:mm:ss dd/dd/dd = date in mm/dd/yy a = X (reserved for future use) b = X (reserved for future use) c = display brightness (0=100%, 1=75%, 2=50%, 3=25%) sss = screen saver time in minutes fffffff = Bulk firmware ggggggg = M&C firmware hhhhhhh = FPGA firmware	N/A	CUS_	CUS_ x….x (see Description of Arguments for details)
Set RTC (Real-Time-Clock) Date	DAT_	8 bytes, numeric	Command or Query. A command/query in the form DAT_mm/dd/yy 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_04/25/03 (would be April 25, 2003)	Same as command	DAT_	DAT_mm/dd/yy (see Description of Arguments for details)
Force Backup Unit	FBU_	0 bytes	Command only. Forces switchover to backup unit in Manual redundancy mode only in the form FBU_	Same as command	N/A	N/A
Operating Frequency	FRE_	11 bytes, alphanumeric	Command or Query. In the form FRE_x_yyyyy.yyy where: x = 'A' (Converter A) or 'B' (Converter B) yyyyy.yyy =Valid Operating frequency, in MHz and 1-kHz step. **Note:** The user has the option to set it at Ku-Band frequency for example, 14500.000 MHz, if the 'frequency display select' option is turned ON. **Example:** FRE_A_00951.000 (Converter A is set to 951 MHz)	Same as command	FRE_x_	FRE_x_yyyyy.yyy (see Description of Arguments for details)
Fault Relay Logic	FRL_	1 byte, numeric	Command or Query. In the form FRL_x where: x = 0 (Normal Logic) or 1 (Inverted Logic)	Same as command	FRL_	FRL_ (see Description of Arguments for details)
Retrieve Firmware Number	N/A		Query only. Gets the Firmware Numbers of the unit. **Example:** FRW_ BULK=FW/9965X M&C =FW/9966X FPGA=FW/9967X (Where 'X' denotes the firmware revision letter)	N/A	FRW_	FRW_ (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes between 48 and 57)	Response to Command (Target to controller)	Query (Instruction Code and qualifier)	Response to query (Target to controller)
List all alarms	N/A	variable	Query only. This command retrieves a list of the stored alarms. **List All Alarms:** LAA_'cr' **Confirmation:** LAA_'cr' xx yyyyyyyyyy hh:mm:ss mm/dd/yy'cr' xx yyyyyyyyyy hh:mm:ss mm/dd/yy'cr' xx yyyyyyyyyy hh:mm:ss mm/dd/yy'cr' " " " " " " " " xx yyyyyyyyyy hh:mm:ss mm/dd/yy'cr''lf'] Where: xx = stored fault number. Yyyyyyyyyy = fault description. Hh:mm:ss = fault time. Mm/dd/yy = fault date.	N/A	LAA_	LLA_ xx y..y h..s m..y (see Description of Arguments for details)
Mute State	MUT_	5 bytes, alpha	Command or Query. Mutes/Unmutes the converter in the form MUT_x_yyy where: x = 'A' (Converter A) or 'B' (Converter B) yyy = ON (mute) or OFF (unmute) **Example:** MUT_A_OFF (Unmutes Converter A)	Same as command	MUT_x_	MUT_x_yyy (see Description of Arguments for details)
Online Unit Status	N/A	1 byte alphanumeric	Query only. Indicates which slot is online in the form ONL_x where: x = A or B (depending on which Converter is online).	N/A	ONL_	ONL_ (see Description of Arguments for details)
Retrieve Alarm Status	N/A	122 bytes alphanumeric	Query only. Used to Query the Alarm status of the unit, where: xx = OK (no fault) or FT (fault): 12VDC1_xx'cr' 12 VDC #1 Fault. 08VDC1_xx'cr' 8 VDC #1 Fault. 05VDC1_xx'cr' 5 VDC #1 Fault. 12VDC2_xx'cr' 12 VDC #2 Fault. 08VDC2_xx'cr' 8 VDC #2 Fault. 05VDC2_xx'cr' 5 VDC #2 Fault. REFLD_xx'cr' Ref Osc. Lock Detect Fault.* IFLOA_xx'cr' Conv A IFLO Lock Detect Fault. RFLOA_xx'cr' Conv A RFLO Lock Detect Fault. TEMPA_xx'cr' Conv A Over Temperature Fault. IFLOB_xx'cr' Conv B IFLO Lock Detect Fault. RFLOB_xx'cr' Conv B RFLO Lock Detect Fault. TEMPB_xx'cr''lf' Conv B Over Temperature Fault. ***Note:** REFLD is only returned if an external reference is present.	N/A	RAS_	RAS_ x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric 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	186 bytes alphanumeric	Query only. Used to Query the Configuration Status of the unit in the form RCS_ : FRE_A_01694.765 Conv A frequency ATT_A_03.00 Conv A attenuation TX_A_ON Conv A mute state SLP_A_0.0 Conv A slope adj. ONL_A_ON Conv A on/offline FRE_B_11444.765 Conv B frequency ATT_B_15.00 Conv B attenuation RX_B_ON Conv B mute state SLP_B_0.0 Conv B slope adj. ONL_B_ON Conv B on/offline RED_OFF Conv redundancy AFR_ON auto flt recovery EXT_NO external ref. REF_087 ref osc adjust REM_YES remote mode COMM_RS-232 remote interface ADD_0001 remote address BR_9600 remote baud rate FMT_8-N-1 remote data format	N/A	RCS_	RCS_ x….x (see Description of Arguments for details)
Redundancy Mode	RED_	3 bytes alphanumeric	Command and Query. Used to set the chassis in redundancy mode or to query status of redundancy in the form RED_xxx where: xxx = ON (if redundancy is enabled) or OFF(if redundancy is disabled)	Same as command	RED_	RED_ (see Description of Arguments for details)
Remote Mode	REM_	1 byte, value 0 or 1	Command or Query Sets to remote mode or local mode in the form REM_x where: x = 0 (local mode) or 1 (remote mode)	Same as command	REM_	REM_x (see Description of Arguments for details)
Retrieve Module Equipment Type	N/A	12 bytes, alphanumeric	Query only. The unit returns a string indicating the frequency of the selected module and the module type (Up-Link or Down-Link) in the form RET_x_ where: x = ‘A’ or ‘B’ **Example:** RET_A_140_DL or RET_B_070_UL	N/A	RET_x_	RET_x….x (see Description of Arguments for details)
