LBC-4000

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

Part Number MN/LBC4000.IOM

Revision 2

Errata A

Comtech EF Data Documentation Update

Subject:	Appendix A. Remote Control Operation
Date:	June 13, 2006
Document:	LBC-4000 L-Band Up/Down Converter System Installation and Operation Manual, Rev. 2 dated March 30, 2006
Part Number:	MN/LBC4000.EA2
Collating Instructions:	Attach this page to page A-15

Comments:

Change CMS Commands to eliminate the comma delimited sentence as follows:

Change Specifics:

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Concise Maintenance Status	N/A	70 bytes numerical	Query only. Used to Query the Maintenance status of the unit in concise format. Syntax: 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 involts 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 for details of arguments)

Errata B

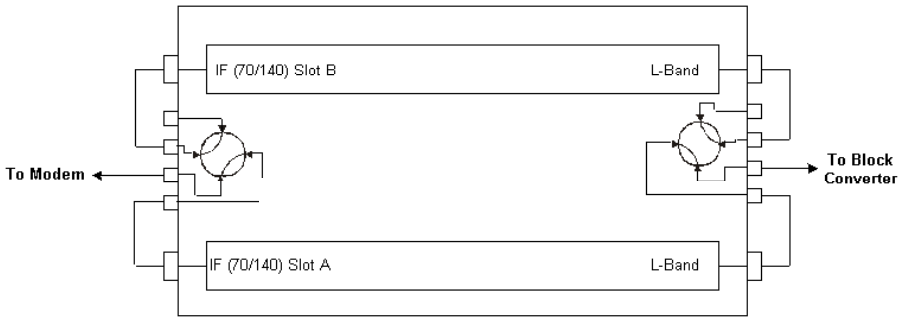
Comtech EF Data Documentation Update

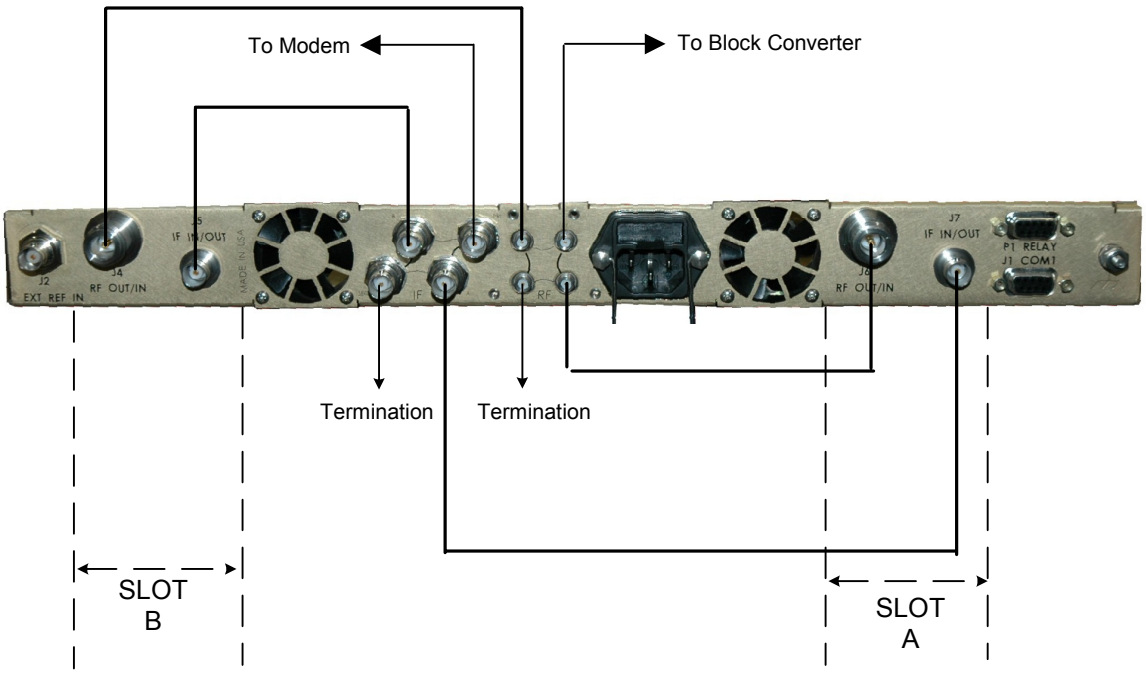
Subject:	Add figure for redundant operation.
Date:	September 7, 2006
Document:	LBC-4000 L-Band Up/Down Converter System Installation and Operation Manual, Rev. 2 dated March 30, 2006
Part Number:	MN/LBC4000.EB2
Collating Instructions:	Attach this page to page 2-3

Comments:

Add figure representing cabling requirements for redundant operation.

Change Specifics:





The drawing represents the cabling requirements for redundant operation. BNC to BNC cables should be 50 Ω BNC-M. Type N to SMA connections is best made with a Type N-M to SMA-F adapter and SMA-SMA cables.

LBC-4000

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

Part Number MN/LBC4000.IOM
Revision 2
March 30, 2006

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Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

CUSTOMER SUPPORT

Contact the Comtech EF Data Customer Support Department for:

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

A Customer Support representative may be reached at:

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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)
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service@comtechefdata.com

Contact us via the web at www.comtechefdata.com.

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1. Request a Return Material Authorization (RMA) number from the Comtech EF Data Customer Support Department.

2. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

3. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

4. Ship the product back to Comtech EF Data. (Shipping charges should be prepaid.)

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

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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.

CONVENTIONS AND REFERENCES

CAUTIONS AND WARNINGS

Indicates information critical for proper equipment function.

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.

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

METRIC CONVERSION

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

TRADEMARKS

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

RECOMMENDED STANDARD DESIGNATIONS

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

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 Customer Support Department.

EMC COMPLIANCE

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

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.

Note: 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.

CHANGES MADE TO REV. 1

Incorporated Errata's A and B

Incorporated all engineering comments.

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.

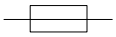
This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

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” listed earlier in this preface.

