CDM-Qx

Multi-Channel Satellite Modem
with DoubleTalk™ Carrier-in-Carrier®
Installation and Operation Manual

(Includes data for the CDM-Qx and CDM-QxL Configurations)

For Firmware Versions 1.6.6/2.1.5 or higher
(see *New in this Release* – Section 1.4)

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

Part Number MN/CDMQX.IOM Revision 7

Errata A

Comtech EF Data Documentation Update

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Part Number MN/CDMQx.IOM
Revision 7

Subject:	Revise "Trademarks" subsection in Preface to include CEFD Patents and Patents Pending note
Original Manual Part Number/Rev:	MN/CDMQx Rev 7
Errata Number/ PLM Document ID:	ER-CDMQX.EA7
PLM CO Number:	C-0022887
Comments:	The updated information will be incorporated into the next formal revision of the manual.

Update the 'Trademarks' subsection (under the Conventions and References section) in the Preface to read (addition in bold):

Trademarks

Carrier-in-Carrier is a registered trademark of Comtech EF Data Corporation. DoubleTalk is a trademark of Applied Signal Technology, Inc. Windows is a trademark of the Microsoft Corporation. Other product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

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

Errata B

Comtech EF Data Documentation Update

CDM-Qx Multi-Channel Satellite Modem

Manual Part Number:	MN/CDMQX.IOM
Revision:	Rev 7
Errata Subject:	Updates to registered trademarks and licenses for Raytheon Applied Signal Technology, DoubleTalk and Carrier-in-Carrier
Errata Part Number:	ER-MNCDMQX-EB7
CO Number:	C-0023089
Comments:	Attach Errata B to Preface, page 1.

Note:
"Applied Signal Technology, Inc." is now "Raytheon Applied Signal Technology". All references to "Applied Signal Technology, Inc." in this manual are changed to "Raytheon Applied Signal Technology".

Patents and Trademarks

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

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

- DoubleTalk® is licensed from "Raytheon Applied Signal Technology".
- DoubleTalk® is a registered trademark of "Raytheon Applied Signal Technology".
- Carrier-in-Carrier® is a registered trademark of Comtech EF Data.

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PREFACE

About this Manual

This manual provides installation and operation information for the Comtech EF Data CDM-Qx Multi-Channel Modem with DoubleTalk™ Carrier-in-Carrier®. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the 70-140 MHz CDM-Qx and its L-Band counterpart, the CDM-QxL.

Revision 7 denotes a complete rewrite of the CDM-Qx Multi-Channel Satellite Modem Installation and Operation Manual (CEFD P/N MN/CDMQX.IOM). It is intended replace all previous versions of this document in their entirety. All content has been reorganized and updated to conform to current Comtech EF Data Technical Publications Standards and Practices.

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

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.

Cautions and Warnings

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

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.

IMPORTANT or NOTE indicates information critical for proper equipment function.

Recommended Standard Designations

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

Trademarks

Carrier-in-Carrier is a registered trademark of Comtech EF Data Corporation. DoubleTalk is a trademark of Applied Signal Technology, Inc. Windows is a trademark of the Microsoft Corporation. Other product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

The user should carefully review the following information:

Electrical Safety

The CDM-Qx/QxL Multi-Channel Satellite Modem has been shown to comply with safety standard **EN60950: Safety of Information Technology Equipment, including Electrical Business Machines.**

Observe the following: The CDM-Qx (70/140 MHz) is rated for operation over the range 100 to 240 VAC. It has a maximum power consumption of 120 watts, and draws a maximum of 1 amp.

The CDM-QxL (L-Band) is rated for operation over the range 100 to 240 VAC. It has a maximum power consumption of 250 watts, and draws a maximum of 2 amps.

Fuses

FOR CONTINUED OPERATOR SAFETY, ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING.

AC Operation: The AC-powered CDM-Qx/QxL is fitted with two fuses – one each for line and neutral connections. These are contained within the body of the IEC power inlet connector, behind a small plastic flap.

For the CDM-Qx:

- For 115 and 230 VAC operation, use 2.0A, slow-blow 20mm fuses.

For the CDM-QxL:

- For 115 and 230 VAC operation, use T3.15A, slow-blow 20mm fuses.

DC Operation: The DC-powered CDM-Qx/QxL is fitted with one fuse for positive connection. Thid fuse is contained within the body of the power inlet, behind a small plastic flap.

For the CDM-Qx:

- For 38 to 60 VDC operation, use X.XA, 20mm fuses.

For the CDM-QxL:

- For 38 to 60 VDC operation if the modem has no BUC power supply, use T3.15A, slow-blow 20mm fuses
- For 38 to 60 VDC operation if the modem is fitted with internal BUC power supply, use T8.0A, slow-blow 20mm fuses.

Environmental

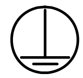
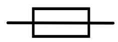
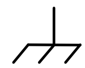
The CDM-Qx/QxL must not be operated in an environment where the unit is exposed to extremes of temperature outside the ambient range 0 to 50°C (32° to 122°F); precipitation, condensation, or humid atmospheres above 95% RH; altitudes (non-pressurized) greater than 2000 meters; excessive dust or vibration; flammable gases, corrosive or explosive atmospheres.

Operation in vehicles or other transportable installations that are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed.

Installation

Do** not **plug in the modulator and demodulator cards while the modem is powered on. Damage to the cards may result.

The CDM-Qx/QxL is shipped with a line inlet cable suitable for use in the country of operation. If it is necessary to replace this cable, ensure the replacement has an equivalent specification. Examples of acceptable ratings for the cable include HAR, BASEC and HOXXX-X. Examples of acceptable connector ratings include VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, BS1636A, BSI, SETI, IMQ, KEMA-KEUR and SEV.

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

CDM-Qx/QxL AC Modem Installation: The installation and connection to the line supply must be made in compliance to local or national wiring codes and regulations. The CDM-Qx/QxL is designed for connection to a power system that has separate ground, line and neutral conductors. The equipment is not designed for connection to a power system that has no direct connection to ground.

CDM-Qx/QxL DC Modem Installation: The CDM-Qx/QxL DC input is connected to a nominal 48 VDC prime power source. The DC input is isolated from the chassis and from the DC output to the BUC if equipped with internal BUC power supply. The chassis may be connected to a local system ground using a separate wire to the ground stud on the back of the chassis. Since the DC input is isolated, either the positive or the negative side of the DC input may be common with local ground. Labeling on the chassis rear panel indicates the positive and negative terminals of the input power socket.

Telecommunications Terminal Equipment Directive

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

CE Mark

Comtech EF Data declares that the CDM-Qx/QxL Multi-Channel Satellite Modem meets the necessary requirements for the CE Mark.

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).

EMC (Electromagnetic Compatibility)

In accordance with European Directive 89/336/EEC, the CDM-Qx/QxL Modem has been shown, by independent testing, to comply with the following standards:

Emissions: EN 55022 Class B - Limits and methods of measurement of radio interference characteristics of Information Technology Equipment.

(Also tested to FCC Part 15 Class B)

Immunity: EN 50082 Part 1 - Generic immunity standard, Part 1: Domestic, commercial and light industrial environment.

Additionally, the CDM-Qx/QxL has been shown to comply with the following standards:

EN 61000-3-2	*Harmonic Currents Emission*
EN 61000-3-3	*Voltage Fluctuations and Flicker*
EN 61000-4-2	*ESD Immunity*
EN 61000-4-4	*EFT Burst Immunity*
EN 61000-4-5	*Surge Immunity*
EN 61000-4-6	*RF Conducted Immunity*
EN 61000-4-8	*Power frequency Magnetic Field Immunity*
EN 61000-4-9	*Pulse Magnetic Field Immunity*
EN 61000-4-11	*Voltage Dips, Interruptions, and Variations Immunity*
EN 61000-4-13	*Immunity to Harmonics*

IMPORTANT

To ensure that the Modem continues to comply with these standards, observe the following instructions:

- Connections to the transmit and receive IF ports (Type 'BNC' female connectors for the CDM-Qx, Type 'N' female connectors for the CDM-QxL) should be made using a good quality coaxial cable; e.g., RG58/U (50Ω) or RG59/U (75Ω).
- All 'D' type connectors attached to the rear panel must have back-shells that provide continuous metallic shielding. Cable with a continuous outer shield (either foil or braid, or both) must be used, and the shield must be bonded to the back-shell.
- The equipment must be operated with its cover on at all times. If it becomes necessary to remove the cover, the user should ensure that the cover is correctly re-fitted before normal operation commences.

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

Refer to p. xx in this Preface for information regarding this product's Warranty Policy.

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 "**Service**" 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.

Chapter 1. INTRODUCTION

1.1 Overview

The CDM-Qx/QxL Multi-Channel Satellite Modem with DoubleTalk™ Carrier-in-Carrier® is a modular multi-channel modem with redundancy contained in a single rack unit (1RU) chassis. The CDM-Qx/QxL offers flexibility, redundancy, integration, and performance with four slots configurable as modulators or demodulators. The CDM-Qx operates on the 70/140 MHz IF frequency, while the CDM-QxL (**Figure 1-1**) is the L-Band (950MHz – 1950MHz) version of the same modem.

The CDM-Qx/QxL supports DoubleTalk™ Carrier-in-Carrier® option, allowing transmit (Tx) and receive (Rx) carriers in a full-duplex link to use the same transponder segment.

Figure 1-1. CDM-Qx/QxL Multi-Channel Satellite Modem (CDM-QxL shown)

1.1.1 Standard and Optional Features

The CDM-Qx/QxL includes, but is not limited to, the following features:

- DoubleTalk™ Carrier-in-Carrier® allowing Tx and Rx carriers of a full-duplex link to use the same transponder segment;
- CDM-Qx: 50 to 90 and 100 to 180 MHz frequency range;
- CDM-QxL: 950 MHz-1950 MHz L-band;
- 32 kbps to 20 Mbps;
- BPSK, QPSK, 8-PSK, 16-QAM operation;
- Flexible Configuration:
  - 1 modem or 2 modems configured as 1:1
  - Up to 4 demodulators
- Optional Built In Redundancy:
  - 1:1 modem

  - Up to 1:3 modulator
  - Up to 1:3 demodulator
- EIA-422/-530, V.35, G.703 (T1/E1/E2) and HSSI Interfaces;
- 1 to 4 Ports of G.703 (E1 with D&I) Quad E1 Interface Card;
- 10/100 BaseT Ethernet, RS-232 or RS-485 for M&C remote control;
- Forward Error Correction (FEC) choices included:
  - Viterbi
  - Viterbi with Reed-Solomon
  - Trellis and Reed-Solomon
  - Optional, 2nd Generation Turbo Product Coding (TPC) (IESS-315 compliant)
- Fully Accessible System Topology (FAST);
- Asymmetric Loop Timing;
- Common frequency reference for all modules;
- Optional High Stability Reference;
- Optional Redundant Power Supply;
- Individual or summed Modulator output power control;
- Interoperable with: CDM-550T, -570L, -600, -600L, SDM-300A, -300L3, and -8000 modems (in compatible modes);
- Drop and Insert, closed network version;
- **E**mbedded **D**istant-end **M**onitor **a**nd **C**ontrol (EDMAC) (see Note)
- **A**utomatic **U**plink **P**ower **C**ontrol (AUPC)

Refer to **Sect. 1.3** for in-depth product information and **Sect. 1.5** for the CDM-Qx/QxL Summary of Specifications.

1.1.2 DoubleTalk™ Carrier-in-Carrier®

Designed for bandwidth compression, Carrier-in-Carrier® is based on Applied Signal Technology's DoubleTalk™ which uses "Adaptive Cancellation," a patented (United States Patent #6,859,641) technology that allows full duplex satellite links to transmit concurrently in the same segment of transponder bandwidth. Available as an option to the modem, this added dimension can result in a significant improvement in satellite transponder utilization.

1.1.3 Turbo Product Coding

The CDM-Qx/QxL offers optional 2nd generation Turbo Product Codec (TPC). TPC simultaneously offers increased coding gain, lower decoding delay, and significant bandwidth savings. The TPC provides:

- BPSK 5/16 and 21/44
- QPSK 21/44, 3/4, 7/8 and 17/18
- 8-PSK 3/4, 7/8, and 17/18
- 16QAM 3/4 and 7/8

1.2 Functional Description

The CDM-Qx/QxL Multi-Channel Satellite Modem has two fundamentally different types of interface – IF and Data:

- The Data interface can be a bi-directional path, which connects with the customer's equipment (assumed to be the DTE) and the modem (assumed to be the DCE).
- The IF interface provides a bi-directional link with the satellite via the uplink and downlink equipment.

Transmit data is received by the terrestrial interface where line receivers convert the clock and data signals to CMOS levels for further processing. A small FIFO follows the terrestrial interface to facilitate the various clocking and framing options. If framing is enabled, the transmit clock and data output from the FIFO pass through the framer, where the overhead EDMAC data is added to the main data. Otherwise, the clock and data are passed directly to the Forward Error Correction encoder.

In the FEC encoder, the data is scrambled, differentially encoded, and then convolutionally encoded. Following the encoder, the data is fed to the transmit digital filters, which perform spectral shaping on the data signals. The resultant I and Q signals are then fed to the BPSK/QPSK/8-PSK/ 16-QAM modulator. The carrier is generated by a frequency synthesizer, and the I and Q signals directly modulate this carrier to produce an IF output signal.

The RX IF signal is translated and filtered at an intermediate frequency (IF) using the coarse step synthesizer. This is mixed with a second synthesizer, resulting in the signal being IF sampled with a high-speed analog to digital converter (A to D). The sampled IF is then digitally split into an In-phase (I) and a Quadrature (Q) component. An AGC circuit keeps the desired signal level constant over a broad range of input levels. The I and Q signals are then decimated to reduce the computation rate into the poly phase matched filter.

Carrier and clock recovery is performed on the baseband I and Q signals after the matched filter. The resultant demodulated signal is fed, in soft decision form, to the selected FEC decoder (which can be Viterbi, TCM, Reed-Solomon, or Turbo if installed). After decoding, the recovered clock and data pass to the de-framer (if EDMAC framing is enabled) where the overhead information is removed. Following this, the data passes to the Plesiochronous/Doppler buffer, which has a programmable size, or alternatively bypasses the buffer. From here, the receive clock and data signals are routed to the terrestrial interface, and are passed to the externally connected DTE equipment.

Physically, a modem chassis is comprised of three main card assemblies:

- **The IF Backplane card** includes the frequency reference, power splitters, power summers, the FSK link (L-Band version only) and the IF Loop back functions.
- **The Digital Backplane card** routes all the control signals, data path switching, Carrier-in-Carrier® signals and power for all modules.
- **The M&C** controls all functions in the unit.

Within the chassis are four slots which allow any combination of modulators or demodulators to be installed. If configured as a single modem, two plug-in cards comprising a modulator and demodulator are required.

- **A Modulator card** contains the transmit interface circuits, the framer, the encoder or encoders and the signal processing functions of modulation.

- **A Demodulator card** performs all of the signal processing functions of carrier search, cancellation, demodulation, Forward Error Correction, the de-framer, plesiochronous/ Doppler buffer and the receive interface circuits.
- **Terrestrial data interface cards** can be on the modulator cards or demodulator cards. When a modulator and demodulator are grouped together, the data interface card can be used for full-duplex data interface. When one or up to four ports of E1 (with D&I) are needed, the Quad E1 Data Interface Module can be installed in Slots 3 and 4.

Figure 1-2 shows a functional block diagram of the modem with either modulators and demodulators in all four slots; and the figure also shows a modulator in Slot 1 and a demodulator in Slot 2 along with a Quad E1 Data Interface Module in Slots 3 and 4.

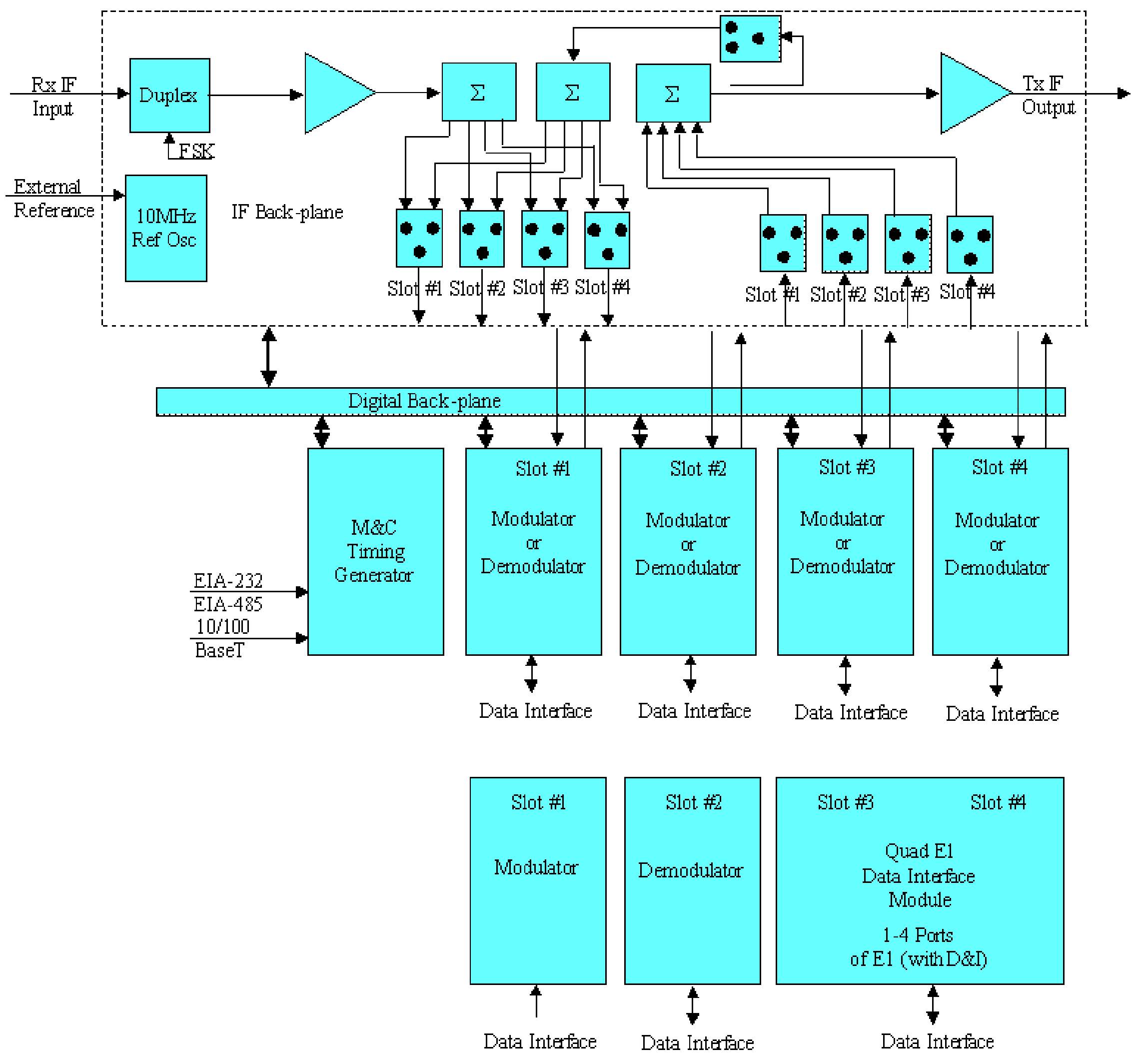


Figure 1-2. CDM-Qx/QxL Open Network Satellite Modem Block Diagrams

1.3 Features

1.3.1 Physical Description

CDM-Qx/QxL Multi-Channel Satellite Modem is constructed as a 1RU-high rack-mounting chassis, which can be free-standing if desired. Rack handles at the front facilitate removal from and placement into a rack.

1.3.2 Compatibility

The CDM-Qx/QxL is backwards compatible with a number of Comtech EF Data CDM, SDM, and SLM modems.

1.3.3 Major Assemblies

CDM-Qx Major Assemblies	
Assembly	**Description**
PL/10570-1	1 PPM Reference IF Backplane 70/140 MHz IF
PL/10570-2	0.1 PPM Reference IF Backplane 70/140 MHz IF
PL/10069	Digital Backplane
PL/10073	Monitor and Control Card
PL/11128	70/140 MHz IF Modulator
PL/10635	70/140 MHz IF Demodulator with Carrier in Carrier®
PL/12960-1	AC Chassis, 70/140 IF
PL/12960-2	DC Chassis, 70/140 IF

CDM-QxL Major Assemblies	
Assembly	**Description**
PL/10070-1	0.1 PPM Reference IF Backplane L-Band IF
PL/10069	Digital Backplane
PL/10073	Monitor and Control Card
PL/10071	L-Band IF Modulator
PL/10072	L-Band IF Demodulator with Carrier in Carrier®
PL/12798-1	AC Chassis, L-Band
PL/12798-2	DC Chassis, L-Band

CDM Qx/QxL Optional Assemblies	
Assembly	**Description**
AS/11014	Turbo Codec – Simplex
PL/10678	EIA-530 Duplex Data interface
PL/10697	G.703 Balanced Duplex Data Interface
PL/10698	G.703 Unbalanced Duplex Data Interface (E1/T1)
PL/10635	G.703 Unbalanced Duplex Data Interface (E2)
PL/12608-1	Quad E1 G.703 Data Interface
PL/10898-1	EIA-612/613 HSSI Interface

1.3.4 Dimensional Envelope

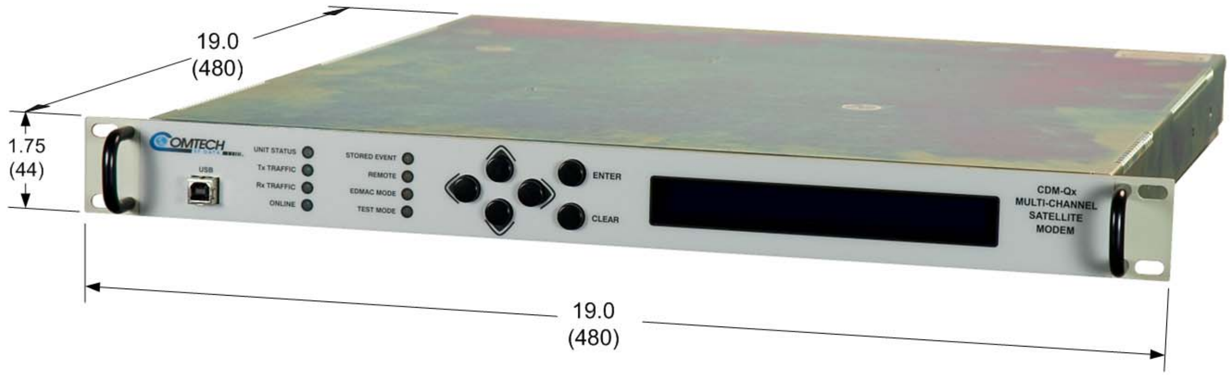


Figure 1-3. CDM-Qx/QxL Dimensional Envelope

1.3.5 Physical Features

1.3.5.1 Front Panel

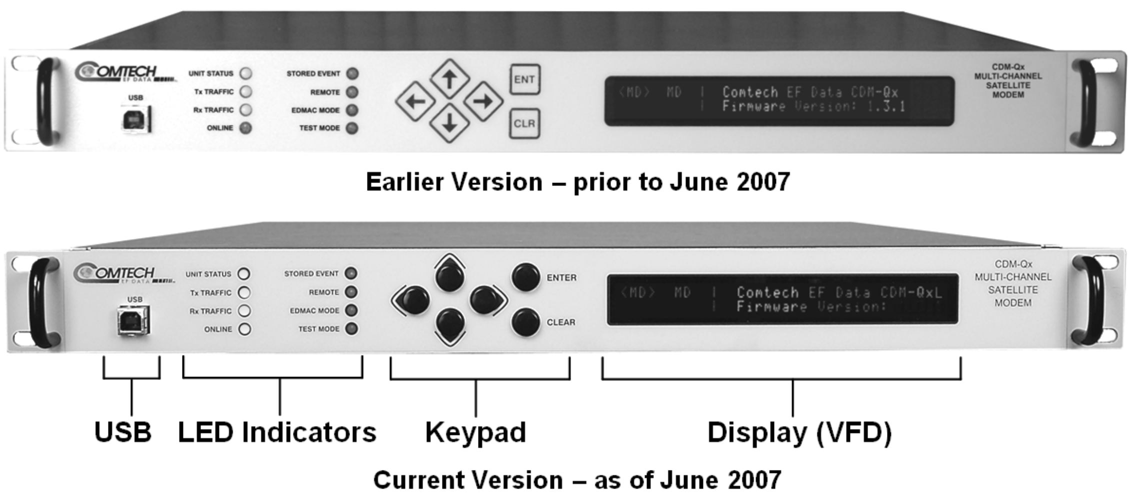


Figure 1-4. Front Panel View (CDM-Qx shown)

Figure 1-4 shows the front panel of the CDM-Qx/QxL Open Network Satellite Modem. The front panel features (from left), a USB port; eight **L**ight-**E**mitting-**D**iode (LED) indicators; a keypad; and a **V**acuum **F**luorescent **D**isplay (VFD):

- The USB port is a slave connector used to reflash the unit's firmware. For more information, refer to **Chapter 4. FLASH UPGRADING**.
- The LEDs indicate, in a summary fashion, the status of the unit.
- The keypad comprises six individual keyswitches. They have a positive 'click' action, which provides tactile feedback. The user enters data via the keypad, and messages are displayed on the VFD.

Note: As shown in **Figure 1-4**, units manufactured prior to June 2007 featured six individual keyswitches mounted behind a fully sealed membrane overlay.

These six switches are identified (in Current Keypad [Earlier Keypad] format) as ▲ [↑], ▼ [↓], ◀ [←], ▶ [→], **ENTER [ENT]**, and **CLEAR [CLR]**.

- The VFD is an active display showing two lines of 40 characters each. It produces a blue light with adjustable brightness. Compared to a **L**iquid **C**rystal **D**isplay (LCD), the VFD has greatly superior viewing characteristics and does not suffer problems of viewing angle or contrast.

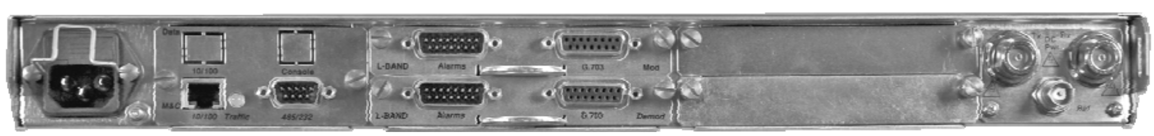
The function and behavior of the LED indicators, keypad, and VFD is described in detail in **Chapter 5. FRONT PANEL OPERATION**.

1.3.5.2 Rear Panel

Figure 1-5 shows the connectors installed in the rear panel of the CDM-Qx/QxL Multi-Channel Satellite Modem. As outlined in A CDM-Qx/QxL base chassis features two IF connectors and three Utility connectors that are typical for all operation. Additionally, an Alarms connector, not part of the base chassis but included in this table for reference only, is provided with every available data interface module.

External cables are attached to these connectors. For detailed information about the connectors outlined in **Table 1-1**, plus the connectors unique to each date interface module, see **Chapter 3. REAR PANEL CONNECTORS**.

CDM-Qx (70/140 MHz) DC Unit



CDM-QxL (L-Band) AC Unit

Figure 1-5. CDM-Qx/QxL Rear Panel View

Table 1-1. CDM-Qx/QxL Rear Panel Connectors – Base Chassis

Connector Group	Connector Name	Connector Type	Function
Power (Sect. 3.2.1)	AC	See Sect. 3.5.1	Chassis power
	DC (optional, CDM-QxL only)	See Sect. 3.5.2	
Ground (Sect. 3.2.2)		#10-32 stud	Common Chassis Ground
Utility (Sects. 3.2.3, 3.2.4, 3.2.6, 3.3.1)	M&C 10/100 (Sect. 3.2.3)	RJ-45	10/100 BaseT Remote Interface
	485/232 (Sect 3.2.4)	9-pin Type 'D' female	EIA Remote Interface
	Ref (Sect 3.2.6)	BNC 50Ω female	External reference for modem synthesizers
	Alarms (not p/o base chassis – typical for each data interface) (Sect. 3.3.1)	15-pin Type 'D' male	Form C Alarms (relay closures)
IF (Sect. 3.2.5)	Rx	CDM-Qx: BNC female (70/140MHz band)	IF Input
		CDM-QxL: Type 'N' female (L-Band)	
	Tx	CDM-Qx: BNC female (70/140MHz band)	IF Output
		CDM-QxL: Type 'N' female (L-Band)	
Terrestrial Data (Sect. 3.3)	Connectors vary dependant on the installed data interface (G.703 Bal, G.703 Unbal, EIA-530, Quad E1, or HSSI) module. See Sect. 3.3.x for complete information about the connectors associated with these interfaces.		

Note: The European EMC Directive (EN55022, EN50082-1) requires using properly shielded cables for DATA I/O. These cables must be double-shielded from end-to-end, ensuring a continuous ground shield.

1.3.6 Hardware Options

1.3.6.1 CDM-Qx/QxL Hardware Options

There are four hardware options available:

- The first hardware option, Comtech EF Data's **Turbo Product Codec (TPC)**, represents a very significant development in the area of Forward Error Correction (FEC). It provides one of the best FEC technologies currently available, and is now offered with a sufficient range of code rates and modulation types to optimize link performance under any conditions.

  Turbo Product Codec consists of a plug-in daughter card (SIMM module) that is field upgradeable. The TPC option provides data rate capability up to 20 Mbps, with the following code rates:

  - Rate 5/16 (BPSK)
  - Rate 21/44 (BPSK, QPSK)
  - Rate 3/4 (QPSK, 8-PSK, and 16-QAM)
  - Rate 7/8 (QPSK, 8-PSK, and 16-QAM)
  - Rate 17/18 (QPSK, 8-PSK)

- The second hardware option is the **Internal Reference Stability**. The high stability option includes a 6 x 10^{-8} 10 MHz reference oscillator on the IF Backplane board, while the low stability option has a 1 x 10^{-6} 10 MHz reference on the IF Backplane board. This option must be configured in the factory at the time of order.

- The third hardware option is the **IF Impedance and Connectors**. The IF may be configured with either BNC female connectors at 75Ω impedance, BNC female connectors at 50Ω impedance, or N-type female connectors at 50Ω impedance. This option also must be configured in the factory at the time of order.

- The fourth hardware option is the **Quad E1 Data Interface Module**. This gives the user 1 to 4 ports of E1, (each are D&I capable). These ports must use a synchronous E1 reference. This option also must be configured in the factory at the time of order.

1.3.6.2 CDM-QxL L-Band

Fully configured, the CDM-QxL will meet or exceed all of the applicable requirements in IESS-315 and is available with a full range of industry standard digital interfaces. The modem expands the capabilities into L-Band frequencies. Utilizing advanced technology and proprietary digital signal processing techniques, the design eliminates analog circuitry to perform modem signal processing, resulting in higher reliability and reduced packaging size.

1.3.7 Data Interfaces

The CDM-Qx/QxL can be ordered with a number of interfaces. Each data interface can operate on a Modulator or Demodulator. This allows the user to exchange interface cards for different applications. The interfaces offered include:

- EIA/TIA-530
  - (EIA-422) DCE (at rates up to 12 Mbps)
  - V.35 DCE (at rates up to 12 Mbps)
- G.703 Balanced T1 & E1 (DB-15) with D&I++
- G.703 Unbalanced T1, E1, & E2 (BNC)
- EIA/TIA-612/613 HSSI (50-pin SCSI connector, to 20 Mbps)
- 1 to 4 Ports of G.703 (E1 with D&I) Quad E1 Interface Card, (RJ-45)

1.3.8 Verification

The CDM-Qx/QxL includes many test modes and loopbacks for rapid verification of the correct functionality of the unit. Of particular interest is the IF loopback (grouped as modem), which permits the user to perform a quick diagnostic test without having to disturb external cabling. During loopback, all of the receive configuration parameters on the selected Demodulator are temporarily changed to match those of the selected Modulator, and an internal RF switch connects the modulator output to the demodulator input. When normal operation is again selected, all of the previous values are restored.

1.3.9 AUPC

An important feature in the CDM-Qx/QxL is the addition of **A**utomatic **U**plink **P**ower **C**ontrol (**AUPC)**. This feature enables the modem to automatically adjust its output power to maintain the Eb/No of the remote end of the satellite link constant. This provides protection against rain fading, a particularly severe problem with Ku-band links.

To accomplish this, either the EDMAC or D&I++ or ESC++ framing types may be used, and the distant end modem constantly sends back information about the demodulator Eb/No using reserved bytes in the overhead structure. Using the Eb/No, the local modem adjusts its output power, and a closed-loop feedback system is created over the satellite link.

A benefit of this **AUPC** feature is that the remote demodulator's Eb/No can be viewed from the front panel display of the local modem.

See **Chapter 7. Automatic Uplink Power Control (AUPC)** for further information.

1.3.10 EDMAC

To facilitate network management for small networks, the CDM-Qx/QxL incorporates the proprietary **E**mbedded **D**istant-end **M**onitor **A**nd **C**ontrol (**EDMAC**). In this mode, an additional 5% overhead is combined with the traffic data, (1.6% in Turbo BPSK modes, Turbo Rate 21/44 QPSK/OQPSK, and all data rates greater than 2 Mbps). M&C information is added (transparent to the user), allowing access to the distant-end modem.

In addition, **EDMAC-2** uses 1.6% overhead in all modes for those applications where the 5% overhead is excessive. The **EDMAC** and **EDMAC-2** modes do not require any additional cabling at either the local or distant-end Modems. Access to **EDMAC** is via the standard M&C control port. Full monitor and control is possible, and the on/off status at the distant-end carrier can be controlled.

See **Chapter 9. EDMAC CHANNEL** for further information.

1.3.11 Flash Upgrading Modem Firmware

The internal firmware is both powerful and flexible, permitting storage and retrieval of up to 10 different modem configurations. The modem uses 'flash memory' technology internally, and new firmware can be uploaded to the unit from an external PC. This simplifies software upgrading, and updates can be sent via the Internet (using the CDM-Qx/QxL Web Server Interface), e-mail, or on CD. The upgrade can be performed without opening the unit, by simply connecting the modem to the USB port or Ethernet port of a computer.

See **Chapter 4. FLASH UPGRADING** for further information.

As of July 2008, Comtech EF Data began incorporating an enhanced flash memory chip into its chassis design. To accommodate this design upgrade, units that employ the original vs. the currently-used flash memory chips are identifiable by the installed Firmware Version.

Observe the following:

- **Original chassis = units typically manufactured prior to July 2008: Firmware No. FW/11245 (Version 1.X.X ↑)**
- **Upgraded chassis = units typically manufactured from July 2008 to present: Firmware No. FW-0000107 (Version 2.1.1↑)**

Note that, while the functionality of the two firmware versions is transparent to the user, these firmware products may not ***be cross-utilized. Always be sure to identify the chassis in use by its installed firmware prior to attempting any firmware flash upgrade, then download the appropriate firmware as needed.***

1.3.12 Fully Accessible System Topology (FAST)

The CDM-Qx/QxL is extremely flexible and powerful, and incorporates a large number of optional features. In order to permit a lower initial cost, the modem may be purchased with only the desired features enabled.

If, at a later date, the user wishes to upgrade the functionality of the modem, Comtech EF Data provides **F**ully **A**ccessible **S**ystem **T**opology (**FAST**), which permits the purchase and installation of options through special authorization codes loaded into the unit either via the front panel keypad or entered remotely via the remote port located on the modem rear panel. These unique access codes may be purchased at any time from Comtech EF Data.

FAST System Theory

FAST facilitates on-location upgrade of the operating feature set without removing a modem from the setup.

With **FAST** technology, operators have maximum flexibility for enabling functions as they are required. **FAST** allows an operator to order a modem precisely tailored for the initial application.

When service requirements change, the operator can upgrade the topology of the modem to meet those requirements within minutes. This accelerated upgrade can be accomplished because of **FAST**'s extensive use of the programmable logic devices incorporated into Comtech EF Data products.

FAST Implementation

Comtech EF Data's **FAST** system is factory-implemented in the modem. All **FAST** options are available through the basic platform unit at the time of order – **FAST** allows immediate activation of available options, after confirmation by Comtech EF Data, through the front panel keypad or via the remote control interface.

See **Appendix C. FAST ACTIVATION PROCEDURE** for further information.

FAST Accessible Options

Hardware options for basic modems can be ordered and installed either at the factory or in the field. The operator can select options that can be activated easily in the field, depending on the current hardware configuration of the modem. A unique access code enables configuration of the available hardware.

The base configuration of the modulators and demodulators are equipped with Viterbi and R-S codecs. It offers modulation types, and data rates up to 5 Mbps. It is, however, limited to Closed Network operation.

On the next page, **Table 1-2** shows the FAST and FAST-accessible hardware options available for the CDM-Qx/QxL.

Table 1-2. FAST and FAST-accessible Hardware Options

Modulator & Demodulator Options	Description and Comments	Option Installation Method
Low Rate Variable	Data rate 32 kbps to 5 Mbps	Base Unit
Mid-Rate Variable	Data rate 32 kbps to 10.0 Mbps	FAST
Full Rate Variable	Data rate 32 kbps to 20.0 Mbps	
8-PSK	Modulation Type	
16-QAM	Modulation Type	
D&I++	Drop and Insert	
DoubleTalk Carrier-in-Carrier	128 ksps – 512 kbps	
	128 ksps – 1 Mbps	
	128 ksps – 2.5 Mbps	
	128 ksps – 5 Mbps	
	128 ksps – 10 Mbps	
	128 ksps – 20 Mbps	
Redundancy Capability	1:1 or 1:2 or 1:3 Redundancy	
Turbo Codec – high rate	20 Mbps Turbo Codec 512 kpbs, 2048 kbps, 5 Mbps, 10 Mbps, 20 Mbps	FAST or Hardware
High Stability Reference	Internal 10 MHz reference – 6×10^{-8}	Hardware (Factory-installed only)
Low Stability Reference	Internal 10 MHz reference – 1×10^{-6}	
75Ω TX/RX Impedance	75Ω impedance with BNC female connectors	
50Ω TX/RX Impedance	50Ω impedance with N female connectors (L-Band)	

1.3.13 Supporting Hardware and Software

Redundancy Applications

For 1:1 and 1:N redundancy applications, the CDM-Qx/QxL is supported by the following Comtech EF Data switching products:

CEFD Product	Description	CDM-Qx	CDM-QxL
CRS-311	1:1 Redundancy Switch	X	X
CRS-300	1:10 Redundancy Switch	X	X
CRS-280*	IF Switch (70/140 MHz)	X	
CRS-280L*	IF Switch (L-Band)		X

* For use in 1:N applications only. Up to one modulator and one demodulator allowed per CDM-Qx/QxL.

ODU Interoperability via FSK / EDMAC

The CDM-QxL incorporates a **F**requency **S**hift **K**eyed (FSK) serial link that, when activated on the Rx-IF port of a CDM-QxL, enables the modem to communicate with the Comtech EF Data line of RF Ku- and C-Band Transceivers.

On the CDM-QxL, when activated on the Tx-IF port, this link can communicate with an FSK-capable Block Upconverter (BUC) or, conversely, when activated on the Rx-IF port, a Low-Noise Block Downconverter (LNB).

In this manner, the user may monitor, configure, and control the Transceiver, BUC or LNB via the modem's front panel display and keypad, or by using the modem's remote control interface.

The EDMAC overhead channel may also be used to convey M&C data to a RF Transceiver at the distant end of a satellite link if it is connected to a CDM-Qx, or to a BUC or LNB at the distant end of a satellite link if it is connected to a CDM-QxL.

For the CDM-QxL, this FSK interface with the BUC includes a BUC output power leveling mode, whereby the modem M&C monitors the detected BUC output power level reported on the FSK link and automatically adjusts the modem Tx output power to maintain a constant BUC Tx output level.

1.4 New in this Release

Revision 7 of this manual denotes a complete rewrite of the CDM-Qx Satellite Modem Installation and Operation Manual (CEFD P/N MN/CDMQX.IOM). It is intended replace all previous versions of this document in their entirety. All content has been reorganized to conform to current Comtech EF Data Technical Publications Standards and Practices.

Note that firmware for the CDM-Qx/QxL is **chassis-specific**, as explained in **Sect. 1.3.11**. Users are strongly urged to upgrade the CDM-Qx/QxL to the *appropriate* current firmware release – for further information, refer to **Chapter 4. FLASH UPGRADING**.

1.4.1 CDM-Qx/QxL Firmware Release Notes

FW-0000107 Ver. 2.1.5 Release (5/20/09) / FW/11245 Ver. 1.6.6 Release (5/20/09)

New Features:

- None.

Feature Enhancements:

- Upgrade power ratio monitor reporting functionality.

1.5 Summary of Specifications

1.5.1 Modulator

Note: Features not in the initial product release are identified in parentheses.

Modulation	See Table A-5
Symbol rate range	Up to 10 Msps (lower end is modulation and FEC rate dependant). Refer to Figure A-1.
Data rate range	See Table A-5
Operating modes	Transparent, closed network, DoubleTalk™ Carrier-in-Carrier®
FEC	See Table A-5
Transmit filtering	Per INTELSAT IESS-308 (0.35) or 0.20 (for use with closer adjacent channel spacing)
Scrambling	V.35 or synchronous
Output frequency	50 to 90, 100 - 180 MHz, 100 Hz resolution (70/140 MHz IF) 950 to 1950 MHz, 100 Hz resolution (L-Band) Stability ± 1 ppm, 0 to 50°C (32° to 122°F) (standard low-stability internal reference) Stability ± 0.06 ppm, 0 to 50°C (32° to 122°F) (Optional high-stability internal reference) Stability ± 0.06 ppm, 0 to 50°C (32° to 122°F) (standard reference for L-Band)
External Reference	1, 2, 5, 10, or 20 MHz @ 0 dBm to +20 dBm. Internal reference phase locks to external reference.
Harmonics and spurious	Greater than -55 dBc/4 kHz (typically <-60 dBC/4kHz) – measured from 25 to 400 MHz (70/140MHz IF) Greater than -55 dBc/4 kHz (typically <-60 dBC/4kHz) – measured from 500 to 2500 MHz (L-Band) Spurious measured relative to an unmodulated (CW) carrier
Transmit On/Off Ratio	55 dB minimum
Output phase noise	< 0.48°rms double sided, 100 Hz to 1MHz (minimum of 10 dB better overall than the INTELSAT IESS-308/309 requirement)
Output power	-5 to -25 dBm, 0.1 dB steps (70/140MHz IF) -5 to -45 dBm, 0.1 dB steps (L-Band). Refer to Automatic Uplink Power Control section.
Power accuracy	±1.0 dB over frequency, temperature, and number of modulators installed in the chassis
Output Connector	Type BNC Female (70/140MHz IF) Type N Female (L-Band)
Output Return Loss	≥ 19 dB (70/140MHz IF) ≥ 10 dB (L-Band)
Clocking Options	Internal, ±1ppm or 0.06 ppm (SCT) External, locking over a ±100 ppm range (TT) Loop timing (Rx satellite clock) - supports asymmetric operation - Rx and Tx data rates do not need to be identical External Clock at transmit data rate.
External TX Carrier Off	By TTL 'low' signal or external contact closure - hardware function automatically over-rides processor

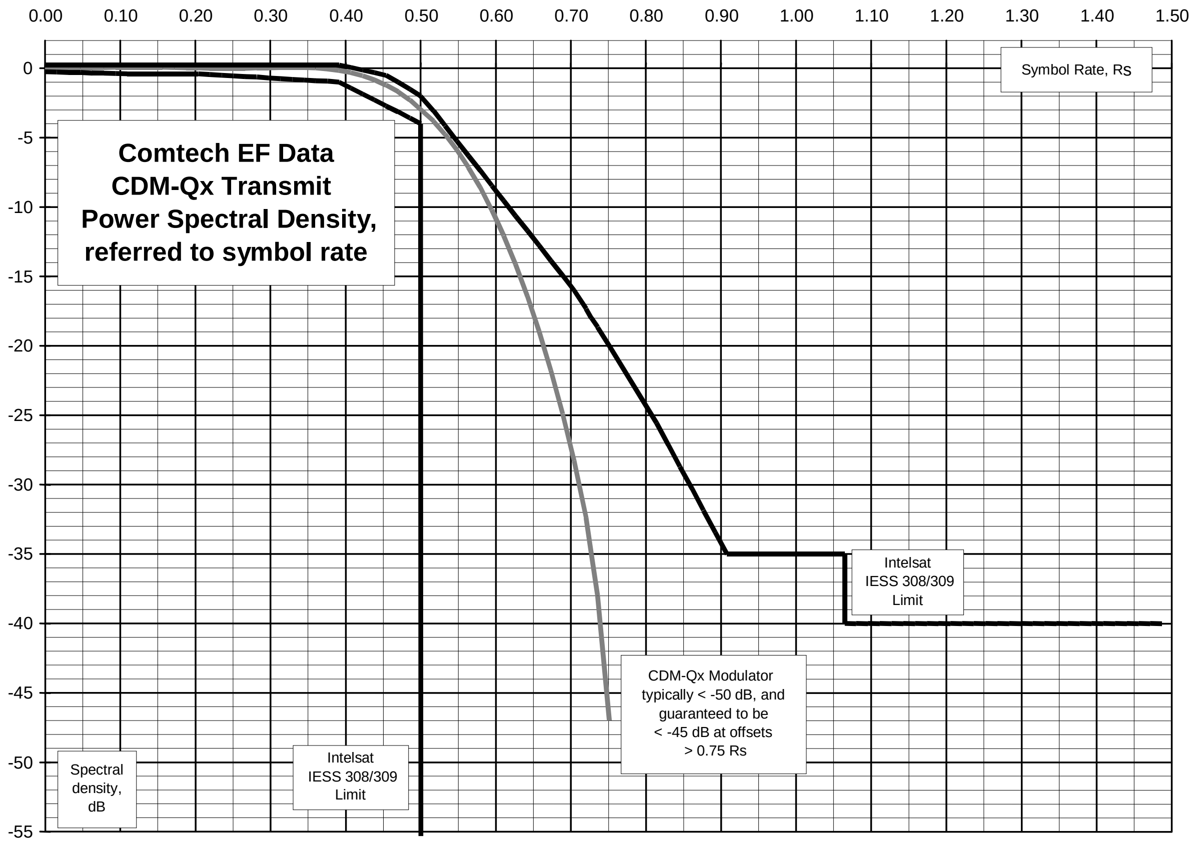


Figure 1-6. Power Spectral Density Chart

1.5.2 Demodulator

Note: FEC, Data rate range, operating modes, descrambling, input impedance/return loss etc, as per Modulator.

Input power range (70/140MHz IF)	-15 to -45 dBm, ≤ 2.048 Msps (desired carrier) -15 to -40 dBm, > 2.048 and ≤ 4.096 Msps (desired carrier) -15 to -35 dBm > 4.096 Msps (desired carrier) +35 dBc maximum composite, up to -5 dBm
Input power range (L-Band)	-130 + 10log(Symbol Rate in Hz) minimum signal level 50dB AGC range
Acquisition range	±1 to ±32 kHz, Symbol rate > 64 ksps (70/140 MHz) ±1 to ± (Symbol rate/2) kHz , Symbol Rate <=64 ksps (70/140 MHz) ±1 to ±200 kHz, Symbol rate > 625 ksps (L-Band) ±1 to ± 32 kHz, 64 ksps < Symbol Rate <=625 ksps (L-Band) ±1 to ± (Symbol rate/2)kHz, Symbol Rate <=64ksps (L-Band) Programmable in 1 kHz increments.
Acquisition time	Highly dependent on data rate, FEC rate, and demodulator acquisition range. Note that Reed-Solomon increases acquisition time, due to the additional time taken for the RS decoder to declare synchronization.
Clock tracking range	± 100 ppm min

VITERBI BER performance **(met in the presence of two adjacent carriers, each 7 dB higher than the desired carrier)**	For:	**Rate 1/2 (B, Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 3/4 (Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 7/8 (Q)** Guaranteed Eb/No: (typical value in parentheses)
	BER=10^{-5}	5.4 dB (4.9 dB)	6.8 dB (6.3 dB)	7.7 dB (7.2 dB)
	BER=10^{-6}	6.0 dB (5.5 dB)	7.4 dB (6.9 dB)	8.4 dB (7.9 dB)
	BER=10^{-7}	6.7 dB (6.2 dB)	8.2 dB (7.7 dB)	9.0 dB (8.6 dB)
VITERBI and RS 220,200 or 200,180 Outer Code BER **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For:	**Rate 1/2 (B, Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 3/4 (Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 7/8 (Q)** Guaranteed Eb/No: (typical value in parentheses)
	BER=10^{-5}	4.3 dB (4.0 dB)	5.6 dB (4.7 dB)	6.5 dB (6.0 dB)
	BER=10^{-6}	4.4 dB (4.1 dB)	5.8 dB (4.8 dB)	6.7 dB (6.2 dB)
	BER=10^{-7}	4.5 dB (4.2 dB)	6.0 dB (5.2 dB)	6.9 dB (6.5 dB)
8-PSK/TCM CODEC BER **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For:	**Rate 2/3 8-PSK/TCM** Guaranteed Eb/No: (typical value in parentheses)	**Rate 2/3 8-PSK/TCM w/concatenated RS** Guaranteed Eb/No: (typical value in parentheses)	
	BER=10^{-5}	7.9 dB (7.2 dB)	6.3 dB (5.4 dB)	
	BER=10^{-7}	9.5 dB (8.7 dB)	6.7 dB (5.8 dB)	
	BER=10^{-8}	10.4 dB (9.5dB)	6.9 dB (6.0 dB)	
TURBO PRODUCT CODEC **Rate 1/2 QPSK** **Rate 21/44 BPSK** **Rate 5/16 BPSK** **BER** **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For:	**Rate 1/2 (Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 21/44 (B)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 5/16 (B)** Guaranteed Eb/No: (typical value in parentheses)
	BER=10^{-6}	2.9 dB (2.6 dB)	2.8 dB (2.5dB)	2.4 dB (2.1dB)
	BER=10^{-7}	3.1 dB (2.7 dB)	3.1 dB (2.8 dB)	2.6 dB (2.3dB)
	BER=10^{-8}	3.3 dB (2.8 dB)	3.3 dB (2.90dB)	2.7 dB (2.4dB)
TURBO PRODUCT CODEC **Rate 3/4 QPSK** **Rate 3/4 8-PSK** **Rate 3/4 16-QAM** **BER** **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For:	**Rate 3/4 (Q)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 3/4 (8-PSK)** Guaranteed Eb/No: (typical value in parentheses)	**Rate 3/4 (16-QAM)** Guaranteed Eb/No: (typical value in parentheses)
	BER=10^{-6}	3.8dB (3.4dB)	6.2 dB (5.8 dB)	7.4dB (7.0 dB)
	BER=10^{-7}	4.1dB (3.7dB)	6.4 dB (6.0 dB)	7.8 dB (7.3 dB)
	BER=10^{-8}	4.4dB (4.0dB)	6.8 dB (6.3 dB)	8.2 dB (7.7 dB)

TURBO PRODUCT CODEC **Rate 7/8 QPSK** **Rate 7/8 8-PSK** **Rate 7/8 16-QAM** **BER** **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For: BER=10^{-6} BER=10^{-7} BER=10^{-8}	**Rate 7/8 (Q)** Guaranteed Eb/No: (typical value in parentheses) 4.3 dB (4.0 dB) 4.4 dB (4.1 dB) 4.5 dB (4.2 dB)	**Rate 7/8 (8-PSK)** Guaranteed Eb/No: (typical value in parentheses) 7.3 dB (6.6 dB) 7.4 dB (6.7 dB) 7.5 dB (6.8 dB)	**Rate 7/8 (16-QAM)** Guaranteed Eb/No: (typical value in parentheses) 8.1 dB (7.7 dB) 8.2 dB (7.8 dB) 8.3 dB (7.9 dB)
TURBO PRODUCT CODEC **Rate 17/18 QPSK** **Rate 17/18 8-PSK** **BER** **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For: BER=10^{-6} BER=10^{-7} BER=10^{-8}	**Rate 17/18 (Q)** Guaranteed Eb/No: (typical value in parentheses) 6.4 dB (6.0 dB) 6.7 dB (6.3 dB) 6.9 dB (6.5 dB)	**Rate 17/18 (8-PSK)** Guaranteed Eb/No: (typical value in parentheses) 9.3 dB (8.9 dB) 9.8 dB (9.4 dB) 10.3 dB (9.9 dB)	
HIGHER-ORDER MODULATION AND CODING **(with two adjacent carriers, each 7 dB higher than the desired carrier)**	For: BER=10^{-6} BER=10^{-8}	**16-QAM Rate 3/4 Viterbi/RS** Guaranteed Eb/No: (typical value in parentheses) 8.1 dB (7.5 dB) 8.6 dB (8.0 dB)	**16-QAM Rate 7/8 Viterbi/RS** Guaranteed Eb/No: (typical value in parentheses) 9.5 dB (9.0 dB) 10.1 dB (9.5 dB)	
Plesiochronous / Doppler Buffer	Selectable size of 512, 1024, 2048, 4096, 8192, 16384 and a32768 bits Size selection is displayed in bytes Supports asymmetric operation - when buffer is clocked from Tx clock, Rx and Tx rates do not need to be identical			
Monitor Functions	Eb/No estimate, 2 to 16 dB (± 0.10 dB accuracy) Corrected Bit Error Rate, 1E-3 to 1E-10 Frequency offset, ± 32 kHz range, 100 Hz resolution (70/140 MHz IF) Frequency offset, ± 200 kHz range, 100 Hz resolution (L-Band) Buffer fill state, in percent Receive signal level accuracy = ± 3.0 dB)			

1.5.3 Data Interfaces

Note: Features not in the initial product release are identified in parentheses.

EIA-530	Synchronous RS-232	25-pin D-sub (female)
EIA-530 (3 selectable modes)	EIA-422/EIA-530 DCE (Rates up to 12 Mbps) Also supports X.21(Rates up to 2.048 Mbps) V.35 DCE (Rates up to 12 Mbps) Synchronous RS-232 (Rates up to 300 kbps)	
G.703 (Balanced)	1.544 Mbps T1 (Balanced 100 Ω) 2.048 Mbps E1 (Balanced 120 Ω)	15-pin D-sub (female)
G.703 (Unbalanced)	1.544 Mbps T1 (unbalanced 75 Ω) 2.048 Mbps E1 (unbalanced 75 Ω) 8.448 Mbps E2 (unbalanced 75 Ω)	BNC (female)
Multi-Port G.703 (Bal) 1 to 4 Ports E1 w/ D&I	2.048 Mbps E1 (balanced 120 Ω) **Note:** All 4 ports must be synchronous	(4) RJ-45 Ports
EIA-612 / 613 (HSSI)	EIA-612/EIA-613 (Rates up to 20 Mbps)	50-pin, mini-D SCSI-II HSSI (female)
Modem Alarms (Present on all modules)	Relay outputs (Tx, Rx & unit faults) Demodulator I & Q test outputs (constellation) Demodulator Rx Signal Level output (0 to 2.5 volts) External carrier off input	15-pin D-sub (male)
Serial Remote Control	EIA-232 or EIA-485 modem control and monitoring	9-pin D-sub (male)
10/100BaseT	IP based monitoring & control	RJ-45

1.5.4 Automatic Uplink Power Control

Operating Mode	Requires Closed Network Framed mode for transport of Eb/No information from remote modem (EDMAC can be enabled or disabled)
Target Eb/No range	0 to 9.9 dB at remote demod (default is 4.0 dB)
Max AUPC range	0 to 9 dB (default is 3 dB)
Monitor functions	Remote demod Eb/No Tx power level increase (front panel or via remote control interface)

1.5.5 Data Rate Ranges

FEC Type	Modulation	Code Rate	Data Rate Range
Viterbi	BPSK	Rate 1/2	32 kbps to 5 Mbps
Viterbi	QPSK	Rate 1/2	32 kbps to 10 Mbps
Viterbi	QPSK	Rate 3/4	32 kbps to 15 Mbps
Viterbi	QPSK	Rate 7/8	32 kbps to 17.5 Mbps
Viterbi + R-S	BPSK	Rate 1/2	32 kbps to 4.5 Mbps
Viterbi + R-S	QPSK	Rate 1/2	32 kbps to 9.1 Mbps
Viterbi + R-S	QPSK	Rate 3/4	32 kbps to 13.7 Mbps
Viterbi + R-S	QPSK	Rate 7/8	32 kbps to 16 Mbps
Viterbi + R-S	16-QAM	Rate 3/4	349.1 kbps to 20 Mbps
Viterbi + R-S	16-QAM	Rate 7/8	407.3 kbps to 20 Mbps
TCM + RS	8-PSK	Rate 2/3	232.7 kbps to 18.3 Mbps
TPC	BPSK	Rate 5/16	32 kbps to 3.1 Mbps
TPC	BPSK	Rate 21/44	32 kbps to 4.7 Mbps
TPC	QPSK	Rate 21/44	32 kbps to 9.5 Mbps
TPC	QPSK	Rate 3/4	32 kbps to 15 Mbps
TPC	QPSK	Rate 7/8	32 kbps to 17.5 Mbps
TPC	QPSK	Rate 17/18	32 kbps to 18.888 Mbps
TPC	8-PSK	Rate 3/4	288 kbps to 20 Mbps
TPC	8-PSK	Rate 7/8	336 kbps to 20 Mbps
TPC	8-PSK	Rate 17/18	362 kbps to 20 Mbps
TPC	16-QAM	Rate 3/4	384 kbps to 20 Mbps
TPC	16-QAM	Rate 7/8	448 kbps to 20 Mbps

1.5.6 Framing Summary (Future)

Feature	Transparent	EDMAC (Future)
Overhead added	None	5% to 2 Mbps 1.5% (see Note 2)
Available data rates and format	All rates and formats	All rates and formats
Overhead components	None	Remote control link between modems' processor
Additional Reed-Solomon Overhead	220/200 225/205 219/201 for IESS-310 mode	200/180
Scrambling (see Note 1)	Basic ITU V.35 (Intelsat)	Proprietary scrambler

Notes:

1. When Reed-Solomon is Off.
2. % for Rates 5/16, 21/44 BPSK Turbo, Rate 21/44 QPSK Turbo, and all rates > 2 Mbps.

1.5.7 Miscellaneous

Front panel		• Tactile keypad: 6 keys (Up/Down, Left/Right, Enter/Clear) • VFD – Vacuum Fluorescent Display (blue): 2 lines of 40 characters each
Loopbacks		Internal IF loopback, RF loopback, digital loopback, and inward/outward loopback
Fault relays		Hardware fault, RX and TX Traffic Alarms
M&C Interface		EIA-232 and EIA-485 (addressable multidrop, 2-wire or 4-wire), 10/100 BaseT Ethernet
M&C Software		SATMAC software for control of local and distant units
AC Consumption	**CDM-Qx (70/140 MHz)**	120 watts (maximum)
	CDM-QxL (L-band)	250 watts (maximum)
AC Operating Voltage		100 to 240 VAC, +6%/-10% - autosensing (total absolute max. range is 90 to 254 VAC)
DC Operating Voltage		36 to 72 VDC, 6.25 amps
Temperature	**Operating**	0 to 50°C (32 to 122°F)
	Storage	-25 to 85 °C (-13 to 185°F)
Dimensions		1.75” H x 19” W x 19” D (44 mm H x 480 mm W x 480 mm D)
Weight		< 20 lbs (7.0 kg) approx (depends on configuration)

1.5.8 Approvals

CE Mark	EMC Safety
FCC	FCC Part 15 Class B

Chapter 2. INSTALLATION

2.1 Unpacking

The CDM-Qx/QxL Satellite Modem and its Installation and Operation Manual are packaged and shipped in a pre-formed, reusable cardboard carton containing foam spacing for maximum shipping protection.

CAUTION

Do not use any cutting tool that extends more than 1" into the container and cause damage to the unit.

IMPORTANT

Be sure to keep all shipping materials for the carrier's inspection.

Unpack and inspect the CDM-Qx/QxL as follows:

Step	Procedure
1	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.
2	Remove the packing list from the outside of the shipping carton.
3	Open the carton by cutting the tape at the top of the carton (indicated by OPEN THIS END).
4	Remove the cardboard/foam space covering the modem. Remove the modem, manual and power cord from the carton.
5	Check the contents against the packing list to verify completeness of the shipment.
6	Inspect the equipment for any possible damage incurred during shipment. If damage is evident, contact the carrier and Comtech EF Data immediately and submit a damage report.
7	Refer to the following sections for further installation instructions.

2.2 Mounting

If the CDM-Qx/QxL is to be mounted in a rack, ensure that there is adequate clearance for ventilation, particularly at the sides. 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).

2.2.1 Method A: Optional Rear-Mounting Support Brackets

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

Quantity	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 2-1** 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.