Retrieve Equipment Type	N/A	22 bytes, alphanumeric	Query only. The unit returns a string indicated the Model Number and the value of internal software revision installed **Example:** RET_LBC-4000 VER:1.1.3	N/A	RET_	RET_x….x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric 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	203 bytes, alphanumeric	Query only. Used to Query the maintenance status of the unit in the form RMS_'cr' : 12VT1=xxx.x'cr' 12 VDC Supply #1 in volts. 08VT1=xxx.x'cr' 8 VDC Supply #1 in volts. 05VT1=xxx.x'cr' 5 VDC Supply #1 in volts. 12VT2=xxx.x'cr' 12 VDC Supply #2 in volts. 08VT2=xxx.x'cr' 8 VDC Supply #2 in volts. 05VT2=xxx.x'cr' 5 VDC Supply #2 in volts. VTREF=xxx.x'cr' Ref Osc tuning voltage in volts. IFLOA=xxx.x'cr' Conv A IFLO tuning voltage, V. RFLOA=xxx.x'cr' Conv A RFLO tuning voltage, V. PIN_A=xxx.x'cr'. Conv A Input power in dBm. POUTA=xxx.x'cr' Conv A Output power in dBm. TEMPA=xxx.x'cr' Conv A temperature in deg C. IFLOB=xxx.x'cr' Conv B IFLO turning voltage, V. RFLOB=xxx.x'cr' Conv B RFLO tuning voltage, V. PIN_B=xxx.x'cr' Conv B Input power in dBm. POUTB=xxx.x'cr' Conv B Output power in dBm. TEMPB=xxx.x'cr'' Conv B temperature in deg C	N/A	RMS_	RMS_ x….x (see Description of Arguments for details)
Retrieve Utility Status	N/A	98 bytes alphanumeric	Query only. Used to Query the utility features of the unit in the form RUS_ where: TIME=hh:mm:ss DATE=mm/dd/yy FSDA=xxxx (Reserved for future use) FSDB=xxxx (Reserved for future use) BVFD=yyy SCRT=zzz BULK=FW9965X (where X is the revision letter) M&C =FW9966X (where X is the revision letter) FPGA=FW9967X (where X is the revision letter)	N/A	RUS_	RUS_ x….x (see Description of Arguments for details)
Set Auto/Manual Redundancy Mode	SAM_	1 byte alphanumeric	Command and Query. Used to set or get status of Redundancy to either Manual or Automatic mode in the form SAM_x where: x = a (if chassis is in Automatic Redundancy mode) or m (if chassis is in Manual Redundancy mode)	Same as command	SAM_	SAM_ (see Description of Arguments for details)
Summary Alarm Status	N/A	2 bytes, alpha	Query only. Used to Query the status of the Summary Fault Relay in the form SAS_xx where: xx = OK or FT **Example:** SAS_OK	N/A	SAS_	SAS_x (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric codes between 48 and 57)	Response to Command (Target to controller)	Query (Instruction Code and qualifier)	Response to query (Target to controller)
Remote Baud Rate	SBR_	4 bytes	Command or Query. Used to set or query the serial baud rate in the form SBR_xxxx where: xxxx = remote baud rate as follows: 1200 = 1200 baud 2400 = 2400 baud 4800 = 4800 baud 9600 = 9600 baud 19K2 = 19200 baud 38K4 = 38400 baud	Same as command	SBR_	SBR_xxxx (see Description of Arguments for details)
Remote Address	SPA_	4 bytes, numeric	Command or Query. Used to set or query the physical address in the form SPA_xxxx where: xxxx = Set Physical Address-between 0001 to 9999. Resolution=0001 **Example:** SPA_0412	Same as command	SPA_	SPA_xxxx (see Description of Arguments for details)
Reference Oscillator Adjust	SRO_	3 bytes, numeric	Command or Query. Used to set or query the Reference Oscilllator Adjustment in the form SRO_xxx where: x = Ref Osc Adjust, between 000 and 255. Resolution 001. **Example:** SRO=087 **Note:** SRO cannot be adjusted when the unit is locked to an external reference source.	Same as command	SRO_	SRO_xxx (see Description of Arguments for details)
Slope Adjust	SSA_	5 bytes, alphanumeric	Command or Query. Used to set or query the Converter slope adjustment level, in the form SSA_x_y.y where: x = 'A' (Converter A) or 'B' (Converter B) y.y = Converter slope adjust level, valid from 0.0 to 1.0 with 0.1 resolution. **Example:** SSA_B_0.3 (Converter B slope adjust is set to 0.3)	Same as command	SSA_x_	SSA_x_ (see Description of Arguments for details)
Serial Number	N/A	9 bytes, numeric 000000000 to 999999999	Query only. Returns the serial number of the selected unit in the form SSN_x_yyyyyyyyy where: x = 'U' (unit), 'A' (Conv A), or 'B' (Conv B) yyyyyyyyy = the 9 digit serial number of the unit or the converter. **Example:** SSN_B_ (queries for serial number of Converter B)	N/A	SSN_x_	SSN_x_yyyyyyyyy (see Description of Arguments for details)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments (Note that all arguments are ASCII numeric 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_	8 bytes, numeric	Command or Query. Sets or queries the real-time clock in the form TIM_hh:mm:ss where: hh=hours (midnight/military format) between 00 and 23 mm = minutes, between 00 and 59 ss = seconds, between 00 and 59 **Example:** TIM_23:12:59 would be 23 hours, 12 minutes and 59 seconds from midnight.	Same as command	TIM_	TIM_hh:mm:ss (see Description of Arguments for details)
Vacuum Fluorescent Display (VFD) Brightness Adjust	VFD_	1 byte, value 0 to 3	Command or Query. Sets the front panel display brightness in the form VFD_x where: x = 0 (100%), 1 (75%), 2 (50%), or 3 (25%)	Same as command	VFD_	VFD_x (see Description of Arguments for details)