WARRANTY POLICY

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

For equipment under warranty, the customer is responsible for freight to Comtech EF Data and all related custom, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges **only** for return of the equipment from the factory to the customer. 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.

LIMITATIONS OF WARRANTY

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

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

EXCLUSIVE REMEDIES

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech 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.

DISCLAIMER

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

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

Chapter 1. Introduction

1.1 OVERVIEW

The LBC-4000 (Figure 1-1), L-Band Up/Down Converter System (LBC-4000) is manufactured by the Comtech EF Data (CEFD) Corporation. The LBC-4000 is designed to interface legacy 70 or 140 MHz equipment to quad-band or tri-band block converters.

Figure 1-1. LBC-4000 L-Band Up/Down Converter System

IMPORTANT

The ON/OFF switch for the LBC-4000 is located in the center behind the front panel.

The front panel display is a two line, 24-character, LCD display. Each configuration function, or operating mode, is shown on the display when the operator enters a command into the keypad on the front panel.

1.2 FUNCTIONAL DESCRIPTION

The LBC-4000 is rack mounted in a standard 19-inch equipment rack. External equipment, such as a modem, is connected to each internal converter by a low-cost coaxial cable. A coaxial cable is also used to connect the output of each module to RF equipment either in the same location or at the antenna location.

The LBC-4000 L-Band IF to 70 MHz IF (140 MHz optional) indoor converter is a 1 RU, 19-inch chassis with two front panel accessible up converter or down converter modules. LBC-4000 contains two diode “OR-ed” internal power supplies for increased reliability, and microprocessor-based Monitor and Control (M&C) functions. (see Figure 1-2.)

All operator controls, indicators and displays for local and remote operation are located on the front panel of the converter. Connectors for the external interface connections are located on the rear of the converter chassis.

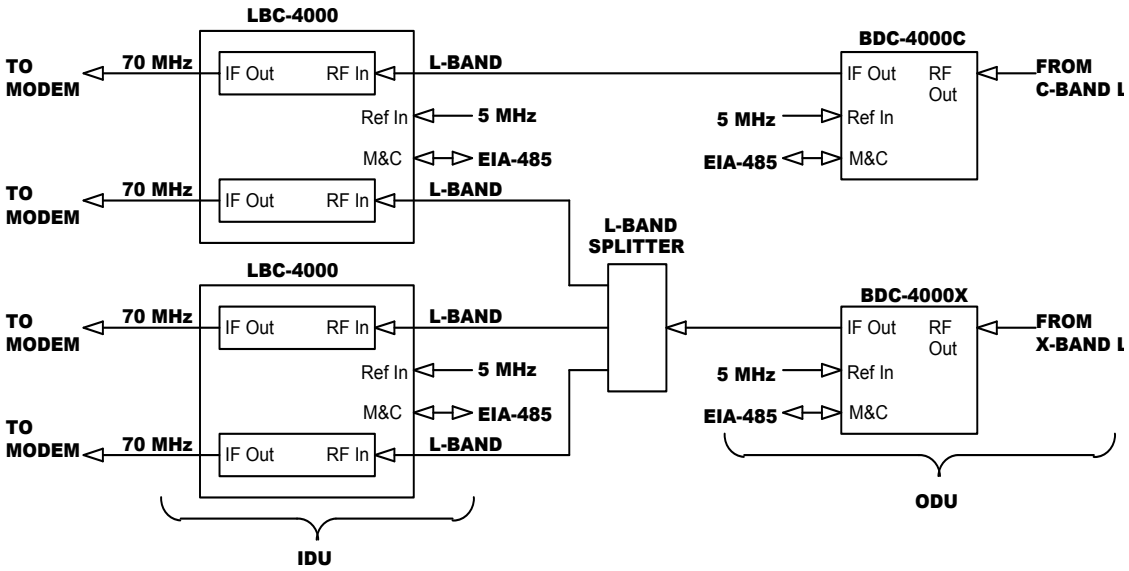


Figure 1-2. LBC-4000 Typical Application

1.3 SPECIFICATIONS

Table 1-1. Specifications

Characteristic	Specifications
LBC-4000 L-Band Down Converter IDU	
Input Frequency	950-2000 MHz, 125 kHz steps (1 kHz optional)
Output Frequency	70± 18 MHz (140± 36 MHz optional)
Input/Output Impedance	50Ω
Input Return Loss	15 dB minimum
Output Return Loss	18 dB minimum
Input Connector	N, Female
Output Connector	BNC, Female
Gain	35 dB nominal at minimum attenuation
User Attenuator Range	0 to 40 dB, in 0.25 dB steps (0.1 dB optional)
Output Power, P1dB	+10 dBm minimum
Third Order Intercept	+20 dBm minimum
Carrier Spurious	-60 dBc
Non-Carrier Spurious	-60 dBm
LBC-4000 L-Band Up Converter IDU	
Input Frequency	70 ± 18 MHz (140 ± 36 MHz optional)
Output Frequency	950-2000 MHz, 125 kHz steps (1 kHz optional)
Input/Output Impedance	50Ω
Input Return Loss	15 dB minimum
Output Return Loss	18 dB minimum
Input Connector	BNC, Female
Output Connector	N, Female
Gain	25± 1 dB nominal at minimum attenuation
User Attenuator 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 requirements of MIL-STD-188-164A
External Reference	5 MHz, 10 MHz –5/+5 dBm

Table 1-1. Specifications (Continued)

Characteristic	Specifications
Environmental	
Temperature:	
Operating	0 to 50° C (32 to 122° F)
Non-Operating	-50° to +71°C (-58° to 160° F)
Operating Altitude	10,000 Feet above sea level
Operating Humidity	5 to 95 % non-condensing
Physical	
Dissipation	35 Watts total, 2 converters
Prime Power	90 to 260 VAC, 47 to 63 Hz
Size	1 RU (1.75”) X 19”W X 22”D
Weight	25 lbs maximum
External Reference	
Input Frequency	5 or 10 MHz
Input Level	±5 dB
Input Impedance	50Ω
Monitor and Control	
Serial M&C Interface	TIA/EIA-232, TIA/EIA-485, 4-wire
Serial Connector	9 pin “D” Female
Alarm Contacts	3 Form-C summary
Alarm Connector	9 pin “D”, Female

Note: Contact CEFD with specific requirements.