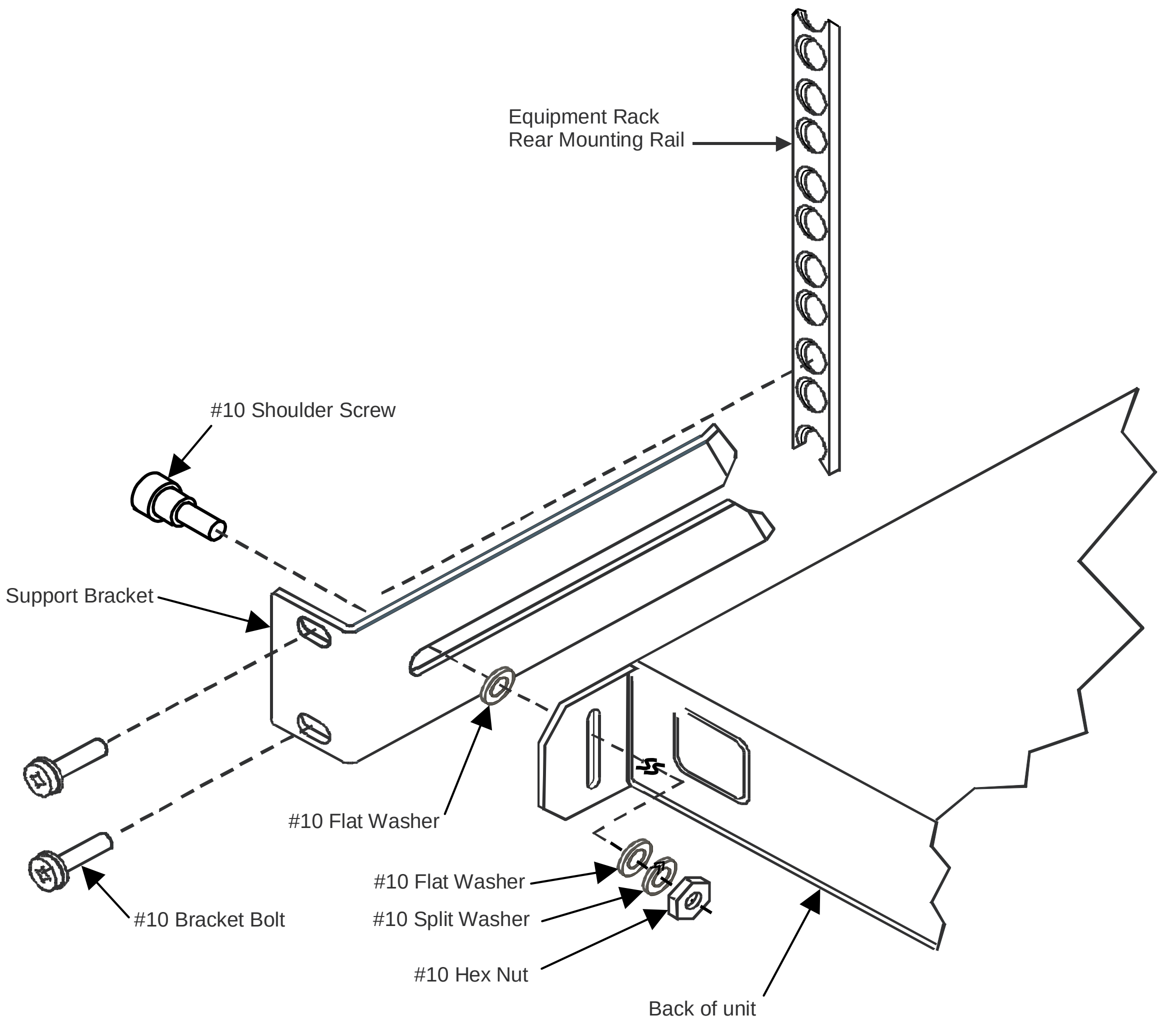
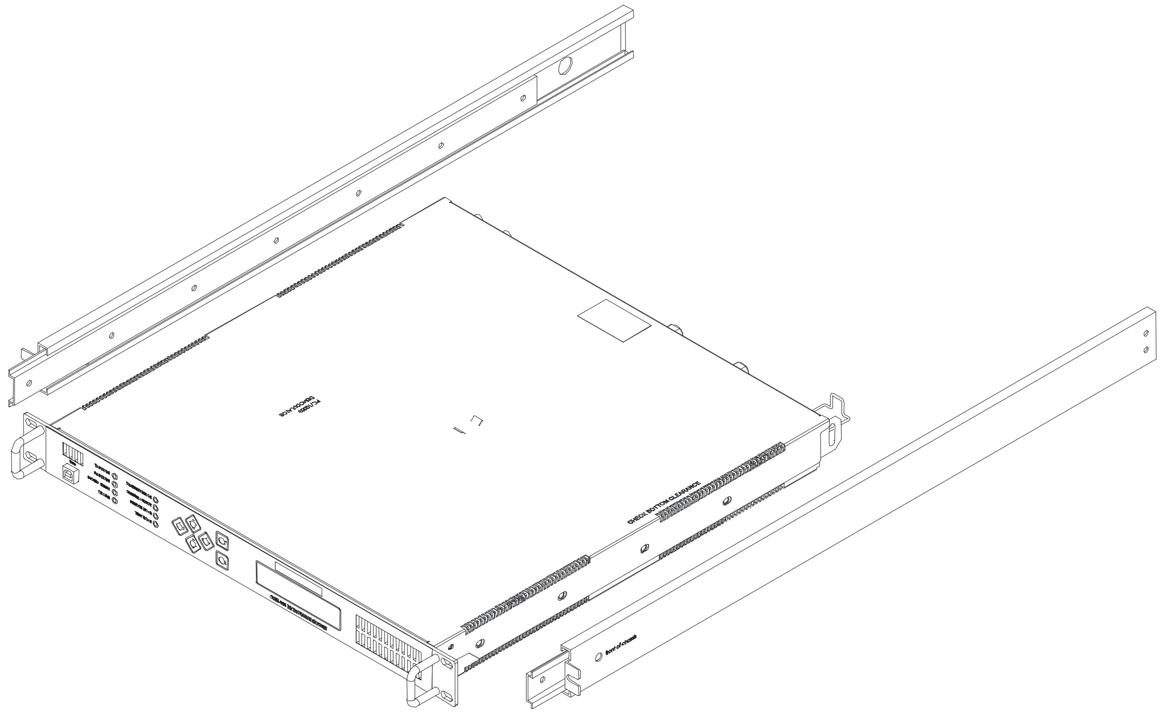


Figure 2-1. Installation of Optional Rear-Mounting Support Brackets

2.2.2 Method B: Optional Bearingless Side-Railings

Figure 2-2 depicts installation of the optional side-railings FP/SL0006, using standard shop tooling and customer-furnished standard shop hardware:



Optional Side-railings FP/SL0006		
Quantity	**CEFD Part Number**	**Description**
2	FP/SL0006	Bearingless Side-Railing

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

2.3 Configuration

The unit ships with a default Viterbi 192 kbps, QPSK, Rate 3/4 configuration. There are no internal jumpers to configure, no interface cards to install, and no other options to install: *all configurations are carried out entirely in software*.

The unit should first be configured locally, using the front panel keypad and display. Refer to **Chapter 5. FRONT PANEL OPERATION** for details on how to fully configure the unit for the desired operating parameters.

Note: The auto-sensing AC power supply does not require any adjustments. Simply plug in the supplied line cord, and turn on the switch on the rear panel.

2.4 Select Internal IF Loop

Correct operation of the unit may be verified rapidly, without the need for externally connected equipment, provided that there is at least one modulator and one demodulator installed:

1. From the top-level menu, select **CONFIG → GROUP → MODEM**.

   IMPORTANT

   This will require a modulator, with TX Output* ON *or* ENABLED*, installed in the rear panel of the chassis into the slot above its paired demodulator.

2. From the top-level menu, select **TEST → IF LOOP** (refer to **Chapter 5. FRONT PANEL OPERATION** for details).

The demod should synchronize, and the green **Rx TRAFFIC** LED should illuminate. If the unit does not pass this test, call Comtech EF Data Customer Support for assistance.

2.5 Connect External Cables

Having verified correct operation in IF loop, enter the desired configuration and proceed to connect all external cables to the connectors outlined in the next chapter (**Chapter 3. REAR PANEL CONNECTOR PINOUTS**). Should difficulties occur, call Comtech EF Data Customer Support for assistance.

Observe the following:

- If modulators and demodulators are to be used without grouping them as a modem, a data interface cable is required to plug into each unit. If a modulator and demodulator are paired as a modem, the modulator must be located above the demodulator and a single data interface cable is used simply by connecting it to the demodulator.
- If a modulator, demodulator, or pair (modem) is defined as a backup unit, a data interface cable is not required to the unit or units.

CAUTION

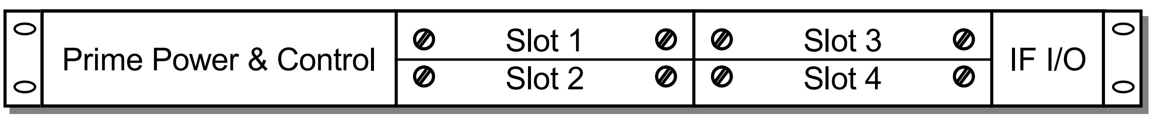
Each modulator has an output power level in the range -5 to -25 dBm (-5 to -45 dBm for L-Band). Even though there is a single IF output connector and a single IF input connector, all four slots are hooked up by way of internal power splitters and summers. If two modulators are turned on, the total power out will be 3 dB higher (assuming both modulators are set to the same power level). If four modulators are turned on, the total power out will be 6 dB higher (assuming all modulators are set to the same power level).

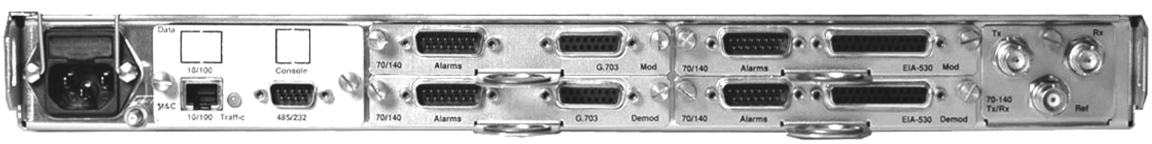
Notes:

Chapter 3. REAR PANEL CONNECTORS

3.1 Connector Overview

The CDM-Qx/QxL Multi-Channel Satellite Modem rear panel can be customized to meet user requirements. As per the three configuration examples shown here in **Figure 3-1**, optional data interface modules, used in tandem with the base chassis connectors, provide all necessary external connections between the modem and other equipment.





Configuration #1 **Modem 1 with G.703 T1/E1 Balanced (DB-15)**
Modem 2 with EIA-422 (DB-25)

Configuration #2 **Modem 1 with G.703 T1/E1 Unbalanced (BNC)**
Modem 2 with EIA-422 (DB-25)

Configuration #3 **Modem 1 with G.703 T1/E1 Balanced (DB-15) and**
Quad E1 Interface Module, 1-4 Ports of E1, with D&I (4) RJ-45

Figure 3-1. CDM-Qx/QxL Rear Panel Configuration Examples

On the next page, **Table 3-1** summarizes the connectors provided on the rear panel for both the base chassis and the optional data interfaces, grouped according to service function.

Note the following:

1. One interface per Modem (i.e. Modulator and Demodulator card combination) or one interface per Modulator card and Demodulator card are required if used independently.
2. When grouping a modulator and demodulator together to use as a modem, the modulator must be located above the demodulator.
3. For redundant operation the backup unit does not need an interface.
4. For redundant operation the backup unit needs to be located in the lower right hand slot (Slot #4) for single module redundancy. For modem redundancy the backup units must be located in the right hand slots (Slots #3 & #4).
5. For the example shown for Configuration #1, because all modules have interfaces, the following configurations are possible:
    a. Two independent modulators - one with a G.703 balanced and the other with an EIA-530 interface, with two independent demodulators one with a G.703 balanced and the other with an EIA-530 interface.
    b. Two independent modems - one with a G.703 balanced and the other with an EIA-530 interface (located on the demodulators).
    c. A 1:1 redundant modem, with the online unit configured with a G.703 interface. The off line modules will provide the backup even with a different interface.
6. For the example shown for Configuration #3, the Quad E1 Interface Module is used in Slots #3 and #4. The modulator in Slot 1 is grouped with the demodulator in Slot 2. This unique combination allows the user to select the Quad E1 interface or the data interface located in the modulator or demodulator.

Table 3-1. Rear Panel External Connections

Name		Ref Des	Conn Type	Function
Base Chassis: TYPICAL ALL CONFIGURATIONS (See Sect. 3.2)				
AC Plug			IEC	Modem Power
DC Plug (Optional – CDM-QxL)			Terminal Block	Modem Power
Ground			#10-32 Stud	Grounding
M&C 10/100BaseT			RJ-45	Remote Interface
485/232			9-Pin Male	Remote Interface
70/140 Tx /Rx (CDM-Qx)	Tx		BNC	RF Output 75Ω or 50Ω
	Rx		BNC	RF Input 75Ω or 50Ω
L-Band Tx/Rx (CDM-QxL)	Tx		Type 'N'	RF Output 50Ω
	Rx		Type 'N'	RF Input 50Ω
Ref			BNC	External Reference for Modem Synthesizers
Configuration #1: Modem1 with G.703 T1/E1 Balanced (DB-15); Modem2 with EIA-422 (DB-25)				
Slot #1 Mod	Alarms		15-Pin Male	Form-C Alarms
	G.703		15-Pin Female	Balanced G.703 Data Input
Slot #2 Demod	Alarms		15-Pin Male	Form-C Alarms
	G.703		15-Pin Female	Balanced G.703 Data Output, or Input/Output
Slot #3 Mod	Alarms		15-Pin Male	Form-C Alarms
	EIA-530		25-Pin Female	Data Input
Slot #4 Demod	Alarms		15-Pin Male	Form-C Alarms
	EIA-530		25-Pin Female	Data Output, or Input/Output
Configuration #2: Modem 1 with G.703 EIA-422(DB-25); Modem2 with G.703 T1/E1 Unbalanced (BNC)				
Slot #1 Mod	Alarms		15-Pin Male	Form-C Alarms
	G.703		BNC	Unbalanced G.703 Data Output (incorrect slot for IO)
Slot #2 Demod	Alarms		15-Pin Male	Form-C Alarms
	G.703		BNC	Unbalanced G.703 Data input
Slot #3 Mod	Alarms		15-Pin Male	Form-C Alarms
	EIA-530		25-Pin Female	Data Input
Slot #4 Demod	Alarms		15-Pin Male	Form-C Alarms
	EIA-530		25-Pin Female	Data Output, or Input/Output
Configuration #3: Modem 1 with G.703 T1/E1 Balanced (DB-15) and Quad E1 Interface (1-4 Ports E1,w/ D&I)				
Slot #1 Mod	Alarms		15-Pin Male	Form-C Alarms
	G.703		BNC	Unbalanced G.703 Data Output (incorrect slot for IO)
Slot #2 Demod	Alarms		15-Pin Male	Form-C Alarms
	G.703		BNC	Unbalanced G.703 Data input
Slot #3 and Slot#4 Quad E1	Port 1	J1	RJ-45	Balanced E1 (Full E1 or Fractional D&I)
	Port 2	J2	RJ-45	Balanced E1 (Full E1 or Fractional D&I)
	Port 3	J3	RJ-45	Balanced E1 (Full E1 or Fractional D&I)
	Port 4	J4	RJ-45	Balanced E1 (Full E1 or Fractional D&I)
	Ext Ref	J5	9-Pin Female	Balanced E1 clock input and output

Note: *The European EMC Directive (EN55022, EN50082-1) requires using properly shielded cables for DATA I/O.*

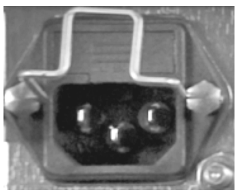
3.2 Base Chassis Connections

3.2.1 Power Connector

IMPORTANT

For continued operator safety, always replace the fuses with the correct type and rating.

3.2.1.1 AC Power Connector



A standard, detachable, non-locking, 3-prong power cord (IEC plug) supplies the Alternating Current (AC) power to the modem. Observe the following:

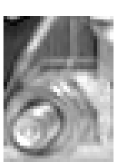
AC Power Specifications	
Input Power	290W maximum, 110W typical without BUC power supply.
Input Voltage	100 - 240 volts AC, +6/-10% - autosensing (total absolute max. range is 90 to 254 VAC)
Connector Type	IEC
Fuse Protection	**CDM-Qx (70/140):** 2.0A Slow-blow Line and neutral fusing 20 mm type fuses
	CDM-QxL (L-Band): 3.15A Slow-blow Line and neutral fusing 20 mm type fuses

3.2.1.2 DC Power Supply (CDM-QxL, Optional)

A standard, 3-screw terminal block supplies the Direct Current (DC) power to the modem. Observe the following:

DC Power Specifications	
Input Power	250W maximum, 110W typical without BUC power supply.
Input Voltage	36 to 72 VDC; 6.25 amps
Connector Type	Terminal Block
Fuse Protection	6.25A Slow-blow **With 24 VDC BUC: TBD** **With 48 VDC BUC: TBD**

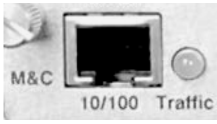
3.2.2 Ground Connector



A #10-32 stud, located adjacent to the power connection on the rear panel of the modem, is used for connecting a common chassis ground among equipment.

Note: The AC power connector provides the safety ground.

3.2.3 M&C 10/100BaseT Connector



The M&C 10/100BaseT connector is an 8-pin RJ-45 10/100BaseT Ethernet port providing access to the modem's management functions. A green LED lights to acknowledge data traffic.

3.2.4 485/232 Connector

The 485/232 connector is a 9-pin 'D' type male (DB-9M). Access is provided to remote control ports of the modem, using both EIA-232 and EIA-485.

Table 3-2. 485/232 (Remote Control) Connector Pin Assignments

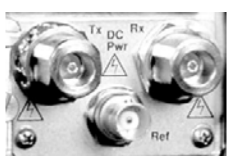
Pin #	Description	Direction
1	Ground	
2	RS-232 TX Data	Out
3	RS-232 RX Data	In
4	Reserved - do not connect to this pin	
5	Ground	
6	RS-485 RX Data B *	In
7	RS-485 RX Data A *	In
8	RS-485 TX Data B	Out
9	RS-485 TX Data A	Out

***Use for 2-wire RS-485 operation**

3.2.5 Tx and Rx IF Connectors

The type of IF connectors available depends on the configuration ordered. The following reflects the configurations available:

70/140 MHz



L-Band

Tx and Rx:

- CDM-Qx (70/140 MHz) – BNC 75Ω
- CDM-QxL (L-Band) – Type 'N' 50Ω

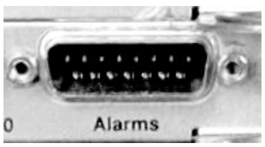
There may be DC voltages present on the Type 'N' Rx and Tx IF connectors, up to a maximum of 48 volts.

3.2.6 Ext Ref Connector

The Ref connector is a Type 'BNC' female 50Ω connector, standard on all configurations as shown in Sect. 3.2.5 (above). It provides an external reference input for the Tx and Rx IF synthesizers and for the internal transmit clock. The load impedance is 60.4Ω, so the VSWR is less than 1.25:1 at either 50Ω or 75Ω. Input level is 0 dBm minimum to +20 dBm maximum at either 1, 2, 5, 10, or 20 MHz. When external reference is enabled, the internal 10 MHz reference oscillator is phase locked to the external reference input by a 10Hz bandwidth PLL. If no activity is present at the external reference input, the modem will revert to the internal 10 MHz reference.

3.3 Data Interface Connectors

3.3.1 Typical Alarms Connector



All available data interface modules contain a 15-pin 'D' type male (DB-15M) **Alarms** connector. The Alarms connector provides the user with access to the Form-C relay contacts, which indicate the fault status of the unit. These are typically connected to an external fault monitoring system, often found in satellite earth stations.

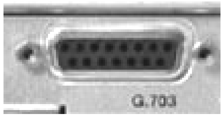
For a Modulator: TX fault and Unit Fault are supported. The transmit I and Q modulator samples are available on this connector. Connecting these signals to an oscilloscope in X,Y mode will provide the modulator signal constellation diagram, which is a useful diagnostic aid. A pin also is provided which can mute the transmit carrier. This requires that the pin be shorted to ground, or a TTL 'low'.

For a Demodulator: RX fault and Unit Fault are supported. If a Modulator and Demodulator are vertically grouped together as a modem, TX fault and the EXT Carrier OFF pin will also be supported. The receive I and Q demodulator samples are provided on this connector. Connecting these signals to an oscilloscope in X,Y mode will provide the receive signal constellation diagram, which is a useful diagnostic aid.

Table 3-3. Alarms Interface Connector Pin Assignments

Pin #	Signal Function	Name
8 15 7	RX Traffic (De-energized, Faulted) RX Traffic (Energized, No Fault) RX Traffic	RX-NC RX-NO RX-COM
14 6 13	TX Traffic (De-energized, Faulted) TX Traffic (Energized, No Fault) TX Traffic	TX-NC TX-NO TX-COM
5 12 4	Unit Fault (De-energized, Faulted) Unit Fault (Energized, No Fault) Unit Fault	UNIT-NC UNIT-NO UNIT-COM
11 3	I Channel (Constellation monitor) Q Channel (Constellation monitor)	TX or RX-I TX or RX-Q
10	No Connection	N/C
2	No Connection	N/C
9	EXT Carrier OFF (modulator or modulator and demodulator grouped together)	EXT-OFF
1	Ground	GND

3.3.2 Balanced G.703 Connector Tx/Rx Connector



The Balanced G.703 connection is a 15-pin 'D' type female (DB-15F) connector located on the rear mounting plate of the modulator or demodulator. If a Modulator and Demodulator are vertically grouped together as a modem, the data interface connector on the Demodulator switches to duplex. This feature allows a single data interface connection to be used for a modem instead of needing a "Y" cable. Otherwise, each module is a simplex data interface.

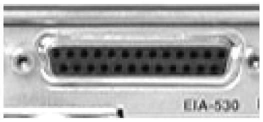
Table 3-4. Balanced G.703 Interface Connector Pin Assignments

Pin #	Signal Function	Name	Direction
1	Drop Data Input (-)	DDI–	In
9	Drop Data Input (+)	DDI+	In
2	Ground	GND	
10	Not Used		
3	Insert Data Output (-)	IDO–	Out
11	Insert Data Output (+)	IDO+	Out
4	Ground	GND	
12	Drop Data Output (-)	DDO–	Out (D&I Only)
5	Drop Data Output (+)	DDO+	Out (D&I Only)
13	Insert Data Input (-)	IDI–	In (D&I Only)
6	Insert Data Input (+)	IDI+	In (D&I Only)
14	Not Used		
7	Not Used		
15	Not Used		
8	Not Used		

3.3.3 Unbalanced G.703 Tx/Rx Connectors

Two female BNC 75Ω connectors are available for unbalanced operation at the G.703 data rates of T1 (1.544 Mbps), E1 (2.048 Mbps), and E2 (8.448 Mbps). If a Modulator and Demodulator are vertically grouped together as a modem, the Tx data input interface connector on the Demodulator becomes active, allowing duplex operation. Otherwise, the Tx data input connector is used on the modulator and the Rx data output connector is used on the demodulator.

3.3.4 EIA-530 Data Interface Connector



The Data connector is a 25-pin 'D' type female (DB-25F). This connector conforms to the RS-530 pinout, which allows for connection of different electrical standards, including EIA-422, V.35, and EIA-232.

IMPORTANT

All data interfaces are duplex! They will only operate as duplex if a Modulator and Demodulator are vertically grouped together as a modem. In that case the data interface connector on the Demodulator switches to duplex. This feature allows a single data interface connection to be used for a modem instead of needing a "Y" cable. Otherwise, the data interface for each module will only operate as simplex.

It is the responsibility of the user to provide the appropriate cables to connect to this EIA-530 connector.

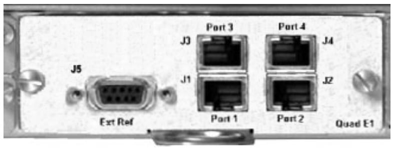
Table 3-5. RS-530 Data Interface Connector Pin Assignments

Pin #	Generic Signal Description	Direction	RS-422 RS- 530 LVDS	V.35	RS-232	Circuit #
2	TX Data A	DTE to Modem	SD A	SD A	BA	103
14	TX Data B	DTE to Modem	SD B	SD B	-	103
24	TX Clock A	DTE to Modem	TT A	SCTE A	DA	113
11	TX Clock B	DTE to Modem	TT B	SCTE B	-	113
15	INT TX Clock A	Modem to DTE	ST A	SCT A	DB	114
12	INT TX Clock B	Modem to DTE	ST B	SCT B	-	114
3	RX Data A	Modem to DTE	RD A	RD A	BB	104
16	RX Data B	Modem to DTE	RD B	RD B	-	104
17	RX Clock A	Modem to DTE	RT A	SCR A	DD	115
9	RX Clock B	Modem to DTE	RT B	SCR B	-	115
8	Receiver Ready A	Modem to DTE	RR A	RLSD *	CF	109
10	Receiver Ready B	Modem to DTE	RR B	-	-	109
23	External Carrier Off (RS-232 '1' or TTL 'low')	DTE to Modem	-	-	-	-
7	Signal Ground	-	SG	SG	AB	102
1	Shield	-	Shield	FG	AN	101

Notes:

1. Receiver Ready is an RS-232 -level control signal on a V.35 interface.
2. DO NOT connect signals to pins which are not shown - these pins are reserved for use by the redundancy system.
3. 'B' signal lines are not used for RS-232 applications.
4. For X.21 operation, use the EIA-422 pins, but ignore RX Clock if the Modem is DTE, and ignore TX clocks if the Modem is DCE.

3.3.5 Quad E1 Data Interface Connectors



The Quad E1 Data interface card allows the user to connect one to four different terrestrial E1 ports, with each port independently configurable for full E1 (framed or unframed E1 data), or fractional E1 (with D&I). These four RJ-45 ports – labeled **J1 Port 1** through **J4 Port 4**, respectively, on the interface card – must be synchronized to each other.

Table 3-6. Quad E1 Data Interface J1-J4 Connector Pin Assignments

Pin #	Signal Function	Name	Direction
1	DDI (+)	Port_Tx+	In
2	DDI (-)	Port_Tx–	In
3	Ground	Gnd	--
4	IDO (+)	Port_Rx+	Out
5	IDO (-)	Port_Rx–	Out
6	Ground	Gnd	--
7	Unused	NC	--
8	Unused	NC	--

The **J5 Ext Ref** connector is a 9-pin Type 'D' female (DB-9F) connector on the interface card that provides two functions:

1. The first function is to provide an output E1 clock for the user to use as an E1 clock reference (if needed for the terrestrial E1 equipment).
2. The second purpose of the connector is to allow the user to provide a reference E1 input clock. The user can then use this E1 clock input to drive the demodulator receive buffer. Refer to **Chapter 5. FRONT PANEL OPERATION**, in particular the section outlining **Config → Rx → Buf → RX BUFFER CLOCK SOURCE**, for further information.

Table 3-7. Quad E1 Clock Interface J5, DB-9F Connector Pin Assignments

Pin #	Signal Function	Name	Direction
1	E1 Clk Ref Out (-)	E1 Clk Out (-)	Out
2	Unused	NC	--
3	Ground	Gnd	--
4	Unused	NC	--
5	E1 Clk Ref In (+)	E1 Clk In (+)	In
6	E1 Clk Ref Out (+)	E1 Clk Out (+)	Out
7	Unused	NC	--
8	Unused	NC	--
9	E1 Clk Ref In (-)	E1 Clk In (-)	In

3.3.6 HSSI Interface and Connectors

This data interface is a plug-in module that inserts into the rear of the CDM-Qx/QxL's Modulators or Demodulators. It provides physical and electrical connection between the external terrestrial device and the internal circuitry of the modulator or demodulator. By convention, a modem is **D**ata **C**ommunications **E**quipment (DCE) where Tx data enters the data interface and Rx data exits it. The plug-in interface has full duplex capability.

The HSSI Card Data Interface Module plugs into the rear of the Modulator or Demodulator. **Figure 3-2** shows a block diagram of the interface.

The HSSI interface provides:

- A single HSSI interface;
- A DCE Connection:
  - ST clock is sourced to the terrestrial interface for use as reference by DTE
  - TT is treated as an incoming External Clock, and the interface phase locks to it
  - TA / CA is supported

Additionally, the module is automatically configured for simplex-transmit or simplex-receive operation when the module is plugged into a Modulator and Demodulator. When the CDM-Qx/QxL is configured as a modem, only the Demodulator is required to have a HSSI Interface and the Modulator is assigned a blank panel with the **Alarms** output only, as shown in **Figure 3-3** on the next page.

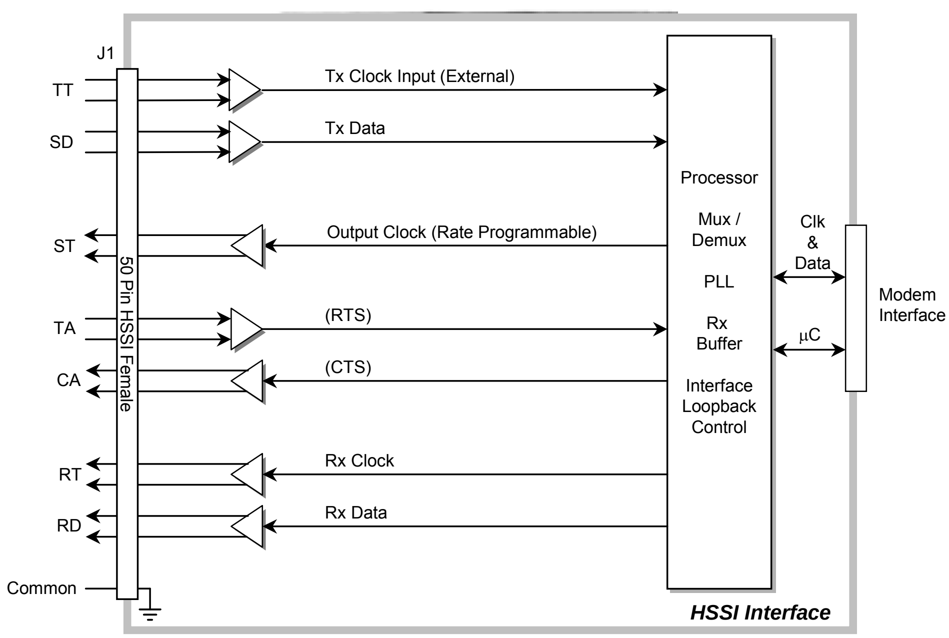


Figure 3-2. HSSI Interface Block Diagram

A summary of specifications for the interface is provided in Sect. **3.3.6.1**; the HSSI connector pin assignments are provided in **Sect. 3.3.6.2** (see **Sect. 3.3.1** for more information on the **Alarms** connector).

3.3.6.1 HSSI Interface Specifications

Item		**Requirement**
Data Rate Range		32 to 20 Mbps
Signals Supported		ST, TT (or external) , SD, TA, CA, RT, RD, SG
Connector		DCE, 50-pin mini-D female per EIA-613 (HSSI)
Electrical		Per EIA-612 (10KH ECL compatible).
Electrical Typical		Differential output voltage: ≥ 590 mV pp into 110Ω load Differential Input voltage: 150 to 1000 mV pp with 110Ω load
Minimum Buffer Size		5.0 mS smallest buffer setting, 0.1 mS step size, 32 mS maximum size
Impedance	**Tx**	110Ω for TT, SD, TA
	Rx	ST, CA, RT, RD will drive 110Ω and meet HSSI voltage levels
Signal Characteristics		The A terminal is *negative* with respect to the B terminal for a binary 0 (Space or OFF) state.
		The A terminal is *positive* with respect to the B Terminal for a binary 1 (Mark or ON) state.
Clock / Data Relationship		The data transitions occur during the OFF to ON transition of the clock. Data is stable during the ON to Off transition of the clock.
Tx Clock Modes		TT (Input clock) continuous. ST (output clock) is continuous output, programmable in 1 bps steps or phase locked to satellite clock
Rx Clock Modes		RT (output clock) is continuous from satellite, ST (internal clock), continuous from TT
Tx / Rx Clock		Asymmetrical clocking with Rx Doppler buffer disabled
TA / CA	**Default**	CA looped to TA
	Selection	CA is asserted when there is no modem fault
Operation		Simplex (Tx only or Rx only) or full duplex
Signal Sense		Programmable Normal or Inverted or TT and TD, RT and RD
Cable Length to 20 Mbps		2 M (6 ft) nominal, up to 15 M (49 ft) maximum – note higher data rates usually require shorter cable lengths

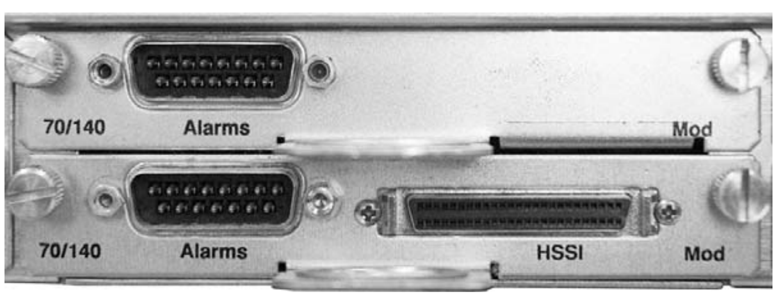
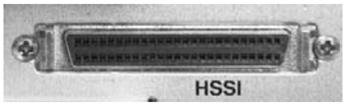


Figure 3-3. HSSI Interface Example

3.3.6.2 HSSI Connector Pin Assignments



The HSSI interface features a 50-pin female SCSI-2 connector (mini-D), with pin assignments as follows:

Signal Function	HSSI Signal	EIA-613 Circuit	Pin # (+,-)	Circuit Direction	Comment
Signal Ground	SG	102	1, 26		Ground
Receive Timing	RT	115	2, 27	from DCE	
DCE Available	CA	107	3, 28	from DCE	
Receive Data	RD	104	4, 29	from DCE	
Loopback circuit C	LC	undefined	5, 30	from DCE	Not used
Send Timing	ST	114	6, 31	from DCE	
Signal Ground	SG	102	7, 32		Ground
DTE Available	TA	108/2	8, 33	to DCE	
Terminal Timing	TT	113	9, 34	to DCE	
Loopback Circuit A	LA	143	10, 35	to DCE	Not used
Send Data	SD	103	11, 36	to DCE	
Loopback Circuit B	LB	144	12, 37	to DCE	Not used
Signal Ground	SG	102	13, 38		Ground
Not used		undefined	14, 39		Not used
TX DVALID		undefined	15, 40		Not used
Ext Carrier Off			16	to DCE	Not used
reserved (to DCE)			17, 42		Not used
reserved (to DCE)			18, 43		Not used
Signal Ground	SG	102	19, 44		Ground
Carrier Detect		undefined	20	from DCE	
		undefined	45		Not used
		undefined	21		Not used
reserved (to DTE)			46		Not used
		undefined	22, 47	from DCE	Not used
		undefined	23, 48	from DCE	Not used
		142	24, 49	from DCE	Not used
Signal Ground	SG	102	25, 50		Ground

Chapter 4. FLASH UPGRADING

4.1 Flash Updating via Internet

The CDM-Qx/QxL Open Network Satellite Modem eliminates the need for updating firmware by physically replacing EPROMs. Instead, the CDM-Qx/QxL uses 'Flash memory' technology internally. This makes software upgrading very simple, and updates can now be sent via the Internet (**Figure 4-1**), via E-mail, or on CD.

This chapter outlines the complete upgrading process as follows:

- New firmware can be downloaded via the Internet to an external PC.
- The upgrade can be performed without opening the CDM-Qx/QxL by simply connecting the unit to the USB or serial port of a computer.
- The firmware update is transferred, via File Transfer Protocol (FTP), to the CDM-Qx/QxL.

Figure 4-1. Flash Update via Internet

4.2 Ethernet FTP Upload Procedure

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

   The current base modem M&C version can be viewed at the top level menu of the front panel display (press the **CLEAR** key several times to view). The firmware information can also be found within the **SELECT: UTIL→ Firmware → Info → Image#1** or **Image#2** menu trees.

   Using serial remote control, the firmware revision levels can be queried with the following commands:

   Abbreviated: **<0/SWR?** **or:** *Detailed:* **<0/FRW?**

   See **Appendix C. REMOTE CONTROL** for more information on using remote commands and queries.

   Alternately, when using the Base Modem Web Server Interface, the Bootrom, Bulk1 and Bulk2 firmware loads may be viewed after selecting the **Unit Info** hyperlink (available under the **Maint** [Maintenance] page tab). For more information, refer to **Chapter 7. WEB SERVER INTERFACE**.

2. **Create** a temporary directory (folder) on an external PC.

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

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

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

3. **Download** the ***correct*** firmware file to this temporary folder.

   IMPORTANT

   As of July 2008, Comtech EF Data began incorporating an enhanced flash memory chip into its chassis design. To accommodate this design upgrade, units that employ the original vs. the currently-used flash memory chips are identifiable by the installed Firmware Version.

   Observe the following:

   - **Original chassis = units typically manufactured prior to July 2008: Firmware No. FW/11245 (Version 1.X.X ↑)**
   - **Upgraded chassis = units typically manufactured from July 2008 to present: Firmware No. FW0000107 (Version 2.1.1↑)**

   Note that, while the functionality of the two firmware versions is transparent to the user, these firmware products may not ***be cross-utilized. Always be sure to identify the chassis in use by its installed firmware prior to attempting any firmware flash upgrade, then download the appropriate firmware as needed.***

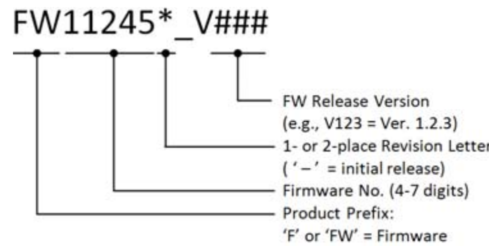
   As shown in **Figure 4-1**:

   a) **Go online** to: www.comtechefdata.com
   b) **Click on:** ***Support*** tab
   c) **Click on:** ***Software Downloads*** drop-down *or* hyperlink from ***Support*** page
   d) **Click on:** ***Download Flash and Software Update Files*** icon
   e) **Click on:** ***(Select a Product Line) Satellite Modems*** hyperlink

f) **Select** the **CDM-Qx & QxL** product hyperlink

g) **Select** the appropriate firmware hyperlink.

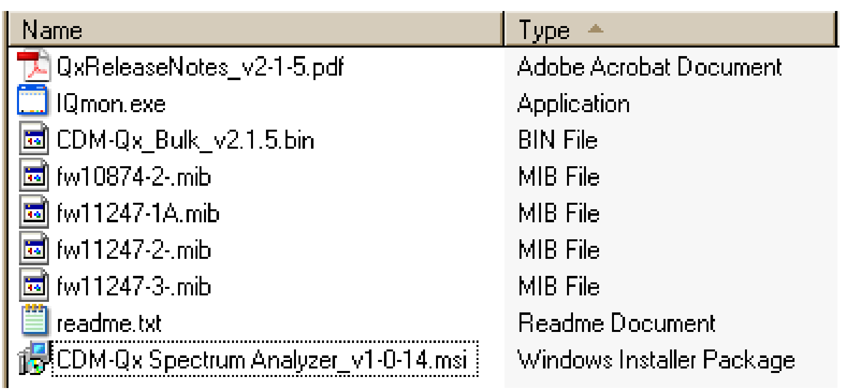
About Firmware Numbers, File Versions, and Formats: The flashable files on the download server are organized by product prefix; firmware number (verify that the correct firmware number is known – see Step 1); revision letter, if applicable; and release version. Where the asterisk is the 1- or 2-place revision letter and V### represents the firmware version; per the chassis restrictions mentioned on the previous page, the bulk firmware for the CDM-Qx/QxL is **FW11245*_V1##** or **FW-0000107 V2##**.



The current version firmware releases are provided. If applicable, a minimum of one version prior to each current release is also available. Be sure to identify and download the desired version. The downloadable files are stored in two formats: *.exe (self-extracting) and *.zip (compressed). Some firewalls will not allow the downloading of *.exe files. In this case, download the *.zip file instead.

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

4. **Unzip t**he files in the temporary folder on the PC. At least three files should be extracted (the FW0000107E.zip firmware download is shown in this example):



Name	Type
QxReleaseNotes_v2-1-5.pdf	Adobe Acrobat Document
IQmon.exe	Application
CDM-Qx_Bulk_v2.1.5.bin	BIN File
fw10874-2-.mib	MIB File
fw11247-1A.mib	MIB File
fw11247-2-.mib	MIB File
fw11247-3-.mib	MIB File
readme.txt	Readme Document
CDM-Qx Spectrum Analyzer_v1-0-14.msi	Windows Installer Package

- **QxReleaseNotes_v#-#-#.pdf** (or a variation of that filename): Firmware Version Release notes, where "v#-#-#" denotes the firmware version.
- **CDM-Qx_Bulk_v#-#-#.bin:** Firmware, where "v#-#-#" denotes the firmware version.
- **readme.txt:** Download instructions.

5. **Confirm** that the files have been extracted to the specified temporary folder on the PC. In DOS, use "**cd c:\temp**" to change to the temporary directory created in Step 2, then use the "**dir**" command to list the files extracted from the downloaded archive file.

6. **Connect** the external PC serial port to the CDM-Qx/QxL modem **M&C 10/100** Ethernet port via a hub or a switch, or directly to a PC using a crossover cable.

IMPORTANT

Base modem firmware can be loaded via the Ethernet M&C port.

7. **Send a "ping" command** to the modem to verify the connection and communication.

   First, determine the IP address of the modem remotely or using the front panel:

   - Remotely - use the **<0/IPA?** command
   - Front panel – Use the **SELECT: CONFIG → Remote → Remote →Ethernet** menu.

   Then**, using DOS** to PING (and FTP): Click "**Start**" on the Windows toolbar, then select the "**Run...**" option. As an alternative, use the "**DOS Prompt**" or "**Command Prompt**" icons in the **Start Menu:**

   - **Using Win95 or Win98:** Type "**command**".
   - **Using WinNT, Win2K or WinXP:** Type "**cmd**".

   At the DOS prompt, type "**ping** ***xxx.xxx.xxx.xxx***" (where "*xxx.xxx.xxx.xxx*" is the modem IP address). The results should confirm whether or not the modem is connected and communicating.

8. **Initiate** an FTP session with the modem (the example uses a DOS window):

   a. From the PC, type "**ftp xxx.xxx.xxx.xxx**" where "xxx.xxx.xxx.xxx" is the IP address of the CDM-Qx/QxL.

   b. **Enter** your admin user name and password to complete login.

   c. **Verify** the FTP transfer is binary by typing "**bin**".

   d. **Type** "**prompt**" then type "**hash**" to facilitate the file transfers.

9. **Transfer** the files.

   Type "**put FW0000114*.bin bulk:**" to begin the file transfers. The destination "**bulk:**" must be all lower case. It will take approximately one minute to transfer the file.

10. **Verify** the file transfer.

    a. The PC should report that the file transfer has occurred, and the display on the modem will stop reporting:

```
Sector  |  REFLASHING.......... PLEASE WAIT
No. XXX |  [███████████████]
```

    b. **Terminate the FTP session** by typing "bye" and closing the DOS window.

    c. **Verify** that the new file loaded using the procedure in Step 1.

    IMPORTANT

    Do NOT ***power down the modem while reflashing –*** please wait!

    d. **Change** the desired image to boot from the modem font panel menu: **SELECT: UTIL → Firmware → Select** and use the left or right arrows (◄►) on the front panel keypad to change to the other image, **then reboot the modem.**

11. **Verify** the new firmware versions are booting by observing the version identified on the 'splash page' of the modem display:

```
<MDF>   |  Comtech CDM-Qx Modem
        |  Firmware Version: V2.1.5
```

Chapter 5. FRONT PANEL OPERATION

5.1 Front Panel Overview

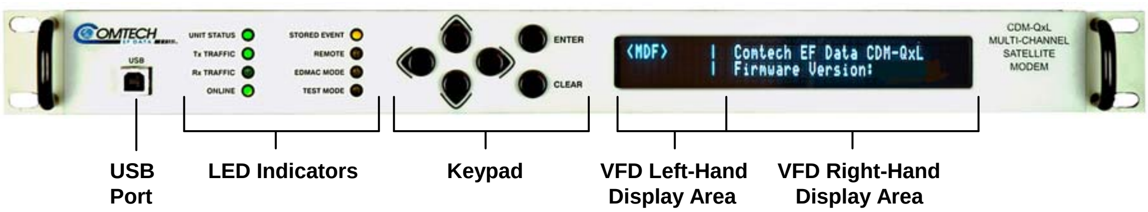


Figure 5-1. CDM-Qx/QxL – Front Panel View

The user can fully control and monitor the operation of the CDM-Qx/QxL 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.

Figure 5-1 identifies the key features of the front panel, which are explained in greater detail in the sections that follow.

5.1.1 USB Port

This USB Slave connector allows the user to reflash firmware. See **Chapter 4. FLASH UPGRADING** for complete information about firmware upgrade procedures for the CDM-Qx/QxL.

5.1.2 LED Indicators

IMPORTANT

In general, the Alarm relay state will reflect the state of the Front Panel LEDs. For example, if the Unit Status LED is red, the Unit Alarm relay will be active, etc. The one exception is the Transmit Traffic relay. This will only be activated if a Transmit Traffic Fault exists – it does not reflect the state of the Tx carrier.

The function of the eight front panel LED indicators is as follows:

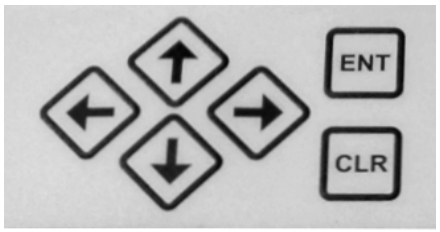
LED	Condition	
Unit Status	**Red**	A Unit Fault exists (**Example:** PSU fault)
	Green	No Unit Faults
		Note: Unit fault does not include Tx or Rx fault.
Transmit Traffic	**Green**	No Tx Traffic Faults
	Off	A Tx Traffic fault exists or the Tx Carrier is in OFF state
		Note: This LED corresponds to the selected slot, example <TX>.
Receive Traffic	**Green**	No Rx Traffic Faults (demod and Viterbi decoder are locked, everything is OK)
	Off	An Rx Traffic fault exists (the demod may still be OK – check the fault status of the unit from the Monitor menu).
		Note: This LED corresponds to the selected slot, example <RX>.
Online	**Green**	The Unit is On Line, and carrying traffic
	Off	The Unit is Off Line (standby) - forced by externally connected 1:1 or 1:N redundancy system
		Note: This LED corresponds to the selected slot, example <RX>.
Stored Event	**Orange**	There is a Stored Event in the log, which can be viewed from the front panel, or retrieved via the remote control interface
	Off	There are no Stored Events
Remote	**Orange**	The Unit is in Remote Mode - local monitoring is possible, but no local control
	Off	The Unit is in Local Mode - remote monitoring is possible, but no remote control
	Flashing	ODU FSK control has been enabled, and there is a communications fault.
EDMAC Mode	**Orange**	Framing on, EDMAC on, and unit defined as Slave - local monitoring is possible, but no local control
	Off	Either the unit is in Transparent mode (no framing), or the framing has been selected, but in AUPC-only mode, or EDMAC Master configuration.
Test Mode	**Orange**	A Test Mode is selected (**Example:** IF Loopback), or BERT Generator is turned on, or BERT Monitor is turned on, or Spectrum Analyzer is turned on.
	Off	There is no Test Mode currently selected, BERT Generator is off, BERT Monitor is off, and spectrum Analyzer is off.

5.1.3 Keypad

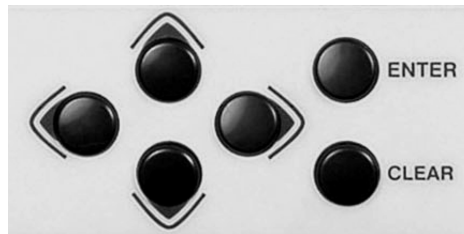
IMPORTANT

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, in its original and current incarnations, is shown in **Figure 5-2**:



Diamond Keypad (used prior to June 2007)



Button Keypad (used as of June 2007)

Figure 5-2. CDM-Qx/QxL Keypad

The function of the keypad is as follows:

ENTER [ENT]	This key is used to select a displayed function or to execute a modem configuration change.
CLEAR [CLR]	This key is used to back out of a selection or to cancel a configuration change that has not been executed using **ENTER [ENT]**. Pressing **CLEAR [CLR]** generally returns the display to the previous selection.
◄ ► **[←] , [→]** **(Left, Right)**	These arrows are used to move to the next selection or to move the cursor position. Most of the menus (space permitting) include arrow key hints to guide the user.
▲ ▼ **[↑] , [↓]** **(Up, Down)**	These arrows are used primarily to change configuration data (numbers), at the current cursor position. Occasionally they may be used to scroll through a number of choices at the current cursor position. Most of the menus (space permitting) include arrow key hints to guide the user.

5.1.4 Front Panel Vacuum Fluorescent Display (VFD)

The CDM-Qx/QxL features a **V**acuum **F**luorescent **D**isplay (VFD). The VFD is an active display showing two lines of 40 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 (for example, a numeric field) the cursor automatically changes 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 that activates after 1 hour. The top line of the display will show the Circuit ID (which can be entered by the user) and the bottom line will show the circuit Eb/No value (if there is a demod and it is locked) followed by '**Press any key....**'. The message moves from right to left across the screen, then wraps around. If there are multiple circuits, their messages and Eb/No's will be displayed sequentially. Press any key to return to the previous screen.

The display is divided into two areas – left-hand and right-hand. The left-hand display area (also referred to as the *slot screen*) can be accessed by using the ◄ arrow key if the menu-level is **MAIN**, **CONFIG**, **MONITOR**, or **INFO** (and there is more than one installed module present for selection).

To go back to the right-hand display area (also referred to as the *menu screen*), just press **CLEAR or ENTER**. Note that, by pressing **ENTER** selects that plug-in card for menu screen operations. The functionality of the two display areas is outlined in the sections that follow.

5.1.4.1 VFD – Left-hand Display Area

The left-hand display area (or *slot screen*) efficiently indicates what is installed into each of the chassis' four plug-in slots, and which slot is currently being addressed. The following example displays four ungrouped plug-ins:

```
 TX   TX   | (right-hand display area)
<RX>  RX   | (right-hand display area)
```

This display indicates modulators in the top slots, and demodulators in the bottom slots. The orientation of these four indicators serve as a mnemonic for the orientation of the four slots as viewed from the rear of the chassis – e.g., the left-hand TX displayed on the VFD corresponds with the top left slot when looking at the chassis rear panel. An empty slot is left blank.

In the above example, the left RX is highlighted, indicating that this is the selected slot. All monitor functions (including the front panel LEDs) reflect the status of this slot. All parameters selected from the menu tree while this slot is selected apply either to this slot or to common functions. The menus for common functions appear redundantly in all four slots. To change slots, move the cursor to the desired slot, and press **ENTER**.

A plug-in device that includes an 'F' suffix indicates the presence of an unmasked failure:

```
 TX   TXF  | (right-hand display area)
<RX>  RX   | (right-hand display area)
```

In this example, the upper right transmitter has a fault, the details of which may be viewed using such menus as Monitor or Alarms.

5.1.4.1.1 Modems

A modulator in a top slot can be grouped with a demodulator in the slot directly below it to form a modem:

```
 TX  <MD>  | (right-hand display area)
 RX        | (right-hand display area)
```

This example indicates a configuration in the right hand slots (when viewed from the back of the chassis) grouped together to form a modem. Selecting the slots is the same as with a basic configuration except that the blank selection slot (below the 'MD') is not selectable. When the modem is selected, the menus display modulator and demodulator functions, and the software selects the appropriate plug-in for the command.

Two modems can share a modem:

```
 MD   MD   | (right-hand display area)
           | (right-hand display area)
```

The selected modem is the modulator demodulator pair on the right side of the chassis (when viewed from the back). When modem is in CnC mode, the brackets (< >) turn into bold characters.

5.1.4.1.2 Redundancy

Modulators and Demodulator modules can be upgraded to operate as redundant units. When enabled, the module can back up any same-type module installed in one of the chassis' three remaining slots. If a modulator and demodulator have redundancy enabled and they are grouped as a modem, the pair can back up the second modem.

Note: The interface selected for the modules does not have to match the interface type used on the prime modules.

Three redundancy modes are possible with a modem. Backup devices are notated with a 'B' suffix. In a non-modem configuration, the backup device must be installed in Slot #4. If a backup device has failed, the 'B' and 'F' suffixes will alternately display.

1:1 redundant modems look similar to the two-modem example. The modems have independent monitor functions, but configuring the prime modem will also configure the backup modem.

In this example, the backup modem is selected:

```
 MD  <MDB> | (right-hand display area)
           | (right-hand display area)
```

1:2 and 1:3 modulators or demodulators look similar to the basic display.

A backup modulator or demodulator will back up all compatible modulators or demodulators in the chassis designated as primes.

The **Online** LED, together with the selection bracket (< >), indicate which device is online.

5.1.4.1.3 Spectrum Analyzer

The built-in spectrum analyzer mode is available, accessible via remote control, front panel operation, or web browser. When it is active, the selected demod will not respond to specific Rx front panel settings, nor will it carry traffic. Marked with an 'S' suffix, it has it is own front panel menu controls under the **Test** menu.

```
 TX    TX   | (right-hand display area)
<RX>   RXS  | (right-hand display area)
```

In this example, the receiver module installed in Slot#4 (bottom right on the VFD and when viewing the rear panel of the chassis) is being used as a spectrum analyzer. Only one Rx is allowed to enable spectrum analyzer in a chassis. To view the spectrum, the user needs to access the CDM-Qx Web Server Interface via a web browser.

5.1.4.2 VFD – Right-Hand Display Area

The right-hand side display area (or *menu screen*) facilitates operation of the selected installed device (module) or group (modules).

Note: To group a modulator and demodulator together requires a modulator module to be installed above a demodulator module; one of the two modules then needs to be selected via the left-hand display area. Returning to the right-hand display area, the user must select **Config → Group → Modem**, then select **Group** (see **Sect. 5.7.1.4** for details).

5.2 Front Panel Operation – Opening Screen

The opening screen is displayed whenever power is first supplied to the unit. On the menu screen side of the display, the top line identifies the unit in use (CDM-Qx for 70/140 MHz operation, CDM-QxL for L-Band operation). The second line of the menu screen identifies the installed firmware version.

IMPORTANT

Note the following:

- **V1.X.X ↑ = Original chassis (units typically manufactured prior to July 2008) running Firmware No. FW/11245.**
- **V2.1.1↑ = Upgraded chassis (units typically manufactured from July 2008 to present) running Firmware No. FW0000107.**

Control of the selected module is determined by the selection made via the left-hand display (slot screen). The slot screen can be accessed by using the ◄ arrow key if the menu-level is **MAIN**, **CONFIG**, **MONITOR**, or **INFO** (and there is more than one installed module present for selection).

Press any key to go to the **Main Menu** screen. **Table 5-1** outlines the chapter sections and, subsequently, the hierarchal structure of the front panel menu tree.

Table 5-1. Prinicpal Menu Tree

Section	Title	Remarks
5.2	Opening Screen	
5.3	Main Menu	Select: Config; Monitor; Test; Info; Save/Load; Utiity
5.4	Config	Select: Remote; Tx; Rx; Group; Frame; Interface; Ref; Mask; *(CDM-QxL only)* ODU
5.4.1	Config → Remote	Select: Local; Serial; Ethernet
5.4.2	Config → Tx	Select: FEC; Mod; Code; Data; Freq; On/Off; Pwr; Scram; Clk; Inv; Txα
5.4.3	Config → Rx	Select: FEC; Demod; Code; Data; Freq; Acq; Descram; Buf; Inv; Misc; CNC
5.4.4	Config → Group	Select: Modem; Redundancy
5.4.5	Config → Frame	Select: Unframed; EDMAC; EDMAC-2; D&I++
5.4.6	Config → Interface	Select: RS422; V.35; RS232; HSSI; G.703; QDI; None
5.4.7	Config → Ref	Select: Internal; 10MHz
5.4.8	Config → Mask	Select: Transmit; Receive; Reference; *(CDM-QxL only)* BUC; *(CDM-QxL only)* LNB
5.4.9	Config → ODU *(CDM-QxL only)*	Select: BUC; LNB
5.5	Monitor	Select: Alarms; Rx-Params; Event-Log; Stats; AUPC; CNC; *(CDM-QxL only)* ODU
5.5.1	Monitor → Alarms	Select: Transmit; Receive; Unit; *(CDM-QxL only)* ODU
5.5.2	Monitor → Rx-Params	Select: Eb/No, BER, ΔF, BUF, RSL
5.5.3	Monitor → Event-Log	Select: View; Clear-All
5.5.4	Monitor → Stats	Select: View; Clear-All; Config
5.5.5	Monitor → AUPC *(CDM-QxL only)*	Framing is required for AUPC Monitor - Select: Remote Eb/No; Tx Power Increase
5.5.6	Monitor → CnC	Carrier in Carrier® (CnC) indicates as Active or N ot Active
5.5.7	Monitor → ODU *(CDM-QxL only)*	Select: ODU; LNB
5.6	Test	Select: Mode; BIST; Spec-Analyzer
5.6.1	Test → Mode	Select: Norm; IF Loop; Dig Loop; I/O Loop; RF Loop; Tx-CW; Tx-1,0
5.6.2	Test → BIST	Select: BERT-Config; BERT-Mon; BERT-Control
5.6.3	Test → Spec-Analyzer	Select: Center-Freq; Span
5.7	Info	Select: Rem; Tx; Rx; Buffer; Frame; Interface; Mask; Ref; ID
5.8	Save/Load	Select: Save; Load
5.9	Utility	Select: RxBuffer; Clock; Ref; ID; Display; Firmware; FAST
5.9.1	Utility → RxBuffer	Select to Re-center buffer
5.9.2	Utility → Clock	Select to edit Real-Time Clock (Time and Date)
5.9.3	Utility → Ref	Select: Adjust; Warm-up Delay
5.9.4	Utility → ID	Select to edit Circuit ID
5.9.5	Utility → Display	Select to adjust VFD brightness
5.9.6	Utility → Firmware	Select: Update-CPLD; Information; Select
5.9.7	Utility → FAST	Select: Base; Slot1; Slot2; Slot3; Slot4

For the purpose of clarity, only the right-hand display area (or *menu screen*) is visually depicted throughout the remainder of this chapter.

5.3 MAIN MENU Screen

```
MAIN MENU: Config   Monitor
Test Info Save/Load Utility
```

Use the ◄ ► arrow keys to select from the choices shown on this top-level selection screen, then press **ENTER**. The following table identifies the menu branch, its content section in this chapter, and the functional description of each branch:

Menu Branch	Sect	Description
Config	**5.4**	**(Configuration)** Permits the user to fully configure the unit.
Monitor	**5.5**	Permits the user to monitor the current status of the modem and view the log of stored events for the modem.
Test	**5.6**	Permits the user to configure the modem into one of several Test modes, and configures/monitors the BER Tester.
Info	**5.7**	**(Information)** Permits the user to view information on the modem, without having to go into the Configuration screens.
Save/Load	**5.8**	**(Store/Load)** Permits the user to store and retrieve up to 10 different modem configurations.
Utility	**5.9**	Permits the user to perform miscellaneous functions, such as setting the Real-Time Clock, adjusting the display brightness, etc.

IMPORTANT

The actual choices displayed in the submenus may vary according to which FAST options have been enabled. Where a FAST option affects a menu, this is shown in the descriptive text.

5.4 (MAIN MENU:) Config (Configuration)

```
CONFIG: Remote   Tx   Rx  Group
Frame Interface   Ref  Mask ODU
```

Use the ◄ ► arrow keys to select from the submenu choices shown, then press **ENTER**. The submenus available from the Configuration menu are as follows:

Submenu	Sect	Description
Remote	**5.4.1**	**(Remote Control)** This menu sub-branch permits the user to define whether the unit is being controlled locally, or remotely. **NOTE:** The unit may be monitored over the remote control bus at any time. When in Local mode, however, configuration parameters may only be changed through the front panel. Conversely, when in Remote mode, the unit may be monitored from the front panel, but configuration parameters may only be changed via the remote control bus.
Tx	**5.4.2**	**(Transmit)** This menu sub-branch permits the user to define, on a parameter-by-parameter basis, the transmit configuration of the unit.
Rx	**5.4.3**	**(Receive)** This menu sub-branch permits the user to define, on a parameter-by-parameter basis, the receive configuration of the unit.
Group	**5.4.4**	This menu sub-branch permits the user to group a vertically aligned modulator and demodulator into a modem, or to group any compatible plug-ins for redundancy.
Frame	**5.4.5**	This menu sub-branch permits the user to define if the unit should operate in a transparent mode (no framing) or in a framed mode. In the framed mode (EDMAC), an overhead of 5% is added to the rate transmitted over the satellite so that M&C information may be passed to the distant end.
Interface	**5.4.6**	**(Interface)** This menu sub-branch permits the user to define which electrical interface type is active at the data connectors.
Ref	**5.4.7**	**(Reference)** This menu sub-branch permits the user to define whether the unit should use its own internal 10MHz reference, or phase lock to an externally applied reference, and if so, at what frequency. If the internal reference is selected, it can optionally drive the connector.
Mask	**5.4.8**	This menu sub-branch permits the user to mask certain traffic alarms, which may cause problems to the user. As an example, certain multiplexers use ‘all ones’ as an idle pattern. However, by convention, the ‘all ones’ condition is taken to be the Alarm Indication Signal (AIS). The CDM-Qx monitors for the AIS condition, and if desired, this alarm may be masked.
ODU (L-Band unit only)	**5.4.9**	**(Outdoor Unit)** This menu sub-branch permits the user to configure externally connected Low-noise Block Down Converter (LNB) and/or Block Up Converter (BUC) for L-Band units.

5.4.1 CONFIG: Remote

```
Remote Control Entry: Local
Serial Ethernet   (◄ ►,ENT)
```

Select **Local, Serial**, or **Ethernet** using the ◄ ► arrow keys, then press **ENTER**.

5.4.1.1 CONFIG: Remote → Local

If **CONFIG: Remote → Local** is selected, remote control is disabled, although remote monitoring is still possible.

5.4.1.2 CONFIG: Remote → Serial

```
Remote Serial Config:
Interface Baudrate (◄ ►,ENT)
```

Select **Interface** or **Baudrate** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Serial → Interface

```
M&C Serial Interface: RS232
RS485-2W RS485-4W (◄ ►,ENT
```

From the **Interface** submenu, the user is further prompted to enter the bus address. Select **RS232**, **RS485-2W** (2-wire), or **RS485-4W** (4-wire) using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Serial → Interface → RS232

```
In RS-232 Mode, Serial Bus
Base Address is fixed @ 0000
```

Note that the bus base address in RS-232 mode is fixed and cannot be edited.

CONFIG: Remote → Serial → Interface → RS485(-2W, -4W)

```
Edit RS-485 Serial Bus Base
Address: 0245    (◄ ►,▲▼,ENT)
```

If either RS-485 mode is selected, edit the RS-485 bus address of this unit by first selecting the digit to be edited using the ◄► arrow keys, then change the value of the digit to be edited by using the ▼▲ arrow keys. The valid range of addresses is from **1** to **9999**. Press **ENTER** when done.

CONFIG: Remote → Serial → Baudrate

```
M&C Serial Bus Baud Rate:
19200 Baud          (▲ ▼,ENT)
```

Using the ▲▼ arrow keys, edit the baudrate of the remote control bus connected locally to the M&C computer. Values of **2400**, **4800**, **9600**, **19200**, **38400**, and **57600** baud are possible. Press **ENTER** when done. Note that the asynchronous character format is **FIXED** at 8-N-1: 8 data bits, 1 stop bit, no parity.)

5.4.1.3 CONFIG: Remote → Ethernet

```
Ethernet Config:     (◄ ►,ENT)
Gateway Address MAC SNMP
```

Select **Gateway**, **Address**, **MAC**, or **SNMP** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Ethernet → Gateway

```
M&C Ethernet IP Gateway:
192.128.001.001  (◄ ► ▲ ▼,ENT)
```

Edit the IP Gateway Address for the Ethernet M&C port for this unit by first selecting the digit to be edited using the ◄ ► arrow keys, then change the value of the digit to be edited by using the ▼▲ arrow keys. Press **ENTER** when done.

CONFIG: Remote → Ethernet → Address

```
M&C Ether IP Address/Range:
192.168.001.001/24(◄ ►,▲ ▼,ENT)
```

Edit the IP Address and Range for the Ethernet M&C port for this unit by first selecting the digit to be edited using the ◄ ► arrow keys, then change the value of the digit to be edited by using the ▼▲ arrow keys. Press **ENTER** when done.

CONFIG: Remote → Ethernet → MAC

```
     M&C Port MAC Address:
      00-06-B0-00-00-D5
```

As shown in this example, this *read-only* window displays the factory program MAC address for the Ethernet management interface.

CONFIG: Remote → Ethernet → SNMP

```
SNMP: Communities Traps
                     (◄ ►,ENT)
```

Select **Communities** or **Traps** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Ethernet → SNMP → Communities

```
SNMP Communities:
Read Write       (◄ ►,ENT)
```

Select **Read** or **Write** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Ethernet → SNMP → Communities → Read

```
Read Community: (◄ ► ▲ ▼,ENT)
public
```

CONFIG: Remote → Ethernet → SNMP → Communities → Write

```
Write Community: (◄ ► ▲ ▼,ENT)
private
```

Edit either the SNMP Read or Write Community string by first selecting the character to be edited using the ◄ ► arrow keys, then change the character to be edited by using the ▼▲ arrow keys. Only the first 20 characters on the bottom line are available.

All printable ASCII characters are available with the exception of the backslash (\ ASCII code 92) and the tilde (~ ASCII code 126). Once the string has been composed, press **ENTER**. All trailing spaces are removed from the Read or Write Community string upon entering.

CONFIG: Remote → Ethernet → SNMP → Traps

```
Traps: Community  Version
IP Addr#1 IP Addr#2   (◄ ►,ENT)
```

Select **Community, Version, IP Addr#1, or IP Addr#2** using the ◄ ► arrow keys, then press **ENTER**. Selecting **Read** displays the following submenu:

CONFIG: Remote → Ethernet → SNMP → Traps → Community

```
Trap Community: (◄ ► ▲ ▼,ENT)
comtech
```

Edit the Trap Community string by first selecting the character to be edited using the ◄ ► arrow keys, then change the character to be edited by using the ▼▲ arrow keys. Only the first 20 characters on the bottom line are available.

All printable ASCII characters are available with the exception of the backslash (\ ASCII code 92) and the tilde (~ ASCII code 126). Once the string has been composed, press **ENTER**. All trailing spaces are removed from the Community string upon entering.

CONFIG: Remote → Ethernet → SNMP → Traps → Version

```
Trap Version:       (◄ ►,ENT)
SNMPv1  SNMPv2
```

Select **SNMPv1** or **SNMPv2** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Remote → Ethernet → SNMP → Traps → IP Addr#X

```
Trap IP Addr#X: (◄ ► ▲ ▼,ENT)
000.000.000.000
```

Where 'X' designates the menu selection as IP Addr#1 -or- IP Addr#2: These two IP Addresses are Trap Destination IP Addresses. Edit the IP Address by first selecting the digit to be edited using the ◄ ► arrow keys, then change the value of the digit to be edited by using the ▼▲ arrow keys. Press **ENTER** when done.