Appendix B. UP/DOWNCONVERTER IDU MODULE REMOVAL/RE-INSTALLATION

B.1 Introduction

This appendix illustrates the procedure required to remove and re-install a LBC-4000 Upconverter / Downconverter IDU into any LBC-4000 L-Band Up/Down Converter System chassis (**Figure B-1**, showing a base unit with the chassis cover removed). This procedure is typical for removing or installing an IDU into the applicable Unit A or Unit B compartment in the LBC-4000 chassis.

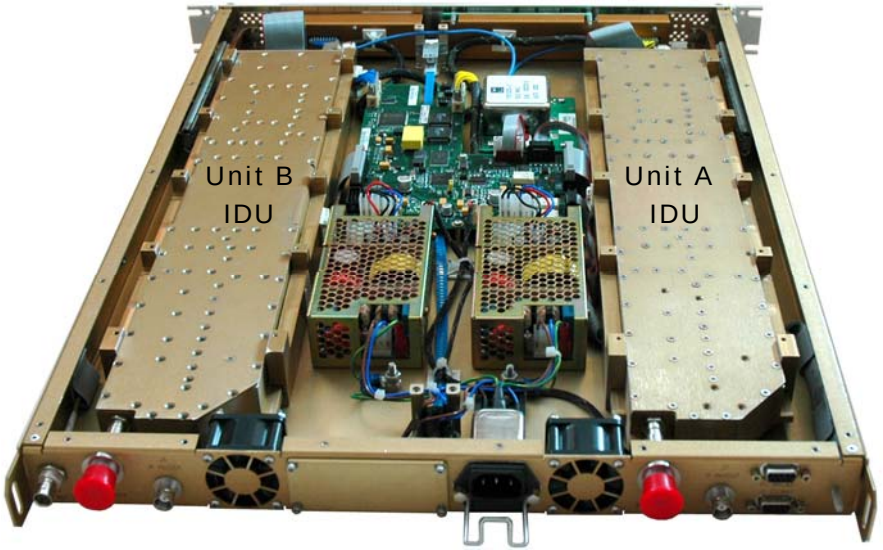
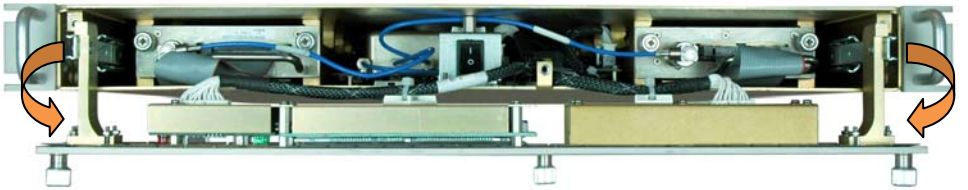
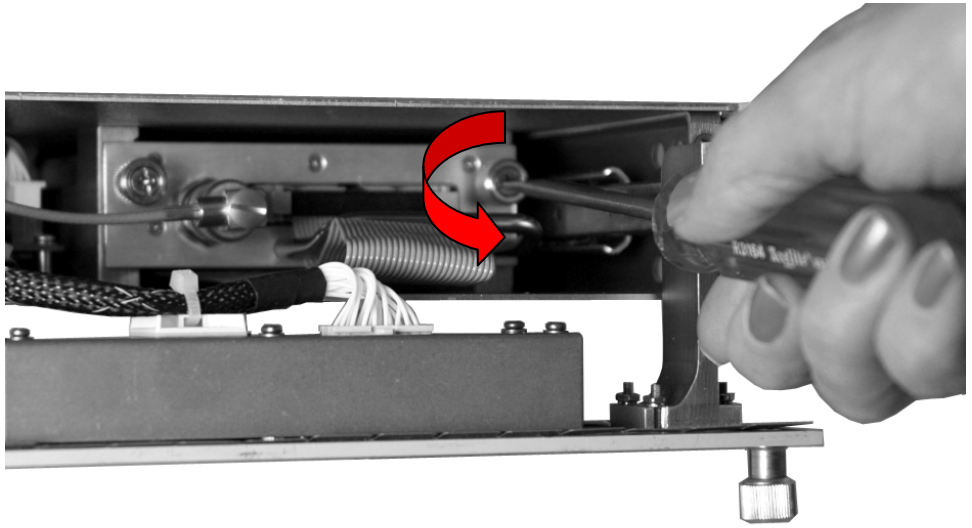
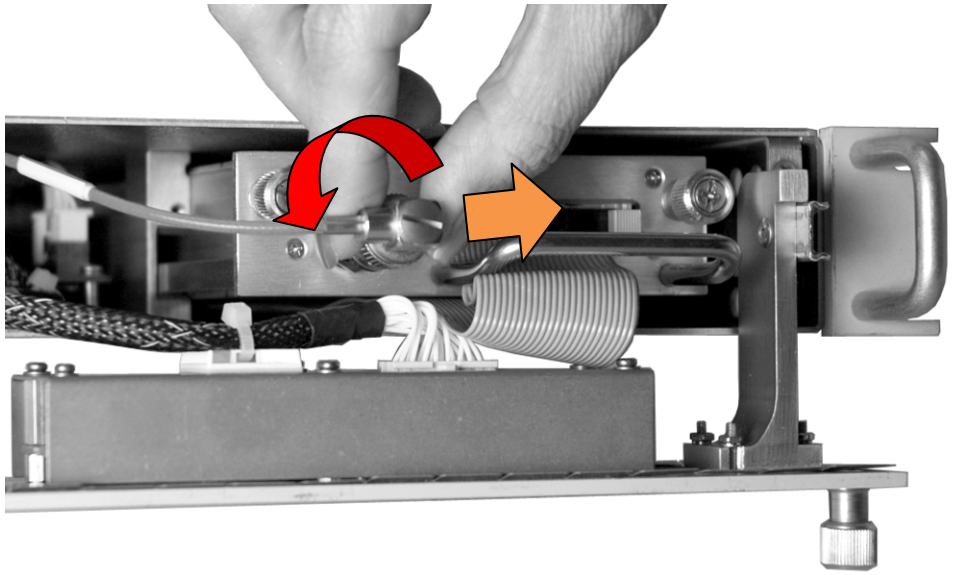
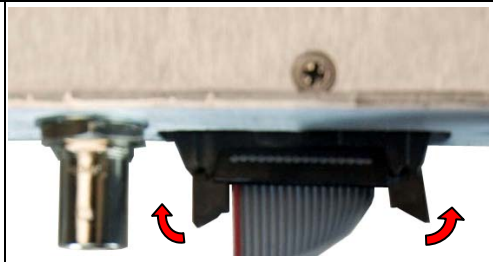
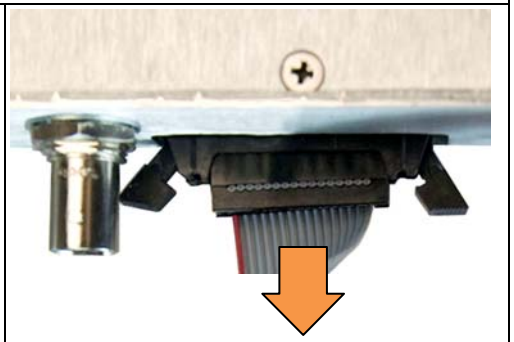
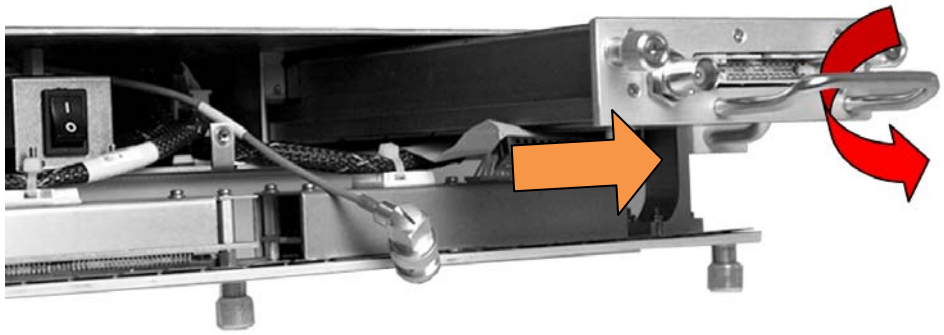