1.3.1 DIMENSIONAL ENVELOPE

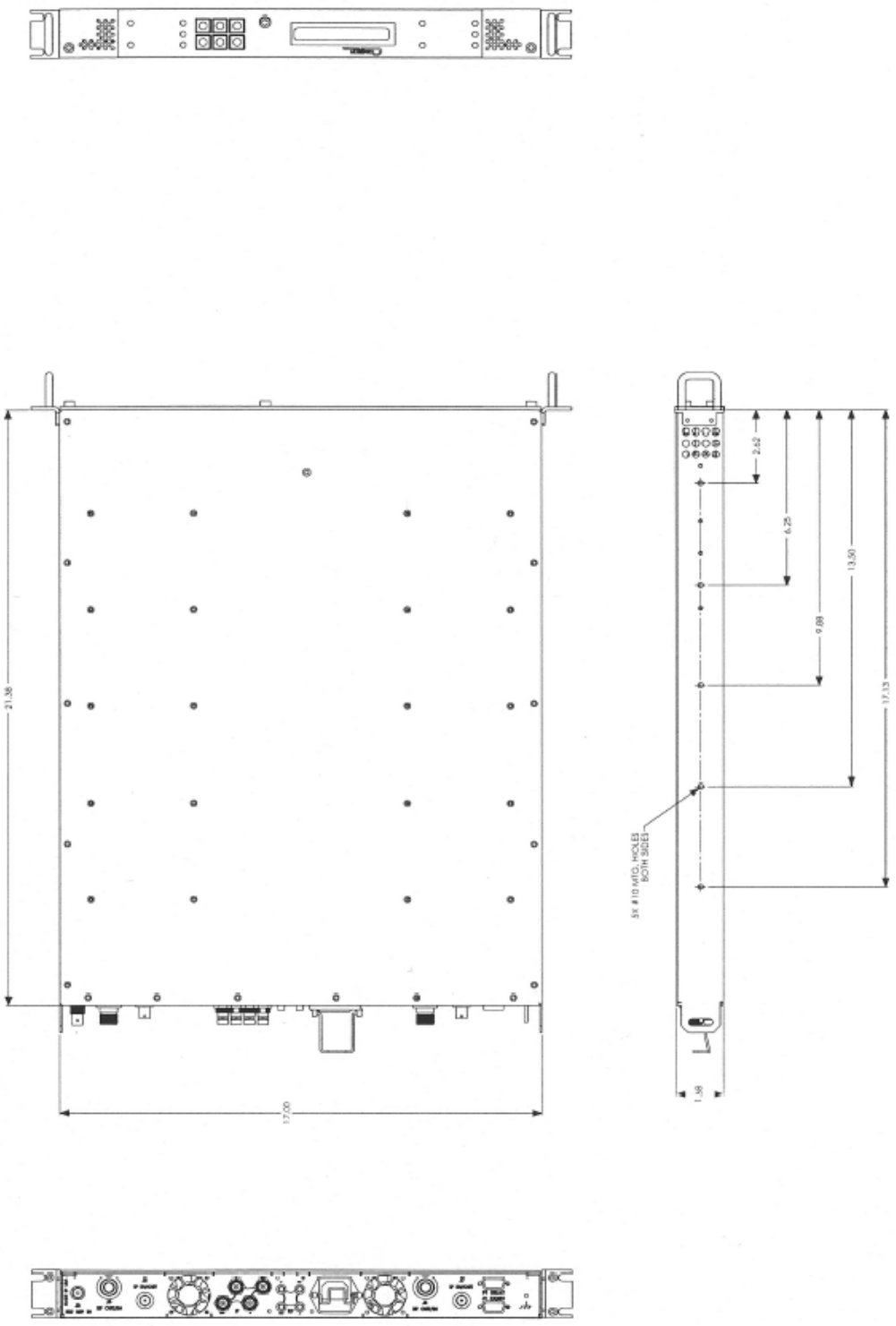


Figure 1-3. LBC-4000 Dimensional Envelope

Chapter 2. Installation

2.1 UNPACKING AND INSPECTION

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

Remove the packing list from the outside of the shipping carton.

- Open the carton and remove the contents, checking the contents against the packing list.
- Verify completeness of the shipment and that the unit functions correctly.
- If damage is evident, contact the carrier and CEFD immediately and submit a damage report.
- If the unit needs to be returned to CEFD, use the original shipping container.

2.2 RACK MOUNT INSTALLATION

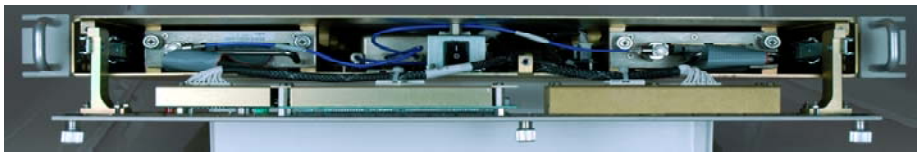
The LBC-4000 L-Band Up/Down Converter System is designed for installation in a standard 19-inch (48.26 cm) rack cabinet or enclosure. The converter chassis requires 1-3/4 inches of panel height space. Adequate air ventilation should be provided on both sides of the rack-mounted equipment.

If the converter is to be mounted on slides, the slides must be the CEFD rack slides provided with the converter.

- Mount the slides on the sides of the converter chassis with the mounting hardware provided.
- Install the slide rails in the rack cabinet enclosure.
- Slide the converter into the front of the rack cabinet until the rear of the front panel contacts the mounting surface of the cabinet.
- Secure the converter to the rack cabinet with four screws inserted through the converter's front panel slotted holes.