Note: If both Trap IP Address are set to **000.000.000.000**, it means Trap is ***disabled***.

5.4.2 CONFIG: Tx (Transmit)

```
Tx: FEC Mod  Code  Data  Freq
On/Off Pwr Scram Clk Inv Txα
```

Select **FEC, Mod, Code, Data, Freq, On/Off, Pwr, Scram, Clk, Inv,** or **Txα** using the ◄ ► arrow keys, then press **ENTER**. The user will then be taken to a further submenu. Each selection is described briefly as follows:

FEC	**(Forward Error Correction)** This submenu permits the user to select the method of FEC used for transmission (Viterbi, TPC, etc). FEC type takes the highest configuration priority.
Mod	**(Modulation)** This submenu permits the user to select the modulation type used for transmission (BPSK, QPSK, 8-PSK, etc.). The available choice of modulation will depend on the FEC type chosen.
Code	**(FEC Code Rate)** This submenu permits the user to select the FEC Code Rate used for transmission (Rate 1/2, Rate 3/4, etc). The available choice of Code Rate will depend on both the FEC type and Modulation type selected.
Data	**(Data Rate)** This submenu permits the user to select the transmit data rate, in steps of 1 bps. The choice of data rate will depend on the FEC type, Modulation type, and Code Rate selected.
Freq	**(Frequency)** This submenu permits the user to select the transmit frequency, from 950 MHz to 1950 MHz, in steps of 100Hz for L-Band units, or from 50 MHz to 90 MHz and from 100 MHz to 180 MHz for 70/140MHz units.
On/Off	This submenu permits the user to control the output state of the transmit carrier.
Pwr	**(Output Power level)** This submenu permits the user to control the output level of transmit carrier, either manually, or using the AUPC (Automatic Uplink Power Control) feature.
Scram	**(Scrambler)** This submenu permits the user to select whether or not data scrambling is used.
Clk	**(Clock Source)** This submenu permits the user to select the clock source for transmission. This can be from the internal source, from an external source, or from the distant-end of the satellite link (loop timed).
Inv	**(Inversion)** This submenu permits the user to invert the sense of the transmitted spectrum, or to invert the sense of the transmitted baseband data or data clock
Txα	**(α-Factor)** This permits the user to select the modulator's roll-off factor either 20% or 35%.

IMPORTANT

The FEC type takes the highest configuration priority, and the selection here depends on what, if any, optional plug-in Codecs are installed. The choice of FEC type then determines what modulation types, code rates, and data rates are available. The order of hierarchy is therefore:

FEC type (Highest) ► Modulation type ► Code Rate ► Data Rate (Lowest)

If the user changes a parameter within this hierarchy, the other parameters may become invalid. In this case, the software will change those other parameters, in order to maintain a valid configuration at all times.

Example: Suppose the user has selected Viterbi + Reed Solomon, QPSK, Rate 1/2. Now, the user changes the modulation type from QPSK to 16-QAM. In this case, Rate 1/2 is no longer a valid code rate, and so it will be automatically changed to the nearest valid code rate (Rate 3/4).

Detailed descriptions for each of the Tx configuration submenus follow.

5.4.2.1 CONFIG: Tx → FEC

```
Tx FEC: Vit Vit+RS TCM+RS
TPC                    (◄ ►,ENT)
```

For the Transmit FEC type, select **Vit, Vit+RS, TCM+RS,** or **TPC** using the ◄ ► arrow keys, then press **ENTER**.

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

Note the following:

FEC TYPE	RULES	COMMENT
Vit (Viterbi)	Always valid.	
Vit+RS (Viterbi +Concatenated Reed-Solomon)	Always valid.	
TCM+RS (Trellis Coded Modulation + Concatenated Reed-Solomon)	Only if 8-PSK FAST is enabled.	Fixed at 8-PSK and Rate 2/3.
TPC (Turbo)	If the TPC codec is installed and Data Rate FAST option is enabled.	

Selecting **VIT+RS** or **TCM+RS** displays the following submenu:

```
Tx Rs (n/k)              (◄ ►,ENT)
IESS-310 network         (219/201)
```

5.4.2.2 CONFIG: Tx → Mod

```
Modulation: BPSK  QPSK  8-PSK
16-QAM                   (◄ ►,ENT)
```

For the Transmit Modulation Scheme, select **BPSK, QPSK, 8-PSK**, or **16-QAM** using the ◄ ► arrow keys, then press **ENTER**.

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

Note the following:

CASE	RULES
BPSK	Valid for all FEC types except TCM+R-S
QPSK	Valid for all FEC types except TCM+R-S
8-PSK	Valid for TCM+R-S, TPC (Turbo) requires 8-PSK FAST option
16-QAM	Valid for Viterbi + R-S, TPC (Turbo) requires 16-QAM FAST option

5.4.2.3 CONFIG: Tx → Code

```
Tx Code Rate: 5/16 21/44 1/2
2/3 3/4 7/8 17/18 (◄ ►)
```

For the Transmit Code Rate, select **5/16**, **21/44**, **1/2**, **2/3**, **3/4**, **7/8**, or **17/18** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

CASE	RULES
5/16	Valid for BPSK and Turbo
21/44	Valid for BPSK, QPSK and Turbo
1/2	Valid for BPSK, QPSK, Viterbi, Viterbi+R-S
2/3	Valid for TCM+R-S only (8-PSK)
3/4	Valid for QPSK, 8-PSK, and 16-QAM
7/8	Valid for QPSK, 8-PSK, and 16-QAM
17/18	Valid for QPSK, 8-PSK , and Turbo

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

5.4.2.4 CONFIG: Tx → Data

```
Tx Data Rate: 05000.000kbps
Sym:02500.000ksps
```

For the Transmit Data Rate, select **5/16**, **21/44**, **1/2**, **2/3**, **3/4**, **7/8**, or **17/18** using the ◄ ► arrow keys, then press **ENTER**.

Note: *In **Q**uad **D**rop & **I**nsert (QDI) mode, these data rates are **read-only;** otherwise, they are **read/write.*** The data rate will be the sum of the tributary rates for all ports. This also will show the calculated symbol rate and Nx64kbps (where N=001 to 128).

IMPORTANT

The overall range of data rates is from 32 to 20000 kbps. The overall range of symbol rates is up to 10000 ksps. The minimum data rate is set to 32 kbps only for BPSK and QPSK, and the maximum data rates are dependent on modulation type and FEC encoder rate. If the user changes the modulation or FEC, and the currently selected data rate can no longer be supported, the data rate will be adjusted automatically, up or down, keeping the symbol rate constant. The bottom line of the display shows the symbol rate, based on FEC type, modulation, FEC Code Rate, and Data Rate. The valid ranges of data rate are shown in the table that follows on the next page.

Note the following:

FEC Type	Modulation	Code Rate	Data Rate Range	EDMAC limited?
Vit (Viterbi)	BPSK	Rate 1/2	32 kbps to 5 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
	QPSK	Rate 1/2	32 kbps to 10 Mbps	
		Rate 3/4	32 kbps to 15 Mbps	
		Rate 7/8	32 kbps to 17.5 Mbps	
Vit+RS (Viterbi +Concatenated Reed-Solomon)	BPSK	Rate 1/2	32 kbps to 4.5 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
	QPSK	Rate 1/2	32 kbps to 9.1 Mbps	
		Rate 3/4	32 kbps to 13.7 Mbps	
		Rate 7/8	32 kbps to 16 Mbps	
	16-QAM	Rate 3/4	349.1 kbps to 20 Mbps	
		Rate 7/8	407.3 kbps to 20 Mbps	
TCM+RS (Trellis Coded Modulation + Concatenated Reed-Solomon)	8-PSK	Rate 2/3	232.7 kbps to 18.3 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
TPC (Turbo)	BPSK	Rate 5/16	32 kbps to 3.1 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
		Rate 21/44	32 kbps to 4.7 Mbps	
	QPSK	Rate 21/44	32 kbps to 9.5 Mbps	
		Rate 3/4	32 kbps to 15 Mbps	
		Rate 7/8	32 kbps to 17.5 Mbps	
		Rate 17/18	32 kbps to 18.888 Mbps	
	8-PSK	Rate 3/4	288 kbps to 20 Mbps	**No**
		Rate 7/8	336 kbps to 20 Mbps	
		Rate 17/18	362.7 kbps to 20 Mbps	
	16-QAM	Rate 3/4	384 kbps to 20 Mbps	
		Rate 7/8	448 kbps to 20 Mbps	

***Important Note**: Where noted in the table above, if EDMAC framing is employed, the upper data rate will be reduced by 5% for data rates up to 2.048 Mbps, and by 1.6% for data rates above 2.048 Mbps, where EDMAC2 framing is used, or for Rate 21/44 BPSK/QPSK Turbo, or Rate 5/16 BPSK Turbo.*

5.4.2.5 CONFIG: Tx → Freq

```
Tx IF Freq: 1156.3456 MHz
            (◄ ►,▲ ▼,ENT)
```

For the Transmit IF Frequency, the range of frequencies depends upon the plug-in module – the preceeding example shows the L-Band version of modem. Edit the Transmit IF Frequency by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. Press **ENTER** when done.

When using the **ODU → BUC** menus, if the user has selected a BUC LO frequency other than zero, and has defined whether the mix is high side or low side, the display will be modified as shown below, to include the calculated Transmit RF frequency of the modem/BUC combination:

```
Tx IF Freq: 1156.3456 MHz
RF=14156.3456  (◄ ►▲ ▼ ENT)
```

As the Tx IF frequency is edited, the RF frequency will automatically be updated.

5.4.2.6 CONFIG: Tx → On/Off

```
Tx Output State:  On  Off
RxTxInhibit Common (◄ ►,ENT)
```

For the Transmit On./Off Control (Output State), select **On**, **Off**, **RxTxInhibit**, or **Common** using the ◄ ► arrow keys, then press **ENTER**.

When **Rx-Tx Inhibit** (RTI) is selected, it prevents the TX carrier from being transmitted until the demodulator is locked.

To avoid the Tx Carrier from being turned off when the demodulator loses lock for a very short period of time, the demodulator must be unlocked continuously for a period of 10 seconds before the transmit carrier is inhibited. ***This time interval is fixed and is not user-changeable***.

IMPORTANT

Having this feature enabled does not affect the internal IF Loopback feature. But, please be aware that if an external IF Loopback is attempted (connecting an external cable from the Tx IF output to the Rx IF input), then this will not work! (The Tx carrier cannot turn on until the demod is locked, and the demod cannot lock, because the TX output is off. The net result is that the demod will not lock, and the Tx carrier will not turn on. USE THE RTI FEATURE WITH EXTREME CARE!

CONFIG: Tx → On/Off → Common

```
Tx Common Output State:
Off On           (◄ ► ENT)
```

For master control of all modulators – i.e., the complete transmit path – select **Off** or **On** using the ◄ ► arrow keys, then press **ENTER**.

5.4.2.7 CONFIG: Tx → PWR

```
Output Power Level Mode:
Manual AUPC (◄ ►,ENT)
```

To set the Transmit Power Level Mode, select either **Manual** or **AUPC** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Pwr → Manual

```
Tx Output Power Level:
-03.9 dBm       (◄ ►, ▲ ▼,ENT)
```

Edit the Transmit Output Power Level by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. Press **ENTER** when done.

CONFIG: Tx → Pwr → AUPC

Selecting **AUPC** *without* **Framed Mode** selected results in display of the following message:

```
Warning! AUPC needs
Framed Mode (ENT or CLR)
```

Press either **ENTER** or **CLEAR** to return to the previous menu (with **Manual** selected).

With **Framed Mode** properly configured, selecting **AUPC** results in display of the following submenu:

```
Target-Eb/No  Max-Range Alarm
DemodUnlock (◄ ►,ENT)
```

Select **Target EbNo**, **Max-Range**, **Alarm**, or **DemodUnlock** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Pwr → AUPC → Target-Eb/No

```
Remote Demod - Target Eb/No
Min Eb/No:9.9dB (◄ ►, ▲ ▼,ENT)
```

Edit the Transmit AUPC Target Eb/No value by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. The default value is **3.0** dB; the upper limit is **9.9** dB. Press **ENTER** when done.

CONFIG: Tx → Pwr → AUPC → Max-Range

```
Maximum-permitted Power
increase: 01dB (▲ ▼,ENT)
```

Edit the Transmit AUPC Maximum Permitted Power Increase value (when in **AUPC** mode) by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. The default value is **1** dB; the upper limit is **9** dB. Press **ENTER** when done.

CONFIG: Tx → Pwr → AUPC → Alarm

```
Action when max Tx Power
reached: None TxAlarm (◄ ►,ENT)
```

To set the action that will occur if the **AUPC** causes the maximum output power level to be reached, select **None** or **TxAlarm** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Pwr → AUPC → DemodUnlock

```
Action when Remote Demod
unlocks: Nom-Pwr Max-Pwr
```

To select the action that will occur if the remote demod is unlocked, using the ◄ ► arrow keys, select **Nom-Pwr** (*Nomimal Power*, where the output level will revert to the nominal power level that was set under **Manual**) or **Max-Pwr** (*Maximum Power*, where the output level will change to the maximum permitted). Press **ENTER** when done.

5.4.2.8 CONFIG: Tx → Scram

```
Scrambling: Default-On
IESS-315-On  Off  (◄ ►,ENT)
```

To set the Transmit Scrambling mode, select **Default-On**, **IESS-315-On**, or **Off** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Default-On	The appropriate scrambler type is automatically selected
IESS-315-On	This only applies when Turbo is installed and has been selected as the FEC type
Off	No scrambling

Scrambler Selection Notes:

1. If CnC is enabled, the V.35 scrambler is always used in order to suppress framing artifacts.
2. As noted previously, all options are displayed all of the time, but the ◄ ► arrow keys will force the cursor to skip past an unavailable choice.

IMPORTANT

The default scrambler types are as follows:

Viterbi, no framing:	*ITU V.35 (Intelsat variant)*
Viterbi, EDMAC frame:	*Comtech proprietary, frame synchronized*
Viterbi + R-S or TCM/R-S:	*Per IESS-308, frame synchronized*
TPC:	*Comtech proprietary, frame synchronized*
CnC:	*ITU V.35 (Intelsat variant) – overrides other settings*

5.4.2.9 CONFIG: Tx → Clk

```
Tx Clocking Mode: Int  Ext
Loop-Timed ExtLoop (◄ ►,ENT)
```

To set the Transmit Clocking Source, select **Int**, **Ext**, **Loop-Timed** , or **ExtLoop** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Int	**(Internal)** Indicates that the CDM-QX will supply a clock to the DTE, which is derived from its internal high-stability source.
Ext	(**External**) Indicates that the CDM-QX expects to receive a clock from the DTE, to which the unit can phase-lock its internal circuits. (If G.703 is selected as the Interface type, the software will force the clock mode to External.)
Loop-Timed	Indicates that the transmit timing source should be the receive clock, from the direction of the satellite. This is a useful mode, in that no external connection needs to be made in this mode. If the demodulator loses lock, or if there is no receive signal present, the internal clock is substituted. Note also that this mode will work even with asymmetric Rx and Tx data rates.
ExtLoop	(External Loop) Indicates that the CDM-Qx expects to receive a clock from the DTE, which is derived from the received clock from the direction of the satellite. This is useful in CnC mode with G.703 interface wherein the remote station is relying on a centralized clock from the hub station.

5.4.2.10 CONFIG: Tx → Inv

```
Tx Inversion functions:
Spectrum  Data  Clock (◄ ►,ENT)
```

To set the Transmit Inversion Functions, select **Spectrum, Data, or Clock** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Inv → Spectrum

```
Tx Spectral Inversion:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Inv → Data

```
Tx Data Sense:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Tx → Inv → Clock

```
Tx Clock Inversion:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

5.4.2.11 CONFIG: Tx → Txα

```
Tx Roll-off: 20%  35%
                         (◄ ►,ENT)
```

To set the Transmit Roll-off (α) Factor, select **20% or 35%** using the ◄ ► arrow keys, then press **ENTER**. Note that the default is **35%**.

5.4.3 CONFIG: Rx (Receive)

```
Rx: FEC Demod Code Data Freq
Acq Descram Buf Inv Misc CnC
```

Select **FEC, Demod, Code, Data, Freq, Acq, Descram, Buf, Inv, Misc,** or **CnC** using the ◄ ► arrow keys, then press **ENTER**. The user will then be taken to a further submenu. Each selection is described briefly as follows:

FEC	**(Forward Error Correction)** This submenu permits the user to select the method of FEC used for reception (Viterbi, TPC, etc). FEC type takes the highest configuration priority.
Demod	**(Demodulation)** This submenu permits the user to select the modulation type used for reception (BPSK, QPSK, 8-PSK, etc.). The available choice of modulation will depend on the FEC type chosen.
Code	**(FEC Code Rate)** This submenu permits the user to select the FEC Code Rate used for reception (Rate 1/2, Rate 3/4, etc). The available choice of Code Rate will depend on both the FEC type and Demodulation type selected.
Data	**(Data Rate)** This submenu permits the user to select the receive data rate, in steps of 1 bps. The choice of data rate will depend on the FEC type, Demodulation type, and Code Rate selected.
Freq	**(Frequency)** This submenu permits the user to select the receive frequency, from 950 MHz to 1950 MHz, in steps of 100Hz for L-Band units, or from 50 MHz to 90 MHz and from 100 MHz to 180 MHz for 70/140MHz units.
Acq	**(Acquisition)** This submenu permits the user to determine the amount of frequency uncertainty the demodulator will search over in order to find and lock to an incoming carrier.
Descram	**(Descrambler)** This submenu permits the user to select whether or not data descrambling is used.
Buf	**(Buffer)** This submenu permits the user to select whether or not the Plesiochronous/ Doppler buffer is used, and if so, the size of that buffer.
Inv	**(Inversion)** This submenu permits the user to invert the sense of the received spectrum, or to invert the sense of the received baseband data.
Misc	**(Miscellaneous)** This submenu will allow the user to select Eb/No Alarm Threshold (EbNo) and Rx roll-off (alpha) factor Rxα.
CnC	**(Carrier-in-Carrier®)** This submenu allows the user to set-up the CnC parameters.

IMPORTANT

The FEC type takes the highest configuration priority, and the selection here depends on what, if any, optional plug-in Codecs are installed. The choice of FEC type then determines what demodulation types, code rates, and data rates are available. The order of hierarchy is therefore:

FEC type ► Demodulation type ► Code Rate ► Data Rate
(Highest) (Lowest)

If the user changes a parameter within this hierarchy, the other parameters may become invalid. In this case, the software will change those other parameters, in order to maintain a valid configuration at all times.

Example: Suppose the user has selected Viterbi + Reed Solomon, QPSK, Rate 1/2. Now, the user changes the demodulation type from QPSK to 16-QAM. In this case, Rate 1/2 is no longer a valid code rate, and so it will be automatically changed to the nearest valid code rate (Rate 3/4).

Detailed descriptions for each of the Rx configuration submenus follow.

5.4.3.1 CONFIG: Rx → FEC

```
Rx FEC: Vit Vit+RS TCM+RS
TPC                   (◄ ►,ENT)
```

For the Transmit FEC type, select **Vit, Vit+RS, TCM+RS,** or **TPC** using the ◄ ► arrow keys, then press **ENTER**.

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

Note the following:

FEC TYPE	RULES	COMMENT
Vit (Viterbi)	Always valid	
Vit+RS (Viterbi +Concatenated Reed-Solomon)	Always valid	
TCM+RS (Trellis Coded Modulation + Concatenated Reed-Solomon)	If 8-PSK FAST is enabled	Fixed at 8-PSK and Rate 2/3
TPC (Turbo)	If the TPC codec is installed	

Selecting**VIT+RS** or **TCM+RS** displays the following submenu:

```
Rx Rs (n/k)            (◄ ►,ENT)
IESS-310 network       (219/201)
```

5.4.3.2 CONFIG: Rx → Demod

```
Demodulation: BPSK  QPSK  8-PSK
16-QAM                  (◄ ►,ENT)
```

For the Receive Demodulation Scheme, select **BPSK, QPSK, 8-PSK**, or **16-QAM** using the ◄ ► arrow keys, then press **ENTER**.

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

Note the following:

CASE	RULES
BPSK	Valid for all FEC types except TCM+R-S
QPSK	Valid for all FEC types except TCM+R-S
8-PSK	Valid for TCM+R-S, TPC (Turbo) requires 8-PSK FAST option
16-QAM	Valid for Viterbi + R-S, TPC (Turbo) requires 16-QAM FAST option

5.4.3.3 CONFIG: Rx → Code

```
Rx Code Rate: 5/16 21/44 1/2
2/3 3/4 7/8 17/18 (◄ ►)
```

For the Receive Code Rate, select **5/16**, **21/44**, **1/2**, **2/3**, **3/4**, **7/8**, or **17/18** using the ◄ ► arrow keys, then press **ENTER**.

Note the following:

CASE	RULES
5/16	Valid for BPSK and Turbo
21/44	Valid for BPSK, QPSK and Turbo
1/2	Valid for BPSK, QPSK, Viterbi, Viterbi+R-S
2/3	Valid for TCM+R-S only (8-PSK)
3/4	Valid for QPSK, 8-PSK, and 16-QAM
7/8	Valid for QPSK, 8-PSK, and 16-QAM
17/18	Valid for QPSK, 8-PSK , and Turbo

IMPORTANT

All possible choices are presented at all times. If an option is not installed (either Hardware, or FAST) or not valid, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

5.4.3.4 CONFIG: Rx → Data

```
Rx Data Rate: 05000.000kbps
Sym:02500.000ksps
```

Note: *In* ***Q****uad* ***D****rop &* ***I****nsert (QDI) mode, these data rates are* ***read-only!*** The data rate will be the sum of the tributary rates for all ports. This also will show the calculated symbol rate and Nx64kbps (where N=001 to 128).

IMPORTANT

The overall range of data rates is from 32 to 20000 kbps. The overall range of symbol rates is up to 10000 ksps. The minimum data rate is set to 32 kbps only for BPSK and QPSK, and the maximum data rates are dependent on modulation type and FEC encoder rate. If the user changes the modulation or FEC, and the currently selected data rate can no longer be supported, the data rate will be adjusted automatically, up or down, keeping the symbol rate constant. The bottom line of the display shows the symbol rate, based on FEC type, modulation, FEC Code Rate, and Data Rate. The valid ranges of data rate are shown in the table that follows on the next page.

Note the following:

FEC Type	Modulation	Code Rate	Data Rate Range	EDMAC limited?
Vit (Viterbi)	BPSK	Rate 1/2	32 kbps to 5 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
	QPSK	Rate 1/2	32 kbps to 10 Mbps	
		Rate 3/4	32 kbps to 15 Mbps	
		Rate 7/8	32 kbps to 17.5 Mbps	
Vit+RS (Viterbi +Concatenated Reed-Solomon)	BPSK	Rate 1/2	32 kbps to 4.5 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
	QPSK	Rate 1/2	32 kbps to 9.1 Mbps	
		Rate 3/4	32 kbps to 13.7 Mbps	
		Rate 7/8	32 kbps to 16 Mbps	
	16-QAM	Rate 3/4	349.1 kbps to 20 Mbps	
		Rate 7/8	407.3 kbps to 20 Mbps	
TCM+RS (Trellis Coded Modulation + Concatenated Reed-Solomon)	8-PSK	Rate 2/3	232.7 kbps to 18.3 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
TPC (Turbo)	BPSK	Rate 5/16	32 kbps to 3.1 Mbps	**Yes** – see **IMPORTANT NOTE** (below)
		Rate 21/44	32 kbps to 4.7 Mbps	
	QPSK	Rate 21/44	32 kbps to 9.5 Mbps	
		Rate 3/4	32 kbps to 15 Mbps	
		Rate 7/8	32 kbps to 17.5 Mbps	
		Rate 17/18	32 kbps to 18.888 Mbps	
	8-PSK	Rate 3/4	288 kbps to 20 Mbps	**No**
		Rate 7/8	336 kbps to 20 Mbps	
		Rate 17/18	362.7 kbps to 20 Mbps	
	16-QAM	Rate 3/4	384 kbps to 20 Mbps	
		Rate 7/8	448 kbps to 20 Mbps	
Important Note*: Where noted in the table above, if EDMAC framing is employed, the upper data rate will be reduced by 5% for data rates up to 2.048 Mbps, and by 1.6% for data rates above 2.048 Mbps, where EDMAC2 framing is used, or for Rate 21/44 BPSK/QPSK Turbo, or Rate 5/16 BPSK Turbo.*				

5.4.3.5 CONFIG: Rx → Freq

```
Rx IF Freq:  1156.3456 MHz
                (◄ ►,▲ ▼,ENT)
```

For the Receive IF Frequency, the range of frequencies depends upon the plug-in module – the preceeding example shows the L-Band version of modem. Edit the Transmit IF Frequency by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. Press **ENTER** when done.

When using the **ODU → LNB** menus, if the user has selected an LNB LO frequency other than zero, and has defined whether the mix is high side or low side, the display will be modified as shown below, to include the calculated Receive RF frequency of the modem/LNB combination:

```
Rx IF Freq: 1156.3456 MHz
RF=14156.3456   (◄ ►▲ ▼ ENT)
```

As the Rx IF frequency is edited, the RF frequency will automatically be updated.

5.4.3.6 CONFIG: Rx → Acq

```
Demod Acquisition Range:
  +/- 32 kHz          (▲ ▼ ENT)
```

For the Receive Demodualtion Acquisition Range, the value entered here determines the amount of frequency uncertainty the demodulator will search over in order to find and lock to an incoming carrier.

Edit the range by first using the ◄ ► arrow keys to select the digit to be edited; the value of the digit is then changed using the ▲▼ arrow keys. Press **ENTER** when done.

Note the following:

- The range varies from ± 1 kHz to ± 32 kHz for 70/140 IF, ± 1 kHz to ±(symbol rate/2) up to ±200 kHz for L-Band.
- For symbol rates < 64 ksps, it will be ± (symbol rate/2).
- For L-Band, Acquisition Range < 625 ksps = ± 32 kHz, ≥ 625 ksps = ± 200 kHz.

5.4.3.7 CONFIG: Rx → Descram

```
Descrambling: Default-On
IESS-315-On  Off  (◄ ►,ENT)
```

To set the Receive Descrambling mode, select **Default-On**, **IESS-315-On**, or **Off** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Default-On	The appropriate scrambler type is automatically selected
IESS-315-On	This only applies when Turbo is installed and has been selected as the FEC type
Off	No scrambling

Descrambler Selection Notes

As noted previously, all options are displayed all of the time, but the ◄ ► arrow keys will force the cursor to skip past an unavailable choice.

IMPORTANT

The default descrambler types are as follows:

Viterbi, no framing:	*ITU V.35 (Intelsat variant)*
Viterbi, EDMAC frame:	*Comtech proprietary, frame synchronized*
Viterbi + R-S or TCM/R-S:	*Per IESS-308, frame synchronized*
TPC:	*Comtech proprietary, frame synchronized*

5.4.3.8 CONFIG: Rx → Buf

```
Rx Buffer: Internal Rx-Sat
Tx-Terr Ins External (◄ ►,ENT)
```

To set the Receive Buffer Clock Source, select **Internal**, **Rx-Sat**, **Tx-Terr**, **Ins**, or **External** using the ◄ ► arrow keys. Press **ENTER** when done.

Note: **Tx-Terrestrial** will only be selected if the modules are grouped as a modem. Selecting either one will allow the user to select the buffer size as shown below (also, note that **External** will only be selected if QDI interface type is selected):

```
Rx Buffer Size
Disabled                (▲ ▼,ENT)
```

Values of **Disabled, ±512, 1024, 2048, 4096, 8192**, and **16384** bits are possible**.** Edit the size, in bits, of the Plesiochronous/Doppler Buffer by changing the value using the ▲ ▼ arrow keys. then pressing **ENTER**.

Note that, for QDI interface type, the selectable Rx Buffer settings are **Rx-Sat**, **Tx_Terr** and **External:**

- **Tx-Terr** is a recovered E1 clock from the Tx terrestrial E1 data. This setting will also loop the Tx terrestrial E1 data to the Rx terrestrial E1 data port. The incoming Rx IF data will be instered and overwrite this “looped” data.
- **External** is a user-provided E1 frequency balanced clock on J5 of the Quad E1 interface card.

When **Disabled** is selected, the Plesiochronous/Doppler buffer is disabled. The receive clock will then be derived from the satellite signal, and will therefore be subject to clock offsets relative to the local transmit clock, This is due in part to the originating clock being slightly different from the local clock (a so-called ***plesiochronous*** offset), and to the motion of the satellite (a ***Doppler*** offset).

The input to the buffer will be the signal from the satellite, with any clock offsets and jitter. The output from the buffer will be derived from the local TRANSMIT clock. In this way, the receive data will be perfectly synchronous with this local clock.

The modem operates with independent receive and transmit data rates. Even in this configuration, where RX data rate <> TX data rate, the output clock for the buffer will be phase locked to the transmit clock.

While it is only possible to select the size in bits, the corresponding total buffer size is displayed in ms (which will vary in inverse proportion to the data rate).

5.4.3.9 CONFIG: Rx → Inv

```
Rx Inversion functions:
Spectrum  Data  Clock (◄ ►,ENT)
```

To set the Transmit Inversion Functions, select **Spectrum, Data, or Clock** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Rx → Inv → Spectrum

```
Rx Spectral Inversion:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Rx → Inv → Data

```
Rx Data Sense:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Rx → Inv → Clock

```
Rx Clock Inversion:
Normal Inverted   (◄ ►,ENT)
```

Select **Normal** or **Inverted** using the ◄ ► arrow keys, then press **ENTER**.

5.4.3.10 CONFIG: Rx → Misc

```
Rx Misc: EbNo  Rxα
                     (◄ ►,ENT)
```

Select **EbNo** or **Rxα** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Rx → Misc → EbNo

```
Rx Clock Inversion:
Normal Inverted  (◄ ►,▲ ▼,ENT)
```

If the Eb/No falls below this selected value, a receive traffic fault will be generated. To set the EbNo alarm, edit the Eb/No alarm point by first selecting the digit to be edited using the ◄ ► arrow keys; then, edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The range of values is from **2.0** to **16.0** dB.

CONFIG: Rx → Misc → Rxα

```
Tx Roll-off: 20%  35%
                     (◄ ►,ENT)
```

To set the Receive Roll-off (α) Factor, select **20% or 35%** using the ◄ ► arrow keys, then press **ENTER**. Note that the default is **35%**.

5.4.3.11 CONFIG: Rx → CnC (CARRIER-IN-CARRIER®)

```
Carrier-in-Carrier (CnC):
Mode FrqOffs SrchDelay ReAcq
```

Select **Mode, FrqOffs, SrchDelay,** or **ReAcq** using the ◄ ► arrow keys, then press **ENTER**. The user will then be taken to a further submenu. Note the following:

Mode	(**Mode of Operation**) This submenu permits the user to select the mode of operation for the CnC.
FrqOffs	(**Frequency Offset**) This submenu permits the user to adjust the frequency offset for the CnC.
SrchDelay	(**Search Delay**) This submenu permits the user to configure the search delay parameters for the CnC.
ReAcq	(**ReAcquisition Time**) This permits the user to set the re-acquisition time in seconds when the desired carrier is lost.

CONFIG: Rx → CnC → Mode

```
CnC Mode: Off  On
                     (◄ ►,ENT)
```

To set the CnC Mode of Operation, select **Off** or **On** using the ◄ ► arrow keys, then press **ENTER**.

If **On** is selected, the front panel menu screen will display messages as follows:

```
  LOADING CnC SAT SEARCH...
      ...PLEASE WAIT!
```

```
CnC SEARCH IS PROCESSING...
      ...PLEASE WAIT!
```

If the CnC Search is **successful**, the following message is displayed:

```
CnC SEARCH SUCCESSFUL!
Delay=239ms   Offset=+001.0k
```

If the CnC Search is **not successful**, the following message is displayed:

```
CnC SEARCH IS UNRESOLVED!
PLEASE CHECK TX POWER LEVEL
```

CONFIG: Rx → CnC → FrqOffs

```
CnC Frequency Offset:
+/-015               (▲ ▼ ENT)
```

To edit the CnC Frequency Offset, use the ▲▼ arrow keys to change the value, then press **ENTER** when done.

CONFIG: Rx → CnC → SrchDelay

```
CnC Min/Max Delay (ms):
Min=000 Max=290 (◄ ►,▲ ▼,ENT)
```

To edit the CnC Min/Max Search Delay (in milliseconds), first select the digit to be edited using the ◄ ► arrow keys; then, edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done.

CONFIG: Rx → CnC → ReAcq

```
CnC Re-Acqusition Time:
120 seconds (◄ ►,▲ ▼,ENT)
```

To edit the CnC ReAcquisition Time (in seconds), first select the digit to be edited using the ◄ ► arrow keys; then, edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done.

5.4.4 CONFIG: Group

```
Grouping:
Modem   Redundancy (◄ ►,ENT)
```

Select **Modem** or **Redundancy** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Modem	**Modem** is selected to group a vertically-aligned modulator/demodulator pair as a modem. The *slot screen* (left-hand side of the VFD) should indicate either one of the devices that is to be grouped.
Redundancy	**Redundancy** is selected to designate the backup for a redundant group. The Device Selection screen should indicate the device to become the backup.

5.4.4.1 CONFIG: Group → Modem

```
Modem Group:
Separate  Grouped  (◄ ►,ENT)
```

Select **Separate** or **Grouped** using the ◄ ► arrow keys, then press **ENTER**.

If there is a vertically aligned modulator demodulator pair with the modulator in the top position, then the Modem selection is allowed. The selection applies to the pair of which one is currently selected on the *slot screen*. Once grouped, the modulator/demodulator pair can be configured as a modem.

5.4.4.2 CONFIG: Group → Redundancy

```
Redundancy: Config  Mode
```

Select **Config** or **Mode** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Config	Selected to allow the user to set redundancy as **None, 1:1**, **1:2**, or **1:3**.
Mode	Selected to allow the unit to switch between the prime and back-up devices on a **Manual** or **Automatic** basis.

CONFIG: Group → Redundancy → Config

```
Config Redundancy
None  1:1  1:2  1:3 (◄ ►,ENT)
```

Select **None, 1:1**, **1:2**, or **1:3** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Group → Redundancy → Config → 1:1

For **1:1** redundancy, modulators are required in the top two slots – Slot#1 and Slot #3, and demodulators in the bottom two slots – Slot#2 and Slot#4.

The backup modem is installed in Slot#3 and Slot #4. For ungrouped scenario, the backup card is always installed in Slot #4.

The user can also configure 1:1 Tx or 1:1 Rx.

Without the proper hardware and FAST option enabled, the ◄ ► arrow keys will force the cursor to skip past the unavailable choice.

CONFIG: Group → Redundancy → Config → 1:2

For **1:2** redundancy, the backup is always installed in Slot#4. This is only applicable for ungrouped scenario (no modem), i.e., 1:2 Tx or 1:2 Rx.

CONFIG: Group → Redundancy → Config → 1:3

For **1:3** redundancy, the backup is always installed in Slot#4. This is only applicable for ungrouped scenario (no modem), i.e., 1:3 Tx or 1:3 Rx.

CONFIG: Group → Redundancy → Mode

```
Redundancy Mode:
Manual    Auto      (◄ ►,ENT)
```

Select **Manual** or **Auto** using the ◄ ► arrow keys, then press **ENTER**.

Manual is the default selection/operation. If **Manual** is selected, when the prime is faulted, the backup will not take over; the user will alsol have the option to do *forced* switching

When **Auto i**s selected, the backup will automatically take over once the designated prime is faulted, and vice-versa.

CONFIG: Group → Redundancy → Mode → Manual

```
Redundancy Manual Mode:
Forced-Backup = Slot#1 (▲▼,ENT)
```

If redundancy is configured (e.g., 1:1) and **Manual** is selected, the force-backup menu appears. This submenu allows the user to do *forced* switching between the backup and the designated primary device. Select the desired slot using thee ▲▼ arrow keys, then press **ENTER** when done.

5.4.5 CONFIG: Frame

IMPORTANT

Framing requires a modulator/demodulator pair grouped into a modem (refer to the previous section,* Sect. 5.4.4 CONFIG: Group*, for details).

```
Framing Mode: Unframed  EDMAC
EDMAC-2   D&I++      (◄ ►,ENT)
```

Select **Unframed**, **EDMAC**, **EDMAC-2**, or **D&I++** using the ◄ ► arrow keys, then press **ENTER**.

5.4.5.1 CONFIG: Frame → Unframed

With this selection, there is no framing – no overhead is added, and the unit will be compatible with other manufacturer's equipment when operating in a 'standard' configuration.

5.4.5.2 CONFIG: Frame → EDMAC, EDMAC-2

```
Framing mix:  AUPC-Only
AUPC+EDMAC            (◄ ►,ENT)
```

From either submenu – **EDMAC** or **EDMAC-2** – select **AUPC-Only** or **AUPC-EDMAC** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

EDMAC	**EDMAC** is backwards compatible with Comtech EF Data's CDM-500, CDM-550, CDM-550T, CDM-600, and CDM-600L modems.
EDMAC-2	**EDMAC-2** is a reduced overhead version of EDMAC, and is not backwards compatible with the modems listed above.

This Comtech EF Data proprietary framing permits the bidirectional passing of M&C and AUPC data between local and distant-end units. Note that, if framing is enabled (either **EDMAC** or **EDMAC-2**), **AUPC** is automatically enabled, but the specific EDMAC feature (passing M&C data from a local to a distant-end unit) needs to enabled here.

If **AUPC-Only** is selected, then none of the EDMAC features are available, even though framing will still be enabled.

If **AUPC+EDMAC** is selected, the user is further prompted to select whether the unit is an EDMAC *Master*, or an EDMAC *Slave*:

CONFIG: Frame → EDMAC, EDMAC-2 → AUPC+EDMAC

```
EDMAC Mode:
Master  Slave      (◄ ►,ENT)
```

Select **Master** or **Slave** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

- An EDMAC *MASTER* is a unit which is local to the M&C computer, and which passes messages, via the overhead, to a distant-end modem.
- An EDMAC *SLAVE* is a unit that is not local to the M&C computer, which is at the distant-end of a satellite link.

CONFIG: Frame → EDMAC, EDMAC-2 → AUPC+EDMAC → Master

```
Distant-end Base Address
0240               (◄ ►,▲ ▼,ENT)
```

To edit the address of the distant-end modem to which this unit will pass messages, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of addresses is from **10** to **9990.**

Note: There is a restriction on values that can be entered here – they may only be entered in increments of 10. This has been implemented so that a single MASTER may pass messages for up to 10 devices at the distant end – this is automatically taken care of, as the user may not edit the last digit of the address.

CONFIG: Frame → EDMAC, EDMAC-2 → AUPC+EDMAC → Slave

```
Address of this Slave
Unit: 0241         (◄ ►,▲ ▼,ENT)
```

To edit the address of the *Slave* unit, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of addresses is from **1** to **9999,** although 'base 10' values will be automatically skipped.

IMPORTANT

Remember that this is a unit that is intended for location at the distant-end of a link, and will therefore be under the control of a MASTER at the other end. This is the equivalent of putting the unit into Remote Control mode – no local control is possible.

5.4.5.3 CONFIG: Frame → D&I++

```
Drop & Insert: EDMAC
Drp-CH/TS Ins-CH/TS (◄ ►, ENT)
```

Select **Drp-CH/TS** or **Ins-CH/TS** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Drp-CH/TS	Displays the Tx Data Rate
Ins-CH/TS	Displays the Rx Data Rate

5.4.6 CONFIG: Interface

```
Interface: RS422 V.35 RS232
HSSI ASI G.703 QDI NONE
```

The data interface for each module (modulator or demodulator) is auto-detected. If grouped as a modem, the operating data interface will be the one installed in the demod module – the data interface on the modulator is not required.

If a QDI interface is installed and a modem is grouped, then either it or the interface installed on the Demod can be selected.

The modulator or demodulator module can support one of the following data interfaces:

- RS-422 (RS-530)
- V.35
- RS-232
- HSSI
- G.703 (for single T1 or E1)

The blinking cursor points to the data interface supported by the installed module(s). Press **ENTER** to continue.

(**Note:** While displayed on the menu, the ASI interface is not implemented/available at this time.)

5.4.6.1 CONFIG: Interface → RS422, V.35, RS232

If grouped as a modem and **RS422**, **V.35**, or **RS232** is selected, the following submenu displays:

```
RTS/CTS operation: (▲ ▼,ENT)
Loop,RTS Controls Tx Out
```

Select the desired option using the ▲▼ arrow keys, then press **ENTER**. Note the following:

RTS/CTS Loop, No Action	RTS and CTS are looped, so that CTS echoes the state of RTS, but RTS does not control the ON/OFF state of the carrier.
Loop, RTS Controls Tx Out	RTS and CTS are looped, so that CTS echoes the state of RTS, and RTS controls the ON/OFF state of the carrier (in other words, the modem will not bring up its TX carrier until RTS is asserted.
Ignore RTS, Assert CTS	RTS is ignored, and CTS is asserted unconditionally.

5.4.6.2 CONFIG: Interface → HSSI

```
HSSI Mode Select:   (▲ ▼,ENT)
TA to CA Loop
```

Select the desired option using the ▲▼ arrow keys, then press **ENTER**. Note the following:

TA to CA Loop	TA and CA are looped, but TA does not control the ON/OFF state of the carrier.
RR controls CA, **TA controls Tx Out**	TA controls the ON/OFF state of the carrier (in other words, the modem will not bring up its TX carrier until TA is asserted.

5.4.6.3 CONFIG: Interface → G.703

```
G.703 Type:  T1 E1-Balanced
E1-Unbal E2-Unbal (◄ ►,ENT)
```

Select **T1**, **E1-Balanced**, **E1-Unbal** , or **E2-Unbal** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

- If the data interface is G.703 Balanced, **T1** and **E1-Balanced** are selectable.
- If the data interface is G.703 Unbalanced, **T1**, **E1-Unbal**, and **E2-Unbal** are selectable.

CONFIG: Interface → G.703 → T1

```
T1 Configuration
Length  Line-Code  (◄ ►,ENT)
```

Select **Length** or **Line-code** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Interface → G.703 → T1 → Length

```
T1 Line Length:
000-133 feet  (▲ ▼,ENT)
```

Select the desired line length by using the ▲▼ arrow keys. Press **ENTER** when done. Note that the values will toggle through the following line length ranges (in feet): **000-133**, **133-266**, **266-399**, **399-533**, and **533-655**.

CONFIG: Interface → G.703 → T1 → Line-Code

```
G.703 T1 Line Code:
B8ZS   AMI         (◄ ►,ENT)
```

Select **B8ZS** or **AMI** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

B8ZS	Selects Bipolar 8-zero Substitution line coding.
AMI	Selects Alternate Mark Inversion line coding.

CONFIG: Interface → G.703 → E1-Balanced, E1-Unbal, E2-Unbal

```
G.703 E1 Line Code:
HDB3   AMI         (◄ ►,ENT)
```

Select **HDB3** or **AMI** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

HDB3	Selects High Density Bipolar Three Zeros Substitution line coding.
AMI	Selects Alternate Mark Inversion line coding.

5.4.6.4 CONFIG: Interface → QDI

```
QDI Tributary Ports
1  2  3  4       (◄ ►,ENT)
```

Select **1, 2, 3**, or **4** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Interface → QDI → 1, 2, 3, or 4

```
Port#X: Drop Insert LineCode
        Alarm      (◄ ► ENT)
```

*Where **X** is the selected tributary port number for this menu and all submenus that follow:* Select **Drop, Insert, LineCode, or Alarm** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: Interface → QDI → 1, 2, 3, or 4 → Drop

```
Port#X Tx Trib Rate:(▲ ▼ ENT)
Disabled            (00x64kbps)
```

Set the desired Drop / Tx Tributary data rate by using the ▲▼ arrow keys. Press **ENTER** when done. Note that this example depicts the Nx64kbps data rate where N=0 (Disabled).

The next example depicts the Nx64kbps data rate where N=24:

```
Port#X Tx Trib Rate:(▲ ▼ ENT)
01536.000kbps     (24x64kbps)
```

To continue, the next example depicts the Nx64kbps data rate where N=32 (Full E1) is specified:

```
Port#X Tx Trib Rate:(▲ ▼ ENT)
Full E1             (32x64kbps)
```

When N=32 (Full E1) is selected, pressing **ENTER** takes the user back to the QDI parent menu. Otherwise, the following submenu displays (where **X** is the selected tributary port number):

```
PX D-CH: 1  2  3  4  5  6 ►
     TS: 11 02 06 04 05 03
```

When ► displays, as per this example, this means that there are more channels available beyond Channel 6. Use right arrow key ► to view more, making sure that **ENTER** is pressed once the selection is made.

CONFIG: Interface → QDI → 1, 2, 3, or 4 → Insert

```
Port#X Rx Trib Rate:(▲ ▼ ENT)
01536.000kbps     (24x64kbps)
```

Similar to the **Drop** side, set the desired Insert / Rx Tributary Data Rate by using the ▲▼ arrow keys. Press **ENTER** when done. Note that this example depicts the Nx64kbps data rate where N=24. Once a data rate has been set, the following submenu displays (where **X** is the selected tributary port number):

```
PX I-CH: 1  2  3  4  5  6 ►
     TS: 11 02 06 04 05 03
```

When ▶ displays, as per this example, this means that there are more channels available beyond Channel 6. Use right arrow key ▶ to view more, making sure that **ENTER** is pressed once the selection is made.

CONFIG: Interface → QDI → 1, 2, 3, or 4 → LineCode

```
Port#X Line Code:
HDB3  AMI           (◄ ► ENT)
```

Select **HDB3** or **AMI** using the ◄ ►arrow keys, then press **ENTER.**

HDB3	Selects High Density Bipolar Three Zeros Substitution line coding.
AMI	Selects Alternate Mark Inversion line coding

CONFIG: Interface → QDI → 1, 2, 3, or 4 → Alarm

```
Port#X Bipolar Violation:
Active  Masked      (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER.** The default is **Masked** (i.e., no alarm is generated).

5.4.7 CONFIG: Ref

The modem can accept an externally supplied frequency reference via the **REF** BNC connector on the rear panel. However, rather than bypassing the internal reference and substituting the external signal, the internal reference is used in a low-bandwidth (~2Hz) phase-locked loop (PLL), so the modem actually phase locks to the reference external signal. There are two distinct advantages to this scheme:

a. It permits hitless switching between the operation of internal and external reference. There are no sudden discontinuities of frequency and phase in the transmitted carrier.

b. Due to the very low bandwidth of the PLL, it permits the external reference to have an inferior phase noise characteristic than the internal reference of the modem. The narrow loop essentially 'cleans up' the external signal. This is particularly important if the modem is being used to supply a 10MHz reference to a BUC or LNB.

Edit the configuration and value of the frequency reference using the ▲▼ arrow keys. Press **ENTER** when done. Available selections are as follows:

- **Internal 10 MHz**
- **External 01 MHz**
- **External 02 MHz**
- **External 05 MHz**
- **External 10 MHz**
- **External 20 MHz**
- **Out Int. 10 MHz**
- **Auto**

Two configuration examples are as follows:

```
Frequency Reference:
Internal 10 MHz     (▲ ▼,ENT)
```

```
Frequency Reference:
External 05 MHz     (▲ ▼,ENT)
```

5.4.8 CONFIG: Mask

```
Alarm Mask: Transmit Receive
Reference  BUC LNB  (◄ ►,ENT)
```

Select **Transmit**, **Receive**, **Reference –** and when applicable with an appropriately-equipped CDM-QxL L-Band unit – **BUC** or **LNB** the using the ◄ ► arrow keys, then press **ENTER**.

5.4.8.1 CONFIG: Mask → Transmit

```
Tx Alarm Mask: Tx-FIFO
G.703-BPV Tx-AIS   (◄ ► ENT)
```

Select **Tx-FIFO, G.703-BPV,** or **Tx-AIS** using the ◄ ► arrow keys, then press **ENTER**.

Note: The functionality of the **Active** and **Masked** selections shown for **CONFIG: Mask → Transmit → Tx-FIFO** are essentially identical for the **CONFIG: Mask → Transmit → G.703-BPV** and **CONFIG: Mask → Transmit → Tx-AIS** submenus.

CONFIG: Mask → Transmit → Tx-FIFO

```
Tx-FIFO Alarm:
Active  Masked     (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER**. If **Active** is selected, then a Transmit Traffic fault will be generated whenever the transmitter sees that the Transmit FIFO has slipped. If **Masked** is selected, no alarm will be generated.

5.4.8.2 CONFIG: Mask → Receive

```
Rx Alarm Mask: AGC Eb/No
Rx-AIS Buffer        (◄ ► ENT)
```

Select **AGC**, **Eb/No**, **Rx-AIS** or **Buffer** using the ◄ ► arrow keys, then press **ENTER.**

Note: The functionality of the **Active** and **Masked** selections shown for **CONFIG: Mask → Receive → AGC** are essentially identical for the **CONFIG: Mask → Receive → Eb/No, CONFIG: Mask → Receive → Rx-AIS,** and **CONFIG: Mask → Receive → Buffer** submenus.

CONFIG: Mask → Receive → AGC

```
AGC Alarm:
Active  Masked      (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER**. If **Active** is selected, then a Receive Traffic fault will be generated whenever the demodulator sees that the composite input level being applied will cause compression in the IF stages, and hence degrade the performance of the demodulator.

5.4.8.3 CONFIG: Mask → Reference

```
Reference Alarm:
Active   Masked     (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER**. If **Active** is selected, then a unit fault will be generated whenever:

- an External Reference is selected;
- there is no signal activity at the external reference port.

If **Masked** is selected, no alarm will be generated.

5.4.8.4 CONFIG: Mask → BUC (CDM-QxL only)

```
BUC Alarm:
Active   Masked     (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER**. If **Masked** is selected, no alarm will be generated.

5.4.8.5 CONFIG: Mask → BUC (CDM-QxL only)

```
LNB Alarm:
Active   Masked   (◄ ► ENT)
```

Select **Active** or **Masked** using the ◄ ► arrow keys, then press **ENTER**. If **Masked** is selected, no alarm will be generated.

5.4.9 CONFIG: ODU

IMPORTANT

These menus are operable only for CDM-QxL L-Band units.

```
ODU (Outdoor Unit):
BUC  LNB             (◄ ►,ENT)
```

The **ODU** (Outdoor Unit) menu permits the user to choose between controlling and monitoring either a **BUC** (Block Upconverter) or an **LNB** (Low-noise Block downconverter).

Select **BUC** or **LNB** using the ◄ ► arrow keys, then press **ENTER**.

5.4.9.1 CONFIG: ODU → BUC

```
BUC: M&C-FSK DC-Pwr 10MHz
Alarm Delay LO Mix (◄ ►,ENT)
```

Select **M&C-FSK, DC-Pwr, 10MHz, Alarm, Delay, LO** or **Mix** using the ◄ ► arrow keys, then press **ENTER**.

Note the following:

M&C-FSK	If an FSK-capable BUC is employed, provides access to a further set of menus that define the FSK setup, and use it for M&C (Monitor & Control).
DC-Pwr	**(DC POWER)** If a BUC supply is installed, permits user to turn DC power **ON** or **OFF**.
10MHz	Permits user to turn the 10MHz frequency reference for the BUC **ON** or **OFF**.
Alarm	Permits user to define the upper and lower limits for a current 'window'. If the measured BUC current falls outside this window, an alarm is generated.
Delay	Permits user to define the carrier-on delay following a power-up sequence.
LO	Permits user to define the LO frequency used in the BUC. This is then used in the display of RF frequency in the **CONFIG: Tx → Freq** menu.
Mix	Permits user to define the sense of the frequency translation – either high-side mix or low-side mix.

CONFIG: ODU → BUC → M&C-FSK

```
BUC M&C-FSK: Comms Address
Tx-On/Off              (◄ ►,ENT)
```

Select **Comms, Address**, or **Tx-On/Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC → M&C-FSK → Comms

```
BUC M&C FSK Comms:
On  Off                (◄ ►,ENT)
```

Select the FSK between the modem and BUC as either **On** or **Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC → M&C-FSK → Address

```
BUC FSK Address: 01
                       (▲ ▼,ENT)
```

Edit the value of the BUC logical address using the ▲ ▼ arrow keys, then press **ENTER**. The valid range is from **01** to **15**.

CONFIG: ODU → BUC → M&C-FSK → Tx-On/Off

```
BUC RF Output:
On  Off                (◄ ►,ENT)
```

Select the RF Output of the BUC as either **On** or **Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC → DC-Pwr

```
BUC DC Power:
On  Off                  (◄ ►,ENT)
```

Select the BUC DC Power as either **On** or **Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC →10MHz

```
BUC 10MHz Reference:
On  Off                  (◄ ►,ENT)
```

Select the BUC 10MHz frequency reference as either **On** or **Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC → Alarm

```
BUC Current Alarm:
Upper  Lower             (◄ ►,ENT)
```

Select **Upper** or **Lower** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → BUC → Alarm → Upper

```
BUC Current Alarm Upper:
Limit:1200mA     (◄ ► ▲ ▼ ENT)
```

To edit the BUC Current Alarm Upper limit, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of current (in mA) is from **500** to **4000**.

CONFIG: ODU → BUC → Alarm → Lower

```
BUC Current Alarm Lower:
Limit:1200mA     (◄ ► ▲ ▼ ENT)
```

To edit the BUC Current Alarm Lower limit, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of current (in mA) is from **500** to **4000**.

CONFIG: ODU → BUC → Delay

```
BUC Power-On Delay:
001 seconds         (◄ ► ▲ ▼ ENT)
```

To edit the BUC Power-On Delay value, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid delay range (in seconds) is from **0** to **999**.

CONFIG: ODU → BUC → LO

```
BUC LO Frequency:
12000 MHz           (◄ ► ▲ ▼ ENT)
```

To edit the BUC Lockout Frequency value, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid delay range (in MHz) is from **0** to **35000**.

Note: This value is used for displaying the RF frequency of the modem/BUC combination. If the default value of **00000** is entered here, then no RF frequency will be displayed on the **CONFIG: Tx → Freq** menu.

CONFIG: ODU → BUC → Mix

```
BUC Frequency Mix:
High-Side  Low-Side   (◄ ►,ENT)
```

To define the sense of the frequency translation, select **High-Side** or **Low-Side** using the ◄ ► arrow keys, then press **ENTER**.

5.4.9.2 CONFIG: ODU → LNB

```
LNB: DC-Voltage  10MHz  Alarm
LO Mix                 (◄ ►,ENT)
```

Select **M&C-FSK, DC-Pwr, 10MHz, Alarm, Delay, LO** or **Mix** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

DC-Voltage	Selects the LNB power supply output voltage as 13 or 18 Volts, and turns the LNB power **OFF**.
10MHz	Permits user to turn the 10MHz frequency reference for the LNB **ON** or **OFF**.
Alarm	Permits user to define the upper and lower limits for a current ‘window’. If the measured LNB current falls outside this window, an alarm is generated.
LO	Permits user to define the LO frequency used in the LNB. This is then used in the display of RF frequency in the **CONFIG: Rx → Freq** menu.
Mix	Permits user to define the sense of the frequency translation – either high-side mix or low-side mix.

CONFIG: ODU → LNB → DC-Voltage

```
LNB DC Supply Voltage:
13V            (▲ ▼,ENT)
```

Use the ▲▼ arrow keys to set the desired LNB DC Supply Voltage, then press **ENTER**. The choices are **13V**, **18V**, or **Power Off**.

CONFIG: ODU → LNB → 10MHz

```
LNB 10MHz Reference:
On  Off          (◄ ►,ENT)
```

Select the LNB 10MHz frequency reference as either **On** or **Off** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → LNB → Alarm

```
LNB Current Alarm:
Upper  Lower      (◄ ►,ENT)
```

Select **Upper** or **Lower** using the ◄ ► arrow keys, then press **ENTER**.

CONFIG: ODU → LNB → Alarm → Upper

```
LNB Current Alarm Upper:
Limit:1200mA     (◄ ► ▲ ▼ ENT)
```

To edit the LNB Current Alarm Upper limit, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of current (in mA) is from **50** to **600**.

CONFIG: ODU → LNB → Alarm → Lower

```
LNB Current Alarm Lower:
Limit:1200mA     (◄ ► ▲ ▼ ENT)
```

To edit the BUC Current Alarm Lower limit, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid range of current (in mA) is from **10** to **400**.

CONFIG: ODU → LNB → LO

```
LNB LO Frequency:
12000 MHz        (◄ ► ▲ ▼ ENT)
```

To edit the LNB Lockout Frequency value, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done. The valid delay range (in MHz) is from **0** to **35000**.

Note: This value is used for displaying the RF frequency of the modem/LNB combination. If the default value of **00000** is entered here, then no RF frequency will be displayed on the **CONFIG: Rx → Freq** menu.

CONFIG: ODU → LNB → Mix

```
LNB Frequency Mix:
High-Side  Low-Side (◄ ►,ENT)
```

To define the sense of the frequency translation, select **High-Side** or **Low-Side** using the ◄ ► arrow keys, then press **ENTER**.

5.5 (MAIN MENU:) Monitor

```
MONITOR: Alarms   Rx-Params
Event-Log Stats AUPC CnC ODU
```

Select **Alarms**, **Rx-Params**, **Event-Log**, **Stats**, **AUPC**, **CnC,** or – with CDM-QxL L-Band units only – **ODU,** using the ◄ ► arrow keys, then press **ENTER**.

5.5.1 MONITOR: Alarms

IMPORTANT

The modem uses a system of Fault Prioritization. In each category of fault, only the highest priority fault is displayed. For instance, if the demodulator is unlocked, it is irrelevant if there are other receive faults present. If the demodulator then locks, but there is a fault of a lower priority present, this will then be displayed. This also holds true for the faults reported via the remote control. This system cuts down drastically on unwanted and irrelevant fault reporting. A comprehensive list of faults is shown at the end of this section.

```
Live Alarms: Transmit
Receive  Unit  ODU (◄ ►,ENT)
```

Select **Transmit**, **Receive, Unit –** and when applicable with an appropriately-equipped CDM-Qx 70/140 MHz unit – **ODU**, using the ◄ ► arrow keys, then press **ENTER**.

5.5.1.1 MONITOR: Alarms → Transmit

```
Tx Traffic: No Tx  Clock
From Terrestrial          (ENT)
```

This ***read-only*** screen indicates if there are any Transmit Traffic Faults. If not, it displays '**None**'. Press **ENTER** to return to the previous menu.

5.5.1.2 MONITOR: Alarms → Receive

```
Rx Traffic: AGC Alarm -
Reduce Inpuit Level       (ENT)
```

This *read-only* screen indicates if there are any Receive Traffic Faults. If not, it displays '**None**'. Press **ENTER** to return to the previous menu.

5.5.1.3 MONITOR: Alarms → Unit

```
Unit Fault: -12 Volt PSU
Is under voltage          (ENT)
```

This *read-only* screen indicates if there are any Unit Faults. If not, it displays '**None**'. Press **ENTER** to return to the previous menu.

5.5.1.4 MONITOR: Alarms → ODU

IMPORTANT

This feature is operable only for CDM-QxL L-Band units.

```
ODU Alarms: None
                              (ENT)
```

This *read-only* screen indicates if there are any ODU Alarms. If not, it displays '**None**'. Press **ENTER** to return to the previous menu.

5.5.2 MONITOR: Rx-Params

```
EbNo=05.7dB   BER=3.4E-9
△F=+11.7k Buf=50% RSL=-24dBm
```

When the demodulator is locked, information appears on the Rx-Params screen as shown in the above example. Note the following:

Eb/No	This shows the value of Eb/No calculated by the demodulator. The value referred to here is the energy per information bit (Ebi), divided by the noise spectral density (No).
BER	This is an estimate of the corrected BER.
△F	This is the frequency offset of the received carrier, in kHz, with a displayed resolution of 100 Hz.
Buf	**(Buffer fill state)** This shows the fill state, in percent, of the receive Buffer. After a reset, it will read 50. A value <50 indicates that the buffer is emptying, and >50 indicates that it is filling.
RSL	**(Receive Signal Level)** A value in dBm, indicating the input power of the desired carrier, as seen by the demodulator. If the signal level is below the AGC range of the demod, this will display RSL <-99.

When the demodulator is ***not*** locked, the following information appears on the Rx-Params screen:

```
  Demodulator: Not Locked
  △F=+11.7k   RSL=-24dBm
```

As per this second example, this screen shows the message '**`Demodulator: Not Locked`**' but continues to display the receive signal level. Press **ENTER** or **CLEAR** to return to the previous menu.

5.5.3 MONITOR: Event-Log

```
Stored Events:
View  Clear-All        (◄ ►,ENT)
```

Select **View** or **Clear-All** using the ◄ ► arrow keys, then press **ENTER**.

5.5.3.1 MONITOR: Event-Log → View

```
Log 023: 30/11/08 10:37:32
Fault - Demod Lock(3)  (▲ ▼,ENT)
```

In this example, the demodulator installed in Slot#3 is faulted on Nov. 30, 2008 at 10:37:32 with log number 23.

IMPORTANT

- ***In accordance with international convention, the date is shown on these screens in DAY-MONTH-YEAR format.***
- ***Up to 255 events may be displayed via this screen.***
- ***Use the ▲▼ keys to display the individual alarms.***
- ***Refer to <table x-x> for lists of available alarms.***

The user may scroll backwards or forwards through the entries in the event log, using the ▲▼ arrow keys. When a fault condition occurs, it is time-stamped and put into the log. Similarly, when the fault condition clears, this is also recorded, as shown below:

Press **ENTER** or **CLEAR** to return to the previous menu.

5.5.3.2 MONITOR: Event-Log → Clear-All

```
Clear All Stored Events?
No  Yes                (◄ ►,ENT)
```

When selected, and in **Local** mode, the user is prompted to answer **No** to retain the stored events, or **Yes** to clear the buffer of all stored events. Select the choice using the ◄ ► arrow keys, then press **ENTER**.

Note: When the unit is in **Remote** mode, and the **Clear-All** menu is selected, the following message is displayed:

```
   THIS UNIT IS CURRENTLY
       IN REMOTE MODE!!
```

When the event log is cleared, the user is returned 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.

5.5.4 MONITOR: Stats

```
Link Statistics:  View
Clear-All  Config    (◄ ►,ENT)
```

Select **View, Clear-All**, or **Config** using the ◄ ► arrow keys, then press **ENTER**.

5.5.4.1 MONITOR: Stats → View

```
Sta198: 30/11/08 10:37:32
16.0, 16.0, 9.0, 9.0 (▲ ▼,ENT)
```

Per this example, link statistics displayed are as follows:

Top Line	• **Sta198 = Log entry number** • **30/11/08 10:37L32 = Time and date of log entry** (in accordance with international convention, the date is shown in DAY-MONTH-YEAR format)
Bottom Line	**16.0, 16.0, 9.0, 9.0 =** Measured and rounded statistics data, from left: Minimum Eb/No, Average Eb/No, Maximum TPLI, Average TPLI (where TPLI means Transmit Power Level increase, if AUPC is enabled).

The user may scroll backwards or forwards through the entries in the statistics log, using the ▲▼ arrow keys. Press **ENTER** or **CLEAR** to return to the previous menu. The event log can store up to 255 events.

The user defines a measurement interval (see **MONITOR: Stats → Config**), and during this interval Eb/No and TPLI are observed at a one second rate. At the end of this period, the average Eb/No is calculated and recorded, and the minimum value seen in the interval. Similarly, the average TPLI is calculated, along with the highest value seen in the interval.

Note: If the demod has lost lock during the measurement interval, the minimum Eb/No will show '**Loss**' rather than indicate a value. However, the average value (while the demod was locked) will still be calculated and shown. If, on the other hand, the demodulator has been unlocked for the entire measurement interval, the average Eb/No will also show '**Loss**'. (The display will show '**Loss, Loss**'.)

If the measured values are greater than or equal to 16.0 dB, the display will show 16.0 dB. If AUPC is not enabled, the values of maximum and average TPLI will both show '**Off**'.