Figure B-1. LBC-4000 Chassis – IDU Modules

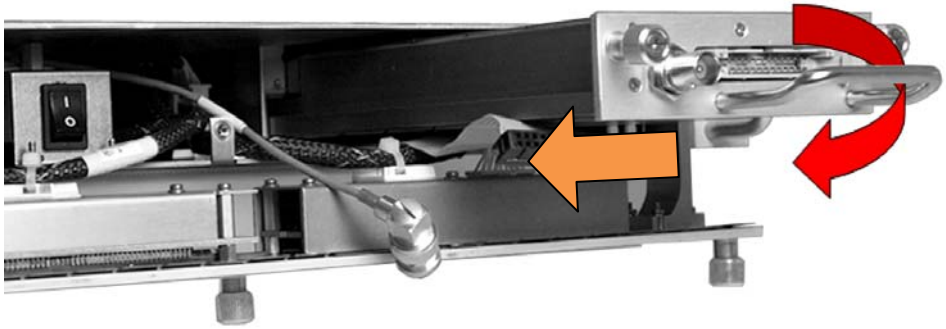
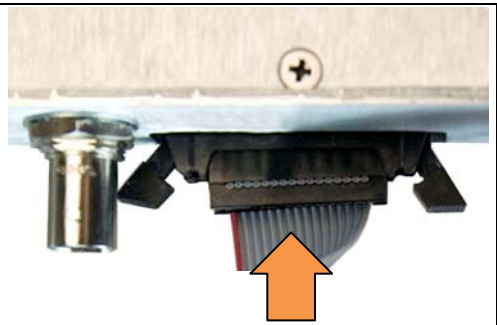
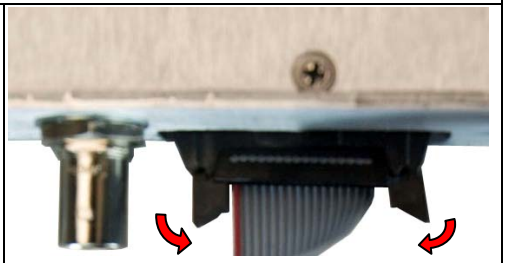
B.2 IDU Module Removal Procedure

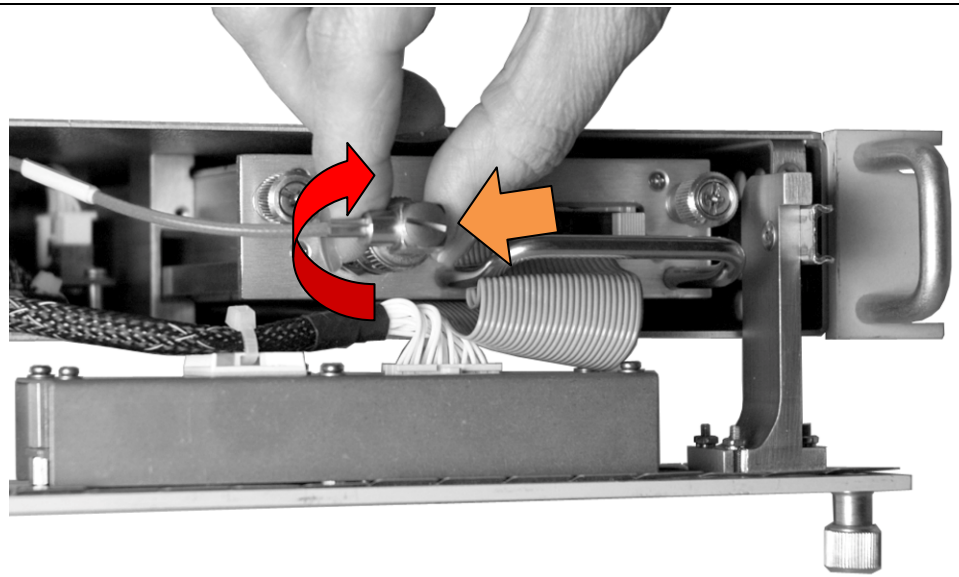
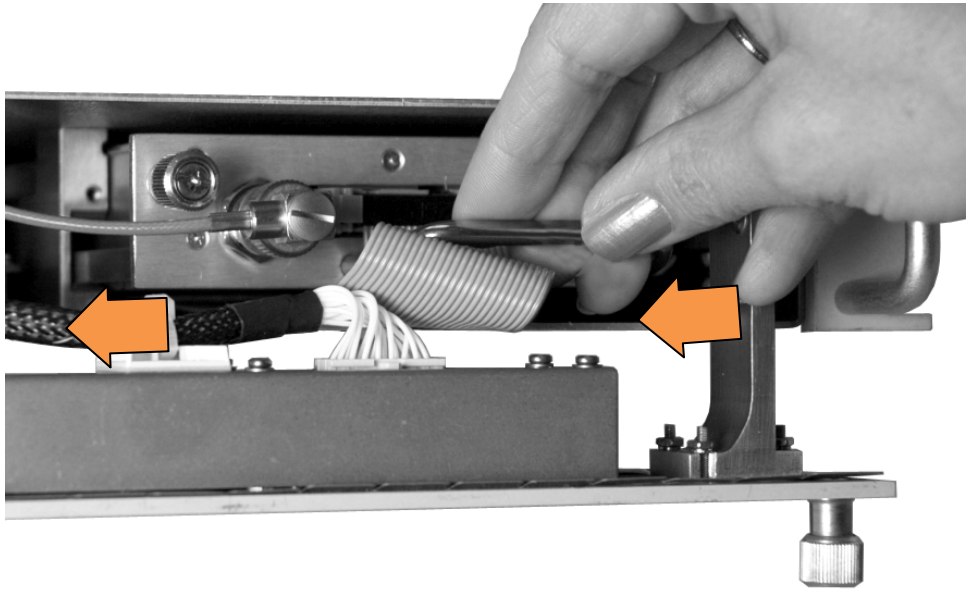
Step	Task	
1	Loosen the three thumb screws and drop the front panel to access the IDU modules.	 
2	Using a Phillip's®-head screwdriver, remove the machine screws holding the IDU module in place.	