2.3 MODULE INSTALLATION/REMOVAL

Refer to the following illustrations to remove the converter modules:



1. Loosen three thumb screws and drop front panel to access modules

2. Remove two screws holding module in place using a Phillip's® Screwdriver.
3. Remove Reference Cable.
4. Remove Ribbon (Data) Cable.
5. Gently pull handle to remove module.

2.4 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.

2.5 CABLE CONNECTIONS

Connect the signal cables to the connectors on the rear panel. The cable signal functions are listed in Table 2-1.

2.5.1 REAR PANEL CONNECTIONS

Table 2-1. Rear Panel Connectors

Connector	Description
Prime Power	AC Prime Power Input (AC POWER), Optional –48 Vdc
J1:	Serial Communications Interface for RS-485 or RS-232C COMM links (COM 1)
J2:	External Reference Oscillator Input
J4:	RF OUT/IN
J5:	IF IN/OUT
J6:	RF OUT/IN
J7:	IF IN/OUT
P1:	Summary Fault Output (RELAY)

2.5.2 RS-485/RS-232 INTERFACE (COM 1), CONNECTOR J1

The RS-485/RS-232 Interface connector, J1, is 9 pin "D" type DB9F connector socket. The pin-out specifications for RS-485 are contained in Table 2-2 and Table 2-3. The specification for RS-232 is contained in Table 2-4. The mating connector is a DB9M.

Table 2-2. J1, 2 Wire RS-485 Interface Pin-Out

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 2-3. J1, 4 Wire RS-485 Interface Pin-Out

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

Table 2-4. J1, RS-232C Interface Pin-Out

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	

2.5.3 SUMMARY FAULT OUTPUT (RELAY) AND SERIAL PORT

The summary fault output connector, P1, is 9-pin "D" type DB-9F connector. The pin-out specifications are contained in Table 2-5. The mating connector is a DB-9F.

Table 2-5. P1, Summary Fault Connector Pin-Out

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

Notes:
1. Pin 1 to Pin 6: Fault.
2. Pin 2 to Pin 6: No Fault.
3. Pin 7 to Pin 5: Forced Fault. Typically used with external group delay equalizers.

Table 2-6. Serial Port (J1) DB-9F

Pin #	SIGNAL NAME
1	GND
2	NC
3	RS232_TD
4	NC
5	RS232_RD
6	RS485_+RX
7	RS485_+TX
8	RS485_-RX
9	RS485_-TX

Chapter 3. System Operation

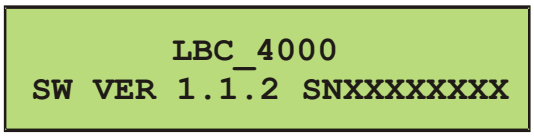
3.1 OVERVIEW

This chapter contains instructions for operating the LBC-4000. Illustrations of the front and rear panels are provided showing the keypad for operator input commands, LCD Display, LED status indicators, and the connectors. Tables are provided to show the control and operating functions of the converter.

The front and rear panels are shown below. **Table 3-1** lists the operating functions for the keypad, LCD display, LED indicators and test sample connections on the front panel.

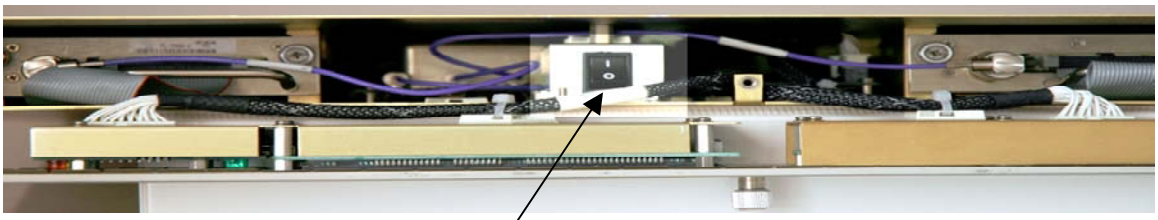
Figure 3-1. LBC-4000

Table 3-1. Operating Functions – Front Panel

Item	Reference Designation	Functional Description
	Enter key	Enters commands into the converter.
	Clear key	Clears commands and data selected and not entered.
	Right Arrow key	Selects functions and the menu operating data.
	Left Arrow key	Selects functions and the menu operating data.
	Up Arrow key	Selects the operating menu and data values.
	Down Arrow key	Selects the operating menu and data values.
	LCD Display	Displays commands and data entered into the keypad.

Indicator	Color	Function
POWER ON	**Green**	Prime power is applied when the light is on.
MUTE	**Yellow**	In Mute Mode when the light is on.
ON LINE	**Green**	Signifies up and/or down converter is operational when the light is on.
SUM FAULT	**Green**	Faults stored and logged when light is on.

3.2 SWITCHING POWER ON



Note: The ON/OFF switch for the LBC-4000 is located in the center behind the front panel as shown in the illustration, above.

Before turning the Prime Power Switch to the ON position, check to ensure that the installation is complete, and verify that the converter is connected to the proper prime power source, RF Input and IF Output.

Switch the ON/OFF Prime Power Switch (located behind the front panel) to ON. Verify the cooling fan is operating, and the POWER ON LED STATUS indicator light is on.

After the AC power is switched ON and before pressing the buttons on the keypad, the LCD display message should be similar to:

```
    LBC-4000
  SW VER 1.1.2   SNXXXXXXXX
```

3.3 OPERATION

Local operation of the RF Down Converter is controlled by operator input commands initiated through the six button keypad on the front panel shown in Figure 3-1. The keypad is the local operator's interface to control, configure and monitor the status of the converter. Operator inputs and commands entered into the keypad are displayed by the front panel 24-character, two line, LCD display.

There are six operating command functions:

- Configuration
- Pre-Select
- Monitor Status
- Currents Faults
- Stored Faults
- Utility Functions.

A flow chart for selecting the commands, operating menus, and data inputs is shown in **Table 3-2**.