Examples:

08.0, 13.5, 2.5, 1.8 means:
Minimum Eb/No observed in the measurement interval = 8.0 dB
Average Eb/No observed in the measurement interval = 13.5 dB
Maximum TPLI observed in the measurement interval = 2.5 dB
Average TPLI observed in the measurement interval = 1.8 dB

Loss, 04.5, Off, Off means:
There was a loss of demod lock during the measurement interval
Average Eb/No observed in the measurement interval = 4.5 dB
Maximum TPLI observed in the measurement interval = AUPC disabled
Average TPLI observed in the measurement interval = AUPC disabled

5.5.4.2 MONITOR: Stats → Clear-All

```
Clear All Stored Stats?
No  Yes                    (◄ ►,ENT)
```

When selected, and in **Local** mode, the user is prompted to answer **No** to retain the stored link statistics, or **Yes** to clear the buffer of all stored link statistics. Select the choice using the ◄ ► arrow keys, then press **ENTER**.

Note: When the unit is in **Remote** mode, and the **Clear-All** menu is selected, the following message is displayed:

```
   THIS UNIT IS CURRENTLY
      IN REMOTE MODE!!
```

When the link statistics log is cleared, the user is returned to the previous menu.

5.5.4.3 MONITOR: Stats → Config

```
Stats Logging Interval:
30 minutes                (◄ ►,ENT)
```

Select a logging interval for the link statistics (i.e., the period of time, in minutes, for which statistics will be measured) using the ▲▼ arrow keys, then press **ENTER**. The available selections are **Disabled, 10, 20, 30, 40, 50, 60, 70, 80,** or **90.**

5.5.5 MONITOR: AUPC

IMPORTANT

- ***This* read-only *screen is operable only for a modulator/demodulator pair grouped as a 'modem'.***
- ***Framing mode must be* active *in order for correct viewing of this screen.***

  If* MONITOR: AUPC *is selected, and the modem is* not *in Framed mode, the following message displays:

  ```
  Framing is required for
  AUPC Monitor    (ENT or CLR)
  ```

  Press* ENTER *or* CLEAR *to return to the previous menu, then, via the* CONFIG: Frame *menus, configure the modem as needed for Framing mode.

  Once configured for Framed mode, when* MONITOR: AUPC *is selected, the proper* read-only *screen should display:

  ```
  AUPC:Remote EbNo   = 14.0dB
  TX Power Increase =  2.2dB
  ```

Per this example:

- The top line displays the value of Eb/No of the demodulator at the distant end of the satellite link. The Eb/No displays **Unlock** if the remote demod is unlocked.
- The bottom line shows how much the AUPC system has increased the output power. If AUPC is not enabled, the value of **Tx Power Increase** will show as 0.0 dB.

5.5.6 MONITOR: CnC (Carrier-in-Carrier®)

IMPORTANT

This* read-only *screen is operable only for a modulator/demodulator pair grouped as a 'modem'.

When **MONITOR: CnC** is selected, the appearance of the CnC screen depends on whether CnC is **locked** or **not locked**:

If **MONITOR: CnC** is selected and CnC is **not locked**, the CnC screen appears as follows:

```
   Carrier-in-Carrier (CnC)
         is not locked
```

If **MONITOR: CnC** is selected and CnC **is locked**, the CnC screen appears as follows:

```
CnC:Dly=000,239µs △f=+001.0k
Eb/No=12.0dB     Ratio=+01dB
```

Per this example, note the following:

Dly	Delay of interferer in microseconds.
△f	Frequency offset of interferer in kHz.
Eb/No	Eb/No estimate in dB.
Ratio	Interferer-to-desired carrier level ratio in dB.

5.5.7 MONITOR: ODU

IMPORTANT

These* read-only *screens are operable only for CDM-QxL L-Band units.

```
Outdoor Unit Monitor:
BUC LNB                    (◄ ►,ENT)
```

Select **BUC** or **LNB**, using the ◄ ► arrow keys, then press **ENTER**.

5.5.7.1 MONITOR: ODU → BUC

```
BUC: DC=47.8V,3.2A  T=38oC
SW=1.1  PLL=Flt  Pwr=02.1W
```

In this example, the BUC parameters displayed are as follows:

DC Pwr	**(DC Power)** If a BUC supply is installed, displays measured BUC supply voltage and load current, measured at the Tx-IF connector.
T	**(Temperature)** If BUC FSK is enabled, displays BUC ambient temperature in °C.
SW	If BUC FSK is enabled, displays the M&C software version of the BUC.
PLL	If BUC FSK is enabled, displays the fault status of the BUC PLL synthesizers.
Pwr	**(Output)** If BUC FSK is enabled, displays the output power as measured by the BUC power monitor.

Press **ENTER** or **CLEAR** to return to the previous menu.

5.5.7.2 MONITOR: ODU → LNB

```
LNB Voltage: 13.1 volts
LNB Current: 235 mA    (ENT)
```

In this example, the LNB parameters displayed are as follows:

LNB Voltage	LNB Voltage (in volts).
LNB Current	LNB Current, in mA.

Press **ENTER** or **CLEAR** to return to the previous menu.

5.6 (MAIN MENU:) Test

```
TEST: Mode  BIST    (◄ ►,ENT)
      Spec-Analyzer
```

Select **Mode, BIST (Built-in System Test), or Spec-Analyzer** using the ◄ ► arrow keys, then press **ENTER**.

5.6.1 TEST: Mode

```
Mode: Norm IF⮌ Dig⮌ I/O⮌ RF⮌
Tx-CW Tx1-0 SSB-CW  (◄ ►, ENT
```

All test modes are available if *grouped* as a modem. However, in *ungrouped* cases – e.g., *Tx only* – **Norm**, **Tx-CW**, and **Tx1-0** are the only selections. For *Rx only*, it is always in **Norm**.

Select **Norm**, **IF Loop**, **Dig Loop**, **I/O Loop**, **RF Loop**, **Tx-CW**, or **Tx-1,0** using the ◄ ► arrow keys, then press **ENTER**. Note the following:

Norm	**(Normal)** This clears any test modes or loopbacks, and places the unit back into an operational state.
IF Loop	**(IF Loopback)** This test mode invokes an internal IF loop. This is a particularly useful feature, as it permits the user to perform a quick diagnostic test without having to disturb external cabling. Furthermore, all of the receive configuration parameters are temporarily changed to match those of the transmit side. When **Normal** is again selected, all of the previous values are restored. During an IF Loop, the Tx carrier continues to be transmitted. **See Figure 5-3.**
Dig Loop	**(Digital Loopback)** Not supported due to the different card configurations in the chassis.
I/O Loop	**(Inward/Outward Loopback)** This test mode invokes two distinct loopbacks. The first of these is the inward loop, which takes data being received from the satellite direction, and passes it directly to the modulator. Simultaneously, the outward loop is invoked, whereby data being fed to the transmit data interface is routed directly back out of the receive data interface. **See Figure 5-3.**
RF Loop	**(RF Loopback)** This test mode is almost identical to the IF loop mode. All of the receive configuration parameters are temporarily changed to match those of the transmit side, however, no internal connection is made. This is useful for performing a satellite Loopback. When **NORMAL** is again selected, all of the previous values are restored.
TX-CW	**(Transmit CW)** This is a test mode, which forces the modulator to transmit a pure carrier (unmodulated). Used for measuring phase noise.
TX-1,0	**(Transmit an alternating 1,0,1,0 pattern)** This is a test mode that forces the modulator to transmit a carrier modulated with an alternating 1,0,1,0 pattern, at the currently selected symbol rate. This causes two discrete spectral lines to appear, spaced at +/- half the symbol rate, about the carrier frequency. This mode is used to check the carrier suppression of the Modulator.
SSB-CW	**(Single-sideband CW)** The test will produce a spectral pattern suitable for the measurement of SSB rejection – useful in determining the phase and amplitude accuracy of the modulator.

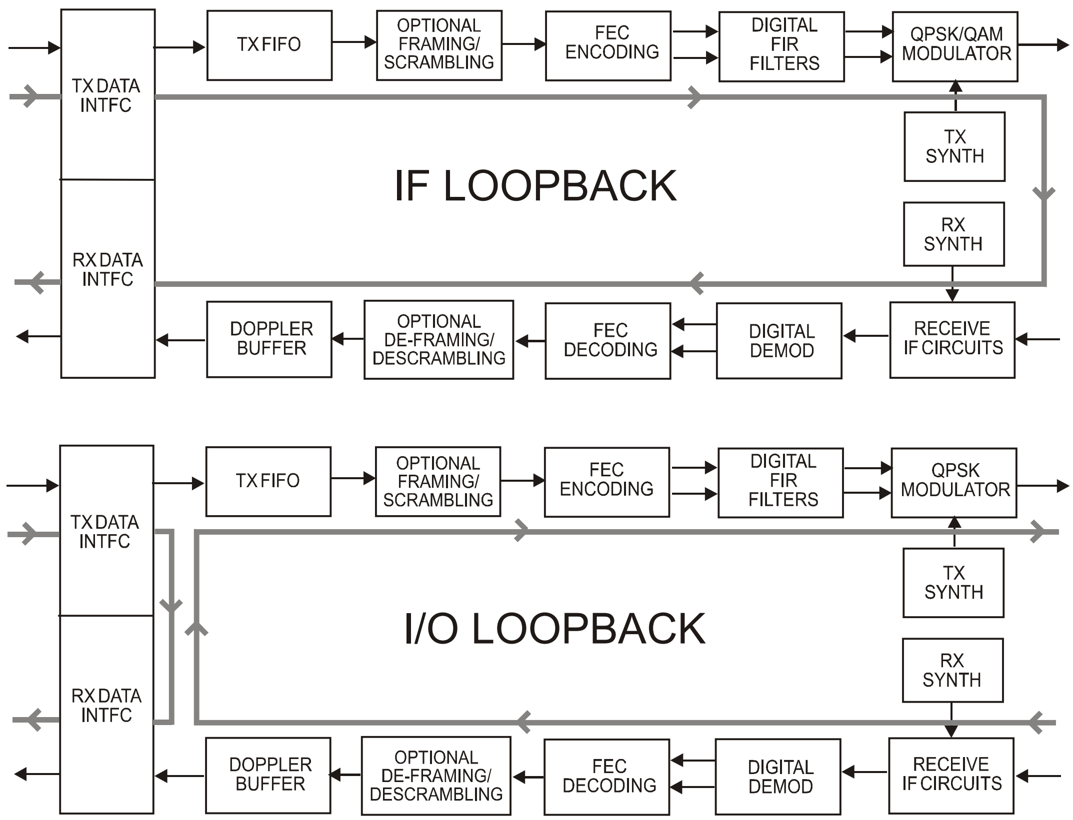


Figure 5-3. Loopback

5.6.2 TEST: BIST

```
BIST: BERT-Config  BERT-Mon
BERT-Control       (◄ ►,ENT)
```

Select **BERT-Config**, **BERT-Mon**, or **BERT-Control** using the ◄ ► arrow keys, then press **ENTER**.

5.6.2.1 TEST: BIST → BERT-Config

```
BERT Config: Tx=ON  Rx=ON
Tx-Pat=2047 Rx-Pat=2047
```

If the selected slot is Tx, the Rx parameters are not selectable, and vice-versa. Note the BERT generator resides at the Tx side while the BERT monitor resides at the Rx side. This menu allows to turn ON/OFF either the BERT generator or monitor and selects the BERT pattern as the user may desire. The BERT patterns supported are **Space, Mark, 1:1, 1:3, 63, 511, 2047, 2047R (or 2047 alternate), MIL-188, 2^15-1, 2^20-1, and 2^23-1**.

5.6.2.2 TEST: BIST → BERT-Mon

```
BERT Monitor: Errs=0000253
              BER=8.5E-07
```

If BERT monitor is turned **ON**, results are being displayed in bit errors and average BER. If it displays **BER=SyncLoss** that means there was a loss of pattern synchronization. If it displays **BER=No Sync**, that means pattern synchronization is not achieved. When the BERT monitor is sync, the BER displays a value (e.g. BER=8.5E-07).

5.6.2.3 TEST: BIST → BERT-Control

```
BERT Control: 10E-3Err=OFF
Restart=NO  SyncThres=>256
```

Note the following:

- The **10E-3Err** control resides at the Tx. This generates an average BER=1.0E-03 once monitored at the Rx side.
- The **Restart** control is to reset the BERT monitor (Rx side) for a fresh start of BER measurement.
- The **SyncThres** control is the synchronization loss threshold as defined:
  a. >**256** = 256 bit errors counted in less than 1000 bits o data
  b. **low** = 100 bit errors in less than 1000 bits of data
  c. **med** = 250 bit errors in less than 1000 bits of data
  d. **high** = 20,000 bit errors in less than 100,000 bits of data

5.6.3 TEST: Spec-Analyzer

```
Spectrum Analyzer:
Mode  Config        (◄ ►,ENT)
```

Select **Mode** or **Config** using the ◄ ► arrow keys, then press **ENTER**.

TEST: Spec-Analyzer → Mode

```
Spectrum Analyzer Mode:
Off  On                (◄ ►,ENT)
```

To control the engine of the spectrum analyzer, select **Off** or **On** using the ◄ ► arrow keys, then press **ENTER**. When the Spectrum Analyzer Mode is **On**, the user can view the spectrum via Comtech EF Data's Windows-based application software or the CDM-Qx/QxL embedded Web browser.

TEST: Spec-Analyzer → Config

```
Config Spectrum Analyzer:
CenterFreq  Span     (◄ ►,ENT)
```

Select **CenterFreq** or **Span** using the ◄ ► arrow keys, then press **ENTER**.

TEST: Spec-Analyzer → CenterFreq

```
Spectrum Analyzer: (◄ ►,▲▼,ENT)
Center Freq = 0070.0000 MHz
```

The Center Frequency is similar to Rx Frequency in a regular demodulation function with a resolution of 100 Hz. To edit the Center Frequency value, first select the digit to be edited using the ◄ ► arrow keys, then edit the value of that digit by using the ▲▼ arrow keys. Press **ENTER** when done.

TEST: Spec-Analyzer → Span

```
Spectrum Analyzer:   (▲▼,ENT)
Span = 12.5 MHz
```

Select a predefined span value using the ▲▼ arrow keys, then press **ENTER**. The user can only select the one of the following span values (default is **12.5 MHz**):

- **97.65625 kHz**
- **195.3125 kHz**
- **390.625 kHz**
- **781.25 kHz**
- **1.5625 MHz**
- **3.125 MHz**
- **6.25 MHz**
- **12.5 MHz**

5.7 (MAIN MENU:) Info (Information)

```
INFO: Rem Tx Rx Buffer Frame
Interface Mask  Ref  ID
```

These screens provide ***read-only*** information on the current configuration of the unit. Select **Rem, Tx, Rx, Buf, Frame, Interface, Mask, Ref,** or **ID** using the ◄ ► arrow keys, then press **ENTER**. This section provides examples of each screen; the actual parameters may vary depending on the unit configuration.

Note: For each ***read-only*** information screen, press **ENTER** or **CLEAR** to return to this top-level menu branch.

5.7.1 INFO: Rem

This screen provides **Remote Control Information**, and shows if the unit is in **Local** or **Remote** mode. It provides details about: the electrical interface type selected; the unit address; the baud rate selected; etc.

Examples:

```
Remote M&C: Monitor Only
(Local Control only)
```

```
Remote M&C: RS485-4Wire
Address: 0001  19200 Baud
```

```
Remote M&C: 100BaseTx
IP Addr: 255.255.255.255
```

5.7.2 INFO: Tx

```
Tx: 1140.000 05000.000 TUR
8P 17/18 S EXT -20.0 ON  N ▲ ▼
```

This screen provides **Transmit Configuation Information**. Per this example, note the following:

Top Line	• **1140.000 05000.000 = Transmit Frequency** and **Data Rate** (**NOTE:** Due to space limitations, the resolution of displayed frequency is limited to 1 kHz, and data rate to 10Hz) • **TUR = FEC Encoder type** (VIT = Viterbi, VRS=Viterbi + Reed-Solomon, TCM = Trellis Coded + Reed-Solomon, TUR = Turbo)
Bottom Line	• **8P = Modulation Type** (Q = QPSK, B = BPSK, 8P = 8-PSK, 16=16-QAM) • **17/18 = Code Rate** (2144 = 21/44, then 5/16, 1/2, 2/3, 3/4, 7/8, 17/18) • **S = Scrambler state** (S = Scrambler on, N = Scrambler off, I=IESS-315) • **EXT = Clocking Mode** (INT = internal, EXT = external, LOP = loop, ELP=external loop) • **-20.0 = Output Power** level • **ON =** (ON = on, OF = off, EO= external off) • N = **TSI State** (I = Transmit Spectral Inversion on, N = off)

Use the ▲▼ arrow keys to display this second page of information:

```
Tx: C N N 35
                       ▲ ▼
```

Per this example, note the following:

Top Line	• **C = Reed-Solomon code rates** (C=Comtech (220,200), E=EF Data (225,205), I=IESS-310 (219,201) • **N = Tx Clock Inversion** (N=Normal, I=Inverted) • **N = Tx Data Inversion** (N=Normal, I=Inverted) • **35 = Tx Roll-Off (α) factor** (20=20% roll-off, 35=35% roll-off)
Bottom Line	▲▼ Page navigation mnemonic

5.7.3 INFO: Rx

```
Rx: 1140.000 05000.000  TUR
8P 17/18 D RX BUF +/-32k  N ▲▼
```

This screen provides **Receive Configuation Information**. Per this example, note the following:

Top Line	• **1140.000 05000.000 = Receive Frequency** and **Data Rate** (NOTE: Due to space limitations, the resolution of displayed frequency is limited to 1 kHz, and data rate to 10Hz) • **TUR = FEC Decoder type** (VIT = Viterbi, SEQ = Sequential, VRS=Viterbi + Reed-Solomon, SRS=Sequential + Reed Solomon, TCM = Trellis Coded + Reed-Solomon, TUR = Turbo)
Bottom Line	• **8P = Demodulation type** (Q = QPSK, B = BPSK, 8P = 8-PSK, 16=16-QAM) • **17/18 = Code Rate** (2144 = 21/44, then 5/16, 1/2, 2/3, 3/4, 7/8, 17/18) • **D = Descrambler state** (D = Descrambler on, N = Descrambler off) • **RX = Buffer Source** (IN = internal, RX = Rx satellite, TT = Tx terrestrial) • **BUF = Buffer Clocking Mode** (SAT = buffer disabled, BUF = buffer enabled) • **+/-32k = Demod Sweep Acquisition range** • N = **RSI state** (I = Receive Spectral Inversion on, N = off)

Use the ▲▼ arrow keys to display this second page of information:

```
Rx: C N N 35
                          ▲ ▼
```

Per this example, note the following:

Top Line	• **C = Reed-Solomon code rates** (C=Comtech (220,200), E=EF Data (225,205), I=IESS-310 (219,201) • **N = Rx Clock Inversion** (N=Normal, I=Inverted) • **N = Rx Data Inversion** (N=Normal, I=Inverted) • **35 = Rx Roll-Off (α) factor** (20=20% roll-off, 35=35% roll-off)
Bottom Line	▲▼ Page navigation mnemonic

5.7.4 INFO: Buffer

```
Buffer:  Enabled      (Tx=Rx)
                     (ENT)
```

This screen provides **Buffer Information**. It displays if the buffer is **Enabled** or **Disabled** and shows the exact clocking mode (TX=RX, or TX<> RX).

5.7.5 INFO: Frame

This screen provides **Framing and EDMAC Information**. It shows the assigned **EDMAC** mode and whether the unit is an EDMAC *MASTER* or *SLAVE*, along with the appropriate address. Some examples are as follows:

```
Framing: AUPC-Only, D&I++
                 (ENT or CLR)
```

```
Framing:AUPC-Only,EDMAC2
                 (ENT or CLR)
```

```
Framing: AUPC+EDMAC2
Master,0240      (ENT or CLR)
```

```
Framing: AUPC+EDMAC
Slave, 0241      (ENT or CLR)
```

5.7.6 INFO: Interface

```
Interface: RS422       (ENT)
RTS/CTS Loop, No Action
```

This screen provides **Interface Information**; it shows details about the electrical interface type of the main data port. Per the example shown, if **RS422**, **V.35** or **RS232** is selected, the screen will also indicate the operation of RTS/CTS.

5.7.7 INFO: Mask

```
Mask:  FIFO  BPV  TAIS  RAIS
AGC  EbNo  BUF  Ref
```

This screen provides **Alarm Mask Information** in the same format as the **CONFIG: MASK** menu branch. It displays which alarms are currently masked. Per the example shown, iIf an alarm is not masked, a blank is displayed in the relevant screen position.

5.7.8 INFO: Ref

```
Frequency Reference:
Internal 10 MHz        (ENT)
```

This screen displays the source of the frequency reference for the CDM-Qx/QxL, as per the example shown.

5.7.9 INFO: ID

```
Circuit ID:            (ENT)
28 CHARACTER TST MESSAGE
```

This displays the user-defined Circuit ID string, which is entered via the **UTILITY: ID** menu branch. Backup devices do not have an ID. Press **ENTER** to return to the previous menu.

5.8 (MAIN MENU:) Save/Load

```
SAVE/LOAD Configuration:
Save  Load          (◄ ► ENT)
```

The CDM-Qx/QxL permit the user to store or load up to 10 different modem configurations in its non-volatile memory. Select **Save** or **Load** using the ◄ ► arrow keys, then press **ENTER**.

5.8.1 INFO: SAVE/LOAD → Save

```
Save Config to Location: 9
Empty                 (▲ ▼ ENT)
```

If **Save** is selected and the chosen location is empty, the screen appears as per the above example. If, however, the location already contains data, the screen appears similar to the following example:

```
Save Config to Location: 9
11:10:29 21/12/08   (▲ ▼ ENT)
```

The screen displays the time and date stamp of the previously stored configuration, in international Day-Month-Year format, for identification purposes.

Locations 1 through 10 are available. Select the location to which to store the current configuration, using the ▲▼ arrow keys, then press **ENTER**.

If the selected location does not contain a previously stored configuration, the following screen is displayed:

```
Your Configuration has been
Saved to Location 9    (ENT)
```

Press **ENTER** or **CLEAR** to return to the previous menu.

If, however, the selected location contains a previously stored configuration, the user is prompted with a message similar to what follows:

```
Location 9 Contains Data!
Overwrite? NO YES    (◄ ► ENT)
```

Select **NO** or **YES** using the ◄ ► arrow keys, then press **ENTER**. By selecting **YES**, this will overwrite the existing configuration at the selected location.

5.8.2 INFO: SAVE/LOAD → Load

```
Load Config from Location: 9
11:10:29 21/12/08    (▲ ▼ ENT)
```

If **Load** is selected and a configuration is already stored in the chosen location, the screen appears as per the above example. The screen displays the time and date stamp of the stored configuration, in international Day-Month-Year format, for identification purposes.

If, however, the selected location contains no data, the screen displays a message similar to what follows:

```
Load Config from Location 9
Empty                    (▲ ▼ ENT)
```

Locations 1 through 10 are available. Using the ▲▼ arrow keys, select the location from which to load a configuration, then press **ENTER**. If the selected location contains valid data, the following screen is displayed:

```
New Config has been Loaded
from Location 9          (ENT)
```

Press **ENTER** or **CLEAR** to return to the previous menu. If the selected location ***does not*** contain valid data, the following screen is displayed:

```
Warning! Location 9
Contains No Data!        (ENT)
```

Press **ENTER** or **CLEAR** to return to the previous menu.

5.9 (MAIN MENU:) Utility

```
UTILITY: RxBuffer Clock Ref
ID  Display  Firmware  FAST
```

Select **RxBuffer**, **Clock**, **Ref**, **ID**, **Display**, **Firmware** or **FAST** using the ◄ ► arrow keys then press **ENTER**.

5.9.1 UTILITY: RxBuffer

```
Press ENT to Re-Center
the Receive Buffer
```

Press **ENTER** to cause a forced re-centering of the Plesiochronous/Doppler Buffer.

5.9.2 UTILITY: Clock

```
Real-Time Clock:(◄ ►,▲ ▼,ENT)
Time=12:00:00  Date:24/04/03
```

IMPORTANT

To edit the Real-Time Clock time and date settings, first select the digit to be edited using the ◄ ► arrow keys, then change the value of that digit using the ▲▼ arrow keys. Press ENTER when done.

Note that, in accordance with international convention, the date is shown in DAY-MONTH-YEAR format.

5.9.3 UTILITY: Ref

```
Internal Freq Ref: Adjust
Warm-up delay    (▲▼,ENT)
```

For fine adjustment of the Internal 10 MHz reference oscillator, use the ▲▼ arrow keys to edit the value, then press **ENTER.** The range of accepted values is from **–2048** to **+2047**.

IMPORTANT

The numbers displayed here do not correspond to an exact frequency increment. The user should perform this fine adjustment while using an external frequency counter connected to either:

a) the internal 10 MHz reference, or

b) the Tx Output set for CW, and an exact center frequency of – for example – 1000 MHz.

5.9.4 UTILITY: ID

```
Edit Circuit ID: (◄ ►,▲ ▼,ENT)
28 CHARACTER TST MESSAGE
```

To edit the Circuit Identification string, use the ◄ ► arrows keys to select the position to edit, then use the ▲▼ arrow keys to select the character for that position.

Only the bottom line is available (28 characters). The following characters are available:

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

Once the Circuit ID string has been composed, press **ENTER** to save.

Note: Backup devices in redundant groups do not have an ID. If plug-in devices are to be grouped, the grouping should precede assigning IDs so the group can be named instead of the individual devices.

5.9.5 UTILITY: Display

```
Edit Display Brightness:
100%                 (▲▼,ENT)
```

To adjust the brightness of the VFD, use the ▲▼ arrow keys to select a value, then press **ENTER.** The available selections are **25%**, **50%, 75%**, and **100%**.

5.9.6 UTILITY: Firmware

IMPORTANT

THESE MENUS ARE INTENDED FOR DIAGNOSTIC PURPOSES ONLY. THE USER SHOULD CHANGE AN IMAGE ONLY IF INSTRUCTED TO DO SO BY A COMTECH EF DATA CUSTOMER SERVICE TECHNICIAN.

This series of submenus permits the user to view information about the CDM-Qx/QxL internal firmware. The modem can store two complete firmware images, and the user can select which image will be loaded the next time the unit reboots.

```
Firmware Images:  Update-CPLD
Information  Select  (◄ ► ENT)
```

Select **Update-CPLD**, **Information,** or **Select** using the ◄ ► arrow keys, then press **ENTER**.

5.9.6.1 UTILITY: Firmware → Update-CPLD

Programming the CPLD requires only one card to be installed in the chassis. If this is not the case, the following message will display:

```
RULE: Only one card must be
installed in the chassis!
```

If this rule has been exercised, this submenu appears as follows (note that the v1.X.X pertains to the version of the feature itself, and not the chassis-dependent firmware versions):

```
Update CPLD to v1.x.x?
No Yes                 (◄ ► ENT)
```

Before selecting **Yes**, please check the current version of the CPLD programmed on the Tx or Rx card – **(MAIN MENU:) UTIL→Firmware→Information→CPLD**. Selecting **Yes** to update to the latest version will cause the following message screen to display:

```
    Programming CPLD . . .
    . . . PLEASE WAIT!
```

IMPORTANT

Whether or not CPLD reprogramming is successful, remember to ALWAYS CYCLE POWER if another module is to be reprogrammed.

5.9.6.2 UTILITY: Firmware → Information

```
F/W Information: Bootrom
Image#1  Image#2   CPLD
```

Typical for either modulator or demodulator modules, select **Bootrom**, **Image#1, Image#2, or CPLD** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: Firmware → Information → Bootrom

```
Bootrom Info:         06/12/08
FW/00108A                2.1.1
```

Press **ENTER** or **CLEAR** to return to the previous menu.

UTILITY: Firmware → Information → Image#1, Image#2

```
Image#x: Bulk Firmware  (▲ ▼)
FW/00107E  05/20/09     2.1.5
```

*For either **Image#1** or **Image#2**:* Use the ▲▼ arrow keys to browse through each read-only screen for each component of the firmware image.

Examples:

```
Image#x: App Firmware   (▲ ▼)
FW/00109E  05/20/09     2.1.5
```

```
Image#x: Mod FPGA       (▲ ▼)
FW/11251G  06/05/08     1.1.8
```

Press **ENTER** or **CLEAR** to return to the previous menu.

UTILITY: Firmware → Information → CPLD

```
CPLD Info:
FW/11255  Tx=1.2.4  Rx=1.2.4
```

Firmware versions for both the Modulator and Demodulator modules are shown, as per the above example. Press **ENTER** or **CLEAR** to return to the previous menu.

5.9.6.3 UTILITY: Firmware → Select

```
Current Active Image: #1
Next Reboot Image: #1 #2
```

The top line shows the current active boot image. Using the ◄ ► arrow keys, on the bottom line, the user may select **#1** or **#2** as the image that will be active the next time the unit is rebooted. Press **ENTER** when done.

5.9.7 UTILITY: FAST

```
FAST – Select the module:
Base Slot1 Slot2 Slot3 Slot4
```

FAST (**F**ully **A**ccessible **S**ystem **T**opology) is used to enable new options in the CDM-Qx/QxL. Contact Comtech EF Data to obtain the **FAST** code for the desired option. For a step-by-step tutorial on this complete upgrade process, refer to **Appendix B. FAST ACTIVATION PROCEDURE**.

Using the ◄ ► arrow keys, select **Base**, **Slot1**, **Slot2**, **Slot 3**, or **Slot 4**, then press **ENTER** when done. Note the following:

- **Base** refers to the base unit, where the redundancy and CnC options may be viewed.
- **Slot#** refers to the four module slots available in the rear panel of the chassis.

UTILITY: FAST → Base

```
FAST: Config  View  (HW 1.02)
Board S/N: 123456789  (Base)
```

The Base unit screen displays the chassis hardware version and the motherboard serial number. This information will be needed when contacting Comtech EF Data Technical Support to obtain the FAST code needed for upgrade. Select **Config** or **View** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Base → Config

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** or **Demo Mode** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Base → Edit Code

```
Edit 20 digit FAST Code:
00000000000000000000   (ENT)
```

The **Edit Code** screen is used to enable new options in the modem. Once the **FAST** code for the new option has been obtained from Comtech EF Data, enter the code *carefully*. Use the ◄ ► arrow keys to move the cursor to each character, then use the ▲ ▼ arrow keys to edit the character. When all characters are edited, press **ENTER**.

The modem will respond with "**Configured Successfully**" if the new **FAST** option has been accepted; otherwise, you may return to the menu to edit futher.

UTILITY: FAST → Base → Demo Mode

```
FAST Demo Mode: Off  On
    604,800 seconds remaining
```

Select **Off** or **On** using the ◄ ► arrow keys, then press **ENTER.** When enabled, **Demo Mode** allows access to *ALL* CDM-Qx/QxL **FAST** options for 3,888,000 seconds (45 full days). Demo Mode may be turned on and off an unlimited number of time until all 3,888,000 seconds have expired; the time count only decrements when the mode is **On**.

When Demo Mode is turned **On**, the following messages display:

```
Please Wait… Resetting
Factory Defaults
```

```
PROCESSOR BOOTING…PLEASE WAIT!
[■■■■■■■■■■■■■■■    ]
```

When the allotted demo period expires, the following message displays:

```
FAST Demo Mode: Off  On
 Demo Period Expired
```

From this time forward, once Demo Mode expires, the display reverts to the previous (Demo Mode) submenu and **On** is rendered **non-selectable**.

UTILITY: FAST → Base → View

```
View Options: 02    (▲ ▼,ENT)
1:2 Redun   - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **`Installed`** or **`Not Installed`** for base unit operation. Press **ENTER** when done.

UTILITY: FAST → Slot#

```
FAST - Slot#1: Mod     Turbo
                   (▲ ▼,ENT)
```

```
FAST - Slot#2: Demod   Turbo
                   (▲ ▼,ENT)
```

Where # denotes the selected Slot#1, #2, #3 or #4: The Slot# menu screen indicates whether the installed module is a Modulator, or Demodulator. If no module is present in the selected slot, the following message displays:

```
      THERE IS NO CARD
   INSTALLED IN THIS SLOT!
```

The user will then be taken to the menu screen for the last valid slot in the configuration. From there, select **Mod (Demod)** or **Turbo** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Slot# → Mod, Demod

```
FAST: Config  View
Board S/N: 223456789  (Mod#1)
```

```
FAST: Config  View
Board S/N: 323456789  (Dem#2)
```

As with the menu screen for **UTILITY: FAST→Base**, this menu screen identifies the serial number for the board of the specific module installed in this slot position. Additionally, the module type and its slot position are identified here. In the examples shown above, a Modulator module resides in the Slot#1 position; a Demodulator module resides in Slot#2.

Select **Config** or **View** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Slot# → Mod, Demod → Config

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** or **Demo Mode** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Slot# → Mod, Demod → Config → Edit Code, Demo Mode

Operation here is identical to selections made via the **UTILITY: FAST→Base→Config** menu screen. Refer to **UTILITY: FAST→Base→Config→Edit Code** or **UTILITY: FAST →Base→Config→Demo Mode** for further details.

UTILITY: FAST → Slot# → Mod, Demod → View

```
View Options: 01    (▲ ▼,ENT)
TPC Codec   - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **`Installed`** or **`Not Installed`** for Mod/Demod operation. Press **ENTER** when done.

UTILITY: FAST → Slot# → Turbo

```
FAST: Config  View
Board S/N: 423456789  (TPC#1)
```

As with the menu screen for **UTILITY: FAST→Base** and **UTILITY: FAST→Mod, Demod**, this menu screen identifies the serial number for the Turbo Product Codec board for the module residing in this slot position (in the above example, Slot#1 has been selected, and the TPC board is therefore identified as **`TPC#1`**).

Select **Config** or **View** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Slot# → Turbo → Config

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** or **Demo Mode** using the ◄ ► arrow keys, then press **ENTER**.

UTILITY: FAST → Slot# → Turbo → Config → Edit Code, Demo Mode

Operation here is identical to selections made via the **UTILITY: FAST→Base→Config** submenu screens. Refer to **UTILITY: FAST→Base→Config→Edit Code** or **UTILITY: FAST→Base→Config→Demo Mode** for further details.