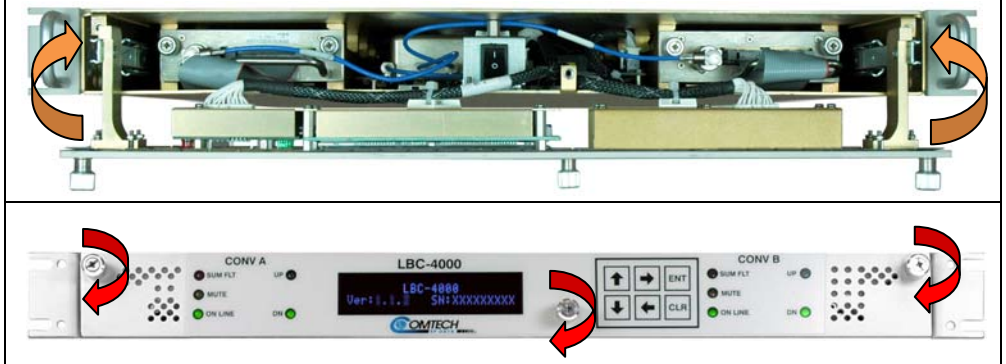
<table>
<tr><td>3</td><td>Remove the Reference Cable by first unlocking (turning counterclockwise), then removing the connector from its socket.</td><td colspan="2">  </td></tr>
<tr><td>4</td><td>Remove the Ribbon (Data) Cable by first unlocking, then removing the connector from its socket.</td><td> 
(a) Unlock Connector</td><td> 
(b) Remove Connector</td></tr>
</table>

5	Using the front handle, remove the IDU module from the chassis by sliding the unit straight out until it is free and clear of its internal housing.	

B.3 IDU Module Installation Procedure

Step	Task	
1	Taking care to ensure the IDU module is properly engaged within its internal housing, using the front handle on the IDU module, slide the IDU module into a position that facilitates installation of the Reference and Ribbon Cables.	
2	Connect the Ribbon (Data) Cable by first inserting, then locking the connector into its socket.	 *(a) Install connector*  *(b) Lock connector*

3	Connect the Reference Cable by first installing the connector onto the socket, then locking the connector (turning clockwise).	
4	Using the front handle on the IDU module, slide the IDU module the remainder of the way into its internal housing.	

5	Swing the front panel back into operating position and finger-tighten the three thumbscrews.	

The IDU module installation has been completed and the LBC-4000 L-Band Up/Down Converter System is ready to be connected to other equipment. Refer to **Chapter 3. REAR PANEL CONNECTIONS** for further information.

Notes:

Appendix C. LBC-4000 REDUNDANCY OPERATION

C.1 Introduction

The Comtech EF Data LBC-4000 L-Band Up/Down Converter System can optionally be configured for redundant system operation. This appendix provides detailed information for cabling and otherwise configuring the LBC-4000 for redundant system operation.

C.2 Redundancy Operations Overview

Figure C-1 depicts the functional schematic for LBC-4000 redundant operation.

Figure C-2 illustrates the cabling requirements for redundant operation.

Of note:

- BNC connections, where applicable, use 50Ω BNC male-to-male cables.
- It is recommended that all Type 'N' to Type 'SMA' connections are best accomplished using a Type 'N' male to Type 'SMA' female adapter, then using Type 'SMA' female-to-female cables.

Sect. C.3 addresses the control and configuration of an LBC-4000 Redundancy System via the modem front panel.

Sect C.4 addresses the control and configuration of an LBC-4000 Redundancy System via serial remote control.