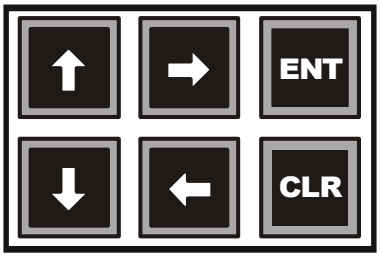


Figure 3-2. Keypad

Table 3-2. LBC-4000 Command Function Menus

Level 1	Level 2	Level 3	Level 4
LBC-4000 Ver: 1.1.2 SN: XXXXXXXXX			
SELECT: **Config** Monitor Faults Util	Configure: **Conv-A** Conv-B Remote Redund RefAdj	CONFIG CnvX (IF=YYYMHZ) Freq/Mute Attn/Slope Where: YYY = 70 or 140 MHz	CONFIG CnvA: Frq=01980.000MHz Rx=On
			CONFIG CnvA: Ofst=+0.0dB Atten=00.00dB Slope=0.0
	Configure: Conv-A **Conv-B** Remote Redund RefAdj	CONFIG CnvX (IF=YYYMHZ) Freq/Mute Attn/Slope Where: YYY = 70 or 140 MHz	CONFIG CnvB: Frq=00970.000MHz Rx=On
			CONFIG CnvB: Ofst=+0.0dB Atten=00.00dB Slope=0.0
	Configure: Conv-A Conv-B **Remote** Redund RefAdj	CONFIG Remote: Control Mode Address Interface Baud	CONFIG Remote**:** **Control Mode**=Local
			CONFIG Remote: Unit **Address**=0001
			CONFIG Remote: **Interface**=RS-485
			CONFIG **Baud** Params: Rate=9600 Format=8N1
	Configure: Conv-A Conv-B Remote **Redund** RefAdj	CONFIG Redundancy: Mode State FrcBkup	CONFIG Redundancy: Control **Mode**=Manual
			CONFIG Redundancy: Control **State**=Enable
			CONFIG Manual Redund: **Force Backup** NO
	Configure: Conv-A Conv-B Remote Redund **RefAdj**	UTIL Ref-OSC: **Adjust**=087 (L R U D E N T)	
SELECT: Config **Monitor** Faults Util	MONITOR: CONV-A CONV-B PwrSupA PwrSUpB RefOsc	MON-**A**: iLO=04.1 rLO=14.6 Pi=+00.4 Po=+00.4 Tp=+32	
		MON-**B**: iLO=04.1 rLO=01.5 Pi=003 Po=+00.3 Tp=+30	
		MON **Power SupplyA**: 12V=12.3 8V=08.2 5V=05.3	
		MON **Power SupplyB**: 12V=12.2 8V=08.3 5V=05.3	
		MON **Ref Osc**: Vtune=04.7	
SELECT: Config Monitor **Faults** Util	FAULTS:CONV-A CONV-B PwrSupA PwrSupB Stored	FAULTS:**CNV-A** IfLO=OK rfLO=OK temp=OK	
		FAULTS:**CNV-B** IfLO=OK rfLO=OK temp=OK	
		FAULTS:**Pwr Supply A**: 12VT=OK 08VT=OK 05VT=OK	
		FAULTS:**Pwr Supply B**: 12VT=OK 08VT=OK 05VT=OK	
		FAULTS: **Stored** View Clear	Fault No. 01 10:28:53 OK-IFLO_A 08/10/04
			Clear all stored Faults? NO

Level 1	Level 2	Level 3	Level 4
SELECT: Config Monitor Faults **Util**	UTILITY: TimeDate FrqSel VFD ScrSaver FWInfo ApID	UTIL **Time/Date**: T=07:32:08 d=08/31/04	
		UTIL **Frequency Select**: Cnv-A=LBand Cnv-B=LBand	
		UTIL **Display**: Brightness=100% (UD ENT)	
		UTILK **ScreenSaver**: Theme=Classic Time =OFF	
		Firmwares: BULK=FW9965- M&C=FW9966- FPGA=9967-	
		APPLICATION ID MESSAGE	

3.3.1 CONVERTER COMMANDS

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 LCD display will contain a message indicating the converter model number and the version number of the firmware installed in the converter.

```
        LBC-4000
  Ver. 1.1.2 SN: XXXXXXXXX
```

To select a Command Function press the "ENT" button on the keypad. The LCD display will indicate:

```
SELECT   Config   Monitor
         Faults Util
```

This will provide the local operator access to the Command Function Menus, which is the top level structure to start the selection of Command Function Menus to input into the converter. To sequence to the next Command Function Menu press a ▲▼arrow button on the keypad. The converter will step to the next Command Function Menu each time a ▲▼arrow button is pressed. The current Command Function Menu will be displayed on the LCD display. The Command Function Menus are shown in **Table 3-2**.

To select a specific Command Function Menu press the "ENT" keypad button. If a function is selected in error, press the clear ("CLR") button which will return the converter to the main command menus to allow the selection of another function. Any one of the Command Function Menus can be selected using this procedure.

Once a Command Function has been selected, use the ◄►arrow keypad buttons to sequence through the Operating Mode Commands. Each of the modes will be displayed on the LCD display. A specific operating mode is selected by pressing the "ENT" button. If a mode is selected in error, press the clear ("CLR") button which will return the converter to the operating menus to allow the selection of another mode.

When an operating mode is selected, a parameter or a digit within the parameter will be flashing on the LCD display. Use the ◄►arrows to sequence through the parameters or digits to select the next parameter or digit. A specific parameter or value is selected by pressing the "ENT" button. If a parameter or value is selected in error, press the clear ("CLR") button which will return the converter to the original parameter or value to allow another selection.

After selecting a parameter or digit, use the ▲▼arrow buttons to select the next parameter, or to increment or decrement the value of a digit. A specific new parameter or new value is selected by pressing the "ENT" button. If a parameter or value is selected in error, press the clear ("CLR") button which will return the converter to the original parameter or value to allow another selection.