UTILITY: FAST → Slot# → Turbo → View

```
View Options: 03    (▲ ▼,ENT)
5M Turbo    - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **`Installed`** or **`Not Installed`** for Turbo Product Codec. Press **ENTER** when done.

Chapter 6. ETHERNET MANAGEMENT

6.1 Introduction

The CDM-Qx/QxL base chassis is equipped for monitor and control purposes with an RJ-45 10/100 BaseT Ethernet management interface. This chapter provides a high-level overview of the functionality provided by this interface, and references other chapters in this manual for further details.

6.2 Ethernet Management Interface Protocols

The modem 10/100BaseT Ethernet Management Interface supports three (3) different management protocols:

- SNMP with public and private MIB
- Telnet interface for remote product M&C
- Web Server interface for complete product management

IMPORTANT

In order to access the SNMP, Telnet, and Web Server features, the user must make sure the unit is in Ethernet Remote Mode (Config → Remote → Ethernet). It is not recommended to have write access enabled while using SNMP, Telnet, or the Web at the same time.

6.3 SNMP Interface

The *Simple Network Management Protocol* (SNMP) is an application-layer protocol designed to facilitate the exchange of management information between network devices. The CDM-Qx/QxL SNMP agent supports both SNMPv1 and v2c.

IMPORTANT

For proper SNMP operation, the CDM-Qx/QxL MIB files must be used with the associated version of the CDM-Qx/QxL modem M&C. Please refer to the pertinent CDM-Qx/QxL FW Release Notes for information on the required FW/SW compatibility.

6.3.1 Management Information Base (MIB) Files

MIB files are used for SNMP remote management and consist of Object Identifiers (OIDs). Each OID is a node that provides remote management of a particular function. A MIB file is a tree of nodes that is unique to a particular device.

The following MIB files are associated with the CDM-Qx/QxL:

MIB File/Name	Description
FW10874-2-.mib ComtechEFData Root MIB file	ComtechEFData MIB file gives the root tree for ALL Comtech EF Data products and consists of only the following OID: Name: comtechEFData Type: MODULE-IDENTITY OID: 1.3.6.1.4.1.6247 Full path: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).comtechEFData(6247) Module: ComtechEFData
FW11247-1-.mib CDM-Qx MIB file	MIB file consists of all of the OIDs for management of the modem functions.
FW11247-2-.mib CDM-Qx Traps MIB file	Trap MIB file is provided for SNMPv1 traps common for base modems.

These MIB files should be compiled in a MIB Browser or SNMP Network Monitoring System server.

Note: The SNMP agent supports both "**SNMPv1"** and "**v2c"**. The "**Traps"** file only needs to be compiled if "**SNMPv1"** traps are to be used.

6.3.2 SNMP Community Strings

The modem uses community strings as a password scheme that provides authentication before gaining access to the modem agent's MIBs.

In "**SNMP v1/v2c"**, the community string is sent unencrypted in the SNMP packets. Caution must be taken by the network administrator to ensure that SNMP packets travel only over a secure and private network if security is a concern. A packet sniffer can easily obtain the community string by viewing the SNMP traffic on the network.

The community string is entered into the MIB Browser or Network Node Management software and is used to authenticate users and determine access privileges to the SNMP agent.

The user defines three Community Strings for SNMP access:

- Read Community default = public
- Write Community default = private
- Trap Community default = comtech

6.3.3 SNMP Traps

The modem has the ability to send out SNMP traps when certain events occur in the modem. The modem sends out traps when an alarm or a fault occurs in the modem. These include unit faults, Tx faults, Rx faults, and ODU faults. A trap is sent both when a fault occurs and is cleared.

The modem supports both **SNMPv1** traps and **SNMPv2** notifications. Which style of traps the modem sends can be configured by the user via the cdmQxSNMPTrapVersion OID.

The following are the MIB2 v1traps/v2 notifications that the modem supports:

MIB2 SNMPv1 trap: Authentication Failure	5
MIB2 SNMPv2 notifications: Authentication Failure	1.3.6.1.6.3.1.1.5.5

The following tables are the Alarms and Faults v1 traps / v2 notifications that the modem supports.

Alarms and Faults **SNMPv1** traps:

cdmQxTxTrafficAlarmV2	6247272
cdmQxUnitAlarmV2	6247271
cdmQxRxTrafficAlarmV2	6247273

Alarms and Faults **SNMPv2** notifications:

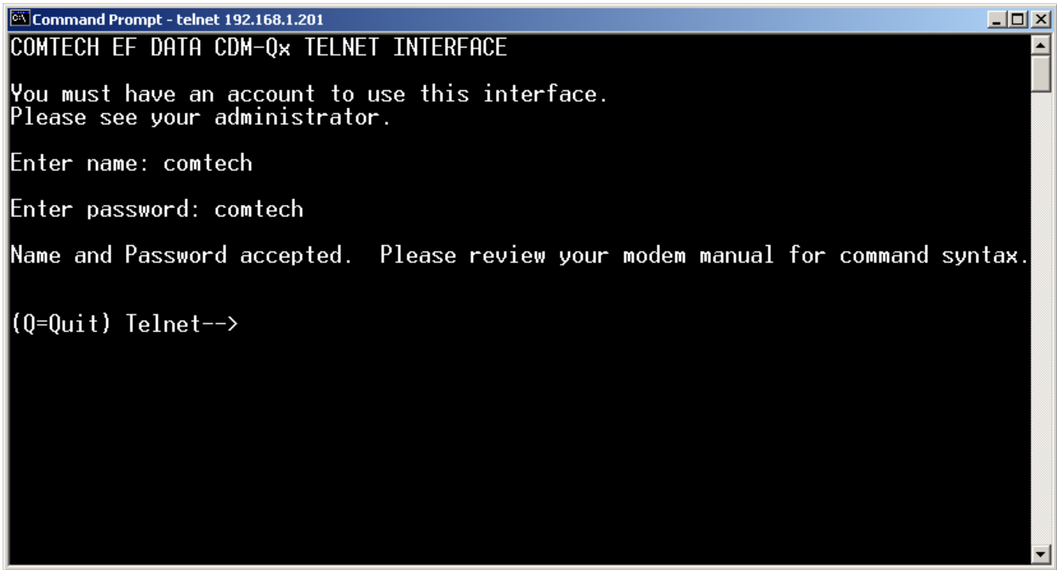
cdmQxUnitAlarm	1.3.6.1.4.1.6247.34.2.0.1
cdmQxTxTrafficAlarm	1.3.6.1.4.1.6247.34.2.0.2
cdmQxRxTrafficAlarm	1.3.6.1.4.1.6247.34.2.0.3

6.4 Telnet Interface

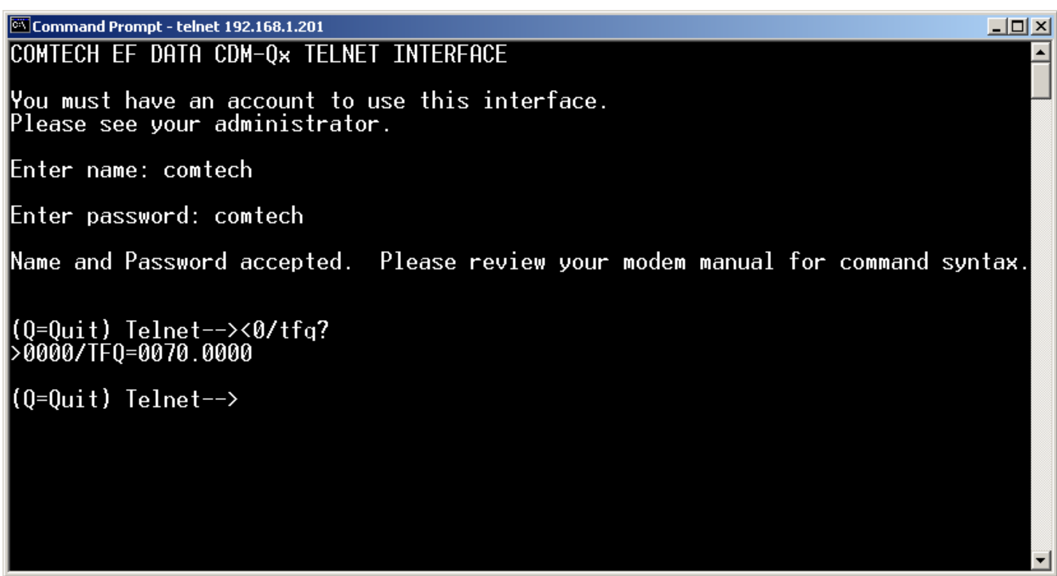
The modem provides a Telnet interface for the purpose of Equipment M&C via the standard equipment Remote Control protocol.

The Telnet interface Requires user login at the **Administrator** level and **Read/Write** level.

This screen capture shows the login process:



Once logged into the Telnet interface as the Administrator, the user can access the standard remote control interface defined in **Appendix B. REMOTE CONTROL**, as shown in the following example:

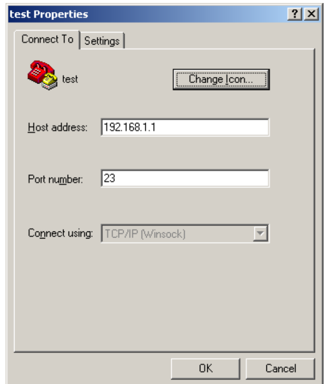


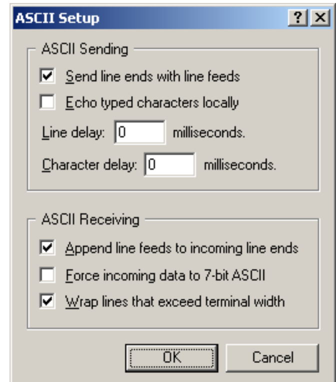
There is a disadvantage when using Windows DOS as Telnet Client. Since Windows DOS cannot translate a '\r' to a '\r\n' for the messages coming from Telnet Server, the multi-line command response (for example, **FRW?** response) will be displayed as one line, with the latter lines overwriting the previous lines.

In order to view the full response messages, CEFD recommends using HyperTerminal configured as Telnet Client. To do so, configure the HyperTerminal as follows:

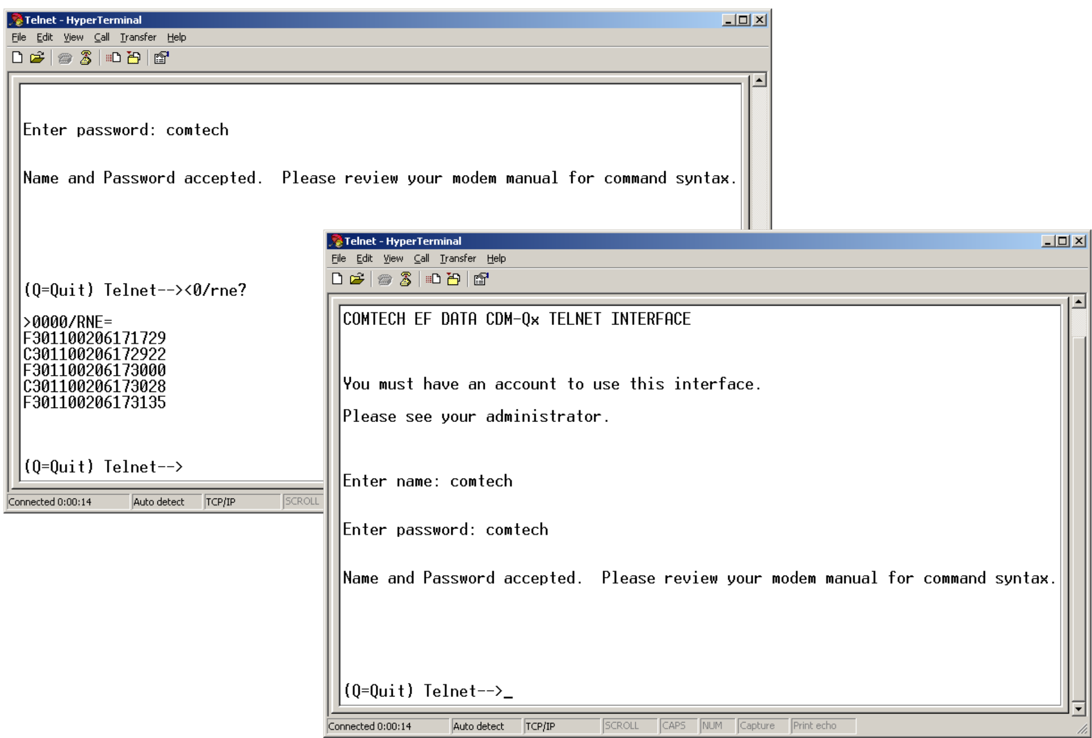
1. Under the HyperTerminal **Properties** tab: Connect using TCP/IP instead of COM1 or COM2.
2. Under the **Settings** tab, ASCII setup (far right): For **ASCII Sending**, check "**Send line ends with line feeds**".

   For **ASCII Receiving**, check "**Append line feeds to in-coming line ends**".





The following screen captures show examples of HyperTerminal configured as Telnet Client:



6.5 Web Server (HTTP) Interface

The sections that follow describe the functionality of the CDM-Qx/QxL Multi-Channel Satellite Modem Web Server (HTTP) Interface. Please refer to **Chapter 5. FRONT PANEL OPERATION**, and the Remote Commands Specifications tables found in **Appendix C. REMOTE CONTROL** for detailed descriptions of the configuration parameters featured on the individual Web pages shown in this chapter.

6.5.1 Web Server Introduction

The embedded Web Server application provides the user with an easy to use interface to configure and monitor all aspects of the CDM-Qx/QxL. These Web pages have been designed for optimal performance when using Microsoft's Internet Explorer Version 5.5 or higher (the examples shown use Internet Explorer Version 6.0).

The user can fully control and monitor base operations of the CDM-Qx/QxL from the Web Server Interface. By rolling the cursor over the navigation tabs located at the top of each page (right), the user can select from the available nested hyperlinks.

6.5.2 Web Server Menu Tree

The menu tree illustrates the options available through this interface:

Home	Admin	Config	ODU*	Main
Home	Access	Quick View	BUC	Unit Info
Contact	Remote	Unit Status	LNB	
Support				

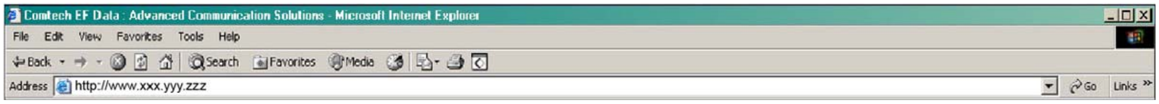
*This navigation tab and its supported hyperlinks are visible/accessible only with a properly-configured CDM-QxL (L-Band) unit.

IMPORTANT

Prior to starting a new Web session, be sure to clear the browser cache of any pages accessed during earlier Web sessions.

6.5.3 User Login

To initiate a Web session with the CDM-Qx/QxL Modem, from the PC type *http://www.xxx.yyy.zzzz* (where "*www.xxx.yyy.zzz*" represents the IP address of the CDM-Qx/QxL Multi-Channel Satellite Modem) into the **Address** area of the Web browser:



The Login window will appear, and the user is prompted to type a User Name and Password.

HTTP Login Access Levels are defined as follows:

User Interface	User Login Access Level		
	Admin User	**Read/Write User**	**Read Only User**
Web	Full Access to all Web Pages	No Access to Admin or Encryption Web pages	No Access to Admin or Encryption Web pages
		Full Access for all other Web Pages	View Only Access for all other Web Pages

CDM-Qx/QxL Satellite Modem Web Server Default Name/Passwords are:

Admin	comtech/comtech
Read/Write	opcenter/1234
Read Only	monitor/1234

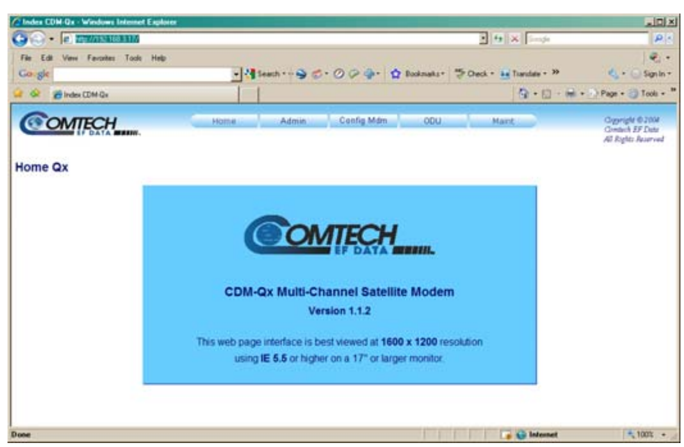
Type the User Name and Password, then click **[OK].**

Once the valid User Name and Password is accepted, the user will see the CDM-Qx/QxL Multi-Channel Satellite Modem Web Server Interface "splash" page (right). From this top level menu, depending on the unit in use the user has access to four or five navigation tabs:

- **Home**
- **Admin** (Administration)
- **Config** (Configuration)
- **ODU** (Outdoor Unit)*
- **Maint** (Maintenance).

* CDM-QxL only.

Click any tab to continue.



6.5.4 Web Server Page Descriptions

6.5.4.1 Home Page

6.5.4.1.1 Home | Home Page

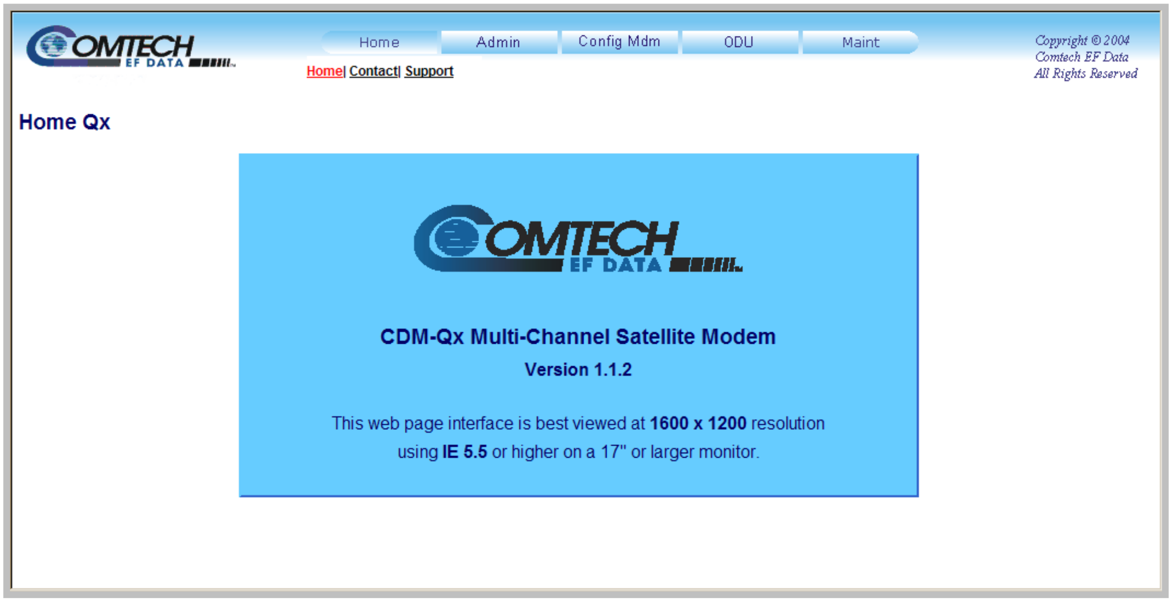


Figure 6-1. CDM-Qx/QxL Multi-Channel Satellite Modem Home page

From any location within the Web Server Interface, the user can select the **Home** tab and/or hyperlink to return back to this top-level page.

6.5.4.1.2 Home | Contact Page

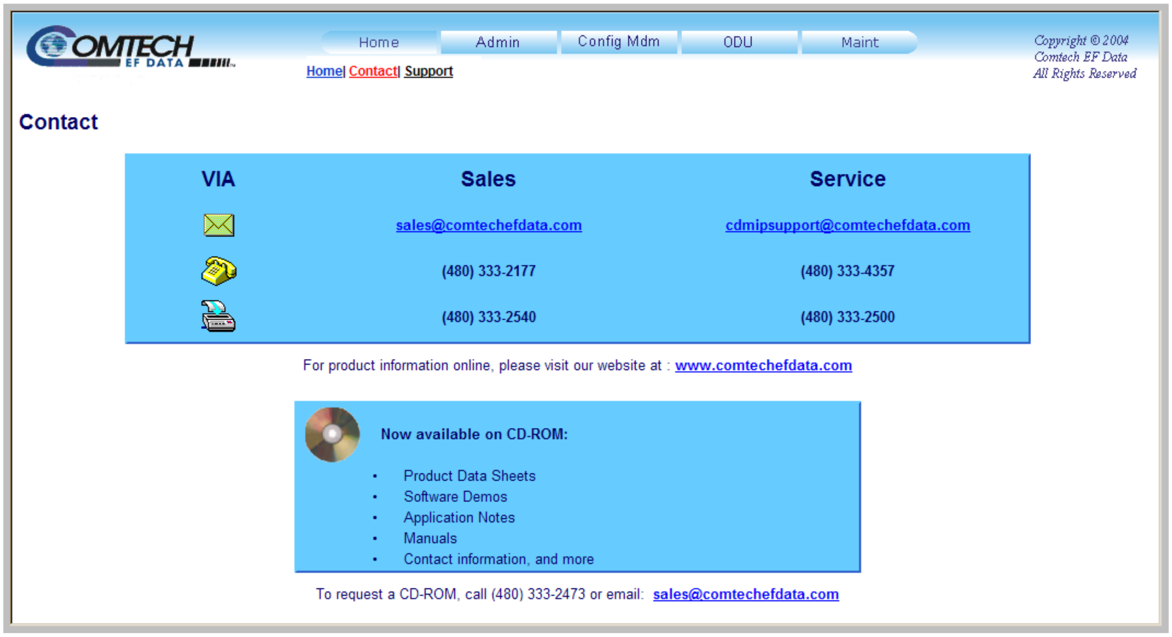


Figure 6-2. Home | Contact Information page

The '**Contact'** page (**Figure 6-2**) provides basic contact information to reach Comtech EF Data Sales and Customer Support via phone or automated e-mail links.

6.5.4.1.3 Home | Support Page

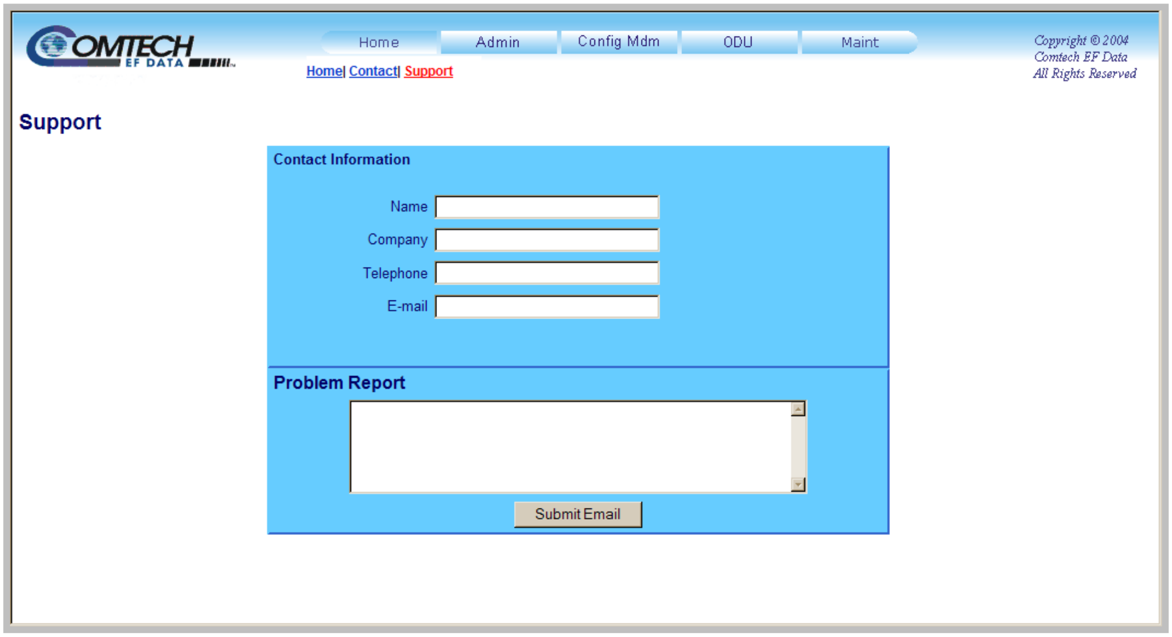


Figure 6-3. Home | Customer Support page

The CDM-Qx/QxL '**Support'** page (**Figure 6-3**) allows the user to compose an e-mail message for questions or problems with the modem.

The **Problem Report** area of the display allows up to 256 characters maximum.

The CDM-Qx/QxL Support Web Page uses SMTP (Simple Mail Transport Protocol) to send e-mail to Comtech EF Data Modem Support (cdmipsupport@comtechefdata.com).

IMPORTANT

For this page to operate correctly, the modem's administrator is required to specify the SMTP server, domain name, and destination on the* Admin | Access *page (see Sect. 6.5.4.2.1).

Once the **Contact Information** is entered and a message composed in the **Problem Report** text window, click [**Submit E-mail]** to send the message.

6.5.4.2 Admin Pages

The '**Admin'** pages provide the means to set up the access parameters required to facilitate communication with the CDM-Qx/QxL Web Server.

IMPORTANT

The Admin pages are available only to users who have logged in using the Administrator Name and Password.

6.5.4.2.1 Admin | Access Page

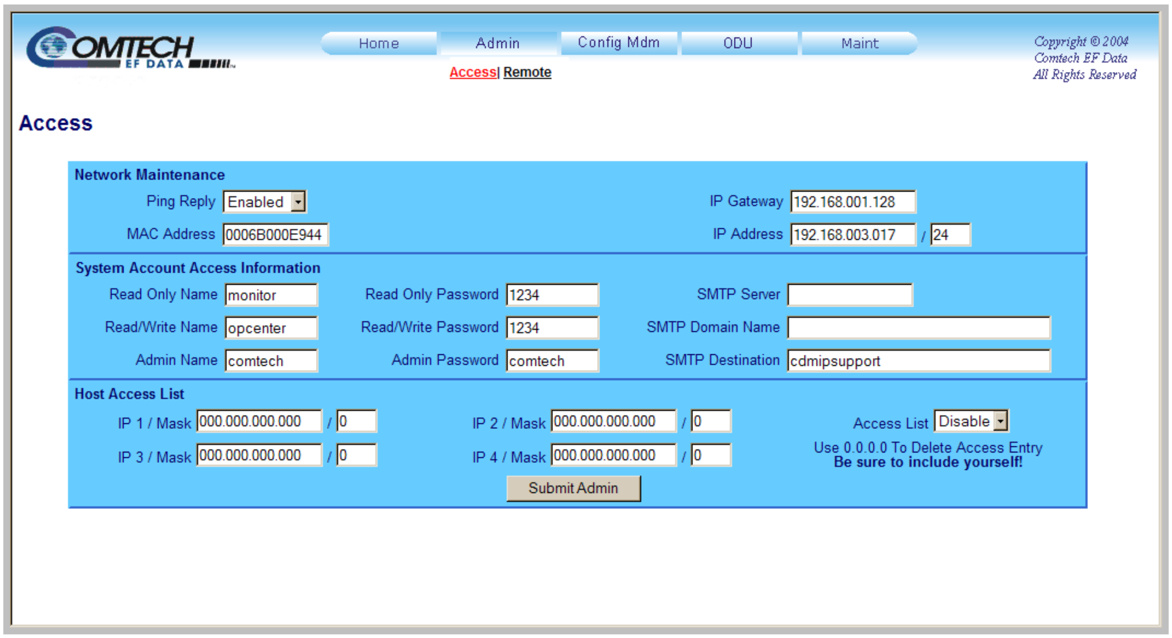


Figure 6-4. Admin | Access page

The '**Admin | Access'** page (**Figure 6-4)** provides the means to set up user names, passwords, the e-mail server, and the host IP addresses to facilitate communication with the CDM-Qx/QxL Web Server.

Network Maintenance

- **Ping Reply:** Use the drop-down menu to select as **Disabled** or **Enabled**.
- **MAC Address:** This parameter is ***read-only*** and cannot be changed.
- **IP Gateway / Address:** Used to configure the modem's IP Gateway and Address.

System Account Access Information

- **Read Only, Read/Write, Admin Names and Passwords:**

  The factory defaults for these names/passwords are:
  - **Read Only** monitor/1234
  - **Read/Write** opcenter/1234
  - **Admin** comtech/comtech

Note the following:

- These **Name** fields can be any alphanumeric combination with a maximum length of 10 characters.
- These **Password** fields can be any alphanumeric combination with a maximum length of 10 characters.

- **SMTP Server:** Specify the mail server IP address from where you want to send the e-mail.
- **SMTP Domain Name / Destination:** The Administrator can assign the SMTP Domain Name and Destination. This is required if the e-mail feature of the Support Page (Sect. 6.5.4.1.3) is to be used.
  - For **SMTP Domain Name**, specify the domain of the e-mail server (usually found to the right of the @ symbol in an e-mail address).
  - For **SMTP Domain Destination**,specify the e-mail recipient name (usually found to the left of the @ symbol in an e-mail address).

Host Access List

- **IP** *(#)* **/ Mask:** The Host Access List allows a user to define which remote clients can connect when the Access List is **Enabled**. Each entry allows a user to specify an IP address and a subnet mask to define a unique class of machines that are allowed access.

  For example, if a user wanted to grant access to a PC with an IP Address of 10.10.10.1 and any PC on a subnet of 192.168.10.xxx, then the Access List would be defined as :

  IP 1 / Mask: 10.10.10.1/32
  IP 2 / Mask: 192.168.10.0/24

  For IP 3 / Mask and IP 4 / Mask, make sure they are not 0.0.0.0/0. An entry with 0.0.0.0/0 simply means any machine is allowed to access.

- **Access List:** The Access List allows a user to grant access via HTTP and SNMP to a well-defined list of client machines.

  Use the drop-down menu to select **Enable** or **Disable**. If **Disabled**, then any client machine will be able to connect via HTTP and SNMP.

Once the desired configuration settings have been made on this page, the user should then click [**Submit Admin]** to save these changes.

6.5.4.2.2 Admin | Remote Page

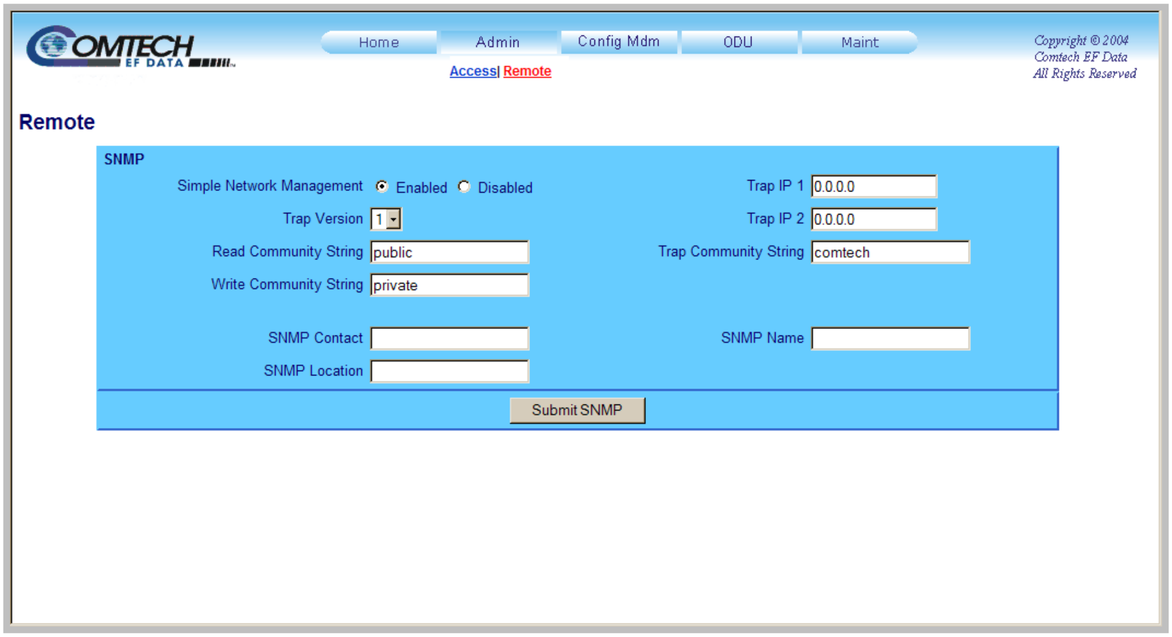


Figure 6-5. Admin | Remote page

The '**Admin | Remote'** page (**Figure 6-5**) sets and returns administration information for the CDM-Qx/QxL Simple Network Management Protocol (SNMP) feature. For complete details pertaining to the configuration parameters available on this page, refer to **Chapter 5. FRONT PANEL OPERATION** and **Sect. 6.3 SNMP INTERFACE**.

Note the following:

- **Select** Simple Network Management as **Enabled** or **Disabled**.
- Use the drop-down menu to **select** the Trap Version as **1** or **2**.
- The Administrator can **assign** up to two **SNMP Trap IP** addresses.
- The Administrator can **assign** SNMP **Read, Write**, and **Trap Community Strings**. Note the following default strings:
  - **Default Read Community String:** public
  - **Default Write Community String:** private
  - **Default Trap Community String:** comtech

  Note that the SNMP Community Strings can be any combination of characters and a length of 0 - 20 characters.

Once the desired configuration settings have been made on this page, the user should then click [**Submit SNMP]** to save these changes.

6.5.4.3 Config Mdm (Configure Modem) Pages

The '**Config Mdm**' pages are used to configure parameters for both the base chassis and up to four modulator or demodulator modules, whether configured independently or grouped as modems; real-time unit status information is also provided. Click either the **Quick View** or **Unit Status** hyperlinks to continue.

6.5.4.3.1 Config Mdm | Quick View

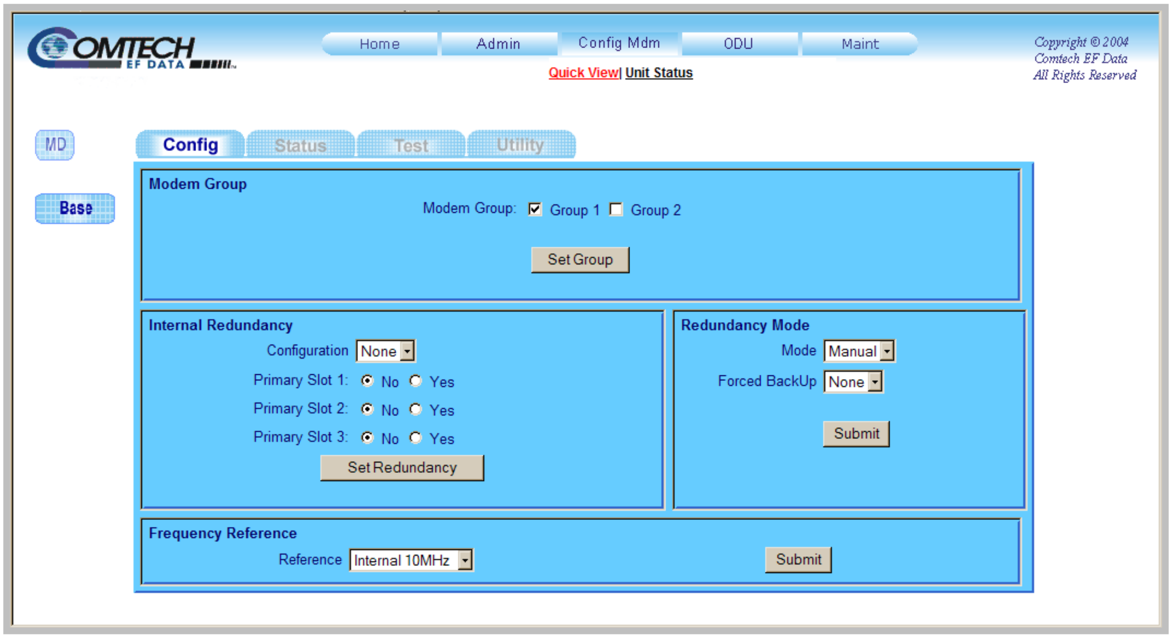


Figure 6-6. Config Mdm | Quick View Page Example

The '**Config | Quick View'** page (**Figure 6-6**) is the 'gateway' page for operation of the complete CDM-Qx/QxL configuration. Once the **Quick View** hyperlink is selected, the page will refresh and the Configuration Icon Group, located at the left side of the page, will display the configuration in use, as per the following schematic:

Slot#1 (MD, Tx, or Rx)	**Slot#3** (MD, Tx, or Rx)
Slot#2 (Tx or Rx)	**Slot4** (Tx or Rx)
Base	

When the unit senses the presence of installed modules, the icon quad just above the **Base** icon will populate to match the active configuration. The icons may display:

- **Tx** (to reflect the presence of a modulator module in that slot);
- **Rx** (to reflect the presence of a demodulator module in that slot).
- **MD** (for a grouped modem pair, a maximum of two will display – Modem 1 in the Slot#1 position, Modem 2 in the Slot#2 position).

If no module is installed, the space assigned to that slot will not be visible. For example, the Configuration Icon Group shown in **Figure 6-6** depicts a modulator pair (a Tx module installed in Slot#1 and an Rx module installed in Slot#2) grouped as a modem; Slots 3 and 4 are empty.

Note: At a minimum, the **Base** icon is *always* displayed and selectable.

Furthermore, the Quick View page highlights the active component (i.e., Base, Tx, Rx, or MD). The display may resemble, but is not limited to, the configuration examples shown in **Figure 6-7**:

(4) independant modules (2 Tx, 2 Rx) present, Base **active**

(1) Modem pair, (2) independant modules present, Slot#4 Rx module **active**

(2) Modem pair present, Base **active**

(4) independant Tx modules present, Base **active**

(4) independant Rx modules present, Base **active**

Figure 6-7. Configuration Icon Group Examples

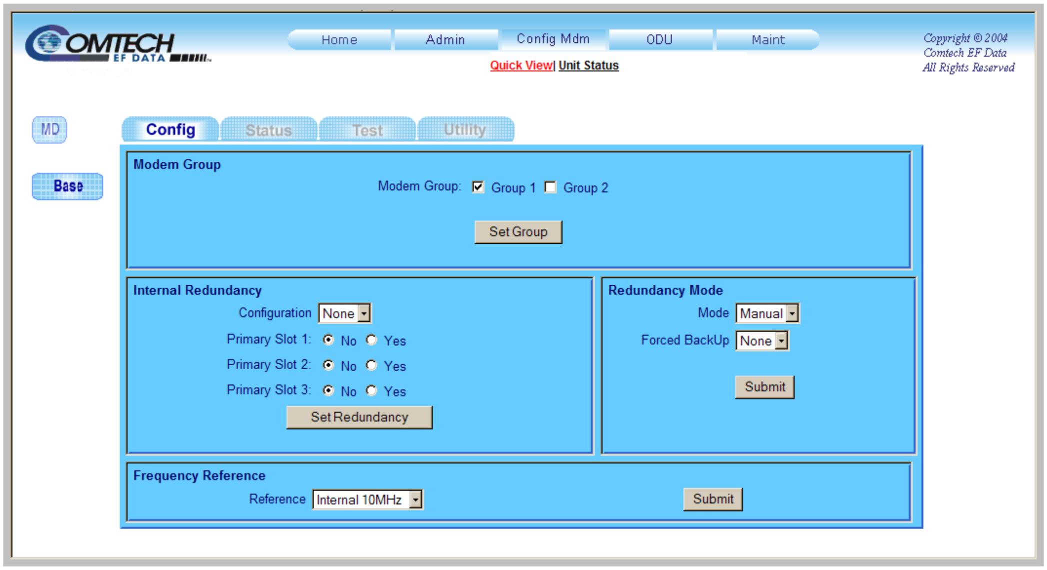
To configure a component (Base, Tx, Rx, or MD), click on that icon. At this point, the user may select one of four configuration tabs available to the right of the Configuration Icon Group (atop the primary info windows of this interface): **Config**, **Status**, **Test**, or **Utility**.

The following subsections detail use of these nested pages. The accessibility of content on each of these nested pages depends on the active component that has been selected from the Configuration Icon Group:

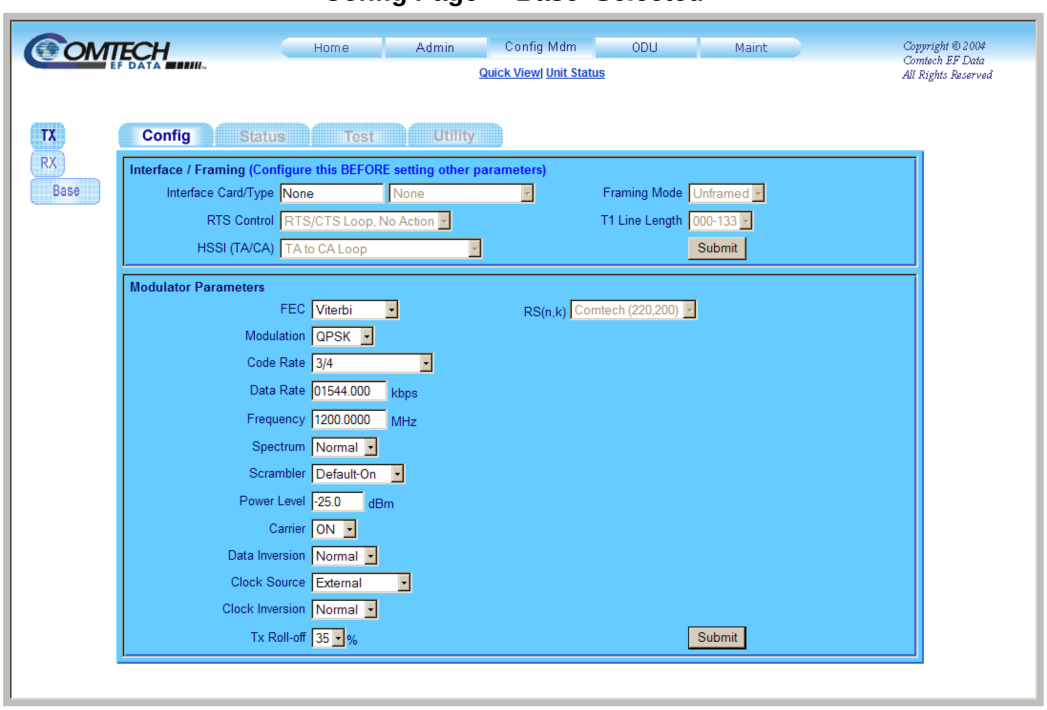
- If the **Base** is selected, the common functions of the installed modules (Tx or Rx) are configurable.
- If a modulator slot (**Tx**) is selected, only the modulator parameters will be displayed and accessible.
- If a demodulator slot (**Rx**) is selected, only the demodulator parameters will be displayed and accessible.
- If a modem (**MD**) is selected, both the modulator and demodulator parameters are accessible.

6.5.4.3.1.1 Config Mdm | Quick View | Config Pages

Depending on the configuration icon selected, the nested **Config** page provides the user with access to an assortment of base unit, modulator, and demodulator configuration parameters. For detailed information on these features, refer to the pertinent subsections of **Sect. 5.2 (MAIN MENU:) CONFIG** in **Chapter 5. FRONT PANEL OPERATION.**

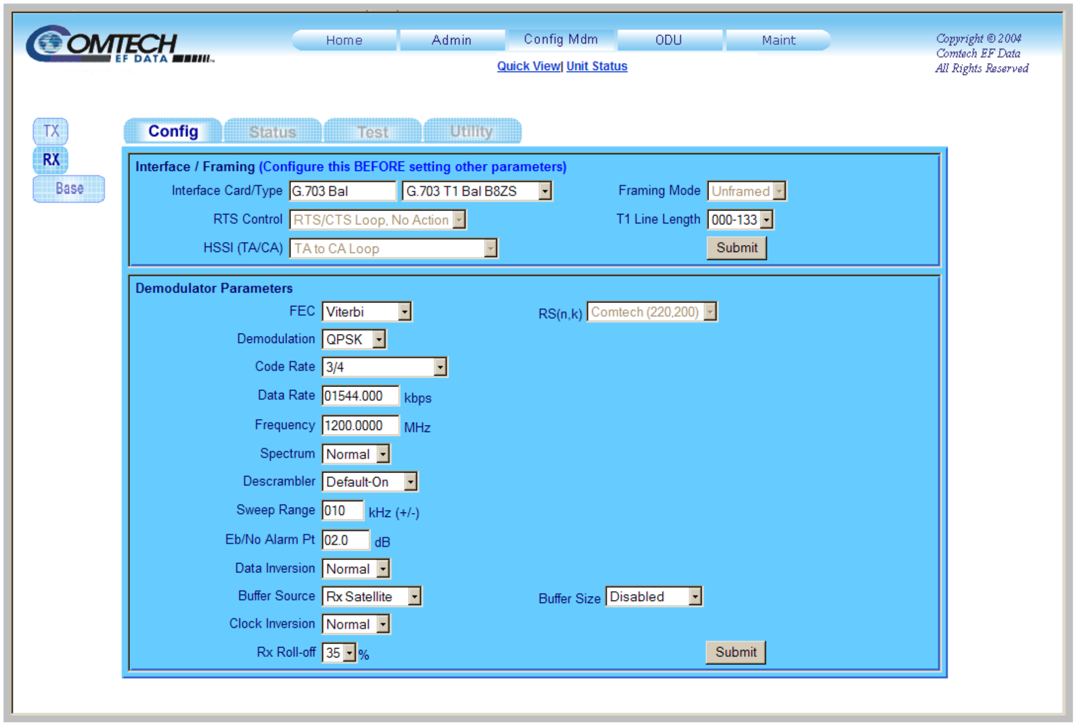


Config Page – 'Base' Selected

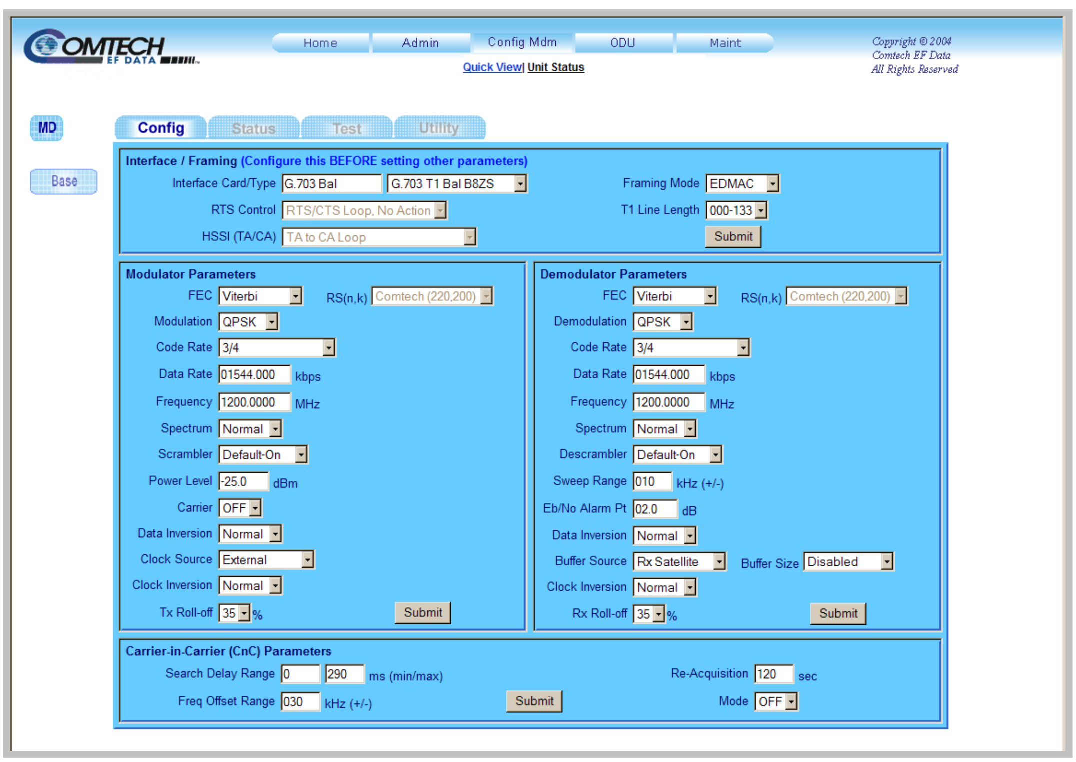


Config Page – 'Tx' Selected

Figure 6-8. 'Config Mdm | Quick View | Config' Nested Pages – Base, Tx



Config Page – 'Rx' selected



Config Page – 'MD' selected

Figure 6-9. 'Config Mdm | Quick View | Config' Nested Pages – Rx, MD

Modem Group

(Available only on the* Base *nested* Config *page) – To create a modem group from the available installed modulator and demodulator modules, click on **Group 1** or **Group 2**, then click **[Set Group]**. Note the following:

- Note that, if **Group 1** is defined, the unit will take the modulator and demodulator modules installed in *Slot#1* and *Slot#2*, respectively, and group them. The individual **Tx** and **Rx** icons in those slot positions will be replaced with the **MD** icon, which will display in the *Slot#1* icon position.
- Similarly, if **Group 2** is defined, the unit will take the modulator and demodulator module pair installed in *Slot#3* and *Slot#4*, respectively, and group them. The individual **Tx** and **Rx** icons in those slot positions will be replaced with the **MD** icon, which will display in the *Slot#3* icon position.
- Deselecting either Group will separate the paired modules for that group back to independent **Tx** and **Rx** operation.

Internal Redundancy

(Available only on the* Base *nested* Config *page) – Note that, in a non-modem configuration, the backup device must be installed in Slot#4.

- **Configuration –** Use the drop-down menu to select the redundant configuration as **OFF** or **ON**.
- **Primary Slot # –** Select **No** or **Yes** to set the modules installed in Slots 1, 2 and 3 as Primary.

Click **[Set Redundancy]** when done.

Redundancy Mode

(Available only on the* Base *nested* Config *page) – Using the drop-down menus:

- **Mode –** Select **Manual** or **Auto**.
- **Forced BackUp –** Select **None**, **Slot1**, **Slot2**, or **Slot3**.

Click **[Submit]** when done.

Frequency Reference

(Available only on the* Base *nested* Config *page) – Use the drop-down **Reference** menu to select **Internal 10MHz**, **External 1MHz**, **External 2MHz**, **External 5MHz**, **External 10MHz**, **External 20MHz**, **Output 10MHz**, or **External Auto**.

Click **[Submit]** when done.

Interface / Framing

IMPORTANT

The available configuration parameters available in this section will change depending on the installed data interface. This section must be configured before setting any other operating parameters.

***(Available on the* Tx, Rx, *and* MD *nested* Config *pages)* –** Click **[Submit]** once all the parameters have been set in this section.

Modulator Parameters

(Available on the* Tx *and* MD *nested* Config *pages) – Click **[Submit]** once all the parameters have been set in this section.

Demodulator Parameters

(Available on the* Rx *and* MD *nested* Config *pages) – Click **[Submit]** once all the parameters have been set in this section.

Carrier-in-Carrier (CnC) Parameters

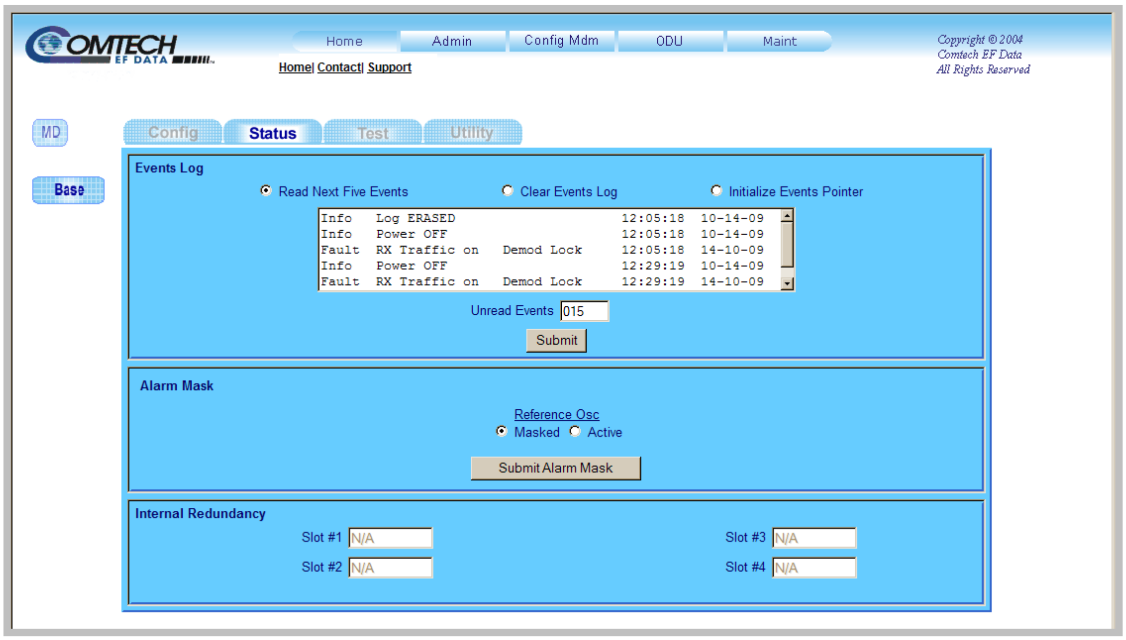
(Available only on the* MD *nested* Config *page) – See **Chapter 9. DoubleTalk™ Carrier-in-Carrier®** for complete details on using this feature. Note the following:

- **Search Delay Range** – Type the minimum and maximum values, in milliseconds, into the provided text boxes.
- **Freq Offset Range** – Type the desired frequency offset range, in kilohertz, into the provided text box.
- **Re-Acquisition** – Type the desired re-acquisition time, in seconds, into the provided text box.
- **Mode** – Using the drop-down menu, select CnC mode as **ON** or **OFF**.

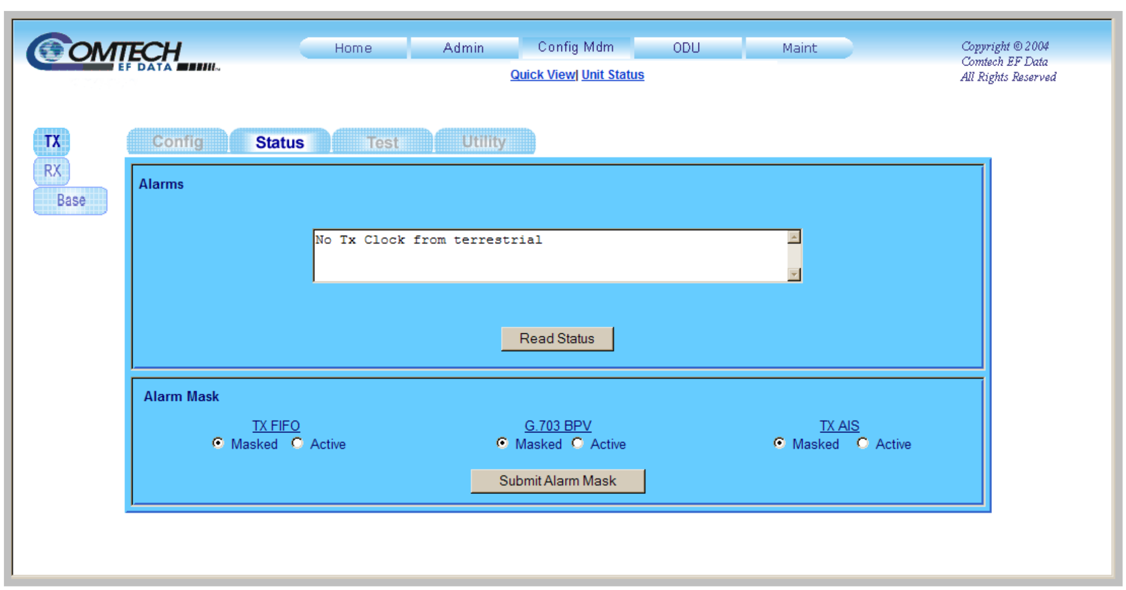
Click **[Submit]** once all the parameters have been set in this section.

6.5.4.3.1.2 Config Mdm | Quick View | Status Pages

Depending on the configuration icon selected, the nested **Status** page provides the user with access to several read-only monitoring windows (events, internal redundancy, and statistics), and alarm controls that determine how fault information is filtered for unit operation and/or user review. For detailed information on these features, refer to the pertinent subsections of **Sect. 5.5 (MAIN MENU:) MONITOR** in **Chapter 5. FRONT PANEL OPERATION.**

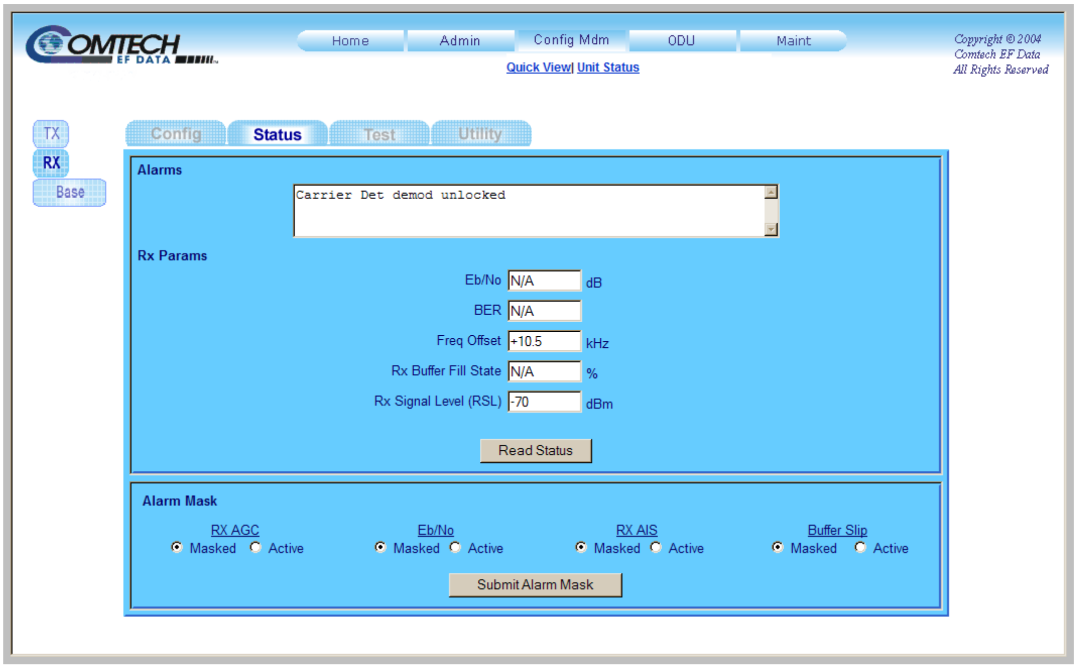


Status Page – 'Base' Selected

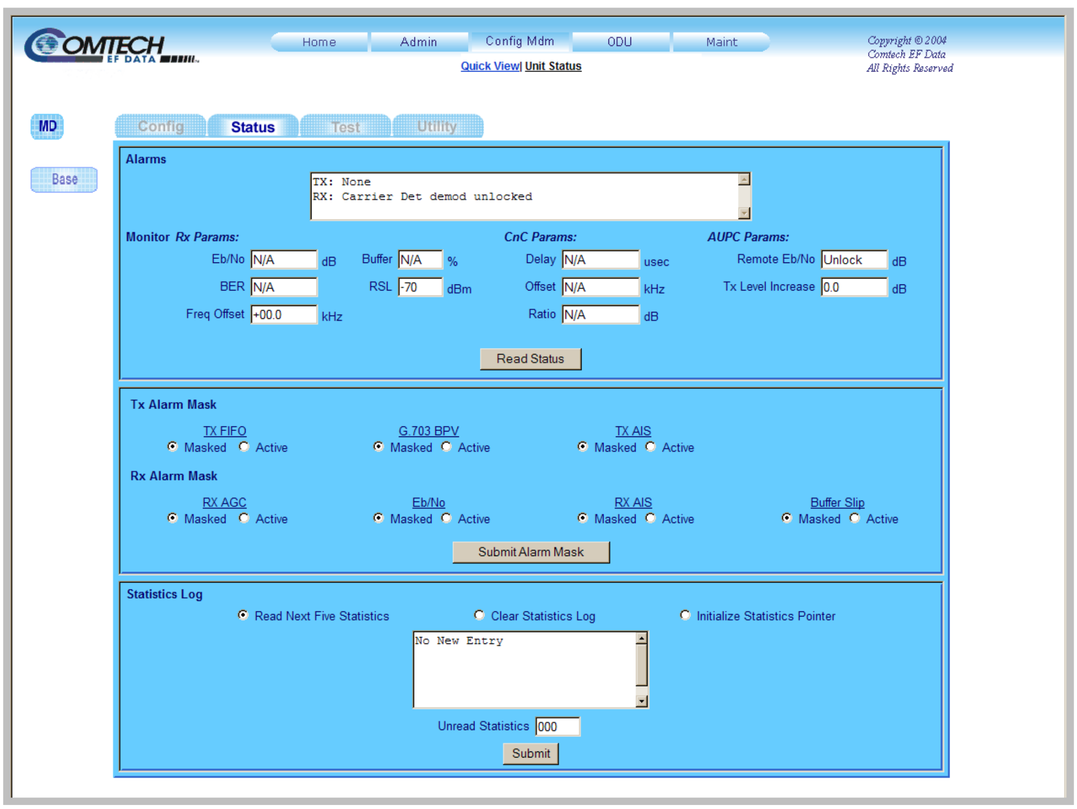


Status Page – 'Tx' Selected

Figure 6-10. 'Config Mdm | Quick View | Status' Nested Pages – Base, Tx



Status Page – 'Rx' Selected



Status Page – 'MD' selected

Figure 6-11. 'Config Mdm | Quick View | Status' Nested Pages – Rx, MD

Events Log

(Available only on the* Base *nested* Status *page) – This scrollable ***read-only*** window provides a visual record of stored events:

- **Read Next Five Events:** Click to buffer the next group of five stored events into the events window.
- **Clear Events Log:** Click to wipe clean the stored events log.
- **Initialize Events Pointer:** Click to Selecting this button to reset the log's internal pointer.
- **Unread Events:** Displays the total number of *unread* stored events in the Events window. As stored event groups are displayed, this number adjusts downward accordingly.

Once the desired settings have been entered, the user should then click **[Submit]** as needed to execute update of this section.

Alarm Mask

A variant of this section permits the user to configure **Alarm Masks** for the base unit and individual modules. Note the following:

- ***(For the* Base *nested* Status *page)*** – Select the alarm mask for the **Reference Osc**(illator) as **Masked** or **Unmasked**.
- ***(For the* Tx, Rx, or MD *nested* Status *pages)*** – The selections available for **Tx**, **Rx**, or **MD** Alarm Masks depend on the data interface selected for the particular module/group (i.e., RS422; V.35; RS232; HSSI; ASI; G.703; or QDI). Set the pertinent alarm mask as **Masked** or **Unmasked**.

For any configuration, once all desired alarm masks have been set, click **[Submit Alarm Mask]**.

Internal Redundancy

(Available only on the* Base *nested* Status *page) – These *read-only* fields indicate the redundancy configuration status for each module slot.

Alarms

A variant of this *read-only* section permits the user to view alarms for the Tx and Rx modules. Note the following:

- ***(For the* Tx *and* MD *nested* Status *pages)*** – Alarms associated with modulation are displayed in this *read-only* window.
- ***(For the* Rx *and* MD *nested* Status *pages)*** – Alarms associated with demodulation are displayed in the provided *read-only* window. Additionally, **Eb/No**, **BER**, **Freq Offset**, **Rx Buffer Fill State**, and **Rx Signal Level (RSL)** operating parameters are monitored.
- ***(For only the* MD *nested* Status *page)*** – In addition to the Tx and Rx Alarms, Carrier-in-Carrier (**CnC**) and **AUPC** operating parameters are monitored.

For any configuration, click **[Read Status]** to refresh the available *read-only* text boxes or windows to their most current values.

Statistics Log

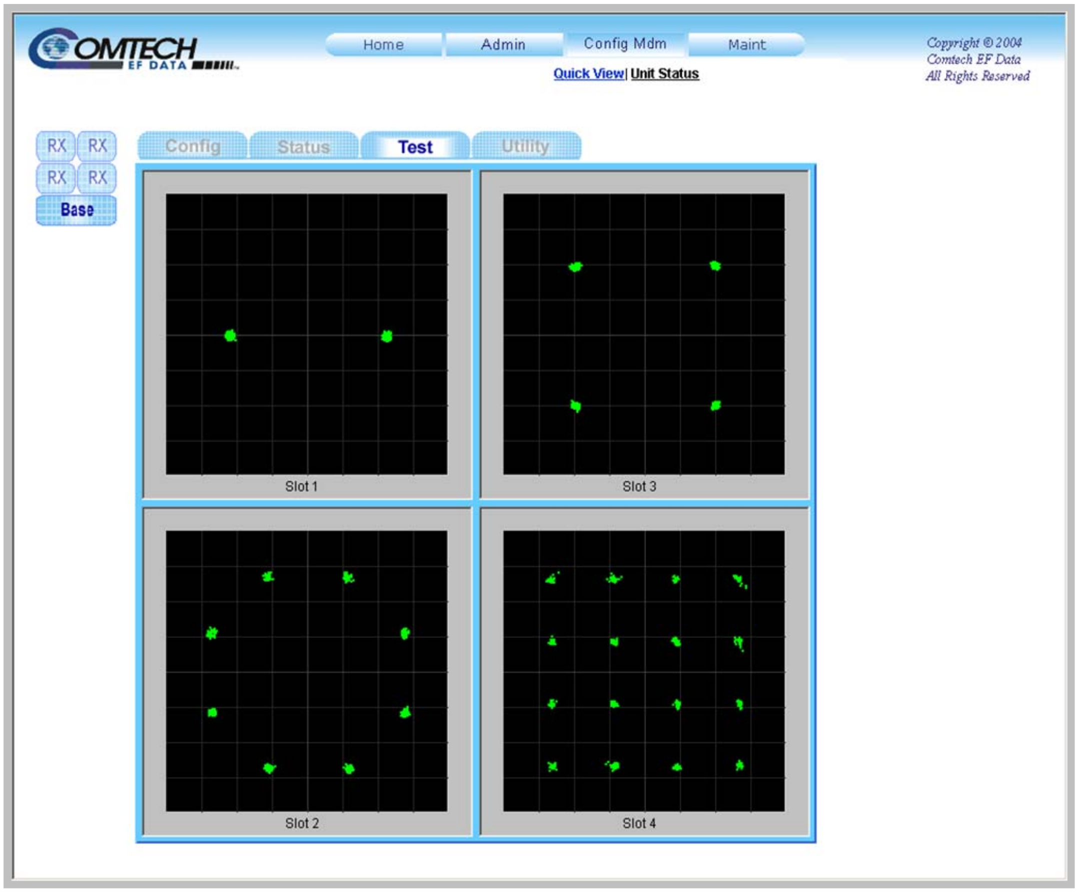
(Available only on the* MD *nested* Status *page) – This scrollable ***read-only*** window provides a visual record of operating statistics:

- **Read Next Five Statistics:** Click to buffer the next group of five stored events into the statistics window.
- **Clear Statistics Log:** Click to wipe clean the stored statistics log.
- **Initialize Statistics Pointer:** Click to Selecting this button to reset the log's internal pointer.
- **Unread Statistics:** Displays the total number of *unread* stored statistics in the Statistics window. As stored statistics are displayed, this number adjusts downward accordingly.

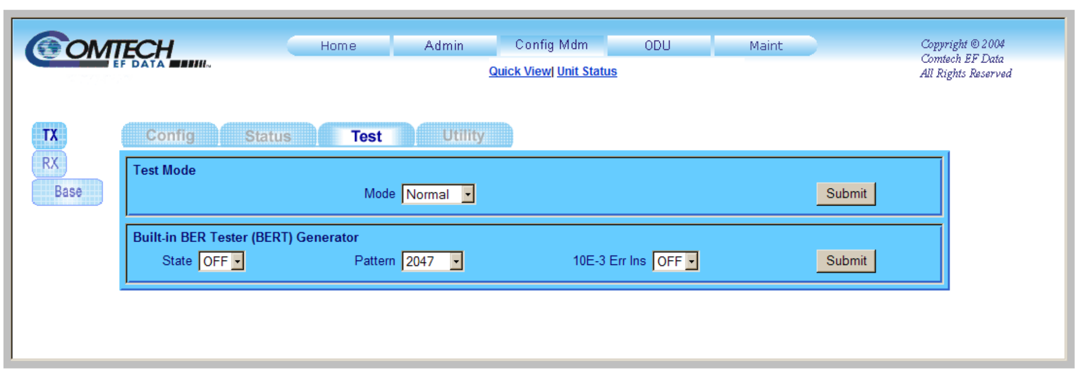
Once the desired settings have been entered, the user should then click **[Submit]** as needed to execute update of this section.

6.5.4.3.1.3 Config Mdm | Quick View | Test Pages

Depending on the configuration icon selected, the nested **Test** page provides the user with access to demodulator module constellation displays and the Spectrum Analyzer feature, and an assortment of modem test functions. For detailed information on these features, refer to **Sect. 5.6 (MAIN MENU:) TEST** in **Chapter 5. FRONT PANEL OPERATION.**

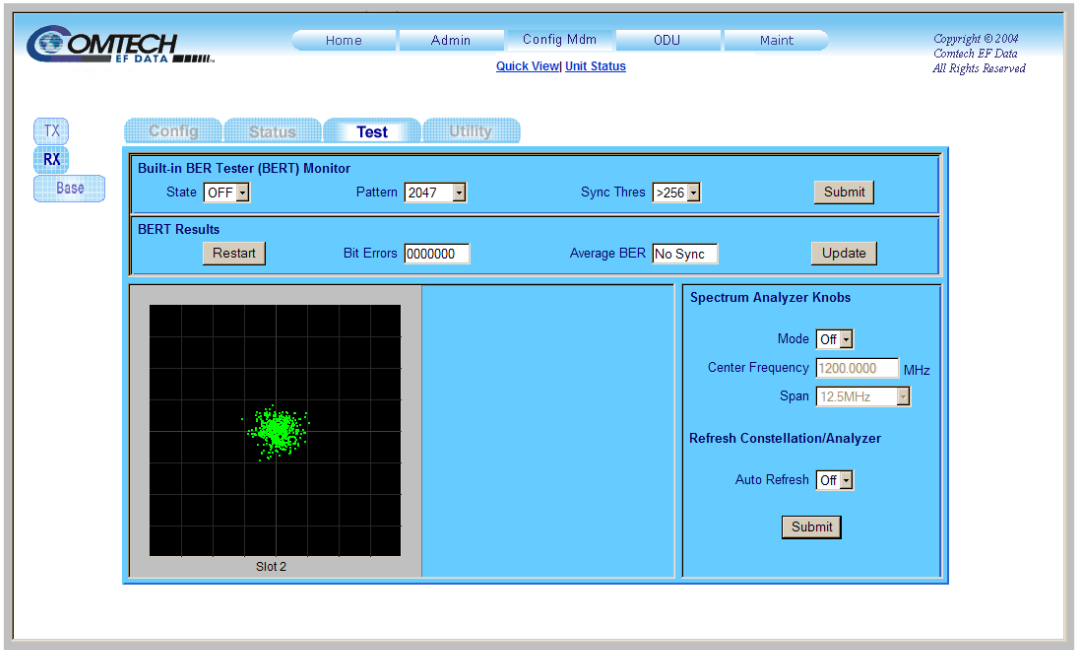


Test Page – 'Base' Selected (Quad Demod Configuration)

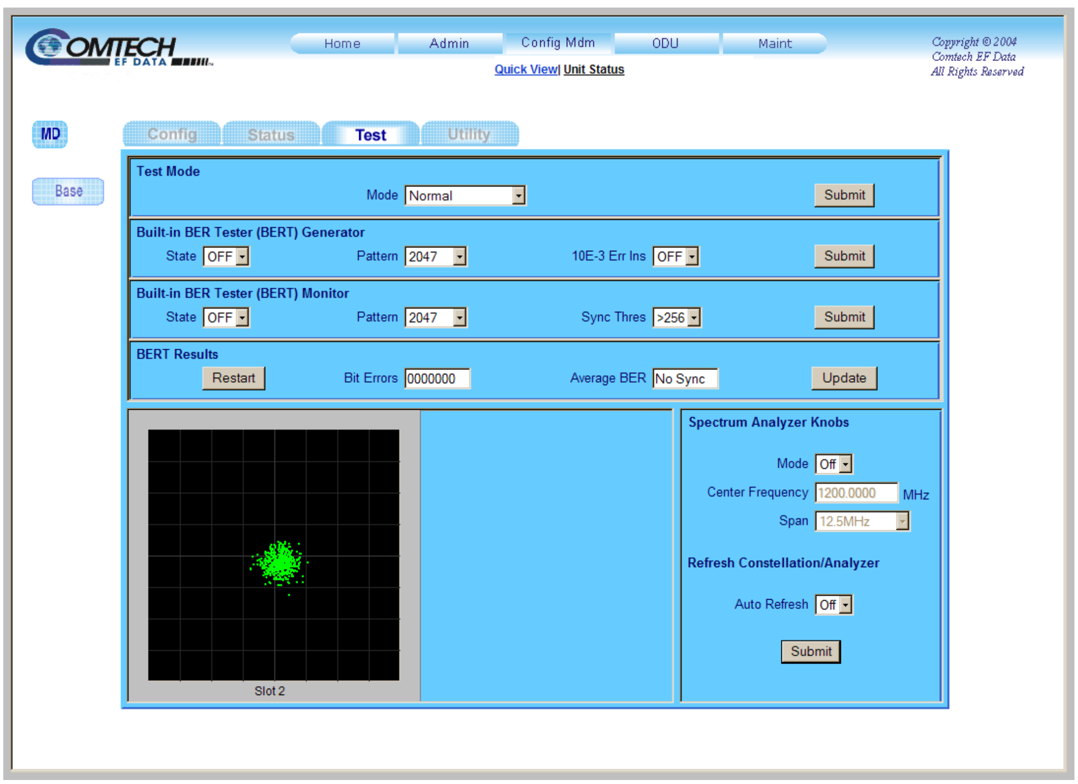


Test Page – 'Tx' Selected (Independent Tx/Rx Configuration)

Figure 6-12. 'Config Mdm | Quick View | Test' Nested Pages – Base, Tx



Test Page – 'Rx' Selected (Independent Tx/Rx Configuration)



Test Page – 'MD' Selected (Grouped Modem Configuration)

Figure 6-13. 'Config Mdm | Quick View | Test' Nested Pages – Rx, MD

With **Base** selected, the nested **Test** page allows the user to simultaneously view the constellations of all installed demodulators. The top image in **Figure 6-12** shows such operation, where **Base → Test** displays the constellations for this particular configuration's four installed demodulator modules.

Contrast this with the bottom image in this same figure where, with **Tx → Test** selected, test functions applicable only to the modulator module are provided on this nested page – because Constellation and Spectrum Analyzer functionality is reserved for demodulator modules, they are not provided here.

The user may also view the constellation for either a standlone demodulator module (i.e., **Rx → Test**), or for the demodulator that is part of a modem group (i.e, **MD → Test**). **Figure 6-13**, on the previous page, illustrates such examples:

- The top image depicts a configuration running independent Tx and Rx modules. The constellation for the demodulator installed in Slot#2 is viewed by selecting the **Rx** icon.
- The bottom image depicts a configuration running a grouped modem. With **MD** selected from the icon quad, the nested **Test** page displays the constellation for the demodulator module installed in Slot#2.

Test Mode

***(Available on the* Tx *and* MD *nested* Test *pages)* –** Use the drop-down menu to select **Normal**, **IF Loopback**, **Digital Loopback**, **I/O Loop**, **RF Loopback**, **Tx CW**, or **Tx Alt 1-0.** Click **[Submit]** when done.

Built-in BER Tester (BERT) Generator

***(Available on the* Tx *and* MD *nested* Test *pages)* –** Using the drop-down menus:

- **State –** Select as **OFF** or **ON**.
- **Pattern –** Select **Space, Mark, 1:1, 1:3, 63, 511, 2047, 2047R, MIL188, 2^15-1, 2^20-1**, or **2^23-1.**
- **10E-3 Err Ins –** Select as **OFF** or **ON**.

Click **[Submit]** once all the parameters have been set in this section.

Built-in BER Tester (BERT) Monitor

***(Available on the* Rx *and* MD *nested* Test *pages)* –** Using the drop-down menus:

- **State –** Select as **OFF** or **ON**.
- **Pattern –** Select **Space, Mark, 1:1, 1:3, 63, 511, 2047, 2047R, MIL188, 2^15-1, 2^20-1**, or **2^23-1.**
- **Sync Thres –** Select as **>256**, **Low**, **Mid**, or **High.**

Click **[Submit]** once all the parameters have been set in this section.

BERT Results

(Available on the* Rx *and* MD *nested* Test *pages)* –** Click **[Restart]** or **[Update]** as needed. Note that the **Bit Errors** and **Average BER** text boxes are ***read-only.

Spectrum Analyzer Knobs

***(Available on the* Rx *and* MD *nested* Test *pages)* –** Note the following:

- **Mode –** Use the drop-down menu to select the Spectrum Analyzer as **On** or **Off**. When the Spectrum Analyzer feature is turned **ON**, the selected demodulator will not be allowed to receive traffic, and the built-in BERT monitoring is ignored. Noted that the Spectrum Analyzer display, which replaces the Constellation display on this page, only captures the spectrum.

  Figure 6-14 depicts a **MD → Test** page with the Spectrum Analyzer activated.

- **Center Frequency –** The Center Frequency is similar to Rx Frequency in a regular demodulation function with a resolution of 100 Hz. Enter the desired value into this field.

- **Span –** To select a predefined span, click on the text box, then select **97.65625 kHz,** 1**95.3125 kHz**, **390.625 kHz**, **781.25 kHz**, **1.5625 MHz**, **3.125 MHz**, **6.25 MHz**, or the default value of **12.5 MHz**.

Refresh Constellation / Analyzer

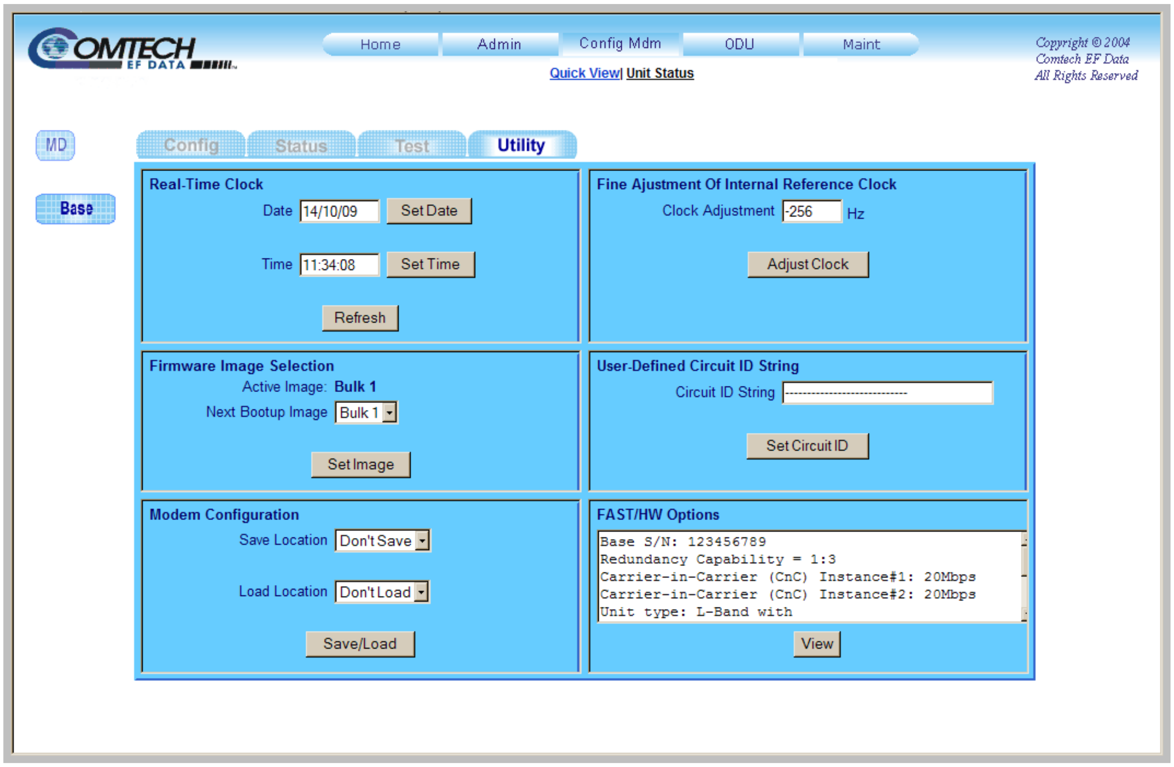
***(Available on the* Rx *and* MD *nested* Test *pages)* –** Use the drop-down menu to select Auto Refresh as **On** or **Off**. When this feature is turned on, depending on the mode selected, the display will automatically update every 10 seconds.

Note that, for the **Spectrum Analyzer Knobs** and **Refresh Constellation / Analyzer** sections, no actions will be recognized until the user clicks **[Submit]**.

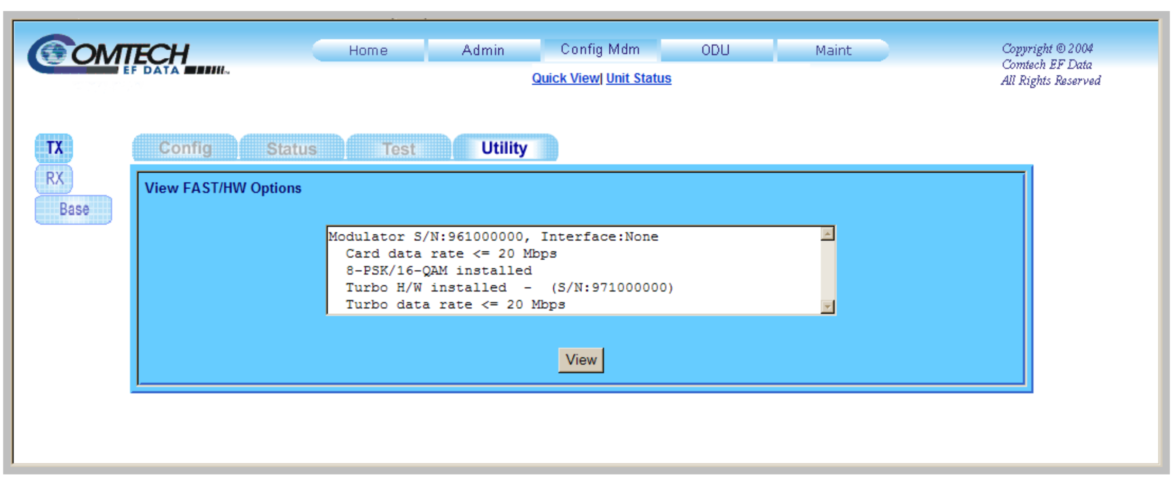
Figure 6-14. Nested Test Page with Spectrum Analyzer Mode 'On' – Rx, MD

6.5.4.3.1.4 Config Mdm | Quick View | Utility Pages

Depending on the configuration icon selected, the nested **Utility** page provides the user with access to an assortment of modem operating settings. For detailed information on these features, refer to **Sect. 5.9 (MAIN MENU:) UTILITY** in **Chapter 5. FRONT PANEL OPERATION.**

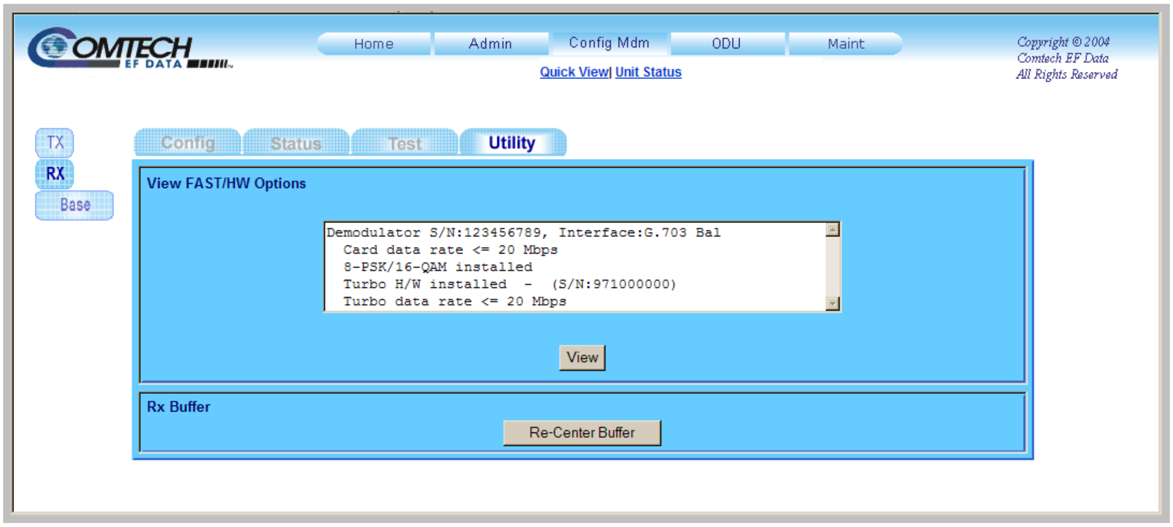


Utility Page – 'Base' Selected

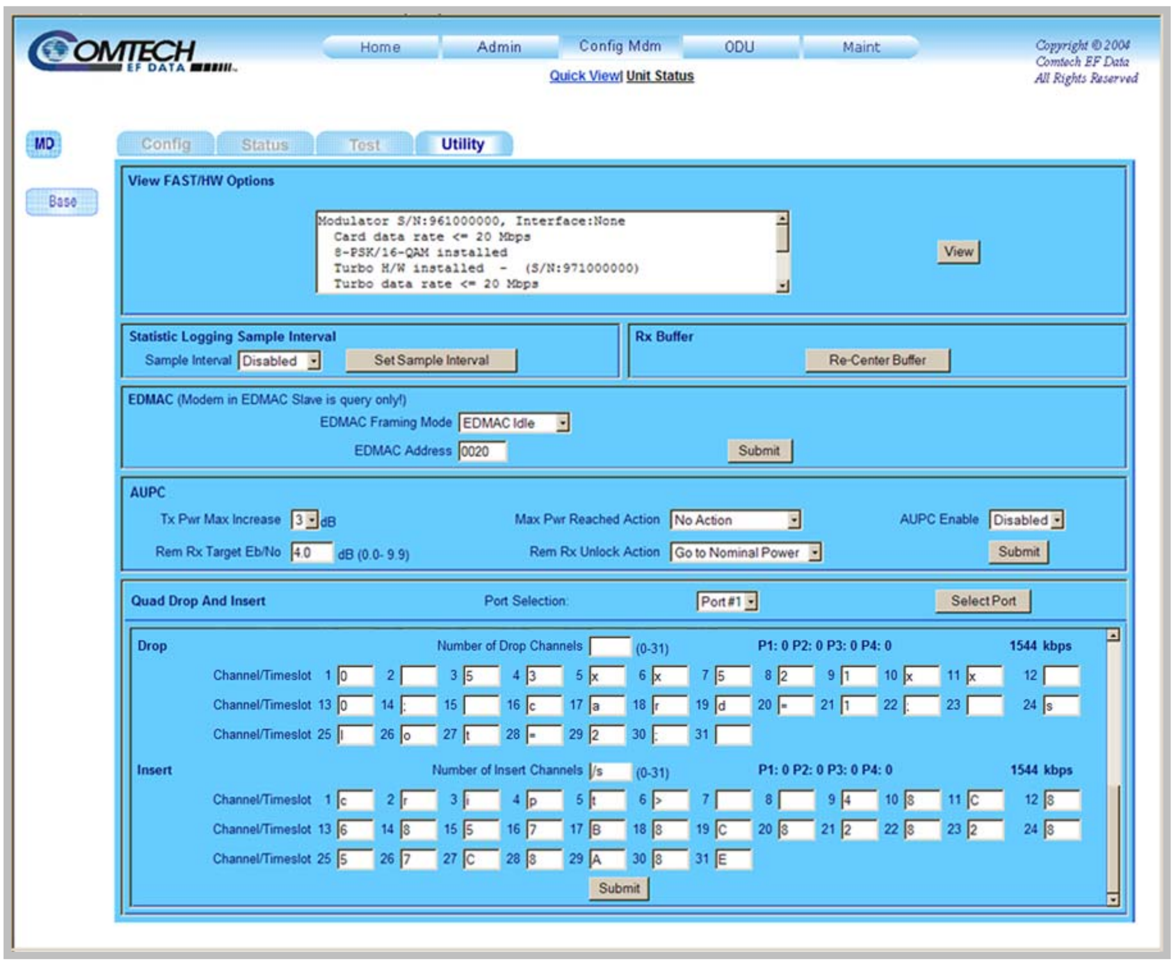


Utility Page – 'Tx' Selected

Figure 6-15. 'Config Mdm | Quick View | Utility' Nested Pages – Base, Tx



Utility Page – 'Rx' Selected



Utility Page – 'MD' Selected

Figure 6-16. 'Config Mdm | Quick View | Utility' Nested Pages – Rx, MD

Real-Time Clock

(Available only on the* Base *nested* Utility *page) – To set the date and time of the unit:

- The user may enter a date using international format in the form DD/MM/YY (where DD = day [01 to 31], MM = month [01 to 12], and YY = year [00 to 99]). Click **[Set Date]** when done.
- The user may enter a time using HH:MM:SS format (where HH = hour [00 to 23], MM = minutes [00 to 59], and SS = seconds [00 to 59]). Click **[Set Time]** when done.
- If the altered Date and Time settings have not been saved, the user may click **[Refresh]** as needed to restore the existing stored date and time configurations.

Fine Adjustment of Internal Reference Clock

(Available only on the* Base *nested* Utility *page) – For fine adjustment of the Internal 10 MHz reference oscillator, type in a value from **–2048** up to **+2047** into the **Clock Adjustment** text box. Once the desired setting has been made in this section, click **[Adjust Clock]**.

Firmware Image Selection

(Available only on the* Base *nested* Utility *page) – The user may specify the firmware boot image in this section. Note the following:

- **Active Image** (*read-only*): The currently-selected image is identified here.
- **Next Bootup Image:** Use the drop-down menu to select **Boot1** or **Boot2**.

Once the desired firmware image has been selected in this section, click **[Set Image].**

User Defined Circuit ID String

(Available only on the* Base *nested* Utility *page) – The user may enter a Circuit ID string of up to 40 characters. Once the desired string had been entered in this section, click **[Enter Circuit ID]** to save this change.

Modem Configuration

(Available only on the* Base *nested* Utility *page) – The user may save a modem configuration or load a stored configuration using this sections. Note the following:

- **To Save a Modem Configuration:** Use the **Save Location** drop-down menu to select a storage location from **0** to **9** (the default is **Don't Save**) – note that any unused location is noted as **Empty** (e.g., **3: Empty**) – then click **[Save/Load]** to *store* the new configuration into the unit's non-volatile memory.

  If, however, a configuration has been previously stored to the chosen location, it will be date-stamped (e.g., **3: 13:20:17 20/10/09** means that a configuration had been previously saved to **Location #3** on **October 20, 2009** at **1:20:17 P.M**.).

IMPORTANT

Saving a modem configuration to an already-stored location will cause the unit to* overwrite *that location's information with the newly-saved information.

- **To Load a Modem Configuration:** Use the **Load Location** drop-down menu to select a storage location from **0** to **9** (the default is **Don't Load**), then click **[Save/Load]** to *load* the saved configuration from the unit's non-volatile memory.

Note: See **Sect. 5.8 (MAIN MENU:) SAVE/LOAD** in **Chapter 5. FRONT PANEL OPERATION** for complete details on loading/saving modem configurations.

(View) FAST/HW Options

A variant of this section permits the user to view a *read-only*, scrollable window that lists the base unit's and individual modules' installed FAST/hardware options. Note the following:

- ***(For the* Base *nested* Utility *page)*** – The chassis motherboard serial number and installed options applicable to the base chassis are displayed here.
- ***(For the* Tx *nested* Utility *page)*** – The modulator module motherboard serial number and installed options applicable to modulation are displayed here.
- ***(For the* Rx *nested* Utility *page)*** – The demodulator module motherboard serial number, the TPC daughterboard serial number, and installed options applicable to demodulation are displayed here.
- ***(For the* MD *nested* Utility *page)*** – The mod/demod board serial numbers and installed options applicable to modulation/demodulation are displayed here.

For any configuration, to update the FAST/HW display window, click **[View]**.

Statistic Logging Sample Interval

(Available only on the* MD *nested* Utility *page) – To select a logging interval for the link statistics (i.e., the period of time, in 10-minute increments, for which statistics will be measured), use the **Sample Interval** drop-down menu to select **10 Minutes** through **90 Minutes**. Alternately, select **Disabled** to turn off this function.

Click **[Set Sample Interval]** once the desired interval setting has been made in this section.

Rx Buffer

(Available only on the* Rx *nested* Utility *page) – Click **[Re-Center Buffer]** to cause a forced re-centering of the Plesiochronous/Doppler Buffer.

EDMAC

(Available only on the* Rx *nested* Utility *page) – See **Chapter 10. EDMAC CHANNEL** for complete details on using this feature. Note the following:

- **EDMAC Framing Mode** – Using the drop-down menu, select **EDMAC Idle**, **EDMAC Master**, or **EDMAC Slave**.
- **EDMAC Address** – Type in the address as needed for proper operation.

Click **[Submit]** once all the parameters have been set in this section.

Note: When EDMAC Slave is selected, the Modem in EDMAC Slave mode is query only!

AUPC

(Available only on the* Rx *nested* Utility *page) – See **Chapter 8. AUTOMATIC UPLINK POWER CONTROL (AUPC)** for complete details on using this feature. Note the following:

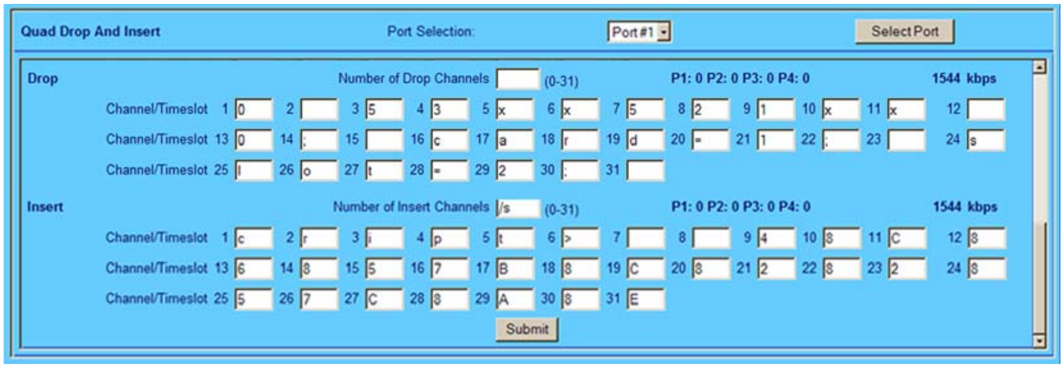
- **Using the drop-down menus…**
  - **Tx Pwr Max Increase –** Select a value (in dB) from **0** to **9**.
  - **Max Pwr Reached Action –** Select **No Action** or **Generate Tx Alarm**.
  - **AUPC Enable –** Select **Enables** or **Disabled**.
  - **Rem Rx Unlock Action –** Select **Go to Nominal Power** or **Go to Maximum Power**.
- For **Rem Tx Target Eb/No** – Type in a target value (in dB) from **0.0** to **9.9**.

Click **[Submit]** once all the parameters have been set in this section.

(Quad, D&I++) Drop and Insert

(Available only on the* MD *nested* Utility *page) – The appearance of the Drop & Insert section of this page is dependent on the **Framing Mode** selected on the '**Config Mdm | Quick View | (Tx, Rx, or MD) Config** page (Sect. 6.5.4.3.1.1.). Contents will vary accordingly:

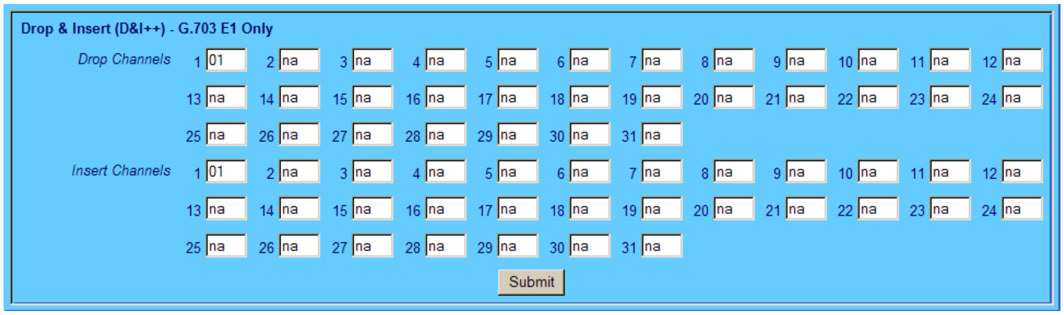
- If the selected **Framing Mode** is **Unframed**, **EDMAC**, or **EDMAC-2**, the section heading reads "**Quad Drop and Insert**" and the available parameters appear as follows:



For full details on Quad Drop and Insert, see **Sect. 5.4.6.4 CONFIG: INTERFACE → QDI** in **Chapter 5. FRONT PANEL OPERATION**.

Once the desired configuration settings have been made on this page, the user should then click **[Submit]** as needed to save those changes.

- If the selected **Framing Mode** is **D&I++**, the section heading will read "**Drop & Insert (D&I++) – G.703 E1 Only**" and the available parameters appear as follows:



For full details on D&I++, see **Sect. 5.4.5.3 CONFIG: FRAME → D&I++** in **Chapter 5. FRONT PANEL OPERATION**.

Once the desired configuration settings have been made on this page, the user should then click **[Submit]** as needed to save those changes.

6.5.4.3.2 Config Mdm | Unit Status Page

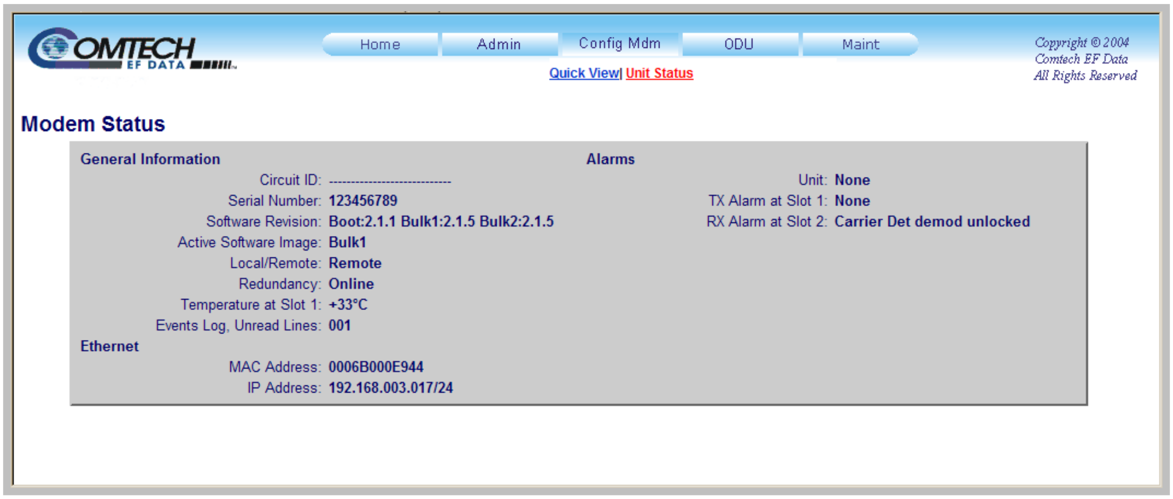


Figure 6-17. Config Mdm | Unit Status Page

The '**Config Mdm | Unit Status'** page (**Figure 6-17)** provides the user with ***read-only*** status window pertaining to:

- **General Information** about the base unit;
- **Ethernet** MAC and IP Address assignments;
- **Alarms.**

Click any tab or hyperlink to use other interface features.

6.5.4.4 ODU (Outdoor Unit) Pages (CDM-QxL only)

The '**ODU'** (Outdoor Unit) tab is used to access the BUC and LNB pages, which in turn are used to control and monitor either a Block Up Converter (BUC) or Low-Noise Block Down Converter (LNB) that is connected via FSK to the CDM-QxL. Click either the **BUC** or **LNB** hyperlinks to continue.

6.5.4.4.1 ODU | BUC (Block Up Converter) Page

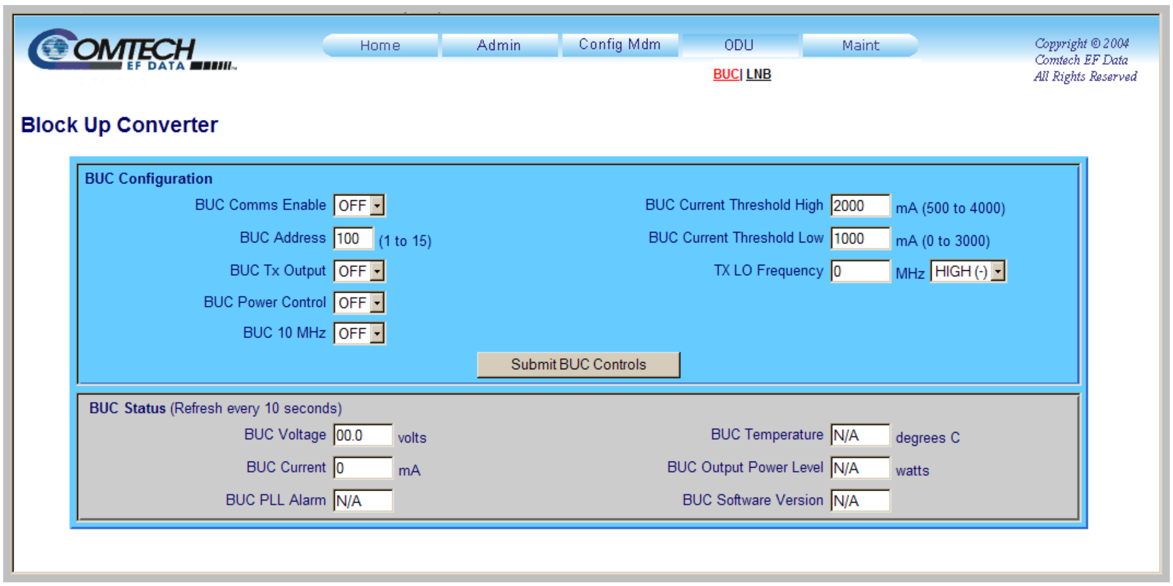


Figure 6-18. ODU | BUC page

The '**ODU | BUC**' page (**Figure 6-18)** is used to configure Block Up Converter parameters, and display the BUC status for L-Band operation.

BUC Configuration

- **BUC Comms Enable**, **BUC Tx Output**, **BUC Power Control**, and **BUC 10 MHz** may be turned **ON** or **OFF** using the drop-down menus.
- The user may assign a **BUC Address** of **1** to **15**.
- The user may assign a **BUC Current Threshold High** limit value ranging from **500** to **4000** mA.
- The user may assign a **BUC Current Threshold Low** limit value ranging from **0** to **3000** mA.
- The user may assign the **Tx Lockout Frequency** and designate the value (using the drop-down menu) as a **HIGH (+)** or **LOW (-)** limit.

Once the desired configuration settings have been made on this page, click **[Submit BUC Controls]** as needed to save those changes.

BUC Status

The parameters shown here are ***read-only*** and cannot be changed.

6.5.4.4.2 Config | LNB (Low Noise Block Down Converter) Page

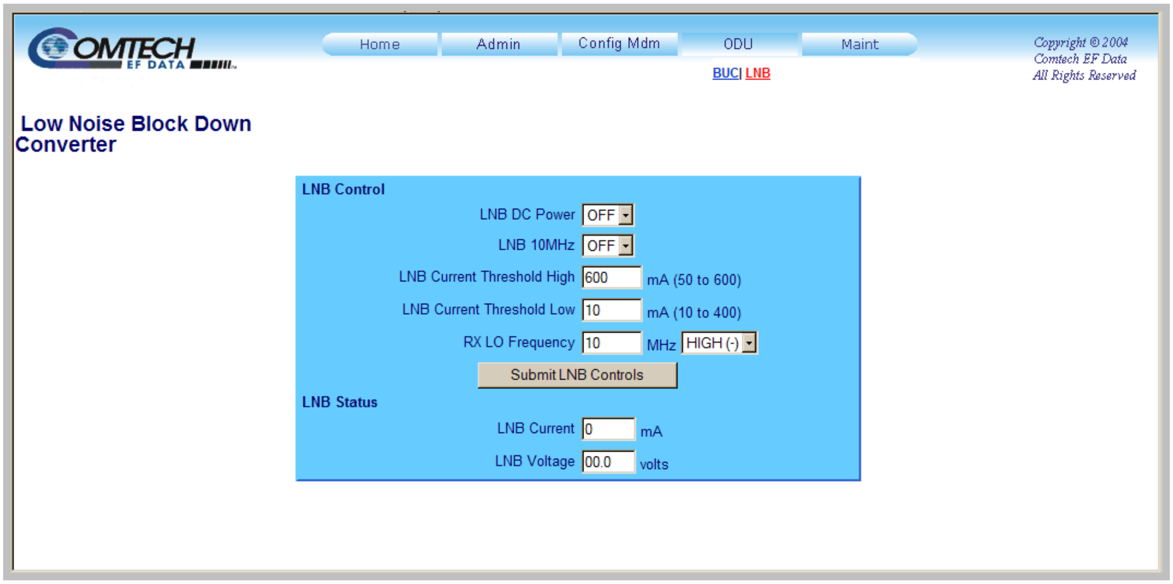


Figure 6-19. ODU | LNB page

The '**ODU | LNB**' page (**Figure 6-19**) is used to configure Low Noise Block Down Converter parameters, and display the LNB status for L-Band operation.

LNB Control

- **LNB DC Power** and **LNB 10MHZ** may be turned **ON** or **OFF** using the drop-down menus.
- The user may assign a **LNB Current Threshold High** limit value ranging from **50** to **600** mA.
- The user may assign a **LNB Current Threshold Low** limit value ranging from **10** to **400** mA.
- The user may assign the **Rx Lockout Frequency** and designate the value (using the drop-down menu) as a **HIGH (+)** or **LOW (-)** limit.

Once the desired configuration settings have been made on this page, the user should then click **[Submit LNB Controls]** as needed to save those changes.

LNB Status

The windows showing the **LNB Current** and **LNB Voltage** refresh automatically every five seconds. They are *read-only* and cannot be changed.

6.5.4.5 Maint (Maintenance) Page

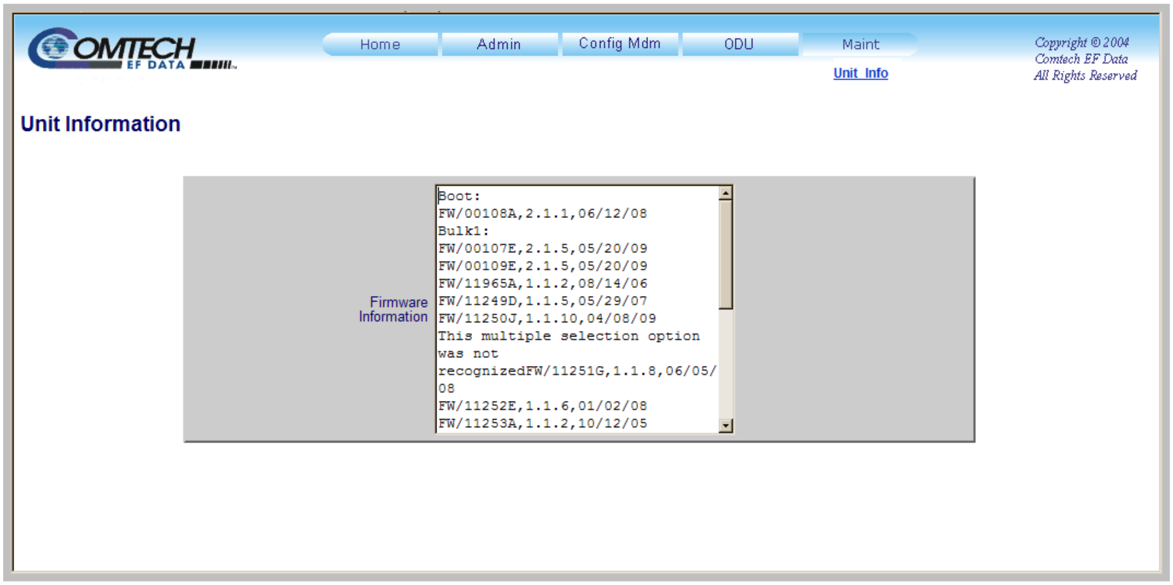


Figure 6-20. Maint | Unit Info page

The '**Maint| Unit Info**' page (**Figure 6-20**) provides the user with a scrollable ***read-only*** status window that identifies the configured unit's installed firmware numbers and versions. For more information, see **Sect. 5.9.6 UTILITY: FIRMWARE in Chapter 5. FRONT PANEL OPERATION**.

Chapter 7. FORWARD ERROR CORRECTION OPTIONS

7.1 Introduction

As standard, the CDM-Qx/QxL Modem is equipped with three **F**orward **E**rror **C**orrection (FEC) encoders/decoders – Viterbi, concatenated Reed-Solomon, and Trellis (TCM, available with the 8-PSK FAST option). The constraint lengths and encoding polynomials are not only Open Network (IESS-315) compatible, but are also Closed Network compatible with the vast majority of existing modems from other manufacturers. Comtech EF Data has performed compatibility testing to ensure interoperability.

Turbo Product Coding represents a very significant development in the area of FEC and, optionally, the CDM-Qx/QxL may be fitted with Turbo Product Codec in the form of a plug-in daughter card (SIMM module) that is field upgradeable. The codec provides data rate capability up to 20 Mbps, and code rates of:

- Rate 5/16 (BPSK)
- Rate 21/44 (BPSK, QPSK)
- Rates 3/4 and 7/8 (QPSK, 8-PSK, and 16-QAM)
- Rate 17/18 (QPSK and 8-PSK)

Turbo Product Coding provides one of the best Forward Error Correction technologies currently available, and is now offered with a sufficient range of code rates and modulation types, such that link performance can be optimized under any conditions.

7.2 Viterbi

The combination of convolutional coding and Viterbi decoding has become an almost universal standard for satellite communications. The CDM-Qx/QxL complies with the Intelsat standards for Viterbi decoding with a constraint length of seven. This is a *de facto* standard, even in a closed network environment, which means almost guaranteed interoperability with other manufacturer's equipment. It provides very useful levels of coding gain, and its short decoding delay and error-burst characteristics make it particularly suitable for low data rate coded voice applications. It has a short constraint length, fixed at 7, for all code rates. (The constraint length is defined as the number of output symbols from the encoder that are affected by a single input bit.)

By choosing various coding rates (Rate 1/2, 3/4, or 7/8) the user can trade off coding gain for bandwidth compression. Rate 1/2 coding gives the best improvement in error rate, but doubles the transmitted data rate, and hence doubles the occupied bandwidth of the signal. Rate 7/8 coding, at the other extreme, provides the most modest improvement in performance, but only expands the transmitted bandwidth by 14 %.

A major advantage of the Viterbi decoding method is that the performance is independent of data rate, and does not display a pronounced threshold effect (i.e., does not fail rapidly below a certain value of Eb/No). Note that, in BPSK mode, the Modem only permits a coding rate of 1/2. Because the method of convolutional coding used with Viterbi, the encoder does not preserve the original data intact and is called *non-systematic*.

Table 6-1. Viterbi Decoding Summary

FOR	AGAINST
Good BER performance – very useful coding gain.	Higher coding gain possible with other methods
Almost universally used, with *de facto* standards for constraint length and coding polynomials.	
Shortest decoding delay (~200 bits) of any FEC scheme – good for coded voice, VOIP, etc.	
Short constraint length produces small error bursts – good for coded voice.	
No pronounced threshold effect – fails gracefully.	
Coding gain independent of data rate.	

7.3 Reed-Solomon Outer Codec

IMPORTANT

It cannot be emphasized strongly enough that the purpose of the concatenated Reed-Solomon is to dramatically improve the BER performance of a link under given noise conditions. It should NOT be considered as a method to reduce the link EIRP requirement to produce a given BER. Factors such as rain-fade margin – particularly at Ku-band – are extremely important, and reducing link EIRP can seriously degrade the availability of such a link.

The concatenation of an outer Reed-Solomon (Reed-Solomon) Codec with Viterbi decoder first became popular when it was introduced by Intelsat in the early 1990's. It permits significant improvements in error performance without significant bandwidth expansion. The coding overhead added by the Reed-Solomon outer Codec is typically around 10%, which translates to a 0.4 dB power penalty for a given link. Reed-Solomon codes are block codes (as opposed to Viterbi and Sequential, which are convolutional), and in order to be processed correctly the data must be framed and de-framed.

Additionally, Reed-Solomon codes are limited in how well they can correct errors that occur in bursts. This, unfortunately, is the nature of the uncorrected errors from Viterbi decoders, which produce clusters of errors that are multiples of half the constraint length. For this reason, the data must be interleaved following Reed-Solomon encoding, and is then de-interleaved prior to decoding. This ensures that a single burst of errors leaving the Viterbi or Sequential decoder is spread out over a number of interleaving frames, so errors entering the Reed-Solomon decoder do not exceed its capacity to correct those errors. In the case of the CDM-Qx/QxL, different Reed-Solomon code rates are used, according to the mode of operation.

7.3.1 Closed Network Modes

A 220,200 code is used in transparent closed network modes, and a 200,180 code is used in framed (EDMAC) modes. (220,200 means that data is put into blocks of 220 bytes, of which 200 bytes are data, and 20 bytes are FEC overhead.) These two codes were chosen because they fit well into Comtech EF Data's clock generation scheme, and they have almost identical coding gain.

When Viterbi decoding is used as the primary FEC, an interleaver depth of 4 is used. The increase in coding gain is at the expense of delay. The interleaving/de-interleaving delay and the delay through the decoder itself can be as high as 25 kbps. At very low data rates, this equates to several seconds, making it highly unsuitable for voice applications. Additionally, the de-interleaver frame synchronization method can add significantly to the time taken for the demodulator to declare acquisition.

A characteristic of concatenated Reed-Solomon coding is the very pronounced threshold effect. For any given modem design, there will be a threshold value of E_b/N_o below which the demodulator cannot stay synchronized. This may be due to the carrier-recovery circuits, or the synchronization threshold of the primary FEC device, or both. In the CDM-Qx/QxL, and Rate 1/2 operation, this threshold is around 4 dB E_b/N_o. Below this value, operation is not possible but, above this value, the error performance of the concatenated Reed-Solomon system produces exceptionally low error rates for a very small increase in E_b/N_o.

CAUTION

Care should be taken not to operate the demodulator near its sync threshold. Small fluctuations in E_b/N_o may cause total loss of the link, with the subsequent need for the demodulator to re-acquire the signal.

Table 6-2. Concatenated Reed-Solomon Coding Summary

FOR	AGAINST
Exceptionally good BER performance – several orders of magnitude improvement in link BER under given link conditions.	Very pronounced threshold effect – does not fail gracefully in poor E_b/N_o conditions. Additional coding overhead actually degrades sync threshold, and reduces link fade margin.
Very small additional bandwidth expansion	Significant processing delay (~25 kbps) – not good for voice, or IP applications
	Adds to demod acquisition time.

7.4 Trellis Coding

In the other FEC methods described here, the processes of coding and modulation are independent – the FEC codec has no knowledge of, or interaction with, the modulator. However, there are schemes in which the coding and modulation are combined together where the encoder places FEC symbols in a precise manner into the signal constellation. This can yield an overall improvement in performance, and is used in higher-order modulation schemes, such as 8-PSK, 16-PSK, 16-QAM, etc.

When convolution coding is used, the overall *coded modulation* approach is referred to as Trellis Coded Modulation (TCM). Ungerboeck was an early pioneer, and developed optimum mapping and decoding schemes. However, the decoding scheme was seen as complex and expensive, and Qualcomm Inc. developed a variation on the theme which uses a Viterbi decoder at the core, surrounded by adjunct processing. The scheme is able to achieve performance very close to the optimum Ungerboeck method but with far less complexity, and is called *pragmatic Trellis Coded Modulation*.

As more and more high power transponders are put in to service, Intelsat recognized that the transponders are no longer *power limited*, but *bandwidth limited.* In order to maximize transponder capacity, 8-PSK was looked at as a method of reducing the occupied bandwidth of a carrier, and adopted Qualcomm's pragmatic TCM, at Rate 2/3.

A Rate 2/3 8-PSK/TCM carrier occupies only 50% of the bandwidth of a Rate 1/2 QPSK carrier; however, the overall coding gain of the scheme is not adequate by itself; accordingly, Intelsat's IESS-310 specification requires that the scheme be concatenated with an outer R-S codec. When combined, there is a threshold value of Eb/No of around 6 dB, and above approximately 7 dB, the bit error rate is better than 1×10^{-8}.

The detractions of the concatenated R-S approach apply here also, along with more stringent requirements for phase noise and group delay distortion – the natural consequences of the higher-order modulation. The modem fully implements the FEC, but not the framing of the IESS-310 specification at data rates up to 18 Mbps.

In accordance with the specification, the R-S outer code can be disabled. Performance curves for both cases are shown in the figures provided at the end of this chapter.

Table 6-3. 8-PSK/TCM Coding Summary

FOR	AGAINST
Exceptionally bandwidth efficient compared to QPSK	Needs concatenated Reed-Solomon outer codec to give acceptable coding gain performance
	Demod acquisition threshold much higher than for QPSK
	8-PSK is more sensitive to phase noise and group delay distortion than QPSK

7.5 Turbo Product Codec (Hardware Option)

7.5.1 Introduction

Turbo Coding is an FEC technique developed within the last few years that delivers significant performance improvements, as compared to more traditional techniques. Two general classes of Turbo Codes have been developed: Turbo Convolutional Codes (TCC) and Turbo Product Codes (TPC, a block coding technique).

Comtech EF Data has chosen to implement an FEC codec based on TPC. A Turbo Product Code is a 2- or 3-dimensional array of block codes. Encoding is relatively straightforward, but decoding is a very complex process requiring multiple iterations of processing for maximum performance to be achieved.

Unlike the popular method of concatenating a Reed-Solomon codec with a primary FEC codec, Turbo Product Coding is an entirely stand-alone method. It does not require the complex interleaving/de-interleaving of the R-S approach and, consequently, decoding delays are significantly reduced. Furthermore, the traditional concatenated R-S schemes exhibit a very pronounced threshold effect – a small reduction in Eb/No can result in total loss of demod and decoder synchronization. TPC does not suffer from this problem – the demod and decoder remain synchronized down to the point where the output error rate becomes unusable. This is considered to be a particularly advantageous characteristic in a fading environment. Typically, in QPSK, 8-PSK and 16-QAM TPC modes the demod and decoder can remain synchronized ***2 – 3 dB below*** the Viterbi/Reed-Solomon or TCM cases.

Comtech now provides the best Forward Error Correction technology currently available, offering a very broad range of TPC code rates, combined with the entire range of modulation types, from BPSK to 16-QAM.

7.5.2 The Evolution of TPC in Comtech Products

When Comtech EF Data first introduced the Turbo Coding option in 1999, only Rate 3/4 QPSK was offered. Further work permitted the addition of Offset QPSK operation. Two further code rates - Rate 21/44 BPSK (very close to Rate 1/2) and Rate 5/16 BPSK (very close to Rate 1/3) were then made available.

(These two rates were developed to address transmission from very small antennas, where ITU flux density limits may be an issue. The combination of code rate and BPSK modulation provides wide spreading, and hence reduces flux density.)

In 2002, the new second generation TPC option was released. This has added data rate capability up to 20 Mbps, in addition to Rate 7/8 and Rate 17/18 capability. The Rate 7/8 TPC is extremely powerful, offering performance very close to the original Rate 3/4 TPC, but using 15% less bandwidth. Note also that the Rate 17/18 TPC adds just 5% FEC overhead, but yields almost identical coding gain to Rate 1/2 Viterbi at a BER of 1 x 10^{-7}. Below is a listing of all the available TPC modes and rates in the CDM-Qx.

Table 6-4. Available TPC Modes

Code Rate/Modulation	Data Rate Range
Rate 21/44 BPSK	32 kbps to 4.772 Mbps
Rate 5/16 BPSK	32 kbps to 3.125 Mbps
Rate 21/44 QPSK	32 kbps to 10 Mbps
Rate 3/4 QPSK	32 kbps to 15 Mbps
Rate 3/4 8-PSK	288 kbps to 20 Mbps
Rate 3/4 16-QAM	384 kbps to 20 Mbps
Rate 7/8 QPSK	32 kbps to 17.5 Mbps
Rate 7/8 8-PSK	336 kbps to 20 Mbps
Rate 7/8 16-QAM	448 kbps to 20 Mbps
Rate 17/18 QPSK	32 kbps to 18.88 Mbps
Rate 17/18 8-PSK	362.7 kbps to 20 Mbps

7.5.3 End-to-End Processing Delay

In many cases, FEC methods that provide increased coding gain do so at the expense of increased processing delay. However, with TPC, this increase in delay is very modest. The table below shows, for the Modem, the processing delays for the major FEC types, including the three TPC modes.

Table 6-5. Turbo Product Coding processing delay comparison

FEC Mode (64 kbps data rate)	End-to-end delay, ms
Viterbi, Rate 1/2	12
Viterbi Rate 1/2 + Reed-Solomon	266
Turbo Product Coding, Rate 3/4	**47**
Turbo Product Coding, Rate 21/44, BPSK	**64**
Turbo Product Coding, Rate 5/16, BPSK	**48**
Turbo Product Coding, Rate 7/8	**245** *
Turbo Product Coding, Rate 17/18	**69**

Note: In all cases, the delay is inversely proportional to data rate, so for 128 kbps the delay values would be half of those shown above. It can be seen that the concatenated Reed-Solomon cases increase the delay significantly (due mainly to interleaving/de-interleaving) while the TPC cases yield delays, which are much less.

* A larger block is used for the Rate 7/8 code, which increases decoding delay.

7.5.4 Comparison of all TPC Modes

Mode	Eb/No at BER = 10^{-6} Guaranteed (Typical in parentheses)	Eb/No at BER = 10^{-8} Guaranteed (Typical in parentheses)	Spectral Efficiency	Symbol Rate	Occupied * Bandwidth for 1 Mbps Carrier
QPSK Rate ½ Viterbi *	6.0 dB (5.5 dB)	7.3 dB (6.8 dB)	1.00 bits/Hz	1.0 x bit rate	1190 kHz
BPSK Rate 21/44 Turbo	2.9 dB (2.6 dB)	3.3 dB (3.0 dB)	0.48 bits/Hz	2.1 x bit rate	2493 kHz
BPSK Rate 5/16 Turbo	2.4 dB (2.1 dB)	2.8 dB (2.5 dB)	0.31 bits/Hz	3.2 x bit rate	3808 kHz
QPSK Rate ½ Turbo	2.9 dB (2.6 dB)	3.2 dB (2.8 dB)	0.96 bits/Hz	1.05 x bit rate	1246 kHz
QPSK Rate ¾ Turbo	3.8 dB (3.3 dB)	4.4 dB (4.0 dB)	1.50 bits/Hz	0.67 x bit rate	793 kHz
QPSK Rate 7/8 Turbo	4.3 dB (4.0 dB)	4.5 dB (4.2 dB)	1.75 bits/Hz	0.57 x bit rate	678 kHz
QPSK Rate 17/18 Turbo	6.4 dB (6.0 dB)	6.9 dB (6.5 dB)	1.90 bits/Hz	0.53 x bit rate	626 kHz
*8-PSK Rate 2/3 TCM ** and R-S (IESS-310)*	6.5 dB (5.6 dB)	6.9 dB (6.0 dB)	1.82 bits/Hz	0.56 x bit rate	666 kHz
8-PSK Rate ¾ Turbo	6.2 dB (5.7 dB)	6.8 dB (6.3 dB)	2.25 bits/Hz	0.44 x bit rate	529 kHz
8-PSK Rate 7/8 Turbo	7.3 dB (6.8 dB)	7.5 dB (7.1 dB)	2.62 bits/Hz	0.38 x bit rate	453 kHz
8-PSK Rate 17/18 Turbo	9.3 dB (8.9 dB)	10.3dB (9.9 dB)	2.85 bits/Hz	0.35 x bit rate	377 kHz
16-QAM Rate 3/4 Turbo	7.4 dB (7.0 dB)	8.2 dB (7.7 dB)	3.00 bits/Hz	0.33 x bit rate	396 kHz
16-QAM Rate 7/8 Turbo	8.1 dB (7.7 dB)	8.3 dB (7.9 dB)	3.50 bits/Hz	0.28 x bit rate	340 kHz
*16-QAM Rate 3/4 ** Viterbi/Reed-Solomon*	8.1 dB (7.5 dB)	8.6 dB (8.0 dB)	2.73 bits/Hz	0.37 x bit rate	435 kHz
*16-QAM Rate 7/8 ** Viterbi/Reed-Solomon*	9.5 dB (9.0 dB)	10.1 dB (9.5 dB)	3.18 bits/Hz	0.31 x bit rate	374 kHz

∗ The occupied bandwidth is defined at the width of the transmitted spectrum taken at the -10 dB points on the plot of power spectral density. This equates to 1.19 x symbol rate for the modem transmit filtering.

∗∗ Included for comparative purposes.

It can be seen that the 8-PSK Rate 3/4 Turbo performance closely approaches that of the Rate 2/3 TCM/Reed-Solomon case – the BER performance is within approximately 0.4 dB. However, it should be noted that the Rate 3/4 Turbo mode is ***20% more bandwidth efficient*** than the TCM case. The additional advantages of Turbo (lower delay, performance during fades etc) should also be considered.

Table 6-6. Turbo Product Coding Summary

FOR	AGAINST
Exceptionally good BER performance - significant improvement compared with every other FEC method in use today	Nothing!
No pronounced threshold effect - fails gracefully	
Exceptional bandwidth efficiency	
Coding gain independent of data rate (in this implementation)	
Low decoding delay	
Easy field upgrade in Modem	

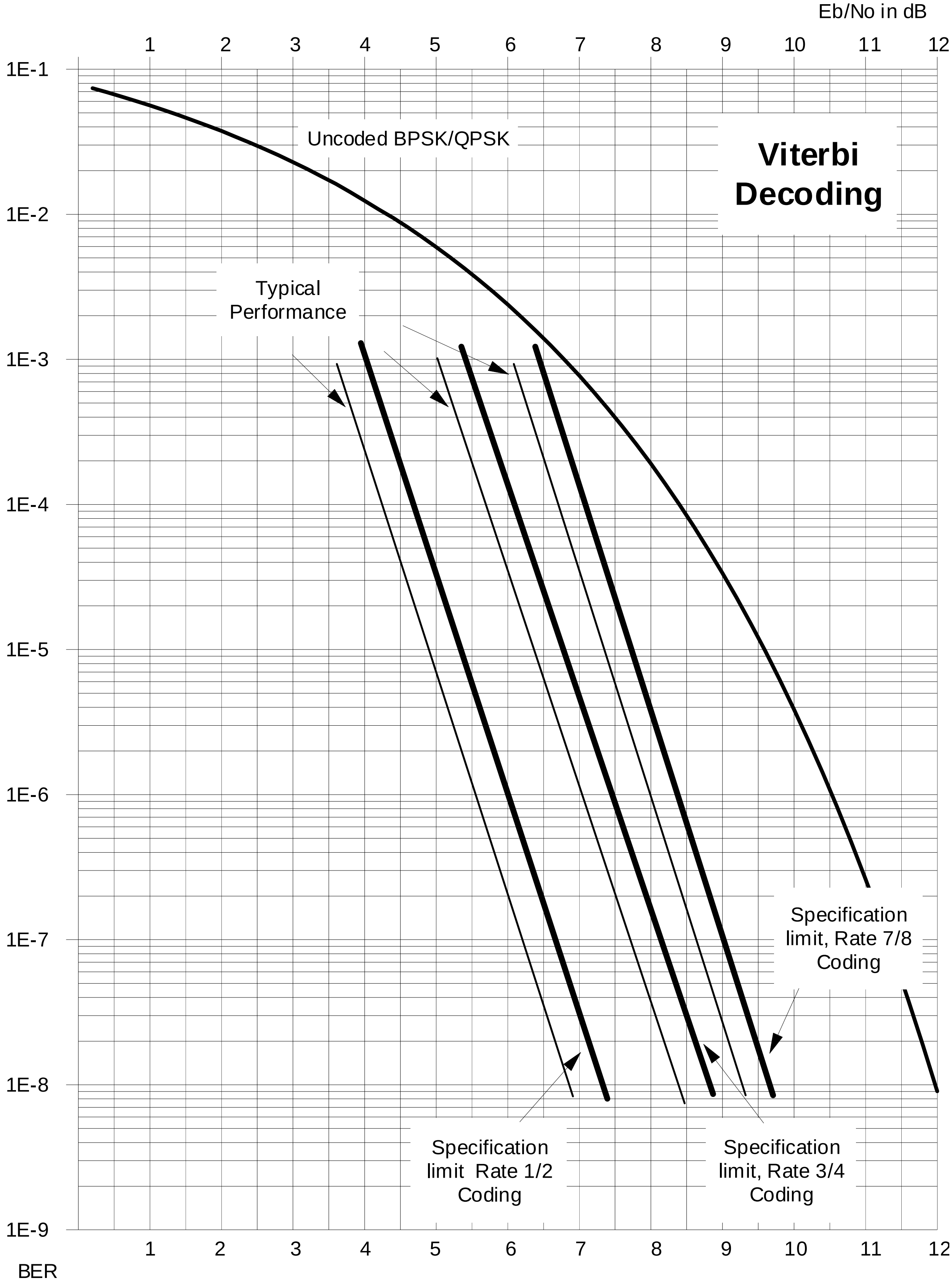


Figure 6-1. Viterbi Decoding

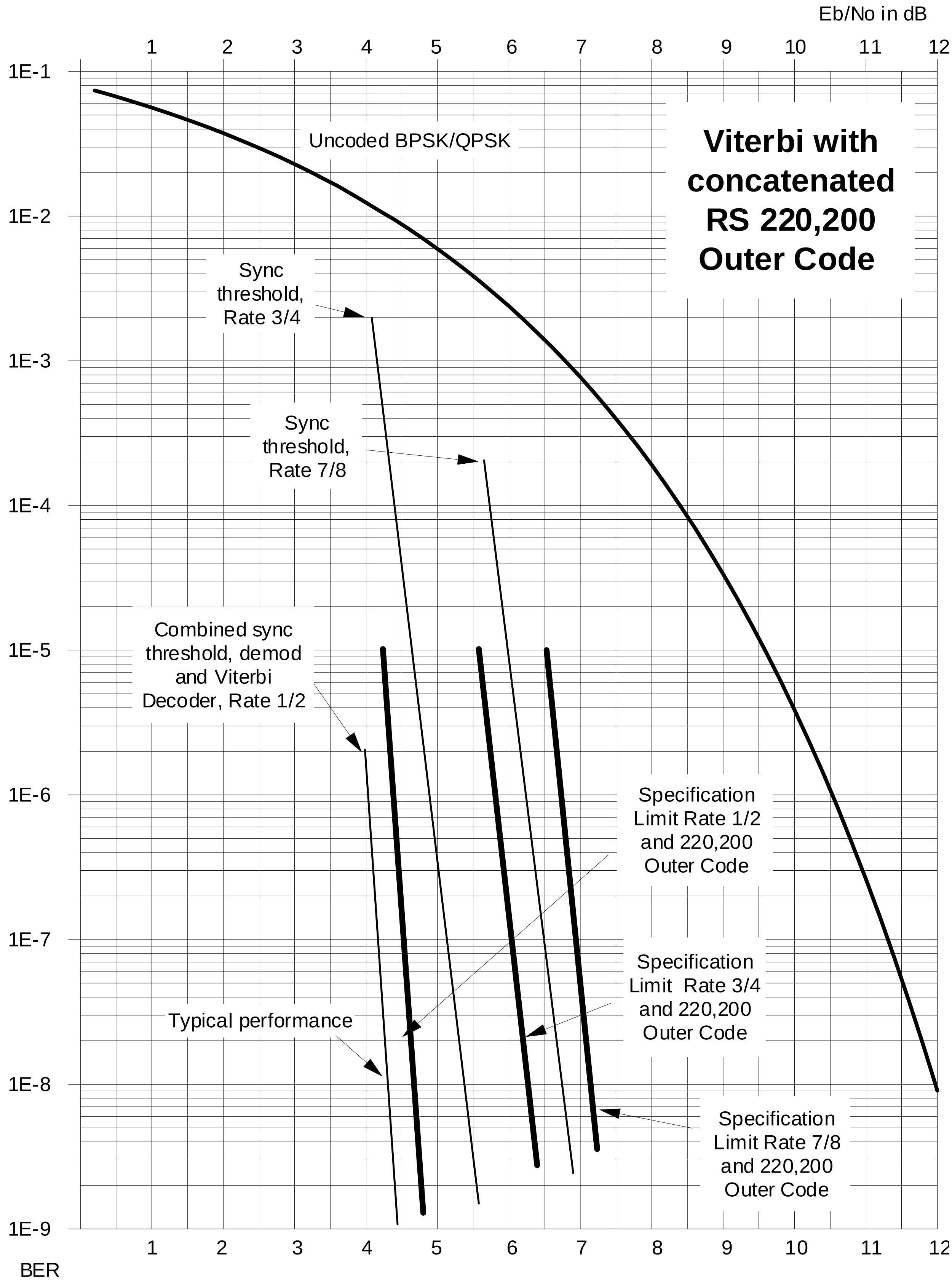


Figure 6-2. Viterbi with Concatenated R-S Outer Code

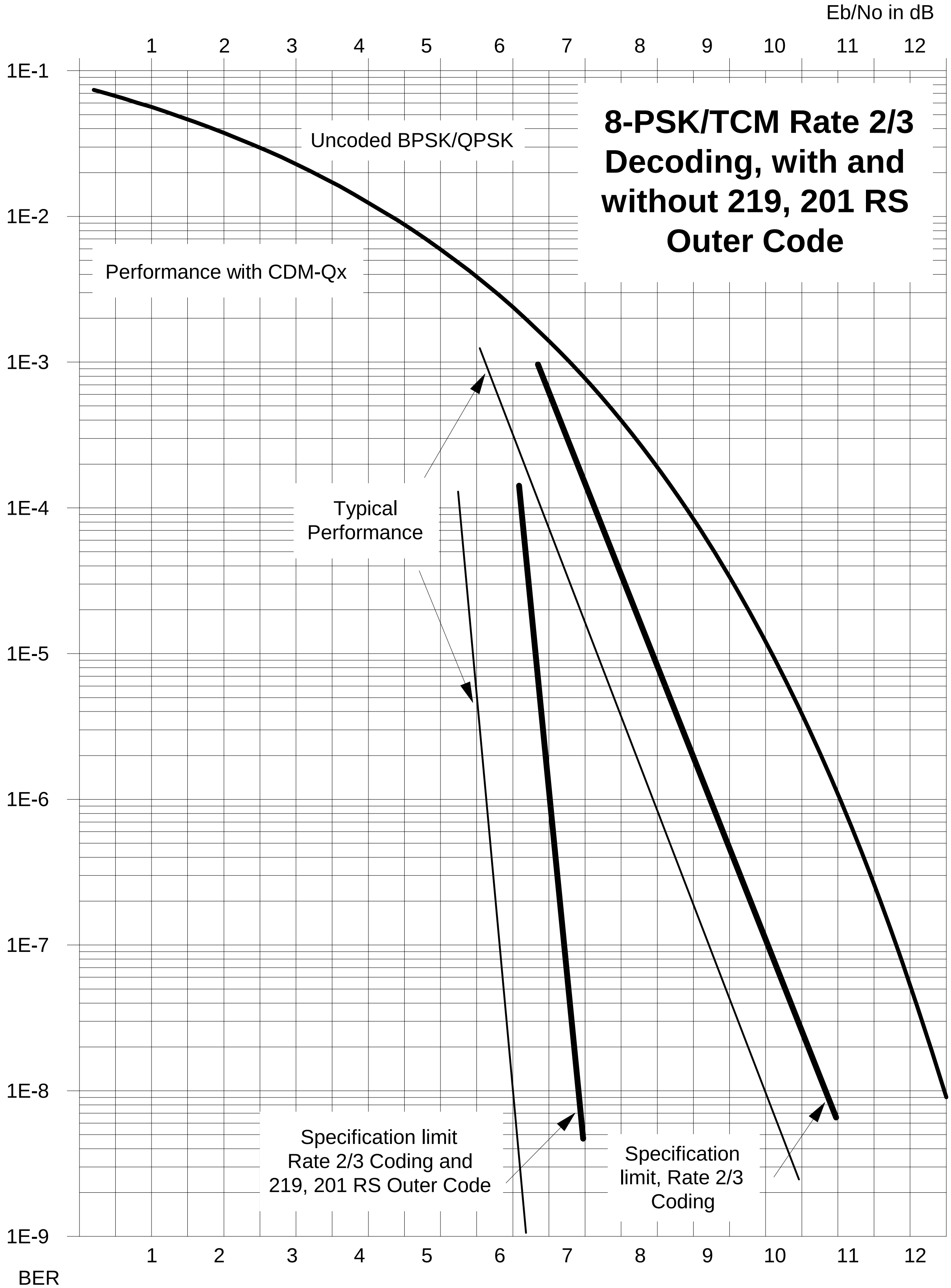


Figure 6-3. 8-PSK/TCM Rate 2/3 with and without concatenated R-S Outer Code

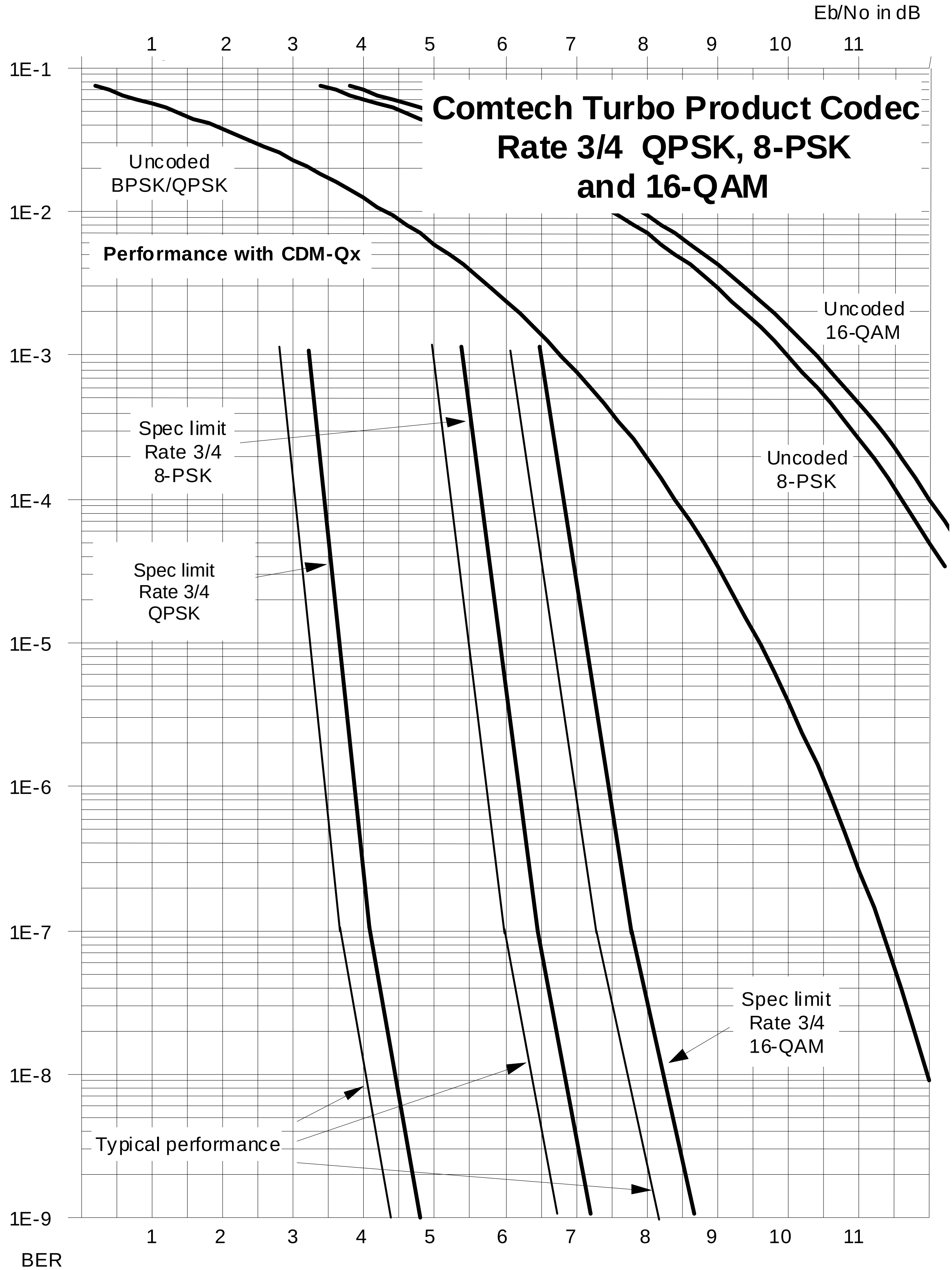


Figure 6-4. Comtech EF Data Turbo Product Codec Rate 3/4 QPSK, 8-PSK and 16-QAM

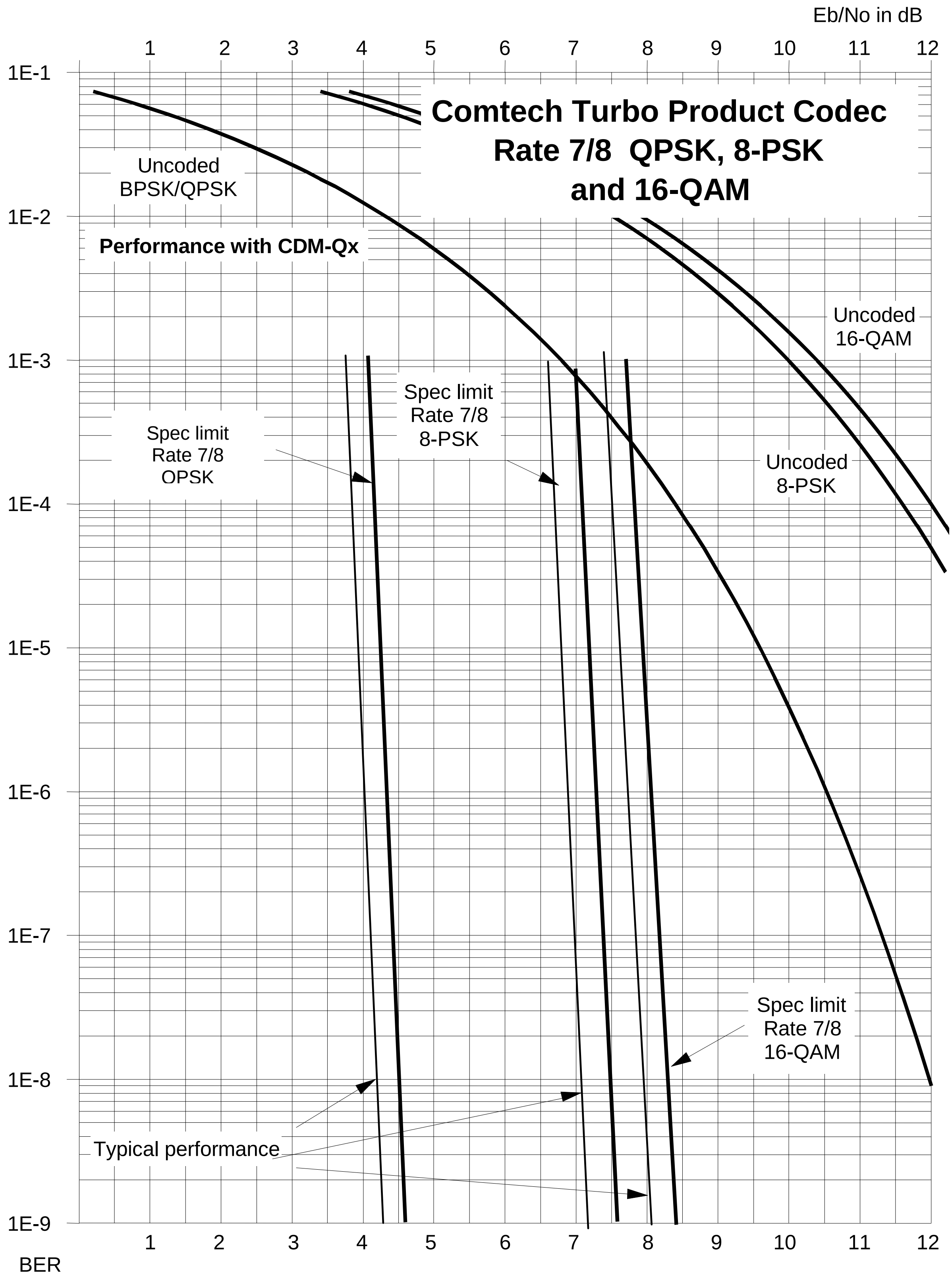


Figure 6-5. Comtech EF Data Turbo Product Codec Rate 7/8 QPSK, 8-PSK and 16-QAM

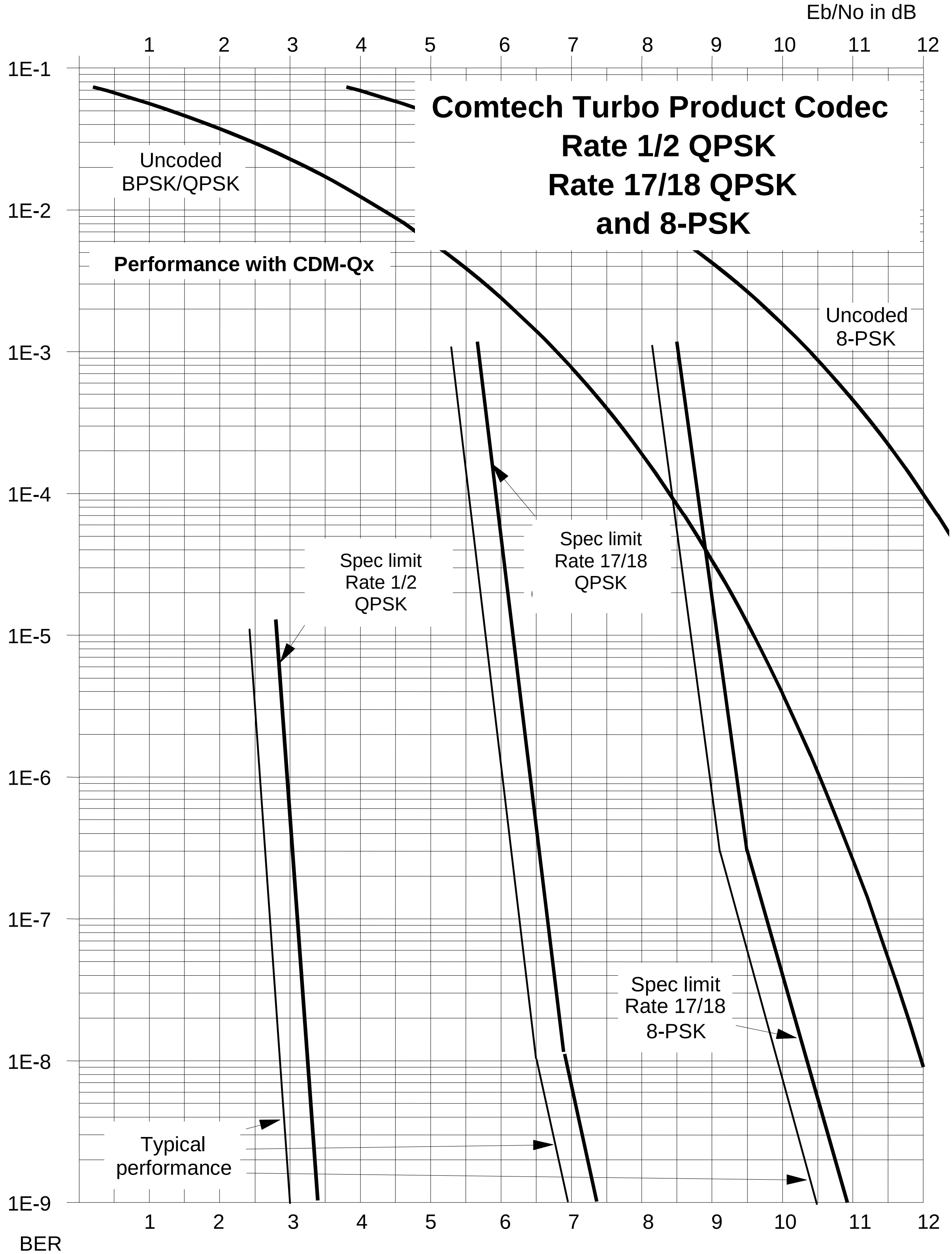


Figure 6-6. Rate 1/2 QPSK, Rate 17/18 QPSK and Rate 17/18 8-PSK

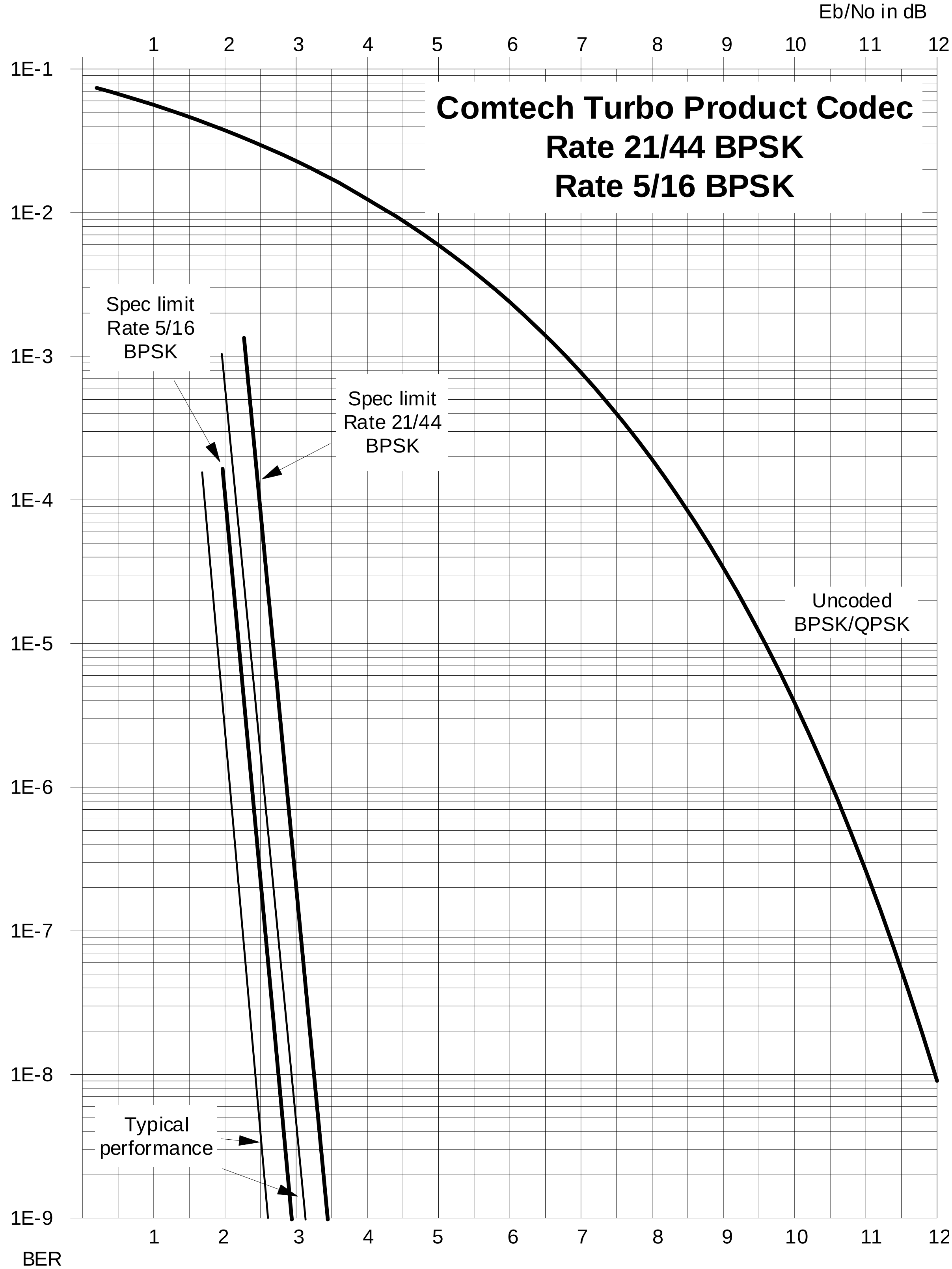


Figure 6-7. Rate 21/44 BPSK and Rate 5/16 BPSK Turbo

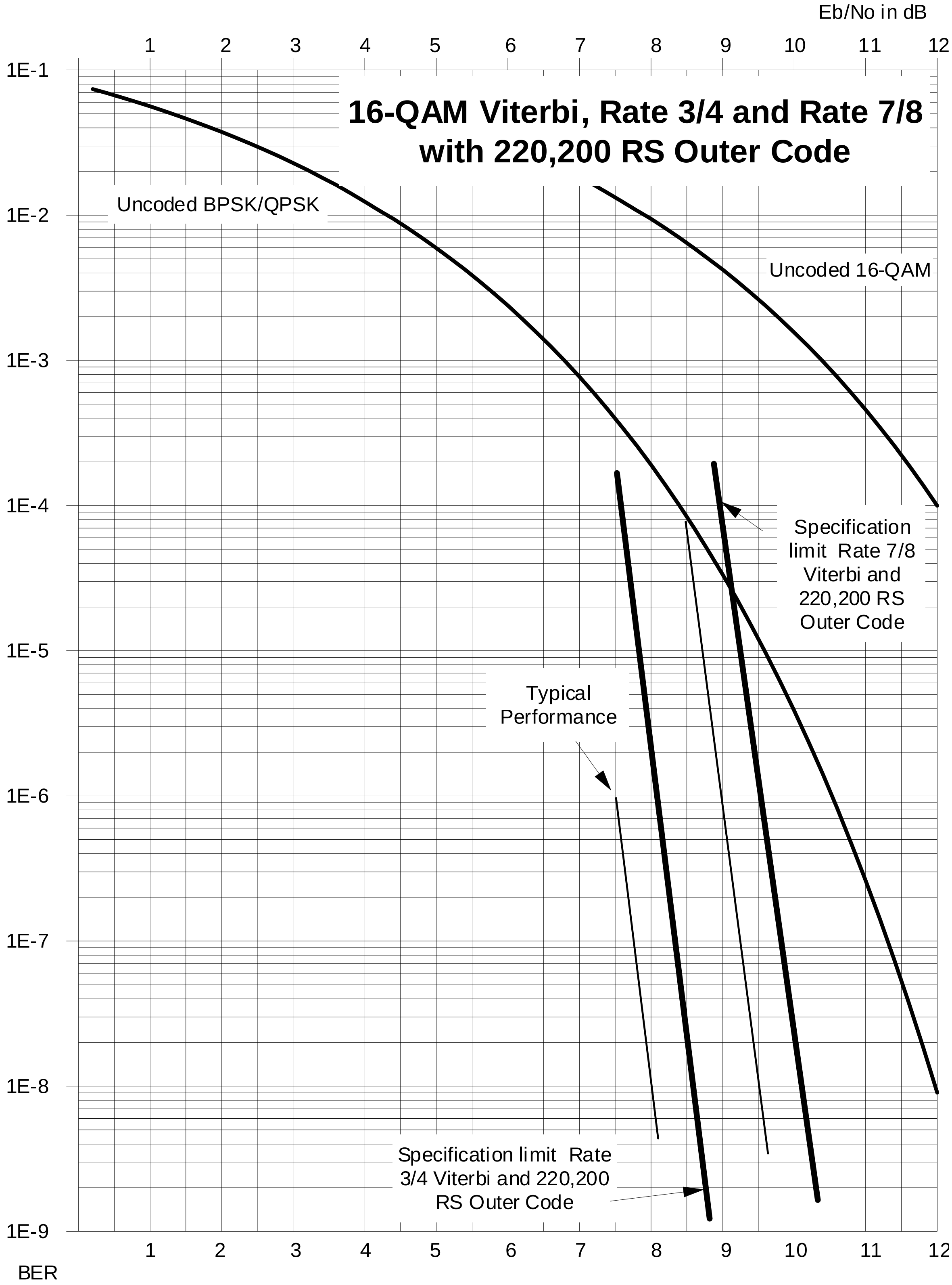


Figure 6-8. 16-QAM Viterbi, Rate 3/4 and Rate 7/8 with 220,200 R-S Outer Code

Notes:

Chapter 8. AUTOMATIC UPLINK POWER CONTROL (AUPC)

8.1 Introduction

WARNING

The user MUST obtain permission from the Satellite Operator to use this feature.

Improper use of this feature could result in a transmitting terminal seriously exceeding its allocated flux density on the Operator's satellite. This could produce interference to other carriers, and could cause transponder saturation problems.

Automatic **U**plink **P**ower **C**ontrol (AUPC) is a feature whereby a local modem is permitted to adjust its own output power level in order to attempt to maintain the E_b/N_o at the remote modem.

To accomplish this, the EDMAC framing type of operation must be used. The remote modem constantly sends back information about the demodulator E_b/N_0 using reserved bytes in the overhead structure. The local modem then compares this value of E_b/N_0 with a pre-defined target value. If the Remote E_b/N_0 is below the target, the local modem will increase its output power, and hence, a closed-loop feedback system is created over the satellite link. A particularly attractive benefit of this feature is that whenever framed operation is selected, the remote demodulator's E_b/N_0 can be viewed from the front panel display of the local modem.

There are several important parameters associated with this mode of operation; the user needs to understand how the AUPC feature works, and the implications of setting these parameters.

8.2 Setting AUPC Parameters

1. Under the menu (**CONFIG: FRAME**), the user must first ensure that the framing type is EDMAC or EDMAC-2.

   (EDMAC or EDMAC-2 may be configured as IDLE, or the unit may be defined as an EDMAC Master or Slave.)

2. The user should verify that the remote modem is correspondingly configured for EDMAC or EDMAC-2 framing.

3. Under the menu (**CONFIG: TX → Pwr**), the user sets the nominal output power of the modem. This is done by selecting the Output Power Level Mode on this menu screen as **MANUAL**, then editing the displayed Tx output power level.

4. The user will then select **AUPC** as the operating mode.

   At this point the user will be prompted to define four key parameters: **AUPC Target E_b/N_0**; **AUPC Max Range**; **AUPC Alarm**; and **Demod Unlock**.

8.2.1 AUPC Target E_b/N_0

TARGET E_b/N_0 is value of E_b/N_0 that the user desires to keep constant at the remote modem.

If the E_b/N_0 exceeds this value, the AUPC control will reduce the Tx output power, but will never drop below the nominal value set.

If the E_b/N_0 falls below this value, the AUPC control will increase the Tx output power, but will never exceed the value determined by the parameter **MAX RANGE**.

- The minimum value the user can enter is 0.0 dB
- The maximum value the user can enter is 9.9 dB
- The default value is 3.0 dB
- The resolution is 0.1 dB

8.2.2 AUPC Max Range

MAX RANGE defines how much – under AUPC control – the modem is permitted to increase the output level.

- The minimum value the user can enter is 0 dB
- The maximum value the user can enter is 9 dB
- The default value is 1 dB
- The resolution is 1 dB

8.2.3 AUPC Alarm

The **ALARM** parameter defines how – under AUPC control – the user wants the modem to react if the maximum power limit is reached.

The two choices are:

- **NONE** (no action – this is the **default setting**).
- **TX ALARM** (generate a Tx alarm).

8.2.4 Demod Unlock

DEMOD UNLOCK defines the action the modem will take if the remote demodulator loses lock.

The two choices are:

- **NOMINAL** (reduce the Tx Output Power to the nominal value – this is the **default setting**).

- **MAXIMUM** (increase the Tx Output Power to the maximum value permitted by the parameter **MAX RANGE**).

(**Note**: If the local demod loses lock, the modem will automatically move its output power to the nominal value.)

8.3 Compensation Rate

As with any closed-loop control system, the loop parameters must be chosen to ensure stability at all times. Several features have been incorporated to ensure that the AUPC system does overshoot, or oscillate.

- First, the rate at which corrections to the output power can be made is fixed at once every 4 seconds. This takes into account the round trip delay over the satellite link, the time taken for a power change to be reflected in the remote demodulator's value of E_b/N_0, and other processing delays in the modems.
- Second, if the comparison of actual and target E_b/N_0 yields a result that requires a change in output power, the first correction made will be 80% of the calculated step. This avoids the possibility of overshoot. Subsequent corrections are made until the difference is less than 0.5 dB. At this point, the output power is only changed in increments of 0.1 dB, to avoid 'hunting' around the correct set point.

8.4 Monitoring

The remote demodulator's value of E_b/N_0 can be monitored at all times, either from the front panel (**MONITOR: AUPC**) or via the remote control interface. The resolution of the reading is 0.2 dB. For all values greater than or equal to 16 dB, the value 16.0 dB will be displayed. As long as framing is enabled, the value will still be available, regardless of the AUPC mode, or framing mix.

Also displayed is the current value of Tx power increase. If EDMAC framing is enabled, but AUPC is disabled, this will indicate 0.0 dB. This value is also available via the remote control interface.

CAUTION

Comtech EF Data strongly cautions against the use of large values of permitted power level increase under AUPC control. Users should consider using the absolute minimum range necessary to improve rain-fade margin.

Notes:

Chapter 9. DoubleTalk™ Carrier-in-Carrier® (CnC)

BEFORE ATTEMPTING TO COMMISSION A SATELLITE LINK USING CARRIER-IN-CARRIER, THE USER MUST ENSURE THAT THE LINK IS ROBUST ENOUGH FOR NORMAL OPERATION. ONLY WHEN THIS HAS BEEN DONE – AND ALL SYSTEM ISSUES (E.G., ANTENNA-POINTING, CABLING, TERRESTRIAL INTERFERENCE, SATELLITE INTERFERENCE, ETC.) HAVE BEEN RESOLVED – SHOULD THE USER ATTEMPT THE USE OF CARRIER-IN-CARRIER.

9.1 What is DoubleTalk Carrier-in-Carrier?

Traditional full-duplex links utilize frequency division multiplexing to allow communications in two directions. This requires allocating two frequency bands – one for each direction (A and B). These standard carriers must occupy non-overlapping spectral segments with no more than one carrier in the same space.

The CDM-Qx/QxL DoubleTalk Carrier-in-Carrier option utilizes a patented (US 6,859,641) signal processing algorithm developed by Applied Signal Technology, Inc. that allows both the forward and reverse carriers of a full duplex link to share the same segment of transponder bandwidth, using adaptive cancellation. Applied Signal uses the term DoubleTalk™, and Comtech EF Data refers to it as DoubleTalk Carrier-in-Carrier (CnC).

CnC allows the two carriers to reside on the same center frequency, a practice that is disastrous for normal carries. When carriers share common bandwidth, up to 50% savings in transponder utilization is possible.

9.2 Application Requirements

The following conditions are necessary in order to operate DoubleTalk Carrier-in-Carrier:

- Both of the earth stations must be able to see each other's carriers.
- The modulator and demodulator must be "grouped" together for CnC to operate.
- The relative power level between the two carriers must be < ± 10dB of each other. For optimal performance the carriers should be < ± 7dB of each other.
- The symbol rate ratio of the two carriers should be < 3:1 (either way).

9.3 System Functionality

Figure 9-1 illustrates a conventional FDMA system, where two carriers are placed in non-overlapping channels.

Figure 9-2 shows the same link using the CDM-Qx/QxL equipped with the DoubleTalk Carrier-in-Carrier option. Note that now only 50% of the bandwidth is being used, as now both carriers are occupying the same bandwidth.

The transponder downlinks the composite signal containing both carriers on the same band to the CDM-Qx/QxL, which then translates the signal to near baseband where it can be filtered (decimated) and then processed as a complex envelope signal. The CDM-Qx/QxL then suppresses the version of the near end carrier on the downlink side and then passes the desired carrier to the demodulator for normal processing.

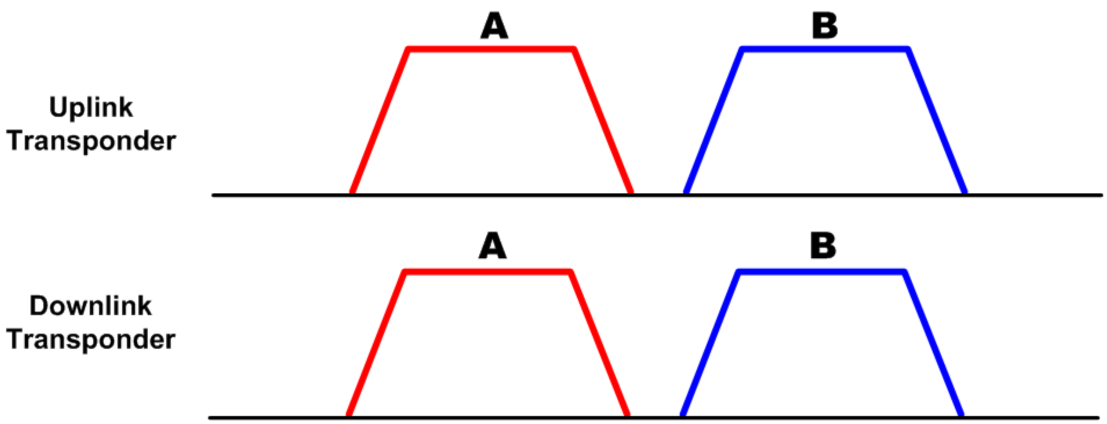


Figure 9-1. Traditional FDMA System (without CnC)

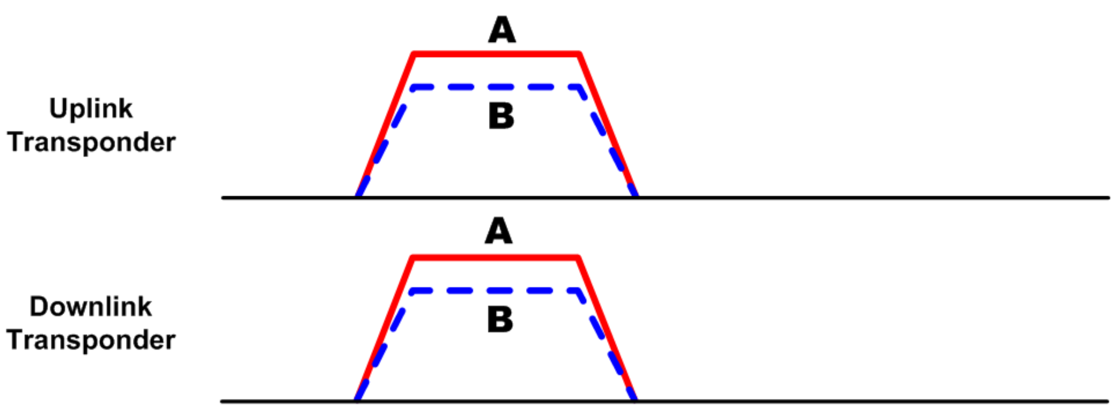


Figure 9-2. Same System Using CDM-Qx/QxL and DoubleTalk Carrier-in-Carrier

It is recommended that the user start with the traditional FDMA configuration as shown in **Figure 9-1**. This allows the user to establish the links, make sure the modems and RF equipment are all functioning correctly, and that a reasonable Eb/No has been set in each direction for the modulation and code rate selected.

The modem generating the 'B' carrier in this example should then be relocated in frequency to be "on top" of Carrier 'A'. At this point the demodulator-receiving carrier "A" will loose lock. The carrier in carrier function must now be enabled in the Rx configuration menus. Once CnC is turned on the demodulator will perform a search for a copy of the outbound modulators signal in time and frequency within the composite signal received by the demodulator.

When the search algorithm has found the carrier, the modem front panel will report "**`Search Successful!`**" It will also display an accurate value for the delay of the signal. The demodulator will then reconfigure itself to match the delay value, cancel out the interfering carrier (user's outbound), then lock to and demodulate the desired carrier.