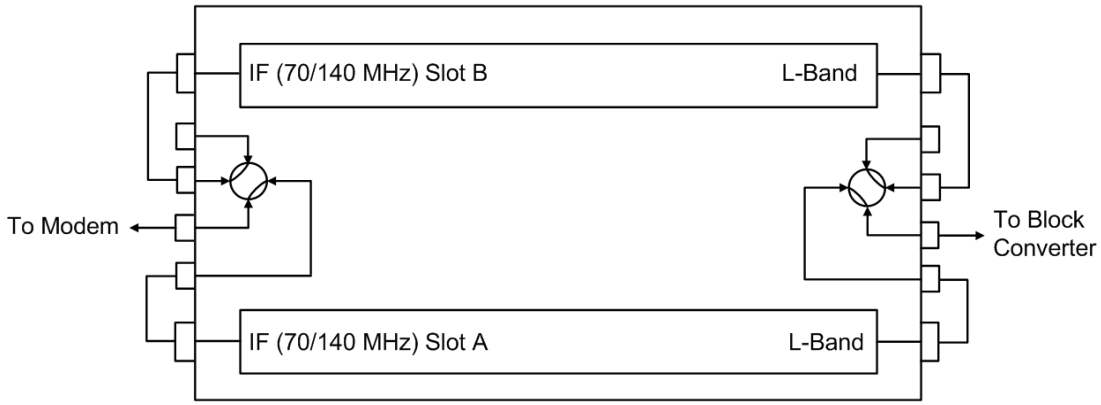


Figure C-1. LBC-4000 Redundancy – Functional Schematic

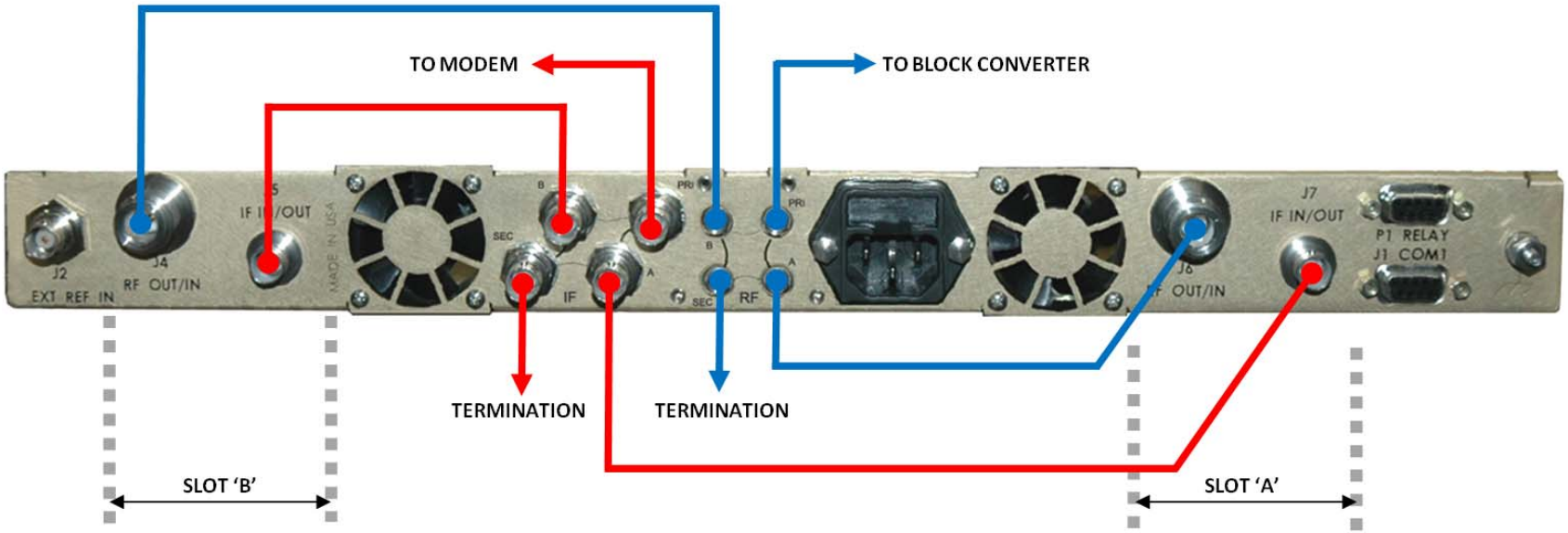


Figure C-2. LBC-4000 Redundancy Cabling Requirements

C.3 Redundancy Operations via the LBC-4000 Front Panel

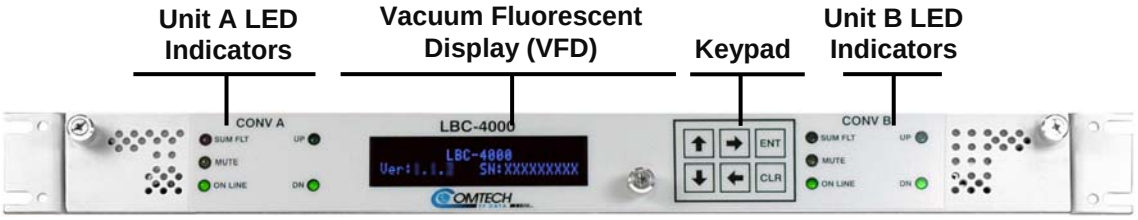


Figure C-3. LBC-4000 Front Panel

The user can configure, monitor, and control redundancy operation via the LBC-4000 front panel, using the keypad and display. Nested menus are used, which display all available options, and prompt the user to carry out a required action.

Figure C-3 identifies the key features of the LBC-4000 front panel; in-depth explanations of the function and operation of these features is provided in **Chapter 4. FRONT PANEL OPERATION**. For this appendix, however, their purpose is summarized as follows:

Feature		Description
LED Indicators		Used to indicate the operational status of the LBC-4000 Up/Down Converter System.
Keypad		Used to select and navigate the available LBC-4000 menu functions as displayed on the Vacuum Fluorescent Display (VFD).
Vacuum Fluorescent Display (VFD)		Used to fully control and monitor operation of the LBC-4000 Up/Down Converter System. Consisting of two lines with a width of 24 characters each, nested menus displayed on the VFD provide all available options and prompt the user to carrout out a required action via the keypad.