Each time the clear ("CLR") button is pressed, the converter will return to the menu level prior to the last "ENT" command.

3.3.2 CONFIGURATION FUNCTIONS MENU

The Configuration Functions for Converter A or Converter B are as follows:

LBC-4000
Ver. 1.1.2 SN: XXXXXXXXX

SELECT: Config	**Monitor**
Faults	**Util**

3.3.2.1 SELECT: CONFIG

The following configuration commands for Converter A and Converter B display the current configuration of the respective converters including the frequency, attenuation and slope. The Config Remote menu identifies the Remote Control Mode, unit address, interface and rate and format of the Baud Parameters. The Config Redundancy menu identifies the redundancy state and mode (refer to Appendix A for Redundant System Operation). Config Fault Recovery (AFR) shows either Auto or Manual mode. RefAdj under UTIL Ref-Osc shows the reference oscillator adjust which can be manipulated with the ◄►▲▼arrow keys. When finished with this section of the command menu, press CLR to return to the main menu. Press the arrow keys to the desired selection to continue through the menu commands.

Configure: Conv-A Conv-B	
Remote Redund RefAdj	

CONFIG CnvA:

Freq/Mute Attn/Slope

CONFIG CnvA:

Frq=01980.000MHz Rx=ON

CONFIG CnvA: Ofst=+0.0dB

Atten=00.00dB Slope=0.0

CONFIG CnvB:

Freq/Mute Attn/Slope

CONFIG CnvB:

Frq=00970.000MHz Rx=ON

CONFIG CnvB:

Atten=00.00dB Slope=0.0

CONFIG Remote: Control Mode

Address Interface Baud

CONFIG Remote:

Control Mode = Local

CONFIG Remote:

Unit Address = 0001

CONFIG Remote:

Interface=RS-485

CONFIG Baud Params:

Rate=9600 Format=8N1

CONFIG Redundancy:

Mode State FrcBkup

CONFIG Redundancy:

Control Mode = Manual

CONFIG Redundancy:

Control State = Enable

CONFIG Manual Redund:

Force Backup NO

CONFIG Fault Recovery:

Mode = Manual

UTIL Ref-Osc:

Adjust=087 (◄►▲▼ ENT)

Notes 1: The default Reference Frequency tuning adjustment is 87, with values from 0 to 255.

2: In Configuration, Converter A – ATT/SLOPE menu, the Gain Offset Command is available only if redundancy is enabled. It allows gain offset compensation for the user can match gain between the two converters. It will be set at installation only. In operation, the normal attenuation setting should be used.

1. Monitor output signal level on power meter / spectrum analyzer.
2. Enable redundancy on converter.
3. Put converter into “Manual” redundancy mode.
4. Force converter B online and measure output.
5. Force converter A online and adjust “OFST” until output matches converter B.
6. Repeat steps 4 and 5 until output levels track.
7. Return unit to desired redundancy state.

3.3.2.2 SELECT: MONITOR

This section monitors and displays the status of Converter A and Converter B power supplies and reference oscillators.

MONITOR: Conv-A Conv-B
PwrSupA PwrSupB RefOsc

MON-A: iLO=04.1 rLO=14.6

Pi=+00.4 Po=+00.4 Tp=+32

MON-B: iLO=04.1 rLO=14.6

Pi=+00.3 Po=+00.3 Tp=+30

MON Power SupplyA:

12V=12.3 8V=08.2 5V=05.3

MON PowerSupplyB:

12V=12.2 8V=08.3 5V=05.3

MON Ref Osc:

Vtune=04.7

3.3.2.3 SELECT: FAULTS

This section displays the current status of fault conditions for Converter A and Converter B including the converter oscillator faults, converter temperature fault condition, power supply faults, and stored faults. 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 command is entered. When the number of faults reaches 100, the 100th fault will display an error (ER).

FAULTS: Conv-A Conv-B

PwrSupA PwrSupB Stored

FAULTS: Cnv-A

ifLO=OK rfLO=OK temp=OK

FAULTS: Cnv-B

ifLO=OK rfLO=OK temp=OK

FAULTS: Pwr Supply A:

12VT=OK 08VT=OK 05VT=OK

FAULTS: Pwr Supply B:

12VT=OK 08VT=OK 05VT=OK

FAULTS: Stored:

View Clear

Fault No. 06 10:28:53

OK-IFLO_A 08/10/04

Clear all stored

Faults? NO

3.3.2.4 SELECT: UTIL

The local operator can input commands to the following Utility Functions, which are displayed on the LCD display:

UTILITY: TimeDate FrqSel

VFD ScrSaver FWInfo ApID

UTIL Time/Date:

t=07:32:08 d=08/31/04

UTIL Frequency Select:

Cnv-A=Lband Cnv-B=Lband

UTIL Display:

Brightness=100% (▲▼ ENT)

UTIL ScreenSaver:

Theme=Classic Time=OFF

Firmwares: BULK=FW9965-

M&C=FW9966- FPGA=9967-

APPLICATION ID

MESSAGE

3.3.3 UTILITY FUNCTION MENU

The local operator can input commands to the following Utility Functions, which are displayed on the LCD display:

- TIME. Military time is used in hours, minutes and seconds.
- DATE. The date is displayed in month, day and year.
- SERIAL MODE (communications link).
- RS-485 or RS-232C.
- PHYSICAL ADDRESS. The default address starts from one (001).
- BAUD (Rate). The default baud rate is 9600.
- PARITY. Even, Odd or None.
- DISPLAY CONTROLS.
- DISPLAY CONTRAST. The default is 15, with values from 0 - 30.
- DISPLAY BRIGHTNESS. The default is 15, with values from 0 - 30.
- REF ADJUST.

REFERENCE FREQUENCY ADJUSTMENT. The default tuning adjustment is 87, with values from 0 – 255.

Notes:

Appendix A. Remote Control

A.1 GENERAL

This section describes the protocol and message command set for remote monitor and control of the L-Band converter.

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). Data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets of variable length.