The modem is like all Comtech EF Data modems in that it has a full compliment of receive monitored parameters. But for CnC operation a new parameter has been added. To access this feature, change the menu from config Rx to monitor Rx, CnC and the following parameters will be displayed. The normal BER, Eb/No and the new is the ratio between the interferer and the desired carriers. The value display is the difference (in dB) of the interferer over the desired carrier. This value is signed as the interferer (which the user side of the link has control over) can be greater or less than the desired you are trying to receive. This is an invaluable piece of information as with two carriers on top of each other it is otherwise impossible to accurately tell if one side or the other should experience a fade. The CnC monitor menu will also report the frequency offset between the two carriers.

Once this side of the link is configured and running properly, the other side of the link must be configured so that the Rx frequency is the same as the Tx and CnC is turned on. At this point both sides of the link should be locked and passing traffic normally.

Once the links have been configured such that the Eb/No values with good weather conditions are such that there is an appropriate fade margin, record the ratio value so that between the Eb/No value of the desired and the ratio value the user can determine if the link has degraded.

If the outbound carrier should go down the demodulator may drop sync but will relock to the desired carrier. When the outbound carrier returns the demod may be able to relock rapidly if the outage was brief or it may have to perform another search first. If the desired carrier should go down the demodulator will continue to cancel the outbound but will be unlocked with respect to the desired carrier. When the carrier returns the demod will relock.

While there are several parameters that can be configured when using CnC, it is recommend to leave them set to the factory default settings. These include changing the minimum delay value (in milli seconds) for the search function. The typical satellite delay will range from about 230 to 270 ms. If the minimum value is increase to say 200 ms the acquisition time will not be significantly improved and if the unit should be tested at the IF level in the future it would not lock as the delay would be in the micro seconds. The maximum delay can be decreased from 290 ms, but again the acquisition time will not be significantly improved. The other parameter is the reacquisition delay value. This determines how long the demodulator will wait to perform another search for the outbound carrier.

9.4 CnC Performance Characterization

In a number of ways, CnC carriers behave similar to conventional carriers in satellite links. They are both exposed to adjacent carriers, cross-polarization and rain fade, and exhibit impairments when any of these become too great. In addition, CnC operates in an environment where:

- Carriers intentionally occupy the same spectral slot;
- Performance depends upon desired and co-located interfering carrier.

Several areas relating to CnC performance are discussed in the sections that follow, including:

- Adjacent carrier performance;
- Eb/No Degradation as a function of the CnC ratio;
- Symbol rate ratio;
- Carrier offset;
- The effects of rain fade and asymmetric antennas.

Nominally, these effects are treated independently so it is possible to add them together to estimate the total degradation. Initially, degradation due to carrier spacing is examined to characterize the adjacent carrier performance. Next, the CnC ratio is evaluated to estimate its impact. The symbol rate ratio of CnC carriers and the allowable carrier offset are discussed followed by some CnC examples.

The rules for CnC operation are summarized below:

- Both earth stations share the same footprint so each sees both carriers;
- CnC carriers are operated in pairs;
- One outbound with multiple return carriers is not allowed;
- Asymmetric data rates are allowed up to a symbol rate ratio of 3;
- Minimum symbol rate for CnC is 128 ksps;
- The CnC ratio is normally less than 10dB;
- CnC operates with modems not modulators only or demodulators only.

9.4.1 Degradation Due To Carrier Spacing

In satellite links, one of the impairments to estimate is the impact of carrier spacing on performance and allocate the degradation to the link budget. Data was taken using the CDM-Qx Modem, operating with Turbo coding, to measure Eb/No degradation with decreasing carrier spacing to characterize performance in the presence of two equally spaced like modulated adjacent carriers. This is done without CnC.

For testing, the modem is initially set up with noise to operate at a nominal or reference Eb/No corresponding to a BER$\approx 10^{-8}$ and with no adjacent carrier present. A like-modulated adjacent carrier is then added and the Eb/No degradation recorded. The test is conducted with a single adjacent carrier as shown in **Case 'A'** of **Figure 9-3**, but this is equivalent to two equally spaced adjacent carriers on either side of the desired carrier, each 3dB less than a single adjacent carrier as shown in **Case 'B'**.

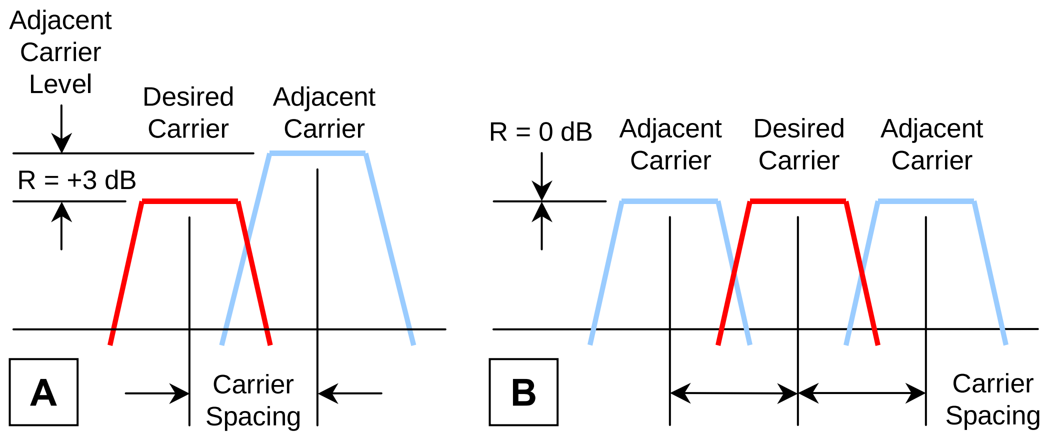


Figure 9-3. Adjacent Carrier: Case A (As Tested) and Case B (As Plotted)

The results are plotted for two equally spaced adjacent carriers each at -3dB, 0dB, +3dB, and +6dB relative to the desired carrier to produce a family of operating curves. **Figure 9-4** through **Figure 9-6** plot the results for the QPSK, 8-PSK and 16-QAM cases.

The following table contains the CDM-Qx configurations tested:

Modulation	Forward Error Correction	Reference Eb/No At BER ≈ 10^{-8}	Symbol Rate	Data Rate	Rolloff (α)
QPSK	3/4 Turbo	3.9dB	1000 ksps	1500 kbps	20 and 35%
8-PSK	3/4 Turbo	6.3dB	1000 ksps	2250 kbps	20 and 35%
16-QAM	3/4 Turbo	7.7dB	1000 ksps	3000 kbps	20 and 35%

The results are plotted for Eb/No degradation versus relative carrier spacing where:

- Eb/No degradation is the difference between the reference Eb/No and the Eb/No read from the modem in the presence of the interfering adjacent carrier.
- Relative Carrier Spacing is the distance between the centers of the desired and adjacent carriers divided by the symbol rate.

There are two sets of adjacent carrier plots representing operation with 20% and 35% rolloff (α). When α is 20%, the spectrum is narrower than it is for 35%. The effect of this is noticed in the adjacent carrier plots. The 20% plots are displaced slightly to the left of those for 35%. This makes it possible to space carriers slightly closer when the rolloff is 20%. The table below generalizes degradation (≤ 0.5dB) for all modulation and coding combinations when there are two adjacent carriers:

Degradation ≤ 0.5dB	
Carrier Spacing for 20% Rolloff	**Carrier Spacing for 35% Rolloff**
≥ 1.1 x Symbol Rate	≥ 1.2 x Symbol Rate

Some caution is required because carriers with 20% rolloff are more sensitive to impairments and non-linearity in the link.

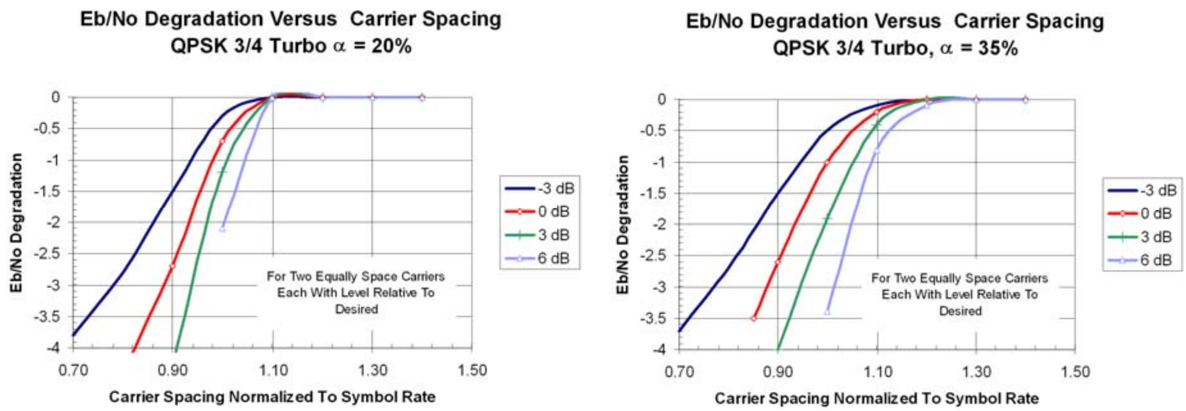


Figure 9-4. QPSK 3/4 Turbo degradation versus relative carrier spacing (for two adjacent carriers)

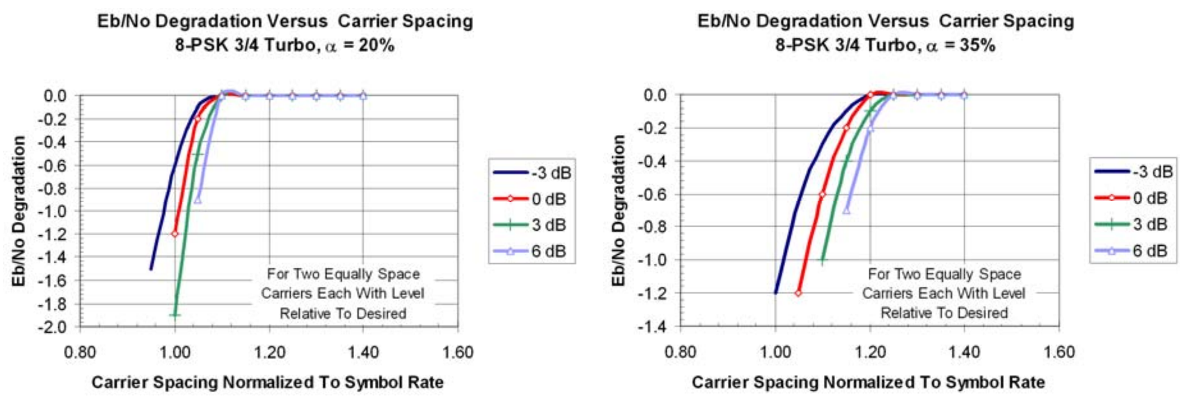


Figure 9-5. 8-PSK 3/4 Turbo degradation versus relative carrier spacing (for two adjacent carriers)

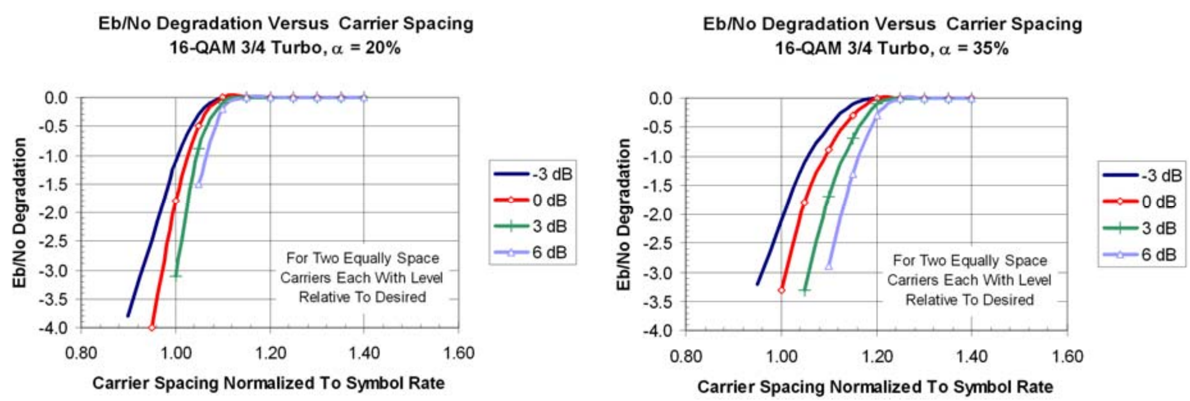
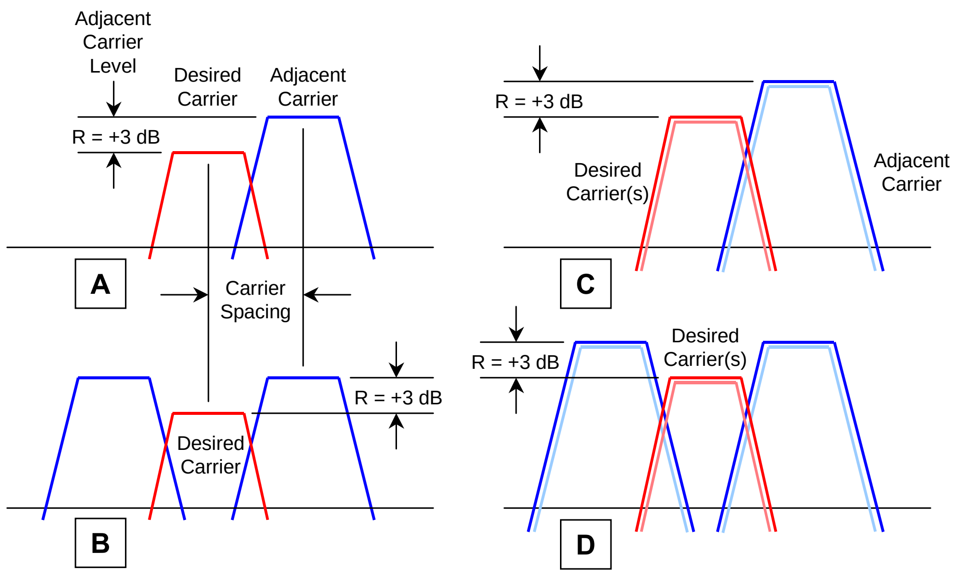


Figure 9-6. 16-QAM 3/4 Turbo degradation versus relative carrier spacing (for two adjacent carriers)

Other QPSK turbo code rates have similar performance and the QPSK plots above are used to estimate their performance. The degradation plots above are also used for other turbo 8-PSK and 16-QAM code rates. A good practice for carrier spacing is to operate the links with sufficient spacing so there is no degradation.

9.4.2 Selecting The Adjacent Carrier Curve

The information presented earlier characterizes the case for one or two adjacent carriers relative to the desired carrier. The desired and adjacent carriers may also be CnC carriers occupying the adjacent slots. These cases are summarized by several variants shown in **Figure 9-7**. Understanding the relationship between the variants illustrated here assists in selection of the correct adjacent carrier degradation curve.



Case	Desired Carrier	Adjacent Carrier (See Note)	Curve To Use In Figure 9-4, Figure 9-5, or Figure 9-6	Curve To Use For Any Ratio R (dB)
A	1 Carrier	1 Adjacent Carrier	0dB	R – 3dB
B	1 Carrier	2 Adjacent Carriers	+3dB	R + 0dB
C	1 CnC Carrier	1 Adjacent Carrier	+3dB	R + 0dB
D	1 CnC Carrier	2 Adjacent Carriers	+6dB	R + 3dB

Note: The adjacent carrier is the composite power for either a conventional carrier or CnC carrier.

Figure 9-7. Adjacent Carrier Cases

Case 'A' illustrates the way the adjacent carrier testing is conducted. It shows a single adjacent carrier 3dB higher than the desired carrier, equivalent to two like-modulated adjacent carriers on either side of the desired carrier, each at the same level as the desired (0dB higher).

Case 'B' shows two adjacent carriers, each 3dB higher than what is desired.

Case 'C' illustrates a CnC with a pair of co-located desired carriers (CnC ratio is 0) and a single adjacent slot with pair of CnC carriers whose total composite power is 3dB higher than the desired pair. The total adjacent power to one of the CnC carriers is 6dB, or the equivalent of two single adjacent carriers (one on each side of the desired) each 3dB higher than "one" of the desired CnC carriers. It does not matter whether the adjacent carrier is a pair of CnC carriers or a standard carrier. It is based on the power.

Case 'D' shows two desired CnC carriers accompanied by a CnC carrier on each side. Again, it does not matter whether the adjacent carriers are CnC or conventional carriers, just the total power. This situation is equivalent to adjacent carriers each 6dB greater than the one desired CnC carrier. The table provided in **Figure 9-7** summarizes which adjacent carrier plot to select for this particular example, and which ones to use with Ratio '**R**' between the composite adjacent and composite desired carriers.

9.4.3 Carrier-in-Carrier® Ratio (CnC Ratio)

The CnC Ratio represents the difference in power between the co-located interfering carrier and the desired carrier (in dB):

CnC Ratio = Interferer Power – Desired Carrier

During CnC operation, the interfering carrier is removed by the CDM-Qx using a stored version of the transmitted carrier to adaptively cancel it from the composite received signal. The desired carrier remaining after the cancellation process is delivered to the demodulator and decoder to recover the data.

When the CnC ratio increases, the level of the interferer rises relative to the desired carrier and degradation grows. As the CnC ratio decreases, the desired carrier dominates and degradation becomes negligible. Figure 9-8 represents two cases of the CnC Ratio when the interfering and desired carriers are equal, and when the interferer is 6dB stronger than the desired carrier. This representation is artificial because a real spectral plot displays only the composite power of the combined carriers and is unable to distinguish two carriers, but it is instructive to describe the underlying principle.

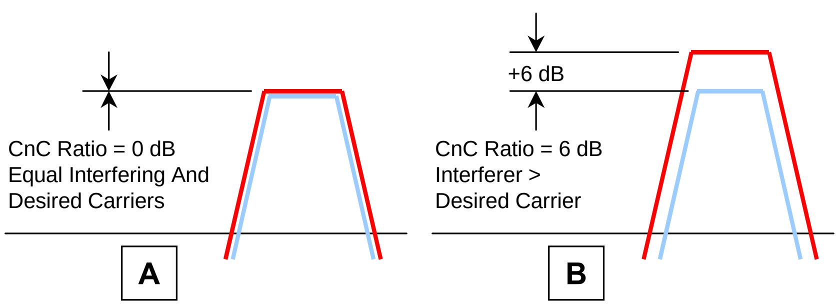


Figure 9-8. CnC Ratio

The following CDM-Qx configurations were tested for Eb/No degradation as a function of CnC ratio:

Modulation	Forward Error Correction	Reference Eb/No At BER≈10^{-6}	C/N
QPSK	21/44 Turbo	2.6dB	2.4dB
	3/4 Turbo	3.7dB	5.5dB
	7/8 Turbo	4.3dB	6.7dB
	17/18 Turbo	6.5dB	9.3dB
8-PSK	2/3 TCM	5.3dB	7.9dB
	3/4 Turbo	6.1dB	9.6dB
	7/8 Turbo	7.1dB	11.3dB
	17/18 Turbo	9.0dB	13.5dB
16-QAM	3/4 Turbo	7.2dB	12.0dB
	7/8 Turbo	8.1dB	13.5dB

The Eb/No degradation is the difference between the reference Eb/No with no interfering carrier present and the Eb/No reported by the modem at a given CnC ratio.

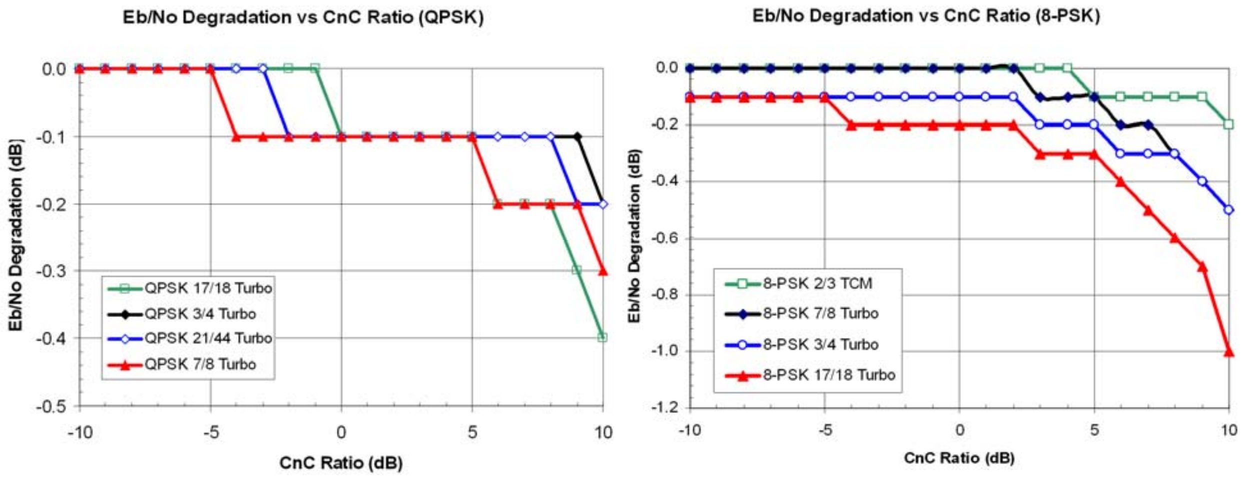


Figure 9-9. CnC Ratio For QPSK and 8-PSK

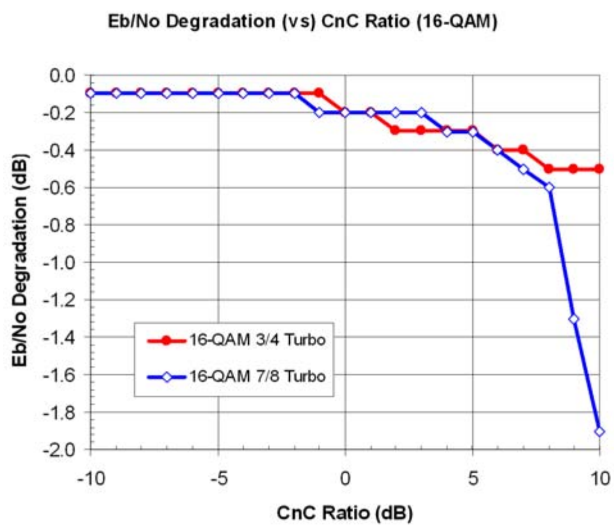


Figure 9-10. CnC Ratio For 16-QAM

Figure 9-9 plots the impact of CnC ratio on QPSK and 8-PSK constellations, while **Figure 9-10** shows 16-QAM. In general, the higher the operating C/N of a carrier, the more sensitive it is to degradation. QPSK is the least sensitive to CnC ratio followed by 8-PSK and 16-QAM.

9.4.4 Symbol Rate Ratio

CnC operation is restricted to a maximum symbol rate ratio ≤3. This is the ratio of the larger carrier to the smaller one. Within these limits, the performance characterized applies. The limitation on the symbol range still allows a wide range of data rates.

It is necessary to take into account the symbol rate ratio to properly estimate the CnC ratio, although the modem does this automatically. For estimating the link parameters, the CnC ratio is adjusted by 10 Log (Symbol Rate Ratio). If the symbol rate ratio is 2.0 then the narrower carrier has a 3dB CnC ratio when the CnC carriers have the same spectral density.

9.4.5 CnC Carrier Offset

CnC carriers are normally placed directly on top of each other with the same center frequency for both carriers. Normal operation is obtained when the center frequency of the two carriers is within ± 32 kHz. This is the same as the normal acquisition range of the modem for standard and CnC carriers.

9.4.6 1st CnC Example: Adjacent Carriers, CnC Ratio and Rain Fade

As an example, a pair CnC carriers is flanked by two adjacent CnC pairs with a carrier spacing of 1.3 x Symbol Rate and the power level is the same for all carriers as shown in **Figure 9-11**. In this scenario, the modulation is 8-PSK 3/4 Turbo with identical data rates. The degradation due to adjacent carrier spacing is negligible when spacing is 1.3 x Symbol Rate and 0dB is allocated for adjacent carrier degradation.

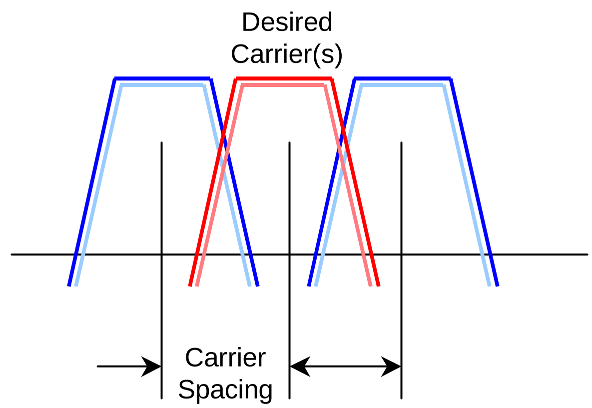


Figure 9-11. CnC Example

Initially, the CnC ratio is 0dB and the desired and interfering carriers are operating at the same power level. At one end of the link (Site 'A'), a downlink fade of 4dB is expected and an uplink fade of 6dB. The other end of the link (Site 'B') is allocated 2dB for downlink and 3dB for the uplink:

	Site 'A'	Site 'B'
DL Fade	4dB	2dB
UL Fade	6dB	3dB

When a rain fade occurs at one site, the effect is felt at both sites as illustrated on the next page in in , which diagrams the worst case fade at **Site 'A'.** The interfering carrier at **Site 'A'** is attenuated twice, once due to the uplink and the second time due to the downlink on the return path. The carrier transmitted from **Site 'B'** sees only the downlink fade when it is received at **Site 'A'.** The resulting power level changes at each site due to the rain fade and the resulting CnC ratio and Eb/No degradation is summarized in **Table 9-1**.

Table 9-1. Rain Fade Degradation

Site 'A'			Site 'B'		
Parameter	dB	Comment	Parameter	dB	Comment
Relative Level of Carrier 'A' at Site 'A'	-10	Due to fade at Site 'A'	Relative Level of Carrier 'B' at Site 'B'	0	Due to fade at Site 'A'
Relative Level of Carrier 'B' at Site 'A'	-4	Due to fade at Site 'A'	Relative Level of Carrier 'B' at Site 'B'	-6	Due to fade at Site 'A'
CnC Ratio at Site 'A'	-6		CnC Ratio At Site 'B'	+6	
Degradation at Site 'A'	-0.1	8-PSK per Fig. 9-12	Degradation at Site 'B'	-0.3	8-PSK per Fig. 9-12

Notice from the table that the CnC change is proportional to the uplink fade. The CnC ratio decreases by the amount of the uplink fade at the near end while the CnC ratio increases by the amount of uplink fade at the distant end. Also, the CnC ratio at opposite ends of the link has the same magnitude but opposite sine.

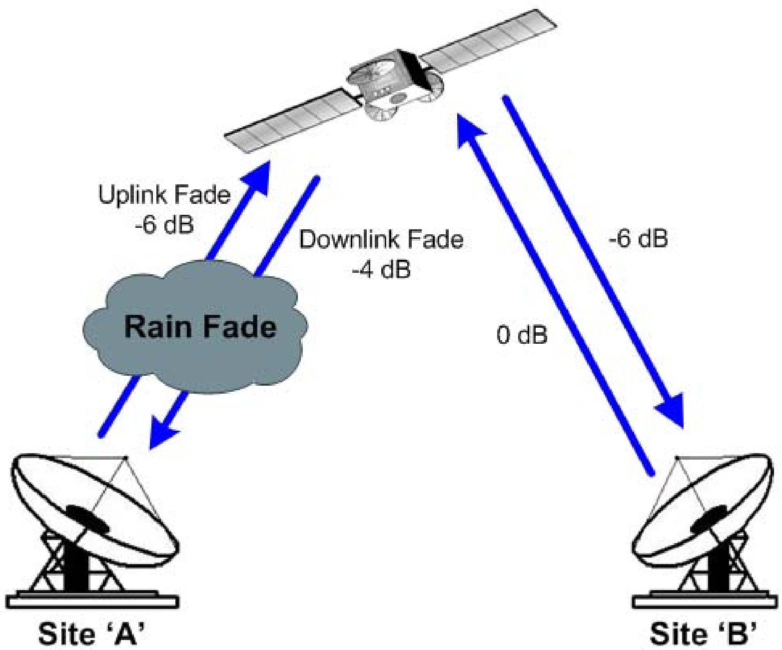


Figure 9-12. Link With Fading At Site 'A'

As shown, the interfering carrier at **Site 'A'** is attenuated twice passing through both the uplink and returning on the downlink back to **Site 'A'.** Since the carrier transmitted and then received at **Site 'A'** is the interfering carrier this extra attenuation is much less of an issue because it makes the CnC ratio more negative (less degradation). In a practical link the interfering carrier might drop into the noise leaving the demodulator to recover the desired carrier nearly absent the undesired interferer.

At **Site 'B'**, the desired carrier from **Site 'A'** is received and attenuated thereby increasing the CnC ratio (more degradation). In links similar to these, the unfaded end of the link has the highest CnC ratio.

In links without rain fade, the CnC ratio is constant and only the asymmetry of link due to satellite footprint, different antenna sizes, different symbol rates, or modulation and code rates alter the ratio.

9.4.7 2nd CnC Example: CnC Ratio With Asymmetric Links

Networks with asymmetric antennas are common with a larger antenna at one site (hub) and smaller ones at the other sites (remotes) and often have asymmetric data rates. In a number of links even a significant rain fade is not a big factor in CnC performance. Some links, particularly C-Band or X-Band, have insignificant rain fades and the key to performance is setting both ends of the link to handle the asymmetry.

In asymmetric links, taking advantage of the available modulation and coding schemes is another tool for building efficient CnC links. In these links the ideal CnC ratio is 0dB, but keeping the CnC ratio less than 7dB, under all conditions, establishes links with margin. A link with a negative CnC ratio is also acceptable because the interfering signal is below the desired signal.

An Asymmetric C-Band link is shown in **Figure 9-13**. It has equal symbol rate carriers but the antenna at **Site 'A'** is 4.5 meters antenna and **Site 'B'** is 2.4 meters.

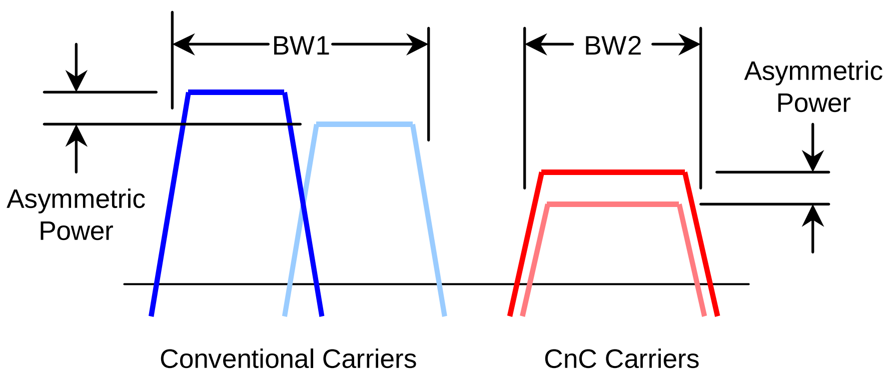


Figure 9-13. Asymmetric Link (Same Data Rate, Different Antennas)

Conventional side-by-side carriers are transmitted by the link on the left, and CnC carriers are deployed on the right. The conventional carriers are 8-PSK 2/3 TCM, and the CnC carriers are QPSK 3/4 Turbo. Notice that the bandwidth to support the two conventional carriers (BW1) is larger than the bandwidth for CnC (BW2), even though the conventional link uses 8-PSK 2/3 while CnC is QPSK 3/4. The benefit of CnC becomes apparent when it is realized that the bandwidth reduction possible with CnC is also accompanied by a reduction in power compared to the conventional link.

The link parameters and results are summarized on the next page in **Table 9-2**. The link asymmetry has increased the CnC ratio at **Site 'A'** to +5.3dB. Yet this results in a degradation of only 0.1dB. This is a C-Band link so no additional change in signal level is expected due to rain fade. The CnC ratio at **Site 'B'** is -5.3dB so no degradation is expected.

What is done if the CnC ratio is 10dB or more? In a C-Band link it is possible to tolerate the additional impairment, but then the modem is operating with less margin. One possibility to reduce the CnC ratio is to increase the amount of power transmitted from the remote site with the smaller antenna. This is feasible in some instances where there are higher power satellite transponders. If the installation is a new one, a larger, though more expensive, antenna is possible at the remote site. This simultaneously decreases the CnC ratio at the hub while increasing it at the remote site.

Another alternative is to reduce the modulation order and/or error correction code rate on the receive side of the remote site. This decreases the power transmitted by the hub and reduces its CnC ratio. The hub's CnC ratio will decrease further if it is possible to increase the modulation order or code rate at the hub. In the above example changing from QPSK 3/4 to QPSK 1/2 helps reduce the power but requires additional 1.5 times more bandwidth. The 1.2dB Eb/No difference between rate 3/4 and 1/2 reduces the CnC ratio at the hub.

Table 9-2. Link Parameters / Results

Parameters	Site 'A'	Site 'B'
Satellite EIRP (dBW)	37	37
Satellite BOo (dB)	6	6
Satellite BOi (dB)	10	10
Satellite SFD (dbW/m^2)	-78	-78
Satellite G/T (dB/K)	0	0
E/S Antenna (meters)	4.5	2.4
Data Rate (kbps)	192	192
Carrier Spacing Factor	1.3	1.3
Conventional Link	8PSK 2/3 TCM	8PSK 2/3 TCM
Occupied BW1 for 2 Carriers (kHz)	274.6	274.6
% of Transponder Power	0.55	0.16
CnC Link	QPSK 3/4 Turbo	QPSK 3/4 Turbo
Occupied BW2 for 2 Carriers (kHz)	166.4	166.4
% of Transponder Power	0.37	0.11
CnC Ratio (dB)	+5.3	-5.3
Expected Eb/No Degradation (dB)	-0.1	0.0

9.4.8 3rd CnC Example: Asymmetric Link With Rain Fade

A reasonable question to ask about the previous example is the impact rain fade has on the link. This example combines parts of the previous two examples using the same symbol rates and asymmetric antennas and adds in fade at **Site 'A',** with the larger antenna and examines the CnC ratio at both sites. The impact on both sites is also estimated due to a fade at **Site 'B'.** Just as in the earlier example, the larger fade (6dB up and 4dB down) occurs at **Site 'A'** (hub), and the smaller fade (3dB up and 2dB down) is allocated to **Site 'B'** (remote).

Treating the fades in this way is convenient as a first order approximation, but other factors influence performance such as noise increase and G/T degradation at the receive site.

From the previous examples there are some characteristics worth summarizing:

At the same symbol rate with the same modulation and code rate:

- The CnC ratio is highest at the site with the larger antenna (**Site 'A'**);

- The CnC ratio for the site with the smaller antenna (**Site 'B'**) is the same magnitude but opposite sign: CnC(**Site 'B'**) = -CnC(**Site 'A'**).

For rain fade:

- The CnC ratio changes by the same amount as the uplink fade;
- Uplink fades at the near end decrease the CnC ratio;
- Uplink fades at the far end increase the CnC ratio.

The tables below summarize the Eb/No degradation at **Site 'A'** when a fade is introduced first at **Site 'A'** and then at **Site 'B'.** Next, the degradation at **Site 'B'** is evaluated when a fade appears at **Site 'B'** and then at **Site 'A'.** For this asymmetric case, the estimated CnC degradation is 0.1dB despite the significant fade.

Table 9-3. Eb/No Degradation For Asymmetric 4.5-Meter Antenna At Site 'A' and 2.4-Meter Antenna At Site 'B'

Eb/No Degradation At Site 'A'			Eb/No Degradation At Site 'B'		
Parameter	Due To Fade at Site 'A' (dB)	Due To Fade at Site 'B' (dB)	Parameter	Due To Fade at Site 'B' (dB)	Due To Fade at Site 'A' (dB)
CnC Ratio at Site 'A'	+5.3	+5.3	CnC Ratio at Site 'A'	–5.3	–5.3
Uplink Fade at Site 'A'	+6	–	Uplink Fade at Site 'B'	+3	–
Uplink Fade at Site 'B'	–	+3	Uplink Fade at Site 'A'	–	6
Faded CnC at Site 'A'	–0.7	+8.3	Faded CnC at Site 'B'	–8.3	+0.7
Eb/No Degradation (dB) at Site 'A' Per Fig. 9-12 QPSK	0.0	–0.1	Eb/No Degradation (dB) at Site 'B' Per Fig. 9-12 QPSK	0.0	–0.1

9.5 Conclusion

There are several conclusions for operation with CnC:

- Operate adjacent carriers with sufficient spacing so there is no degradation;
- Adjust the modulation and code rate to alter the CnC ratio;
- Change the modulation and code rate to scale the symbol rate;
- Maximum CnC ratio is 7dB with plenty of margin;
- Maximum CnC ratio is 10dB with some degradation;
- Eb/No degradation is relatively tolerant to fades;
- QPSK is least sensitive to adjacent carrier and CnC ratio, followed by 8-PSK, then 16-QAM.

Chapter 10. EDMAC CHANNEL

10.1 Theory Of Operation

EDMAC, an acronym for **E**mbedded **D**istant-end **M**onitor **A**nd **C**ontrol, is a feature that permits the user to access the M&C features of modems which are at the distant-end of a satellite link. This is accomplished by adding extra information to the user's data, but in a manner that is completely transparent to the user.

On the transmit side:

The data is split into frames – each frame containing 1008 bits (except Rate 21/44 BPSK Turbo, or when the data rates exceed 2048 kbps, where the frame length is 2928 bits, and Rate 5/16 BPSK Turbo where the frame length is 3072 bits). 48 bits in each frame are overhead, and the rest of these bits are the user's data. This increases the rate of transmission by 5% (approximately 1.6% for the Turbo BPSK cases, and for all data rates greater than 2.048 Mbps). For example, if the user's data rate is 64 kbps, the actual transmission rate will now be at 67.2 kbps. Note that the user may also select EDMAC-2 framing, which uses a 2928 bit frame, and yields a 1.6% overhead for all modulation types and data rates.

At the start of each frame, a 12-bit synchronization word is added. This allows the demodulator to find and lock to the start of frame. At regular intervals throughout the frame, additional data bytes and flag bits are added (a further 36 bits in total). It is these additional bytes that convey the M&C data.

When framing is used, the normal V.35 scrambler is no longer used. This V.35 approach is called 'self synchronizing' because, in the receiver, no external information is required in order for the descrambling process to recover the original data. The disadvantage of this method is that it multiplies errors.

On average, if one bit error is present at the input of the descrambler, three output errors are generated. However, there is an alternative when the data is in a framed format; in this case, a different class of scrambler may be used – one which uses the start of frame information to start the scrambling process at an exact known state. In the receiver, having synchronized to the frame, the descrambler can begin its processing at exactly the right time. This method does not multiply errors, and therefore has a clear advantage over V.35 scrambling.

This is fortunate, as there is a penalty to be paid for adding the framing. By adding the extra 5% to the transmitted data rate, the effective Eb/No seen by the user will degrade by a factor of 10log(1.05), or 0.21 dB (0.07 dB in the case of the two BPSK Turbo rates). The use of an externally synchronized scrambler and descrambler almost exactly compensates for this degradation. The net effect is that the user will see effectively identical BER performance whether framing is used or not.

On the receive side:

When the demodulator locks to the incoming carrier, it must go through the additional step of searching for, and locking to, the synchronization word. This uniquely identifies the start of frame, and permits the extraction of the overhead bytes and flag bits at the correct position within the frame. In addition, the start of frame permits the descrambler to correctly recover the data. The user's data is extracted and sent through additional processing in the normal manner. The extracted overhead bytes are examined to determine if they contain valid M&C bytes.

10.2 M&C Connection

Data to be transmitted to the distant-end is sent to a local unit via the remote control port. A message for the distant-end is indistinguishable from a 'local' message – it has the same structure and content, only the address will identify it as being for a distant-end unit.

Before the M&C data can be successfully transmitted and received, pairs of units must be split into EDMAC Masters and EDMAC Slaves. Masters are local to the M&C Computer, and Slaves are distant-end.

Now, a unit which has been designated an EDMAC *Master* not only responds to its own unique bus address, but it will also be configured to listen for the address which corresponds to its EDMAC *Slave*. When a complete message packet has been received by the EDMAC Master, it will begin to transmit this packet over the satellite channel, using the overhead bytes which become available.

Note: The 'normal' protocol for the message packet is not used over the satellite path, as it is subject to errors. For this reason, a much more robust protocol is used that incorporates extensive error checking.

At the distant-end, the EDMAC Slave configured for the correct address receives these bytes. When a complete packet has been received, it will take the action requested, then send the appropriate response to the EDMAC Master, using the return overhead path on the satellite link. The EDMAC Master assembles the complete packet and transmits the response back to the M&C Computer.

Apart from the round-trip satellite delay, the M&C Computer does not see any difference between local and distant-end units – it sends out a packet addressed to a particular unit, and gets back a response. It can be seen that the EDMAC Master simply acts as forwarding service, in a manner that is completely transparent.

10.3 Setup Summary

To access a distant-end unit:

- Designate a Master/Slave pair: Master at the local-end, Slave at the distant-end.
- On the local-end unit, enable framing, and EDMAC, define the unit as MASTER, then enter the bus address. This is constrained to be 'base 10' meaning that only addresses such as 10, 20, 30, 40, etc, are allowed.
- Choose a unique bus address for the distant-end. This should normally be set to the 'base 10' address + 1. For example, if the MASTER unit is set to 30, choose 31 for the distant-end unit.
- On the distant-end unit, enable framing, and EDMAC, define the unit as SLAVE, then enter the bus address. The orange EDMAC Mode LED should be illuminated.
- Set the local-end unit to RS-485 remote control, and set the bus address of this local unit. The orange Remote Mode LED should be illuminated.
- Once the satellite link has been established, connect the M&C Computer, and begin communications, with both the local and distant end units.

Note: EDMAC modes are fully compatible with AUPC modes.

Notes:

Chapter 11. REDUNDANCY

Redundancy is built into the modem and can be enabled via the **FAST** option activation procedure. Redundancy can be selected so as to perform backup in the following scenarios:

- **1:1 Redundancy, meaning:**
  - One modulator for one modulator;
  - One demodulator for one demodulator;
  - One modem for one modem.
- **1:2 Redundancy, meaning:**
  - One modulator for two modulators;
  - One demodulator for two demodulators.
- **1:3 Redundancy, meaning:**
  - One modulator for three modulators;
  - One demodulator for three demodulators.

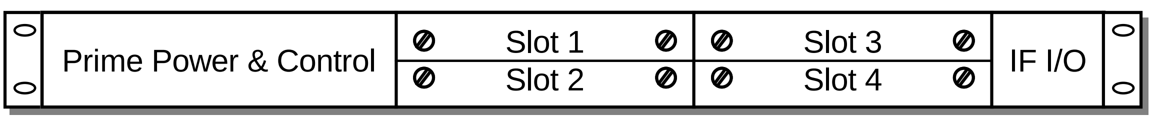


Figure 11-1. CDM-Qx/QxL Chassis Rear Panel Schematic

Location of the modules in the chassis is critical for correct operation of the redundancy functions. Using the **Figure 11-1** schematic for reference, note the following:

- When single modules are backed up, the backup unit must be located in the lower right-hand slot (Slot#4) as viewed from the rear.
- When modules grouped as a modem are configured as redundant, the backup modem has to be located in the right-hand column of slots (Slot#3 and Slot#4), with the modulator module on top (Slot#3).

If a 1:1 modulator and a 1:1 demodulator configuration is desired, group the boards as modems and set up as described above.

Redundancy switching is implemented after the data interface. This means that the unit or units designated as the backups do not require a data interface that matches the online units or an interface at all to operate as a backup.

Note: CEFD recommends that at least one extra interface be purchased, so that if an interface should fail in the field, that interface can be replaced. This is easily accomplished by removing the modulator or demodulator module by loosening the captive thumbscrews keeping it in place, then installing the new module into the desired chassis slot and hand-tightening its captive thumbscrews.

Notes:

Appendix A. CABLE DRAWINGS

A.1 Introduction

The EIA-530 standard pinout provided on the CDM-Qx/QxL is becoming more popular in many applications. However, there are still occasions, particularly with existing EIA-422/449 and V.35 users, when a conversion must be made.

For situations where such conversions are required, refer to the following table to select the appropriate cable.

In addition, the standard EIA-232 cable used for performing Flash Upgrading is depicted. This cable connects the CDM-Qx/QxL Remote Control Port to the serial communications port of an external PC.

App. A FIG	CEFD CABLE P/N	DESCRIPTION
A-1	CA/WR0049	Modem Conversion Cable: EIA-530 → RS-422/449 DCE Conversion (DB-25M →DB-25F, 40”)
A-2	CA/WR0059-2	Modem Conversion Cable: EIA-530 → V.35 Winchester DCE Conversion (DB-25M → Winchester 34-pin Female, 8’)
A-3	CA/WR9718-1	Modem Conversion Cable: CDM → EIA-530 Conversion (DB-25M → DB-25F, 8’)
A-4	N/A	EIA-232 Switch Programming Cable (for Flash upgrading): CDM-Qx/QxL Remote Port → PC Serial Port (DB-9F → DB-9F)

A.1.1 EIA-530 to RS-422/449 Data Cable

Figure A-1 shows the cable drawing for EIA-530 to RS-422/449 DCE conversion for connections between the CDM-Qx/QxL and the User data.

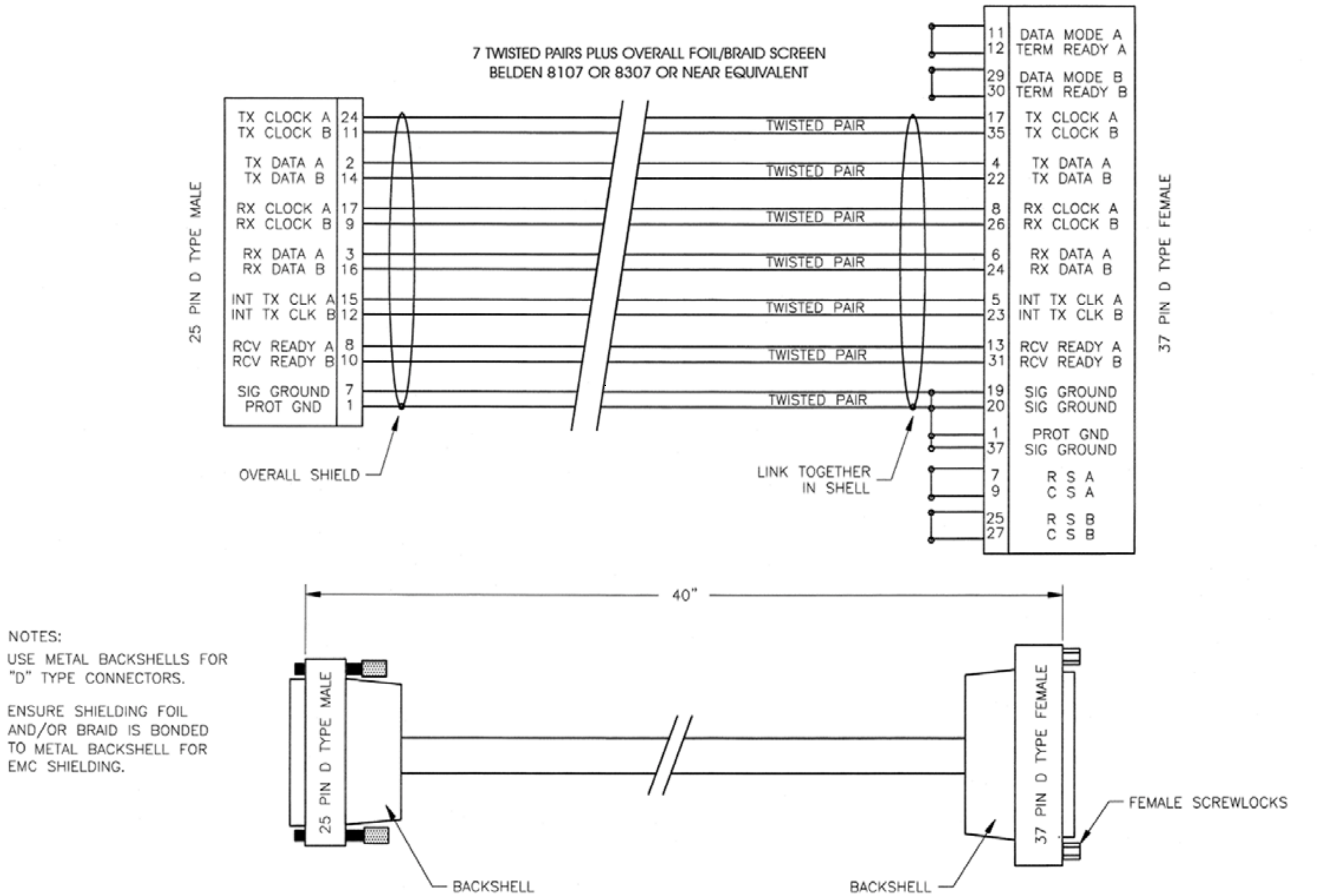
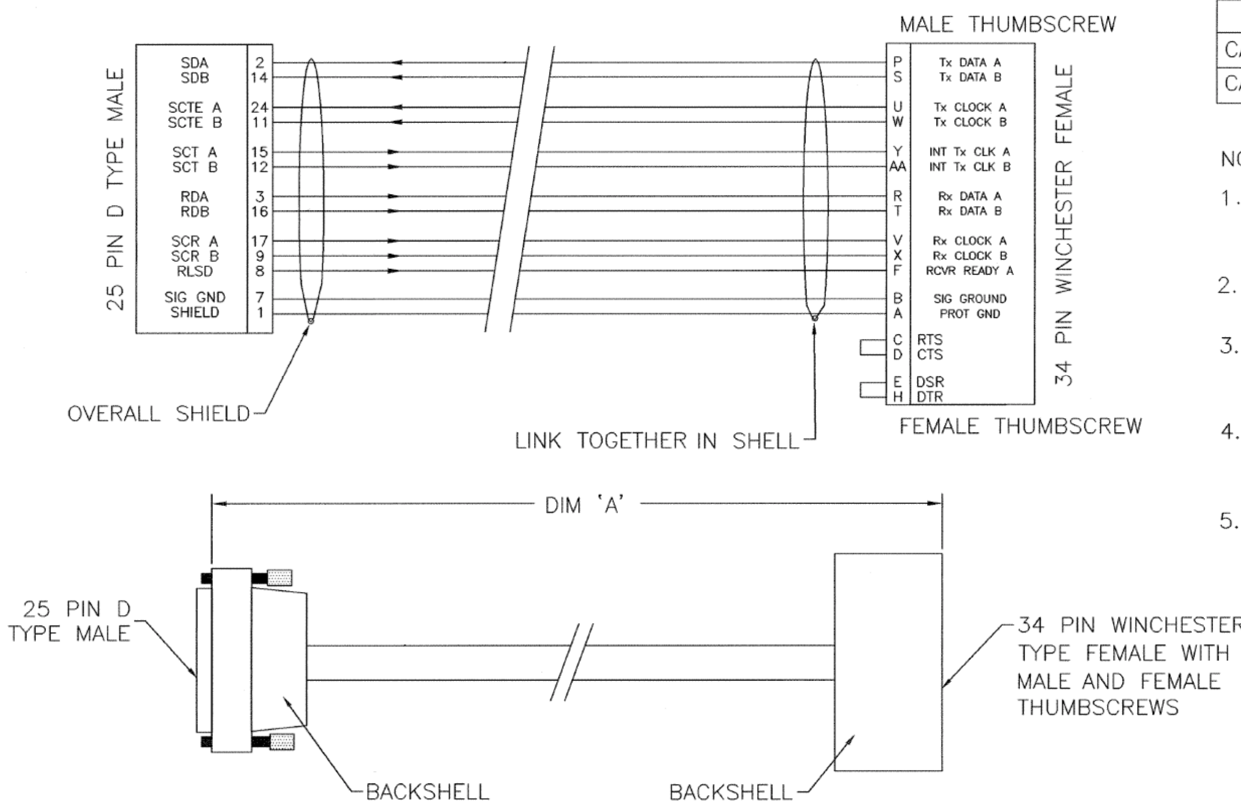


Figure A-1. : EIA-530 to RS-422/449 DCE Conversion Cable (CA/WR0049)

A.1.2 EIA-530 to V.35 Data Cable

Figure A-2 shows the cable drawing for EIA-530 to V.35 DCE conversion for connections between the CDM-Qx/QxL and the User data.



DIM TABLE	
P/N	DIM 'A'
CA/WR0059	8.00 ± .30
CA/WR0059-2	8' ± 3.00"

NOTES:

1. WIRE TO BE 7 TWISTED PAIRS PLUS FOIL/BRAID SCREEN BELDEN 8107, 8307 OR APPROVED EQUIVALENT.
2. USE METAL BACKSHELLS FOR D TYPE CONNECTORS.
3. ENSURE SHIELDING FOIL AND/OR BRAID IS BONDED TO METAL BACKSHELL FOR EMC SHIELDING.
4. WINCHESTER CABLE COMES WITH BOTH MALE AND FEMALE THUMBSCREWS. SEE ILLUSTRATION FOR ORIENTATION.
5. ALL MATERIALS MUST BE RoHS COMPLIANT IN ACCORDANCE WITH DIRECTIVE 2002/95/EC.

Figure A-2. : EIA-530 to V.35 DCE Conversion Cable (CA/WR0059)

A.1.3 EIA-530 Conversion Cable

Figure A-3 shows the cable drawing for modem to EIA-530 conversion for connections between the CDM-Qx/QxL and the User data.

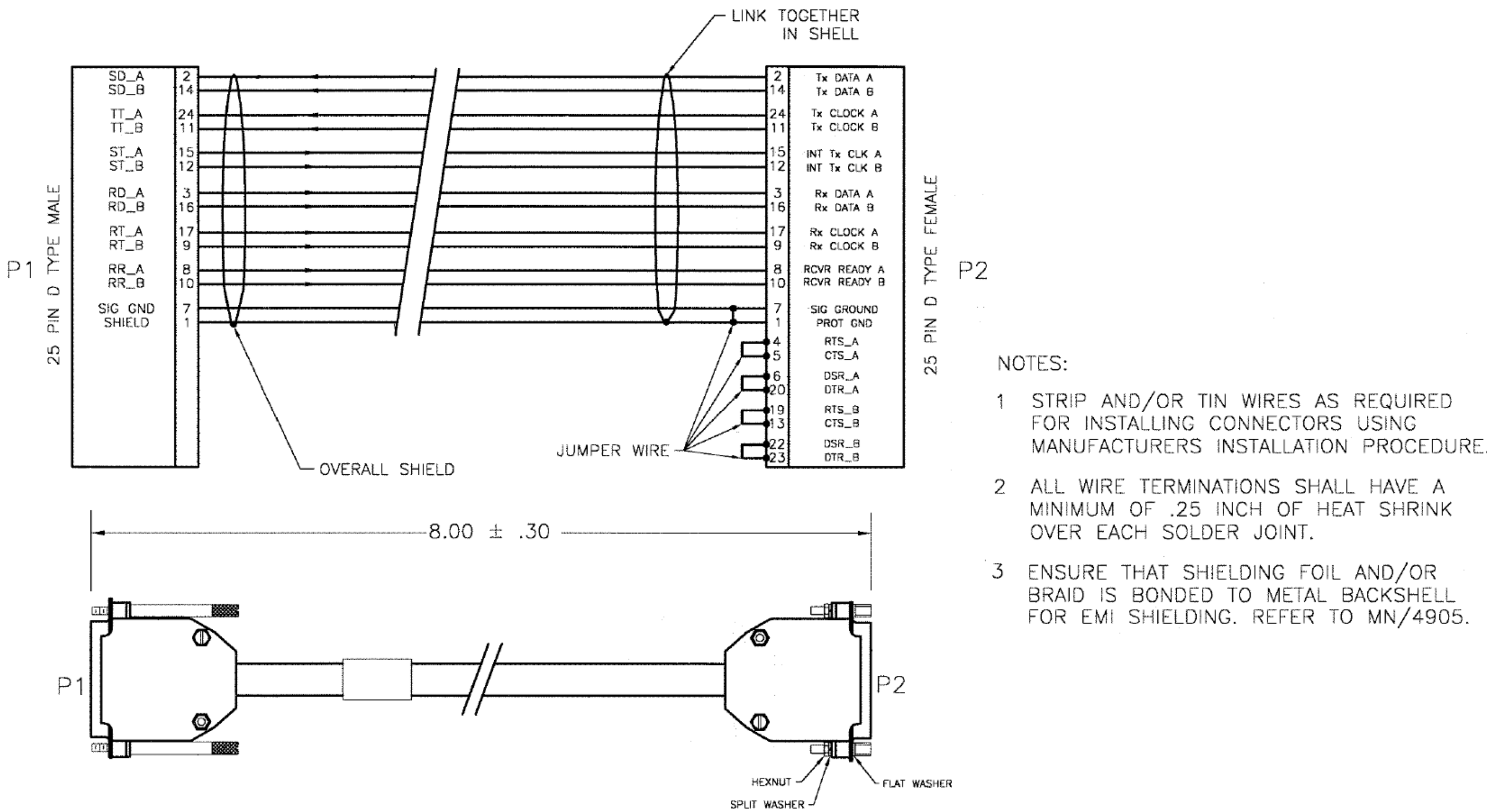


Figure A-3. EIA-530 DCE Conversion Cable (CA/WR9718-1)

A.1.4 Switch Programming Cable

Figure A-4 shows the cable required for a simple EIA-232 connection between the CDM-Qx/QxL Remote Control port and an external PC serial port. This cable is needed for Flash upgrading.

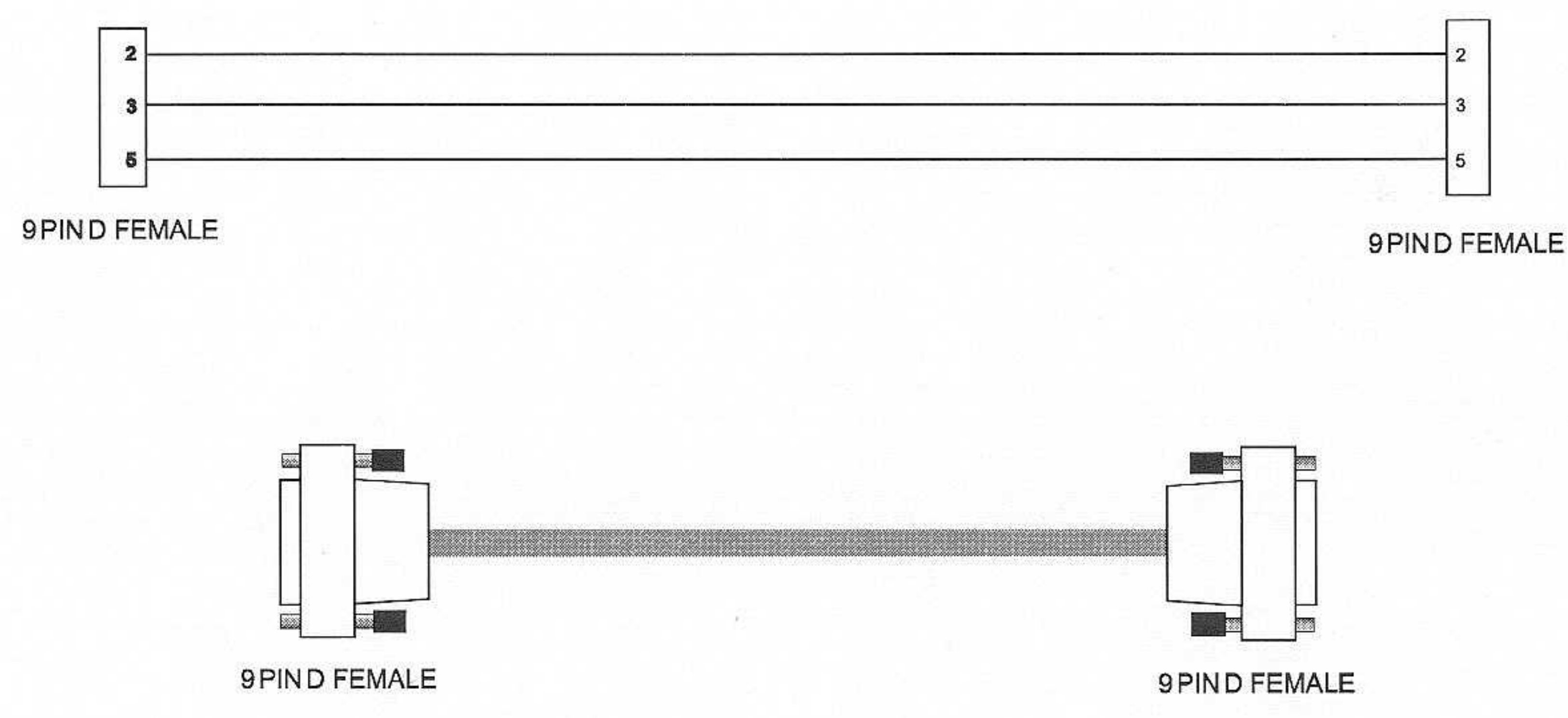


Figure A-4. Switch Programming Cable

Notes:

Appendix B. FAST ACTIVATION PROCEDURE

B.1 Introduction

Fully **A**ccessible **S**ystem **T**opology (**FAST**) is an enhancement feature available in Comtech EF Data products, enabling on-location upgrade of the operating feature set – in the rack – without removing a CDM-Qx/QxL from the setup.

This accelerated upgrade can be accomplished only because of FAST's extensive use of programmable devices incorporating Comtech EF Data-proprietary signal processing techniques. These techniques allow the use of a unique access code to enable configuration of the available hardware.

FAST access codes can be purchased at any time from Comtech EF Data. Once obtained, the FAST code is loaded into the unit via the front panel keypad.

B.2 Activation Procedure

B.2.1 Obtain Serial Numbers

Four individual components are FAST-upgradable and, as such, each has its own Serial Number:

- The CDM-Qx/QxL Base unit;
- The Modulator module;
- The Demodulator module;
- The TPC (Turbo Product Codec) daughterboard on either the mod or demod module.

To obtain the pertinent Serial Number, from the CDM-Qx/QxL front panel menu screen:

1. *Via the **MAIN MENU:*** Using the ◄ ► arrow keys, select **Utility**, then press **ENTER**.