C.3.1 SELECT: (Main) Menu

The **SELECT:** (Main) menu for the LBC-4000 appears as follows:

```
SELECT: Config  Monitor
Faults Util
```

For quick reference, a description of each of the menu branches follows, and the section in this Appendix that addresses use relevant to Redundancy operation (as shown in **bold**). Otherwise, refer to **Chapter 4. FRONT PANEL OPERATION** for complete information on the functionality of these features:

Menu Branch	Chapter 4 Sect Ref:	Description
Config	*4.4,* **C3.2**	**(Configuration)** Permits the user to fully configure the LBC-4000.
Monitor	*4.5*	*Permits the user to monitor the alarm status of the unit, to view the log of stored events, and to display the Receive Parameters screen.*
Faults	*4.6*	*Permits the user to view information on the unit, without having to go into configuration screens.*
Util	*4.7*	*(Utility) Permits the user to perform miscellaneous functions, such as setting the Real-time clock, adjusting the display brightness, etc.*

C.3.2 SELECT: Config (Configure) Menu

Select **Config (Configure)** using the **[←][→]** arrow keys, then press **[ENT]**. The **Configure** menu for the LBC-4000 appears as follows:

```
Configure: Conv-A Conv-B
 Remote Redund RefAdj
```

For quick reference, a description of each of the submenu branches follows, and the section in this Appendix that addresses use relevant to Redundancy operation (as shown in **bold**): Otherwise, refer to **Chapter 4. FRONT PANEL OPERATION** for complete information on the functionality of these features:

Submenu	Sect	Functional Description
Conv-A *Conv-B*	*4.4.1,* **C.3.4**	**(Converter Unit A** or B**)** Displays the current configuration of the selected converter, including the frequency, attenuation, and slope.
Remote	*4.4.2*	*(Remote Control) Permits the user to define whether the unit is being controlled locally or remotely, and identifies the unit address, interface type, and rate and format of the baud parameters.*
Redund	**C.3.3**	**(Redundancy)** Permits the user to identify the redundancy state and mode.
RefAdj	*4.4.4*	*(Ref-Osc Adjust) Permits the user to adjust the reference oscillator.*

C.3.3 CONFIGURE → Redund (Redundancy)

From the **SELECT: Configure** menu branch, use the **[←][→]** arrow keys to select **Redund**, then press **[ENT]**. The **CONFIG Redundancy** submenu for the LBC-4000 appears as follows:

```
CONFIG Redundancy:
Mode  State  FrcBkup
```

Select **Mode**, **State**, or **FrcBkup** using the **[←][→]** arrow keys, then press **[ENT]**.

CONFIG Redundancy → Mode

```
CONFIG Redundancy:
Control Mode = Manual
```

Select **Manual** or **Auto** using the **[↑][↓]** arrow keys, then press **[ENT]**.

Note that if the user attempts to access this menu and the **Redundancy State** is selected as **Disabled,** the following message displays:

```
    Not in Redundancy
         Mode!
```

CONFIG Redundancy → State

```
Redundancy Mode:
Control State = Enable
```

Select **Disable** or **Enable** using the **[↑][↓]** arrow keys, then press **[ENT]**.

CONFIG Redundancy → FrcBkup

```
CONFIG Manual Redundancy:
Force Backup     NO
```

To force the redundant unit into standby mode, select **YES** or **NO** using the **[↑][↓]** arrow keys, then press **[ENT]**.

Note that if the user attempts to access this menu and the **Redundancy State** is selected as **Disabled,** the following message displays:

```
     Not Available In
       Current Mode
```

C.3.4 Gain Offset for Redundant Operations

Once redundancy has been enabled, the **Ofst** (Gain Offset) command, available from the **Configure: Conv-A → Atten/Slope** submenu, allows gain offset compensation in order for the user to match gain between the two converters.

Gain Offset is set at installation only. In operation, the normal attenuation setting should be used.

The procedure to set the Gain Offset parameters for redundant operation is as follows:

STEP	PROCEDURE
1	Monitor output signal level on power meter / spectrum analyzer.
2	Enable Redundancy on converter (**SELECT: CONFIG → REDUND → STATE=Enable**).
3	Put converter into "Manual" Redundancy Mode (**SELECT: CONFIG → REDUND → MODE=Manual**).
4	Force Converter B online (**SELECT: CONFIG→REDUND→FrcBkup=YES)** and measure output .

5	Force Converter A online (**SELECT: CONFIG→REDUND→FrcBkup=YES)** then, using the **SELECT: CONFIG → Conv-A** menu:
	`CONFIG CnvA: Ofst=+0.0dB`
	`Atten=00.00dB Slope=0.0`
	Adjust **Ofst** (Gain Offset) by first using the **[←][→]** arrow keys to select the Gain Offset digit to edit, then the **[↑][↓]** arrow keys to edit the value of that digit. Once the Gain Offset output value matches Converter B, press **[ENT]**.

6	Repeat Steps 4 and 5 until output levels track.
7	Return unit to desired redundancy state.

C.4 Redundancy Operations via Serial Remote Control

For a complete overview of Serial Remote Control and the commands and queries associated with remote Redundancy configuration, operation, and monitoring, refer to **Appendix A. SERIAL REMOTE CONTROL**.

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Temperature	° Fahrenheit	° Centigrade
Water freezes	32	0
Water boils	212	100
Absolute 0	-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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480 • 333 • 2161 FAX