A.1.1 RS-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire) RS-485 is preferred. Half-duplex (2-wire) 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 there is a 'controller' device (a PC or dumb terminal), which transmits data, in a broadcast mode, via one of the pairs. Many 'target' devices are connected to this pair, which all simultaneously receive data from the controller. The controller is the only device with a line-driver connected to this pair; the target devices only have line-receivers connected.

In the other direction, on the other pair, each target has a tri-stateable line driver connected, and the controller has a line-receiver connected. All the line drivers are held in high impedance mode until one target transmits back to the controller.

Each target has a unique address, and each time the controller transmits, in a framed 'packet' of data, the address of the intended recipient target is included. All of the targets receive the packet, but only the intended one 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) and all targets have line-receivers.
Target-to-controller pair	One line receiver (controller) and all targets have tri-state drivers.

A.1.2 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.2 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:

- 8 data bits, no parity, and 1 stop bit (8NI)
- 7 data bits, even parity, and 2 stop bits (7E2)
- 7 data bits, odd parity, and 2 stop bits (7O2)

The following are the baud rates being supported: 1200, 2400, 4800, 9600, 19200, and 38400 baud.

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

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

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

A.3 PACKET STRUCTURE

Controller-to-target:

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	(4 characters)	/ ASCII code 47 (1 character)	(3 characters)	_ ASCII code 95 (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 De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	(4 characters)	/ ASCII code 47 (1 character)	(3 characters)	_ ASCII code 95 (1 character)	(From 0 to n characters)	Carriage Return, Line Feed ASCII code 13,10 (2 characters)

Example: >0412/MUT_A_ON{CR}{LF}

Each of the components of the packet is now explained.

A.3.1 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.3.2 ADDRESS

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

The 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.3.3 INSTRUCTION CODE

This is a three-character alphabetic sequence that identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance. This aids in the readability of the message, should it be displayed in its raw ASCII form. Upper case and lower case alphabetic characters may be used (A-Z, and a-z).

A.3.4 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 value is:
   _ (ASCII code 95)

They have these meanings:

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'.

The '_' code without additional parameter 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_ would mean '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.

A.3.5 ERROR RESPONSE

If a converter cannot execute a Command or detects a protocol violation, an error response is generated. 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. For this document, ER is used for the generic case examples response.

Example: >DEV?COM ER Error Message 'cr"lf']

A.3.6 MESSAGE ARGUMENTS

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

A.3.7 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 code 10.)

Both indicate the valid termination of a packet.

A.4 REMOTE COMMANDS

Table A-1. Customer Commands

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Operating Frequency	FRE_	11 bytes, alphanumeric	Command or Query. FRE_x_yyyyy.yyy Where: x = 'A' (converter A) or 'B' (converter B) yyyyy.yyy =Valid Operating frequency, in MHz and 1-kHz step. Example: FRE_A_00951.000 It means converter A is set to 951 MHz. 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.	Same as command	FRE_x_	FRE_x_yyyyy.yyy (see description of arguments)
Attenuation	ATT_	7 bytes, alphanumeric	Command or Query. ATT_x_yy.yy Where: x = 'A' (converter A) or 'B' (converter B) yy.yy = Valid attenuation level, in dB, at 0.1-dB 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)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Attenuation Offset	ATO_A_SY.Z	6 bytes Alphanumeric	Command or Query Used to control or query attenuation offset. Applicable only on Slot A. Slot B will return error. Example: ATO_A_+2.3 <Enter> = Command Syntax: ATO_A_SY.Z <Center> Where: S=Sign (+ or -) Y=Number between 0 and 5 Z=Number between 0 and 9 (cannot be greater than 5.0) Note: 1. If (displayed attenuation + offset) < 0, actual attenuation will be set to 0dB. 2. If (displayed attenuation + offset) > maximum attenuation, actual attenuation will be set to maximum attenuation. 3. Actual attenuation is the sum of Attenuation displayed on front panel and Offset.	ATO_A_SY.Z	ATO_A_<Enter>	See Description

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Attenuation Offset	ATO_A_SY.Z	6 bytes, alphanumeric	Command or Query Used to control or query attenuation offset. Applicable only on Slot A. Slot B will return error. Example: ATO_A_+2.3 <Enter> = Command Syntax: ATO_A_SY.Z <Center> Where: S=Sign (+ or -) Y=Number between 0 and 5 Z=Number between 0 and 9 (cannot be greater than 5.0) Note: 1. If (displayed attenuation + offset) < 0, actual attenuation will be set to 0dB. 2. If (displayed attenuation + offset) > maximum attenuation, actual attenuation will be set to maximum attenuation. 3. Actual attenuation is the sum of Attenuation displayed on front panel and Offset.	ATO_A_SY.Z	ATO_A_<Enter>	See Description
Mute State	MUT_	5 bytes, alpha	Command or Query. Mutes/Unmutes the converter: 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)
Slope Adjust	SSA_	5 bytes, alphanumeric	Command or Query. 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)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Reference Oscillator Adjust	SRO_	3 bytes, numerical	Command or Query. 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)
Remote Address	SPA_	4 bytes, numerical	Command or Query. 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)
Remote Baud Rate	SBR_	4 bytes	Command or Query. 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)
Remote Baud Data Format	SBF_	1 byte, value 0 to 2	Command or Query SBF_x Where: x = 0 (8N1), 1(7E2), or 2(7O2)	Same as command	SBF_	SBF_x (see description of arguments)
Set RTC (Real-Time-Clock) Date	DAT_	8 bytes, numerical	Command or Query. DAT_mm/dd/yy A command/query in the form **mm/dd/yy**, where: dd = day of the month, between 01 and 31, mm = month of the year, between 01 and 12 and 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)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Set RTC Time	TIM_	8 bytes, numerical	Command or Query. TIM_hh:mm:ss A command/query in the form **hh:mm:ss**, indicating the time from midnight, where hh=hours, between 00 and 23; mm = minutes, between 00 and 59, and 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=xx (see description of arguments)
Vacuum Fluorescent Display (VFD) Brightness Adjust	VFD_	1 byte, value 0 to 3	Command or Query. Sets the front panel display brightness. VFD_x Where: x = 0(100%), 1(75%), 2(50%), 3(25%)	Same as command	VFD_	VFD_x (see description of arguments)
Remote Mode	REM_	1 byte, value 0 or 1	Command or Query Sets to remote mode or local mode. REM_x Where: x = 0 (local mode) or 1(remote mode)	Same as command	REM_	REM_x (see description of arguments)
Clear All Stored Alarms	CAA_	None	Command only CAA_xxx Where: xxx = YES Instructs the target to clear all Stored Events	CAA_CLEARED	N/A	N/A
Serial Number	N/A	9 bytes, numerical 000000000 to 999999999	Query only. 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 the serial number of converter B)	N/A	SSN_x_	SSN_x_yyyyyyyyy (see description for details of arguments)
Retrieve Module Equipment Type	N/A	12 bytes, alphanumeric	Query only. RET_x_ Where: = 'A' or 'B' The unit returns a string indicating the frequency of the selected module and the module type (Up-Link or Down-Link) Example: RET_A_140_DL or RET_B_070_UL	N/A	RET_x_	RET_x….x (see description for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
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 for details of arguments)
List all alarms	N/A	variable	Query only This command retrieves a list of the stored alarms. List All Alarms: Confirmation: 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'] 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 for details of arguments)
Summary Alarm Status	N/A	2 bytes, alpha	Query only. SAS_xx Where: xx = OK or FT Used to Query the status of the Summary Fault Relay. Example: SAS_OK	N/A	SAS_	SAS_x (see description for details of arguments)
Application Identification	AID_	24 bytes, alphanumeric	Command or Query AID_xxx…x Used to identify or name the unit or station. First line is limited to 12 characters. Second line is also limited to 12 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 for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Retrieve Firmware Number	N/A		Query only Gets the Firmware Numbers of the unit. Example: FRW_ BULK=FW10023 M&C =FW11220 FPGA=FW11122	N/A	FRW_	FRW_ (see description for details of arguments)
Force Backup Unit	FBU_	0 bytes	Command only. Forces switchover to backup unit in Manual redundancy mode only. Syntax: FBU_	Same as command	N/A	N/A
Online Unit Status	N/A	1 byte alphanumeric	Query only. Indicates which slot is online Syntax: ONL_x where: x = A or B (depending on which Converter is online).	N/A	ONL_	ONL_ (see description for details of arguments)
Redundancy Mode	RED_	3 bytes alphanumeric	Command and Query. Used to set the chassis in redundancy mode or to query status of redundancy. Syntax: RED_xxx where: xxx = ON, if redundancy is enabled OFF, if redundancy is disabled	Same as command	RED_	RED_ (see description for details of arguments)
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 Syntax: SAM_x where: x = a, if chassis is in Automatic Redundancy mode m, if chassis is in Manual Redundancy mode	Same as command	SAM_	SAM_ (see description for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Retrieve Maintenance Status	N/A	167 bytes, alpha numeric	Query only. Used to Query the maintenance status of the unit RMS_'cr' 12VT1=xxx.x'cr' 08VT1=xxx.x'cr' 05VT1=xxx.x'cr' 12VT2=xxx.x'cr' 08VT2=xxx.x'cr' 05VT2=xxx.x'cr' VTREF=xxx.x'cr' IFLOA=xxx.x'cr' RFLOA=xxx.x'cr' PIN_A=xxx.x'cr' POUTA=xxx.x'cr' TEMPA=xxx.x'cr' IFLOB=xxx.x'cr' RFLOB=xxx.x'cr' PIN_B=xxx.x'cr' POUTB=xxx.x'cr' TEMPB=xxx.x'cr''lf' Conv B temperature in deg C	N/A	RMS_	RMS_ x….x (see description for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Concise Maintenance Status	N/A	70 bytes numerical	Query only. Used to Query the Maintenance status of the unit in concise format. Response is comma delimited. Syntax: CMS_aaa.abbb.bccc.cddd.deee.efff.fggg.ghhh.hiii.i jjj.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 for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Retrieve Utility Status	N/A	98 bytes alpha numerical	Query only. Used to Query the utility features of the unit. Syntax: RUS_ 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=FW9965- M&C =FW9966- FPGA=FW9967-	N/A	RUS_	RUS_ x….x (see description for details of arguments)
Concise Utility Status	N/A	43 bytes alpha numerical	Query only. Used to Query the Maintenance status of the unit. Syntax: 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 ffffffff = Bulk firmware gggggggg = M&C firmware hhhhhhh = FPGA firmware	N/A	CUS_	CUS_ x….x (see description for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Retrieve Alarm Status	N/A	89 bytes alphanumeric	Query only. Used to Query the Alarm status of the unit RAS_ 12VDC1_xx'cr' 08VDC1_xx'cr' 05VDC1_xx'cr' 12VDC2_xx'cr' 08VDC2_xx'cr' 05VDC2_xx'cr' REFLD_xx'cr' IFLOA_xx'cr' RFLOA_xx'cr' TEMPA_xx'cr' IFLOB_xx'cr' RFLOB_xx'cr' TEMPB_xx'cr''lf' Where: xx = OK or FT. OK means no fault and FT means fault. *Note: REFLD is only returned if an external reference is present.	N/A	RAS_	RAS_ x….x (see description for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Concise Alarm Status	N/A	10 bytes numerical	Query only. Used to Query the Alarm status of the unit. Syntax 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 for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Retrieve Configuration Status	N/A	177 bytes alphanumeric	Query only. Used to Query the configuration status of the unit Example: 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_EIA-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 for details of arguments)

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, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to Query (target to controller)
Concise Configuration Status	N/A	52 bytes numerical	Query only. Used to query the summarized version of RCS. Syntax: 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 = □nmated, 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 for details of arguments)

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

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

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

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	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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