```
MAIN MENU: Config   Monitor
Test Info Save/Load Utility ODU
```

2. *Via the **Utility** menu branch:* Using the ◄ ► arrow keys, select **FAST**, then press **ENTER**.

```
UTILITY: RxBuffer Clock Ref
ID  Display  Firmware  FAST
```

3. *Via the **UTILITY: FAST** submenu:* Using the ◄ ► arrow keys, select **Base**, **Slot1, Slot2**, **Slot3**, or **Slot3**, then press **ENTER**.

```
FAST – Select the module:
Base Slot1 Slot2 Slot3 Slot4
```

Base refers to the base unit, where the redundancy and CnC options may be upgraded; the **Slot#** refers to the populated module slots in the rear panel of the chassis – either a modulator or demodulator module may be installed (the combination and quantity of modules will vary per specific user setup).

4. *If **UTILITY: FAST → Base** is selected:* The menu screen displays the chassis hardware version on the top line, and the Base unit's Motherboard Serial Number on the bottom line:

```
FAST: Config  View  (HW 1.02)
Board S/N: 123456789  (Base)
```

   a. Record the **Base Unit Motherboard** Serial Number:

   ____

5. *If **UTILITY: FAST → Slot#*** (where # designates the chosen slot number) *is selected:*

```
FAST - Slot#1: Mod     Turbo
                     (▲ ▼,ENT)
```

```
FAST - Slot#2: Demod   Turbo
                     (▲ ▼,ENT)
```

As per the above examples, the selected menu screen indicates whether the installed module is a Modulator, or Demodulator. Select **Mod (Demod)** or **Turbo** using the ◄ ► arrow keys, then press **ENTER**.

   a. *If **UTILITY: FAST → Slot# → Mod (Demod)** is selected*, the module's Board Serial Number is identified on the bottom line:

```
FAST: Config  View
Board S/N: 223456789  (Mod#1)
```

```
FAST: Config  View
Board S/N: 323456789  (Dem#2)
```

   Record the **Module's Board** Serial Number:

   ____

   b. *If **UTILITY: FAST → Slot# → Turbo** is selected*, the Board Serial Number for the module for Turbo Product Codec (TPC) daughterboard is identified on the bottom line:

```
FAST: Config  View
Board S/N: 423456789  (TPC#1)
```

   Record the **Module's TPC Daughterboard** Serial Number:

   ____

B.2.2 View Currently Installed FAST Features

To view currently installed features, proceed as instructed via the sections that follow.

B.2.2.1 View Base Unit FAST Features

Select **MAIN MENU: Utility → Fast → Base** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST: Config  View  (HW 1.02)
Board S/N: 123456789  (Base)
```

Select **View** using the ◄ ► arrow keys, then press **ENTER**.

```
View Options: 02    (▲ ▼,ENT)
1:2 Redun   - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **Installed** or **Not Installed** for **base unit** operation. Any feature identified as **Not Installed** may be purchased from Comtech EF Data. Press **ENTER** when done.

Note the following (typical only for the base unit):

View Option No. (Top Line)	FAST Option Name (Bottom Line)	Description
01	1:1 Redun	
02	1:2 Redun	
03	1:3 Redun	
04	CnC-1 512K	
05	CnC-1 1M	
06	CnC-1 2.5M	
07	CnC-1 5M	
08	CnC-1 10M	
09	CnC-1 20M	
10	CnC-2 512K	
11	CnC-2 1M	
12	CnC-2 2.5M	
13	CnC-2 5M	
14	CnC-2 10M	
15	CnC-2 20M	
16	D&I++ (1)	
17	D&I++ (2)	
18	24V BUC SPS	
19	48V BUC SPS	
20	24V BUC DPS	
21	48V BUC DPS	
22	Future H/W	
23	Future S/W	

B.2.2.2 View Installed Module (Mod/Demod, Turbo) FAST Features

Select **MAIN MENU: Utility → Fast → Slot#** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST - Slot#2: Demod   Turbo
                         (▲ ▼,ENT)
```

Depending on the installed module, select **Mod (Demod)** or **Turbo** using the ◄ ► arrow keys, then press **ENTER**.

1. If **Mod (Demod)** is selected (a Demod module is shown in this example):

```
FAST: Config  View
Board S/N: 323456789  (Dem#2)
```

Select **View** using the ◄ ► arrow keys, then press **ENTER**.

```
View Options: 02    (▲ ▼,ENT)
1:2 Redun    - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **`Installed`** or **`Not Installed`** for **mod/demod** operation. Any feature identified as **`Not Installed`** may be purchased from Comtech EF Data. Press **ENTER** when done.

Note the following (typical for either modulator or demodulator modules):

View Option No. (Top Line)	FAST Option Name (Bottom Line)	Description
01	TPC Codec	
02	Future H/W	
03	5Mbps Card	
04	10Mbps Card	
05	20Mbps Card	
06	8-PSK	
07	16-QAM	
08	Future H/W	
09	Future S/W	

2. If **Turbo** is selected:

```
View Options: 03    (▲ ▼,ENT)
5M Turbo    - Installed
```

Use the ▲ ▼ arrow keys to display which **FAST** options are either **`Installed`** or **`Not Installed`** for **TPC** operation. Any feature identified as **`Not Installed`** may be purchased from Comtech EF Data. Press **ENTER** when done.

Note the following (typical for either modulator or demodulator modules):

View Option No. (Top Line)	FAST Option Name (Bottom Line)	Description
01	Future S/W	
02	Future S/W	
03	5M Turbo	
04	10M Turbo	
05	20M Turbo	
06	Future H/W	
07	Future S/W	

B.2.3 Acquire FAST Code

Contact a Comtech EF Data Customer Support representative to order features. You will be asked to provide the pertinent serial numbers for the base unit motherboard, module motherboard, and the modules' TPC daughterboard.

The Comtech EF Data Customer Support representative will verify the order and provide an invoice and instructions, including the pertinent 20-character FAST access/configuration code.

B.2.4 Enter FAST Codes

From the CDM-Qx/QxL front panel, prepare to enter the access codes obtained from Comtech EF Data Customer Support:

1. *Via the **MAIN MENU:*** Using the ◄ ► arrow keys, select **Utility**, then press **ENTER**.

```
MAIN MENU: Config   Monitor
Test Info Save/Load Utility
```

2. *Via the **Utility** menu branch:* Using the ◄ ► arrow keys, select **FAST**, then press **ENTER**.

```
UTILITY: RxBuffer Clock Ref
ID  Display  Firmware  FAST
```

3. *Via the **UTILITY: FAST** submenu:* Using the ◄ ► arrow keys, select **Base**, **Slot1, Slot2**, **Slot3**, or **Slot3**, then press **ENTER**.

```
FAST - Select the module:
Base Slot1 Slot2 Slot3 Slot4
```

To activate newly-purchased features, proceed as instructed via the sections that follow.

B.2.4.1 Entering the Base Unit FAST CODE

Having selected **MAIN MENU: Utility → FAST → Base**:

```
FAST: Config  View  (HW 1.02)
Board S/N: 123456789  (Base)
```

Select **Config** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** using the ◄ ► arrow keys, then press **ENTER**.

```
Edit 20 digit FAST Code:
00000000000000000000   (ENT)
```

Enter the 20-digit **FAST** code that was obtained from Comtech EF Data *carefully*. Use the ◄ ► arrow keys to first move the cursor to the numeral to be edited, then use the ▲ ▼ arrow keys to edit that numeral (0-9). When all numbers are edited, press **ENTER**. The CDM-Qx/QxL will respond with "`Configured Successfully`" if the **FAST** access code has been accepted; otherwise, if the code is not valid, the following message displays:

```
FAST Code Rejected!
               (ENT or CLR)
```

Press **ENTER** or **CLEAR** to return to the previous menu, and re-enter the code. If the problem persists, contact Comtech EF Data Customer Support for further assistance.

B.2.4.2 Entering the Installed Module FAST CODE

Having selected **MAIN MENU: Utility → FAST → Slot# (*where # denotes the selected Slot#1, Slot#2,Slot #3 orSlot #4*):**

```
FAST - Slot#1: Mod     Turbo
                      (▲ ▼,ENT)
```

Depending on the type of module (modulator or demodulator) that has been installed into the chosen Slot, select **Mod** or **Demod** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST: Config  View
Board S/N: 223456789  (Mod#1)
```

Select **Config** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** using the ◄ ► arrow keys, then press **ENTER**.

```
Edit 20 digit FAST Code:
00000000000000000000   (ENT)
```

Enter the 20-digit **FAST** code that was obtained from Comtech EF Data *carefully*. The procedure and user prompts are identical to those outlined for the Base Unit FAST Code entry.

B.2.4.3 Entering the Installed Module TPC Board FAST CODE

Having selected **MAIN MENU: Utility → FAST → Slot# (*where # denotes the selected Slot#1, Slot#2,Slot #3 orSlot #4*):**

```
FAST - Slot#1: Mod     Turbo
                      (▲ ▼,ENT)
```

Typical for either a modulator or demodulator module, select **Turbo** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST: Config  View
Board S/N: 423456789  (TPC#1)
```

Select **Config** using the ◄ ► arrow keys, then press **ENTER**.

```
FAST Configuration:
Edit Code    Demo Mode
```

Select **Edit Code** using the ◄ ► arrow keys, then press **ENTER**.

```
Edit 20 digit FAST Code:
00000000000000000000   (ENT)
```

Enter the 20-digit **FAST** code that was obtained from Comtech EF Data *carefully*. The procedure and user prompts are identical to those outlined for the Base Unit FAST Code entry.

Appendix C. REMOTE CONTROL

C.1 Overview

This appendix describes the protocol and message command set for remote monitor and control of the CDM-Qx/QxL Modem. While the protocol presented here is based on remote commands for the CDM-570/570L Satellite Modem, it is modified to address features unique to CDM-Qx/QxL operation (e.g., to separately address the four plug-in slots).

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

C.2 EIA-485

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

In full-duplex EIA-485 communication there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions. It is assumed that there is a 'Controller' device (a PC or dumb terminal), which transmits data, in a broadcast mode, via one of the pairs. Many 'Target' devices are connected to this pair, which all simultaneously receive data from the Controller. The Controller is the only device with a line-driver connected to this pair – the Target devices only have line-receivers connected.

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

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

EIA-485 (full duplex) summary:

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

- Target-to-Controller pair has one line receiver (Controller), and all Targets have Tri-State drivers.

C.3 EIA-232

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

C.4 Basic Protocol

Whether in EIA-232 or EIA-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. In this case, the asynchronous character format is fixed at 8N1. The baud rate may vary between 1,200 and 38,400 baud.

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

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

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

C.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: <0135/TRQ=70.2345{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: >0654/RSW=32{CR} {LF}

C.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.

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.

C.5.2 Target Address

Up to 9,999 devices can be uniquely addressed. The EIA-485 base address is set by the front panel; the EIA-232 base address is always zero. Each plug-in Slot (as viewed from the back of the chassis) has its own address.

Slot	Address
Upper Left	Base
Lower Left	Base + 1
Upper Right	Base + 2
Lower Right	Base + 3

Common functions can be accessed through any of the four addresses. If several devices share a RS-485 bus, it must be noted that the Qx will require four addresses, and should be spaced apart accordingly. Empty slots in the Qx chassis still occupy an address.

IMPORTANT

A single CDM-Qx occupies four addresses. For modulator and demodulator grouped as modem, the address will be the same as the modulator.

C.5.3 Address Delimiter

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

C.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 – e.g., **TFQ** for **Tx** **F**re**Q**uency; **RMD** for **Rx** **M**o**D**ulation type, etc. This aids in the readability of the message, should it be displayed in its raw ASCII form. Only upper case alphabetic characters may be used (A-Z, ASCII codes 65 - 90).

C.5.5 Instruction Code Qualifier

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

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

= **(ASCII code 61**	The **=** code is used as the **assignment** operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) that follow it. **For Example:** In a message from Controller-to-Target, TFQ=0950.0000 would mean 'set the Tx frequency to 950 MHz'
? **(ASCII code 63)**	The **?** code 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, **TFQ?** would mean 'return the current value of the transmit frequency'.

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

= **(ASCII code 61)**	The **=** code is used in two ways: **First**, if the Controller has sent a query code to a Target (**for Example: TFQ?**, meaning '*what is the Tx frequency?*'), the Target would respond with **TFQ=xxxx.xxxx**, where **xxxx.xxxx** represents the frequency in question. **Second**, if the Controller sends an instruction to set a parameter to a particular value, and if the value sent in the argument is valid, then the Target will acknowledge the message by replying with **TFQ=** (with no message arguments).
? **(ASCII code 63)**	The **?** code is only used as follows: If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the Target will acknowledge the message by replying, for example, with **TFQ?** (with no message arguments). This indicates that there was an error in the message sent by the Controller.
***** **(ASCII code 42)**	The ***** code is only used as follows: If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is valid, BUT the modem will not permit that particular parameter to be changed at that time, the Target will acknowledge the message by replying, for example, with **TFQ*** (with no message arguments).
! **(ASCII code 33)**	The **!** code is only used as follows: If the Controller sends an instruction code which the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character. **Example: XYZ!**
# **(ASCII code 35)**	The **#** code is only used as follows: If the Controller sends a correctly formatted command, BUT the modem is not in remote mode, it will not allow reconfiguration, and will respond with **TFQ#**.
~ **(ASCII Code 126)**	The ~ code is only used as follows: If a message was sent via a local modem to a distant end device or ODU, the message was transmitted transparently through the local modem. In the event of the distant-end device not responding, the local modem would generate a response. **Example: 0001/RET~**, indicating that it had finished waiting for a response and was now ready for further communications.
$ **(ASCII code 36)**	The target acknowledges the message indicating that there is no module installed in that Slot.
@ **(ASCII code 64)**	The target acknowledges the message indicating that a Tx command was sent to an Rx module or vice-versa. For example: TFQ was sent to a demod.
^ **(ASCII Code 94)**	The **^** code is only used as follows: The target acknowledges the message indicating that the unit is in Ethernet mode. While in Ethernet mode, the unit cannot be serially queried for modem parameters. This mode will allow the user to access the Web server, SNMP, or Telnet.

C.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); plus miscellaneous printable characters.

C.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' (ASCII code 13), and 'Line Feed' (ASCII code 10).

Both indicate the valid termination of a packet.

C.6 Remote Commands and Queries

1. The remote commands and queries are arranged as subsections of this appendix as follows:
   - Sect. D.6.1 Transmit (Tx) Commands and Queries
   - Sect. D.6.2 Receive (Rx) Commands and Queries
   - Sect. D.6.3 Common (Tx, Rx, or Modem) Commands and Queries
   - Sect. D.6.4 Queries
   - Sect. D.6.5 Bulk Commands and Queries
   - Sect. D.6.6 BUC Commands and Queries – CDM-QxL ONLY
   - Sect. D.6.7 LNB Commands and Queries – CDM-QxL ONLY
   - Sect. D.6.8 Built-in BERT Commands and Queries (BER Tester)
   - Sect. D.6.9 Spectrum Analyzer Commands and Queries – Rx Module ONLY
   - Sect. D.6.10 D&I++ (Drop & Insert) Commands and Queries (E1 CCS only) – Modem ONLY
2. Typical for all tablature, the following codes are used in the '**Response to Command**' column (See Sect. C.5.5 for complete details):

   = Message ok

   ? Received ok, but invalid arguments found

   * Message ok, but not permitted in current mode

   # Message ok, but unit is not in Remote mode

   ~ Time out of an EDMAC pass-through message

   $ Message ok, but no module is installed in the slot.

   @ Message ok, but sending Tx command to an Rx module or vice-versa.

   ^ Message ok, but unit is in Ethernet mode.

3. **Index Notes: Column 'C'** = Command; **Column 'Q'** = Query: Columns marked '**X**' designate instruction code as *Command only*, *Query only*, or *Command/Query*. The numeric superscript (XXX[#]) indicates the 6.5.X subsection where this code is explained in detail.

CODE	C	Q	PAGE
A			
APP[3]	X	X	C-16
AUP[3]	X	X	C-16
B			
BAD[6]	X	X	C-33
BCE[6]	X	X	C-34
BCH[6]	X	X	C-34
BCL[6]	X	X	C-34
BCP[8]	X	X	C-37
BCS[2]	X	X	C-12
BCT[8]	X	X	-=C-38
BDC[6]		X	C-34
BDV[6]		X	C-34
BER[4]		X	C-24
BFR[6]	X	X	C-34
BFS[4]		X	C-24
BKE[8]	X	X	C-38
BLO[6]	X	X	C-34
BOE[6]	X	X	C-35
BOL[6]		X	C-35
BPA[6]		X	C-35
BPC[6]	X	X	C-35
BRE[8]		X	C-38
BRM[8]	X		C-38
BRR[8]		X	C-38
BST[8]	X	X	C-38
BSV[6]		X	C035
BUT[6]		X	C-35
C			
CAE[3]	X		C-16
CAS[3]	X		C-16
CCF[3]	X	X	C-16
CDM[4]		X	C-24
CFM[4]		X	C-24
CID[3]	X	X	C-16
CLD[3]	X		C-17
CNM[3]	X	X	C-17
CRA[3]	X	X	C-17
CRM[4]		X	C-24
CSD[3]	X	X	C-17
CST[3]	X	X	C-17

CODE	C	Q	PAGE
D			
DAY[3]	X	X	C-17
DNI[10]	X	X	C-40
DTS[10]	X	X	C-40
E			
EBA[2]	X	X	C-12
EBN[4]		X	C-25
EFM[3]	X	X	C-18
EID[4]		X	C-25
ERF[3]	X	X	C-18
ESA[3]	X	X	C-18
F			
FBU[3]	X	X	C-18
FLT[4]		X	C-26
FRM[3]	X	X	C-15
FRW[4]		X	C-27
G			
GRP[3]	X	X	C-19
H			
HHC[3]	X	X	C-19
I			
IEP[3]	X		C-19
IMG[4]	X	X	C-27
IPA[3]	X	X	C-19
IRA[3]	X	X	C-19
IRM[3]	X	X	C-20
ISP[3]	X		C-20
ITF[3]	X	X	C-15
ITP[4]		X	C-27
ITS[10]	X	X	C-40
L			
LBO[3]	X	X	C-20
LCH[7]	X	X	C-36
LCL[7]	X	X	C-36
LDC[7]		X	C-36
LDV[7]		X	C-36
LFR[7]	X	X	C-36
LLO[7]	X	X	C-37

CODE	C	Q	PAGE
LPC[7]	X	X	C-37
LRS[3]	X	X	C-20
M			
MGC[5]	X	X	C-32
MSK[3]	X	X	C-21
N			
NUE[4]		X	C-27
NUS[4]		X	C-28
O			
OGC[5]	X	X	C-33
ONL[3]		X	C-21
P			
PLI[4]		X	C-28
Q			
QDI[3]	X	X	C-23
R			
RAM[3]	X	X	C-21
RBS[2]	X	X	C-13
RCB[3]	X		C-21
RCI[2]	X	X	C-13
RCR[2]	X	X	C-11
RDI[2]	X	X	C-13
RDR[2]	X	X	C-12
RDS[2]	X	X	C-13
REB[4]		X	C-28
RFO[4]		X	C-28
RFQ[2]	X	X	C-13
RFT[2]	X	X	C-11
RMD[2]	X	X	C-11
RNE[4]		X	C-29
RNS[4]		X	C-29
RRS[2]	X	X	C-12
RSI[2]	X	X	C-14
RSL[4]		X	C-30
RSW[2]	X	X	C-14
RTS[3]	X	X	C-22
RXA[2]	X	X	C-14

CODE	C	Q	PAGE
S			
SNM[4]		X	C-30
SNO[4]		X	C-30
SNT[4]		X	C-30
SPF[9]	X	X	C-30
SPM[9]	X	X	C-30
SPS[9]	X	X	C-30
SSI[3]	X	X	C-22
SWR[4]		X	C-30
T			
TCI[1]	X	X	C-7
TCK[1]	X	X	C-7
TCR[1]	X	X	C-7
TDI[1]	X	X	C-7
TDR[1]	X	X	C-8
TFQ[1]	X	X	C-8
TFT[1]	X	X	C-8
TIM[3]	X	X	C-22
TMD[1]	X	X	C-8
TMP[4]		X	C-30
TPL[1]	X	X	C-9
TRF[7]		X	C-37
TRS[1]	X	X	C-9
TSC[1]	X	X	C-9
TSI[1]	X	X	C-9
TST[3]	X	X	C-22
TTF[6]		X	C-36
TXA[1]	X	X	C-9
TXC[1]	X	X	C-10
TXO[1]	X	X	C-10
U			
UID[4]		X	C-31
W			
WHO[4]		X	C-30
X			
Y			
Z			

C.6.1 Transmit (Tx) Commands and Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Data Clock Invert	TCI=	1 byte, value 0,1	Command or Query. Invert Transmit Data Clock in the form x, where: 0=Normal 1=Inverted	TCI= TCI? TCI* TCI# TCI$ TCI^ TCI@	TCI?	TCI=x (see Description of Arguments)
TX Clock Source	TCK=	1 byte, value 0 1, 2	Command or Query. TX Clock Source in the form x, where: 0=Internal 1=TX Terrestrial 2=Loop-Timed 3=Ext loop (G.703 interface only) **Example**: TCK=0 (Internal)	TCK= TCK? TCK* TCK# TCK$ TCK^ TCK@	TCK?	TCK=x (see Description of Arguments)
TX FEC Code Rate	TCR=	1 byte, value of 0 though 7	Command or Query. TX Code Rate in the form x, where: 0=Rate 5/16 (Turbo only) 1=Rate21/44 (Turbo only) 2=Rate 1/2 3=Rate 2/3 (8-PSK, TCM+RS only) 4=Rate3/4 5=Rate7/8 6=Rate 17/18 (Turbo only) 7=Reserved Depending on FEC and Modulation Type, not all of these selections will be valid. **Example**: TCR=4 (Rate 3/4)	TCR= TCR? TCR* TCR# TCR$ TCR^ TCR@	TCR?	TCR=x (see Description of Arguments)
TX Data Invert	TDI=	1 byte, value 0,1	Command or Query. Invert Transmit Data in the form x, where: 0=Normal 1=Inverted **Example**: TDI=1(Inverted TX Data)	TDI= TDI? TDI* TDI# TDI$ TDI^ TDI@	TDI?	TDI=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
TX Data Rate	TDR=	9 bytes	Command or Query. TX Data rate, in kbps, between 32 kbps and 20 Mbps depending upon code rate and modulation scheme, in the form xxxxx.xxx. Resolution=1 bps. (See **Chapter 5. FRONT PANEL OPERATION** for the valid rates) Query ONLY if Interface Type is Quad Drop & Insert (ITF=D). **Example**: TDR=02047.999 (2047.999 kbps)	TDR= TDR? TDR* TDR# TDR$ TDR^ TDR@	TDR?	TDR=xxxx.xxx (see Description of Arguments)
TX Frequency	TFQ=	9 bytes	Command or Query. TX Frequency in the form xxxx.xxxx, where: 0950.0000 to 1950.0000 MHz (for L-Band units) or 0500.0000 to 0090.0000 and 0100.0000 to 0180.0000 MHz (for 70/140 MHz units) Resolution=100 Hz **Example**: TFQ=0950.9872	TFQ= TFQ? TFQ* TFQ# TFQ$ TFQ^ TFQ@	TFQ?	TFQ=xxxx.xxxx (see description arguments)
TX FEC Type	TFT=	1 byte, value of 0 though 7	Command or Query. TX FEC coding type in the form x, where: 0=Reserved 1=Viterbi 2=Viterbi + Reed-Solomon 3=Reserved 4=Reserved 5=TCM+Reed-Solomon (Forces TCR=3 2/3) 6=Turbo 7=Reserved	TFT= TFT? TFT* TFT# TFT$ TFT^ TFT@	TFT?	TFT=x (see description arguments)
TX Modulation Type	TMD=	1 byte, value of 0 though 5	Command or Query. TX Modulation Type in the form x, where: 0=BPSK 1=QPSK 2=Reserved 3=8-PSK 4=16-QAM (Turbo or Viterbi + RS only) 5=Reserved Depending on FEC type, not all of these selections will be valid. **Example**: TMD=1 (QPSK)	TMD= TMD? TMD* TMD# TMD$ TMD^ TMD@	TMD?	TMD=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
TX Power Level	TPL=	4 bytes	Command or Query. TX Output power level between -5 and –25 dBm (minus sign assumed) **Example**: TPL=13.4 (Command not valid in AUPC mode) **Note:** When output power level is enabled: Power level configuration is not allowed. Response will be TPL*. The response to the query TPL? Will be the adjusted levelled value.	TPL= TPL? TPL* TPL# TPL$ TPL^ TPL@	TPL?	TPL=xx.x (see Description of Arguments)
TX Reed-Solomon (n, k) values	TRS=	1 byte	Command or Query. TX Reed-Solomon (n, k) values in the form x, where: 0=Unframed closed network (220,200) 1=EFD closed network (225,205) 2=IESS-310 compatible operation (219,201) 3=EDMAC mode, closed (200,180) – EDMAC only **Notes:** 1. Selection is valid only when TFT=2 or TFT=5. 2. For D&I++, selection 0,1, and 2 are supported.	TRS= TRS? TRS* TRS# TRS$ TRS^ TRS@	TRS?	TRS=x (see Description of Arguments)
TX Scrambler	TSC=	1 byte, value of 0, 1, 2	Command or Query. Tx Scrambler state in the form x, where: 0=Off 1=ON (Default scrambler type) 2=ON IESS-315 (Turbo Only) **Example**: TSC=1 (Scrambler one)	TSC= TSC? TSC* TSC# TSC$ TSC^ TSC@	TSC?	TSC=x (see Description of Arguments)
TX Spectrum Invert	TSI=	1 byte, value of 0, 1	Command or Query. TX Spectrum Invert Selection in the form x, where: 0=Normal 1=TX Spectrum Invert **Example**: TSI=0 (Normal)	TSI= TSI? TSI* TSI# TSI$ TSI^ TSI@	TSI?	TSI=x (see Description of Arguments)
TX roll-off (alpha) factor	TXA=	1 byte	Command or Query. Tx roll-off (alpha) factor in the form x, where: 0=20% 1=35% (default)	TXA= TXA? TXA* TXA# TXA$ TXA^ TXA@	TXA	TXA=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Common Carrier State	TXC=	1 byte	Command or Query. Tx carrier state common to all Tx in the form x, where: 0=Off 1=On	TXC= TXC? TXC* TXC# TXC$ TXC^ TXC@	TXC?	TXC=x (see Description of Arguments)
TX Carrier State	TXO=	1 byte, value 0 though 4	Command or Query. TX Carrier State in the form x, where: 0=OFF due to front panel or remote control command 1=ON 2=RTI (Receive/Transmit inhibit) 3=OFF due to EXT H/W TX Carrier Off command (not a valid argument when used as a command) 4=OFF due to BUC warm up delay (not a valid argument in a command format) **Example**: TXO=1 (TX Carrier ON)	TXO= TXO? TXO* TXO# TXO$ TXO^ TXO@	TXO?	TXO=x (see Description of Arguments)

C.6.2 Receive (Rx) Commands and Queries

Priority System = RFT (Highest Priority), RMD, RCR, RRS, and RDR (Lowest Priority), as indicated by **shading**. Any changes to a higher priority can override any of the parameters of lower priority.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX FEC Type	RFT=	1 byte, value of 0 through 6	Command or Query. RX FEC Type in the form x, where: 0=Reserved 1=Viterbi 2=Viterbi + Reed-Solomon 3=Reserved 4=Reserved 5=TCM + Reed-Solomon 6=Turbo Example: RFT=1 (Viterbi only)	RFT= RFT? RFT* RFT# RFT$ RFT^ RFT@	RFT?	RFT=x (see Description of Arguments)
RX Demod Type	RMD=	1 byte, value of 0 through 5	Command or Query. RX Demodulator Type in the form x, where: 0=BPSK 1=QPSK 2=Reserved 3=8-PSK 4=16-QAM (Turbo or Viterbi + Reed-Solomon) 5=Reserved Depending on FEC type, not all of these selections will be valid. All other codes are invalid. Example: RMD=1 (QPSK)	RMD= RMD? RMD* RMD# RMD$ RMD^ RMD@	RMD?	RMD=x (see Description of Arguments)
RX FEC Code Rate	RCR=	1 byte, value of 0 through 7	Command or Query. Rx FEC Code Rate in the form x, where: 0=Rate 5/16 (Turbo Only) 1=Rate 21/44 (Turbo Only) 2=Rate 1/2 3=Rate 2/3 (8-Psk TCM or 8-QAM only) 4=Rate 3/4 5=Rate 7/8 6= Rate 17/18 (Turbo Only) 7= Reserved Depending on FEC and demodulation type, not all of these selections will be valid. Example: RCR=4 (Rate 3/4)	RCR= RCR? RCR* RCR# RCR$ RCR^ RCR@	RCR?	RCR=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX Reed-Solomon (n, k) values	**RRS=**	**1 byte, value of 0 through 3**	**Command or Query.** **RX Reed-Solomon (n, k) values in the form x, where:** **0=Unframed closed network (220,200)** **1=EFD closed network (225,205)** **2=IESS-310 compatible operation (219,201)** **3=EDMAC mode, closed (200,180) – EDMAC only** **Notes:** **1. Selection is valid only when RFT=2 or RFT=5.** **2. For D&I++, selection 0,1, and 2 are supported.**	**RRS=** **RRS?** **RRS*** **RRS#** **RRS$** **RRS^** **RRS@**	**RRS?**	**RRS=x** **(see Description of Arguments)**
RX Data Rate	**RDR=**	**9 bytes**	**Command or Query.** **Query ONLY if Interface Type is Quad Drop & Insert (ITF=D).** **RX Data Rate in the form xxxxx.xxx where:** **In kbps, between 32 kbps and 20 Mbps** **Resolution = 1 bps (see Chapter 5. FRONT PANEL OPERATION for valid rates).** **Example: RDR=02047.999**	**RDR=** **RDR?** **RDR*** **RDR#** **RDR$** **RDR^** **RDR@**	**RDR?**	**RDR=xxxxx.xxxx** **(see Description of Arguments)**
RX Buffer Clock Source	BCS	1 byte, value of 0 through 4	Command or Query. RX buffer clock source in the form x, where: 0=Internal 1=Rx Satellite 2=Tx Terrestrial (grouped as modem only) 3=Insert (D&I++ mode only) 4=External (QDI Interface only) **Notes:** 1. Rx Satellite is also available in D&I++ mode. 2. Rx Satellite and Tx Terrestrial are also available for QDI interface type.	BCS= BCS? BCS* BCS# BCS$ BCS^ BCS@	BCS?	BCS=x (see Description of Arguments)
Eb/No Alarm Point	EBA=	4 bytes	Command or Query. Eb/No alarm point in dB in the form xx.x where: Range is between 0.1 and 16 dB. Resolution = 0.1 dB **Example**: EBA=12.3	EBA= EBA? EBA* EBA# EBA$ EBA^ EBA@	EBA?	EBA=xx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX Buffer Size	RBS=	1 byte, value of 0 through 6	Command or Query. RX Buffer size in the form x, where: 0=Buffer disabled 1=± 512 bits 2=± 1024 bits 3=± 2048 bits 4=± 4096 bits 5=± 8192 bits 6=± 16384 bits **Example**: RBS=0	RBS= RBS? RBS* RBS# RBS$ RBS^ RBS@	RBS?	RBS=x (see description of arguments)
RX Data Clock Invert	RCI=	1 byte, value of 0, 1	Command or Query. Invert Receive Data Clock in the form x, where: 0=Normal 1=Inverted	RCI= RCI? RCI* RCI# RCI$ RCI^ RCI@	RCI?	RCI=x (see Description of Arguments)
RX Data Invert	RDI=	1 byte, value of 0, 1	Command or Query. Invert Receive Data in the form x, where: 0=Normal 1=Inverted **Example**: RDI=1 (Inverted RX Data)	RDI= RDI? RDI* RDI# RDI$ RDI^ RDI@	RDI?	RDI=x (see Description of Arguments)
RX Descrambler	RDS=	1 byte, value of 0 1, 2	Command or Query. RX Descrambler state in the form x, where: 0=Off 1=On (default descrambler type) 2=On (IESS-315 Turbo only)	RDS= RDS? RDS* RDS# RDS$ RDS^ RDS@	RDS?	RDS=x (see Description of Arguments)
RX Frequency	RFQ=	9 bytes	Command or Query. Tx Frequency in the form xxxx.xxxx, where: 0950.0000 to 1950.0000 MHz (for L-Band units), 0050.0000 to 0090.0000 or 0100.0000 to 0180.0000 MHz (for 70/140 MHz units) Resolution = 100 Hz **Example**: RFQ=0950.9872	RFQ= RFQ? RFQ* RFQ# RFQ$ RFQ^ RFQ@	RFQ?	RFQ=xxxx.xxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX Spectrum Invert	RSI=	1 byte, value of 0, 1	Command or Query. RX Spectrum Invert in the form x, where: 0=Normal 1=RX Spectrum Invert **Example**: RSI=0 (Normal)	RSI= RSI? RSI* RSI# RSI$ RSI^ RSI@	RSI?	RSI=x (see Description of Arguments)
RX Demod Acquisition Sweep Width	RSW=	3 bytes	Command or Query. RX acquisition sweep range of demodulator,in the form xxx, where: xxx = in kHz, ranging from 001 to 032 kHz . **Example**: RSW=009 (9 kHz)	RSW= RSW? RSW* RSW# RSW$ RSW^ RSW@	RSW?	RSW=xxx (see Description of Arguments)
RX roll-off (alpha) factor	RXA=	1 byte	Command or Query. Rx roll-off (alpha) factor in the form x, where: 0=20% 1=35% (default)	RXA= RXA? RXA* RXA# RXA$ RXA^ RXA@	RXA	RXA=x (see Description of Arguments)

C.6.3 Common (Tx, Rx, or Modem) Commands and Queries

Priority System = ITF(Highest Priority), then FRM as indicated by **shading**. Any changes to a higher priority can override any of the parameters of lower priority.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Module Interface Type	ITF=	1 byte	Command or Query. Terrestrial interface type in the form x, where: 0=RS422/EIA530 DCE 1=V.35 DCE 2=RS232 (SYNC) 3=G.703 TI Bal AMI 4=G.703 T1 Bal B8ZS 5=G.703 E1 Unbal AMI 6=G.703 E1 Unbal HDB3 7=G.703 E1 Bal AMI 8=G.703 E1 Bal HDB3 9=HSSI A=ASI B=G.703 TI Unbal AMI C=G.703 T1 Unbal B8ZS D=Quad Drop & Insert F=None (Query only) All other codes are invalid. Example: ITF=1 (V.35)	ITF= ITF? ITF* ITF# ITF$ ITF^	ITF?	ITF = x (see Description of Arguments)
Framing Mode (Modem only)	FRM=	1 byte, value of 0, 1, 2	Command or Query. Unit operating mode in the form x, where: 0=Unframed 1=EDMAC Framing 2=EDMAC-2 Framing 3=D&I++ Framing Example: FRM=0 (unframed)	FRM= FRM? FRM* FRM# FRM^	FRM?	FRM=x (see description arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
AUPC Parameters (Modem only)	APP=	6 bytes	Command or Query. Defines AUPC operating parameters in the the form abc.cd, where: a=Defines action on max power condition (0=do nothing, 1=generate TX Alarm) b=Defines action on remote demod unlock. (0=go to nominal power, 1=go to max power) c= target Eb/No value, for remote demod, from 0.0 to 9.9 dB d=Max increase in Tx Power permitted, from 0 to 9 dB **Example**: APP=015.67 (sets no alarm, max power, 5.6 dB target and 7 dB power increase)	APP= APP? APP* APP# APP^	APP?	APP=abc.cd (see Description of Arguments)
AUPC Enabled (Modem only)	AUP=	1 byte, value of 0, 1	Command or Query. AUPC mode enable/Disable in the form x, where: 0=Disabled 1=Enabled **Example**: AUP=1 (Enabled) **Note:** EDMAC framing must be selected for the AUPC feature to work.	AUP= AUP> AUP* AUP# AUP^	AUP?	AUP=x (see Description of Arguments)
Clear All Stored Events	CAE=	None	Command only. Forces the software to clear the software events log. **Example**: CAE= **Note:** This command takes no arguments.	CAE= CAE? CAE* CAE# CAE^	N/A	N/A
Clear All Stored Statistics	CAS=	None	Command only. **Note:** This command takes no arguments. Forces the software to clear the software statistics log. **Example**: CAS=	CAS= CAS? CAS* CAS# CAS^	N/A	N/A
Carrier-in-Carrier (CnC) Frequency Offset	CCF=	3 bytes	Command or Query. CnC Sweep frequency range in the form xxx, where: xxx = 000 to 032 (in kHz) **Example**: CCF=030	CCF= CCF? CCF * CCF # CCF $ CCF ^ CCF@	CCF?	CCF =xxx,yyy (see Description of Arguments)
Circuit ID String	CID=	28 bytes	Command or Query. Sets or queries the user-defined Circuit ID string which is a fixed length of 28 characters. Valid characters include: [Space] ( ) * + - , ./0 9,and A through Z	CID= CID? CID* CID# CID^	CID?	CID=-xxxxxxxxxxxxxxxxxxxxxxxxxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Configuration Load	CLD=	1 byte	Command only. Causes the unit to retrieve a previously stored unit configuration (common functions and all four slots) in Configuration Memory location defined by the 1-byte argument (0 to 9) **Example**: CLD=4 (retrieve unit configuration from location 4)	CLD= CLD? CLD* CLD# CLD^	N/A	N/A
Carrier-in-Carrier (CnC) Mode	CNM=	1 byte, value of 0,1,2	Command or Query. CnC Mode of Operation in the form x, where: 0=Off 1=On	CNM= CNM? CNM* CNM# CNM$ CNM^ CNM@	CNM?	CNM=x (see Description of Arguments)
CnC Re-Acquisition Time	CRA=	3 bytes	Command or Query. CnC re-Acquisition time in seconds. This is the time wherein CnC will start searching for the delay and frequency offset if long duration of unlock occurs. **Example**: CRA=120 (default & max=120 seconds) (min=15 for symbol rate < 256 ksps) (min=10 for symbol rate >= 256 ksps)	CRA= CRA? CRA* CRA# CRA$ CRA^ CRA@	CRA?	CRA=xxx (see Description of Arguments)
Carrier-in-Carrier (CnC) Min/Max Search Delay	CSD=	7 bytes	Command or Query. CnC min/max delay value in milliseconds. Maximum allowable value is 330ms. Syntax: CSD=xxx,yyy Where: xxx=min, yyy-max **Example**: 010,325	CSD= CSD? CSD* CSD# CSD$ CSD^ CSD@	CSD?	CSD=xxx,yyy (see Description of Arguments)
Configuration Save	CST=	1 byte	Command or Query. Causes the CDM-QX to store the current unit configuration (common functions and all four slots) in Configuration Memory location defined by the 1-byte argument (0 to 9) **Example**: CST=4 (store the current configuration in location 4)	CST= CST? CST* CST# CST^	N/A	N/A
RTC Date	DAY=	6 bytes	Command or Query. A date in the form ddmmyy, where: dd=day of the month (01 to 31) mm=month (01 to 12) yy=year (00 to 99) **Example**: DAY=240457 (April 24, 2057)	DAY= DAY? DAY* DAY# DAY^	DAY?	DAY=ddmmyy (see Description of Arguments

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
EDMAC Framing Mode (Modem only)	EFM=	1 byte, value of 0, 1, 2	Command or Query. EDMAC mode in the form x, where: 0=EDMAC Off (Framing is on, AUPC active) 1=EDMAC Master 2=EDMAC Slave (Query Only) **Example**: EFM=1 (EDMAC Enabled as Master)	EFM= EFM? EFM* EFM# EFM^	EFM?	EFM=x (see Description of Arguments)
External Reference Frequency	ERF=	1 byte, value of 0 through 7	Command or Query. External Reference Frequency in the form x, where: 0=Internal, external reference connector not used 1=External 1 MHz 2=External 2 MHz 3=External 5 MHz 4=External 10 MHz 5=External 20 MHz 6=Internal with 10 MHz driven to reference connector 7=External auto detect (1,2,5,10,or 20 MHz) **Example**: ERF=0 (External reference not used, uses Internal)	ERF= ERF? ERF* ERF# ERF^	ERF?	ERF=x (see Description of Arguments)
EDMAC Slave Address Range (Modem only)	ESA=	4 bytes	Command or Query. EDMAC Slave Address Range – sets the range of addresses of distant-end units (modems or transceivers), which this unit, as the Master, will forward, messages for. Only values which are integer multiples of 10 are permitted (0010, 0020, 0030, 0040, etc) **Example**: ESA=0090 This command is only valid for an EDMAC Master. When used as a Query, it may be sent to an EDMAC Slave, which will respond with the appropriate address.	ESA= ESA? ESA* ESA? ESA^	ESA?	ESA=xxxx (see Description of Arguments)
Forced Back-up in redundancy	FBU=	1 byte	Command or Query. Valid only if redundancy is enabled (see IRM command). If FBU is activated, this will force the back-up module(s) to take over the selected primary, in the form x, where: 0 = back to primary being backed-up or none 1 = Slot#1 is the primary module to be backed-up. 2 = Slot#2 is the primary module to be backed-up. 3 = Slot#3 is the primary module to be backed-up. **Note:** For 1:1 Modem, use FBU=1	FBU= FBU? FBU* FBU# FBU$ FBU^	FBU?	FBU=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Group	GRP	1 byte	Command or Query. Group a modulator/demodulator pair into a modem. A grouped mod and demod will respond to either address, in the form x, where: 0=Both sides ungrouped 1=Left side (as viewed from back of chassis) grouped 2=Right side grouped 3=Both sides grouped **Example**: GRP=3 (both sides of chassis are grouped into modems)	GRP= GRP? GRP* GRP# GRP$ GRP^	GRP?	GRP=x
HSSI handshake control (valid only for HSSI interface)	HHC=	1 byte, value of 0,1	Command or Query. Defines how TA/CA control the HSSI interface, where: 0 = TA to CA loop (default) 1 = RR control CA, TA control Tx output. **Example**: HHC=0 (TA to CA loop)	HHC= HHC? HHC* HHC# HHC^	HHC?	HHC=x (see Description of Arguments)
Initialize Events Pointer	IEP=	None	Command only. Resets internal pointer to allow RNE? Queries to start at the beginning of the stored events log.	IEP= IEP# IEP^	N/A	N/A
IP Address	IPA=	18 bytes numerical	Command or Query. Sets the IP Address and network prefix for the 10/100 BaseT Ethernet management port, in the format xxx.xxx.xxx.xxx.yy where: yy is the network prefix (0 to 31) **Example**: 010.006.030.001.24	IPA= IPA? IPA* IPA#	IPA?	IPA=xxx.xxx.xxx.xxx.yy (see Description of Arguments)
Internal Reference Oscillator Adjust	IRA=	5 bytes, numeric	Command or Query. Fine adjustment to the internal reference oscillator tuning voltage, thereby, fine tuning the required internal reference frequency, in the form sxxxx, where: s = sign (- or +) xxxx=Range: -2048 to +2047. **Example**: IRA=+0192	IRA= IRA? IRA* IRA# IRA^	IRA?	IRA=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Internal Redundancy Mode	IRM=	5 bytes	Command or Query. Redundancy mode in the form x,abc, where: For x: 0 = No Redundancy 1=1:1 modem (back-up modules at Slot#3 and Slot#4), or 1:1 Tx (back-up Tx on Slot#4), or 1:1 Rx (back-up Rx on Slot#4) 2=1:2 Tx, or 1:2 Rx (back-up module on Slot#4) 3=1:3 Tx, or 1:3 Rx (back-up module on Slot#4) 4=Reserved For abc: 000=no redundancy or 1:1 modem or 1:3 Tx or 1:3 Rx. If a=1, Slot#1 is selected as primary, otherwise it's not. If b=1, Slot#2 is selected as primary, otherwise it's not. If c=1, Slot#3 is selected as primary, otherwise it's not. **Note:** The settings on a,b, and c fields are only required if Qx is in 1:1 Tx or 1:1 Rx or 1:2 Tx or 1:2 Rx . **Example**: IRM =1,000 (1:1 modem) IRM =1,010 (1:1 Tx or 1:1 Rx with primary at Slot#2)	IRM = IRM? IRM* IRM# IRM$ IRM^	IRM?	IRM = x,abc (see Description of Arguments
Initialize Statistics Pointer	ISP=	None	Command only. Resets internal pointer to allow RNS? Queries to start at the beginning of the statistics log.	ISP= ISP# ISP^	N/A	N/A
T1 Line Build-Out	LBO=	1 byte, value of 0 though 4	Command or Query. Valid only for T1 interface in the form x, where: 0=0 to 133 feet 1=133 to 266 feet 2=266 to 399 feet 3=399 to 533 feet 4=533 to 655 feet **Example**: LBO=2	LBO= LBO? LBO* LBO# LBO$ LBO^ LBO@	LBO?	LBO=x (see Description of Arguments)
Local/Remote Status	LRS=	1 byte, value of 0, 1	Command or Query. Local/Remote status in the form x, where: 0=Local 1=Serial Remote 3=Ethernet Remote **Example**: LRS=1 (Serial Remote)	LRS= LRS? LRS* LRS#	LRS?	LRS=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Alarm Mask	MSK=	12 bytes	Command or Query. Alarm mask condition, in form abcdefghijkl, where: a=TX FIFO (0=Unmasked, 1=Masked, X=no Tx) b=G.703 BPV (0=unmasked, 1=Masked, X=no Tx) c=Tx-AIS (0=Unmasked, 1=Masked, X=no Tx) d=RX AGC Alarm (0=Unmasked, 1=Masked, X=no Rx) e=Eb/No Alarm (0=Unmasked, 1=Masked, X=no Rx) f=RX-AIS (X=no Rx) g=Buffer Slip (X=no Rx) h=EXT REF Alarm i=BUC Alarm j=LNB Alarm k=Spare l=Spare **Example**: MSK=010110010100	MSK= MSK? MSK* MSK# MSK^	MSK?	MSK=abcdefghijkl (see Description of Arguments)
Online status for Internal Redundancy	N/A	4 bytes	Query only. Sets Internal Redundancy online status in the form abcd, where: a=1, Slot#1 is online, 0 otherwise b=1, Slot#2 is online, 0 otherwise c=1, Slot#3 is online, 0 otherwise d=1, Slot#4 is online, 0 otherwise In 1:1 modem, abcd=1100, modem #1 is online abcd=0011, modem #2 is online	N/A	ONL?	ONL=abcd (see Description of Arguments)
Redundancy Auto or Manual Switching	RAM=	1 byte	Command or Query. Sets redundancy switch control in the form x, where: 0 = manual switching (default) 1 = automatic switching	RAM = RAM? RAM * RAM # RAM^	RAM?	RAM=x (see Description of Arguments)
ReCenter Buffer	RCB=	None	Command only. **Note:** This command takes no argument. Forces the software to recenter the receive Plesiochronous/Doppler buffer. **Example**: RCB=	RCB= RCB? RCB* RCB# RCB$ RCB^ RCB@	N/A	N/A

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Request to Send	RTS=	1 byte, value of 0, 1, 2	Command or Query. Defines how RTS/CTS will operate at the main data interface in the form x, where: 0=RTS/CTS Loop, No Action RTS and CTS are looped, so that CTS echoes the state of RTS, but RTS does not control the ON/OFF state of carrier. 1=Loop, RTS Controls TX O/P RTS and CTS are looped, so that CTS echoes the state of RTS and RTS controls the ON/OFF state of carrier (in order words, the modem will not bring up its TX carrier until RTS is asserted. 2=Ignore RTS, Assert CTS **Example**: RTS=0 (RTS/CTS Loop, No Action)	RTS= RTS? RTS* RTS# RTS^	RTS?	RTS=x (see Description of Arguments)
Statistics Sample Interval	SSI=	1 byte, numerical	Command or Query. Sets the sample interval for the Statistics Logging Function I n the form x, where: x = 0 to 9 in 10-minute increments **Note:** Setting this parameter to 0 disables the statistics logging function. **Example**: SSI=3 means 30 minutes	SSI= SSI? SSI* SSI# SSI^	SSI?	
RTC Time	TIM=	6 bytes	Command or Query. Sets time, indicated from midnight, in the form hhmmss, where: hh=hours (00 to 23) mm=minutes (00 to 59 ss=seconds (00 to 59) **Example**: TIM=231259 (23 hours, 12 minutes, 59 seconds)	TIM= TIM? TIM* TIM# TIM^	TIM?	TIM= hhmmss (see Description of Arguments)
Test Mode (Modem or Tx only)	TST=	1 byte, value of 0 through 6	Command or Query. Test Mode in the form x, where: 0=Normal Mode (No Test) 1=IF Loopback 2=Reserved 3=I/O Loopback 4=RF Loopback 5=TX CW 6=TX Alternating 1,0 Pattern 7=SSB CW **Example**: TST=1 (IF Loopback)	TST= TST? TST* TST# TST$ TST^ TST@	TST?	TST=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Quad Drop & Insert (Modem only)	QDI=	77 bytes	Command or Query. QDI=pccdddddddddddddddddddddddddddddddtCCiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiTLMrrrrrr, where: p = Port number 1 thru 4 cc = Number of Drop Channels, 0-32. Used to decide Port p's TX Tributary Rate if Interface Type is Quad Drop & Insert (ITF=D). 31 bytes of Drop information: d = 31 bytes defining timeslot locations (or channels) t = Drop type: (0=reserved, 1=reserved, 2=E1-CCS, 3=reserved) CC = Number of Insert Channels, 0-32. Used to decide Port p's RX Tributary Rate if Interface Type is Quad Drop & Insert (ITF=D). 31 bytes of Insert information: I = 31 bytes defining timeslot locations (or channels) T = Insert type: (0=reserved, 1=reserved, 2=E1-CCS, 3=reserved) Timeslot definition: 0 = Unused 1-9 for timeslots 1–9, A=10, B=11, C=12, D=13…V=31. L = Line Code: (0=AMI, 1=reserved, 2=HDB3) M = Bipolar Violation Mask (0=active, 1=masked) r = reserved (set to value 0) **Example** 1: 131123456789ABCDEFGHIJKLMNOPQRSTUV231123456789ABCDEFGHIJK LMNOPQRSTUV200000000 Port 1's Drop channels 1–31 using timeslots 1–31. Same for Insert. Port 1's Line code is AMI. **Example 2:** 304123400000000000000000000000000002041234000000000000000000000000 00000220000000 Port 3's Drop channels 1–4 using timeslots 1–4. Same for Insert. Port 3's Line code is HDB3-_. **Notes:** 1. This command is a bit forgiving in the sense that the modem accepts the command even though the interface type is other than Quad Drop & Insert. This was intentional because it's being used with the CRS-300 switch for 1:N redundancy. 2. To select Full E1 for the port, set Number of Drop/Insert channel to be 32, and the timeslot locations to be "123456789ABCDEFGHIJKLMNOPQRSTU".	QDI= QDI? QDI* QDI# QDI$ QDI^	QDI?p QDI?pn	QDI=pccdddddddddddddddddddddddddddddddtCCiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiTLMrrrrrr (see Description of Arguments) Returns current Drop and Insert configuration of a single port. Where n=0 to 9 returns the QDI portion of 1 of 10 stored configurations for a single port on Quad Drop & Insert Interface.

C.6.4 Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX BER	N/A	5 bytes	Query only. Unit returns the value of the estimated corrected BER in the form a.b x 10^{-c}, where: First 3 bytes are the value. Last 2 bytes are the exponent. Returns 99999 if the demodulator is unlocked. **Example**: BER=4.8E3 (BER = 4.8 x 10^{-3})	N/A	BER?	BER=a.bEc (see Description of Arguments)
Buffer Fill State	N/A	2 bytes	Query only. Unit returns the value of the buffer fill state in the form xx, where: xx = value between 1 to 99% Returns 00 if demodulator is unlocked **Example**: BFS=33 (33%)	N/A	BFS?	BFS=xx (see Description of Arguments)
CnC Delay Monitor	N/A	7 bytes	Query only. When CnC is enabled and it's locked, it monitors the delay of the interferer in microseconds. **Example** 1: CDM=229,500 (229.5 ms) **Example** 2: CDM=999,999 (not locked or CnC not enabled)	N/A	CDM?	CDM=xxx.xxx (see Description of Arguments)
CnC Freq Offset Monitor	N/A	6 bytes	Query only. When CnC is enabled, an estimated frequency offset between desired and interferer will be calculated. Unit is in kilohertz (kHz). **Example** 1: CFM=+001.0 (1 kHz) **Example** 2: CFM=9999.9 (not locked or CnC not enabled)	N/A	CFM?	CFM=xxxx.x (see Description of Arguments)
CnC Ratio Monitor	N/A	4 bytes	Query only. When CnC is enabled and it's locked, it monitors the ratio between the interferer and the desired power in dB. **Example** 1: CRM==+02 (interferer > desired) **Example** 2: CRM=LT10 (less than –11 dB) **Example** 3: CRM=GT10(greater than +11 dB) **Example** 4: CRM=99.9 (not locked or CnC not enabled)	N/A	CRM?	CRM=xxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX Eb/No	N/A	3 bytes	Query only. Unit returns the value of Eb/No, between 0 and 16 dB, Resolution 0.1 dB. Returns 99.9 if demod is unlocked. **Example**: EBN=12.3 (Eb/No=12.3 dB) For values greater than 16.0 dB, the reply will be: EBN=+016	N/A	EBN?	EBN=xxxx (see Description of Arguments)
Equipment ID	N/A	14 bytes	Query only. Unit returns information on a per module basis concerning the equipment identification and the option field in the form abbbcdefghijk, where: a=Turbo H/W option: 0=None, 1=Turbo, 2=TPC/LDPC bbb=defines the model number (Qx0 in this case) c=RS Codec H/W Option: 0=None 1=Installed d=Module Data Rate S/W Option: 0=None , 3=up to 5 Mbps, 4=up to 10 Mbps, 5=up to 20 Mbps e=Higher-order modulation: 0=None, 1=8-PSK/8-QAM, 2=16-QAM, 3=8-PSK, 8-QAM, 16-QAM f=Spare – for future use g=Spare – for future use h=Turbo data rate S/W option: 0=None, 1=up to 512Kbps, 2=up to 2048Kbps, 3=up to 5Mbps, 4=up to 10Mbps, 5=up to 20Mbps i=Module type: 0=None, 1=Modulator, 2=Demodulator, 3=Quad Drop & Insert j=Modem group: 0=ungrouped, 1=grouped as modem#1, 2=grouped as modem#2 k=Spare – for future use l=Spare – for future use **Example** 1: EID=1Qx0033xx31xxx means Turbo installed, CDM-QX 70/140 band, No RS Codec, up to 5 Mbps, 8-PSK/8-QAM and16-QAM, Turbo data rate up to 5Mbps, module is modulator. **Example** 2: EID=xQx0xxxxx0xxx, means there's no mod or demod module installed. This tells the user that this remote address belongs to a CDM-Qx. **Example** 3: EID=xQx0xxxxx30xxx, means Quad Drop and Insert module is installed in the Slot (Slot 4 always).	N/A	EID?	EID=abbbcdefghijkl (see Description of Arguments) Notes: QxO is the 70/140 module (mod or demod) Qx1 is the L-Band module (mod or demod)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Faults and Status	N/A	12 bytes	Query only. Unit returns the current ***highest-prority*** fault and status codes for the Unit (hardware), TX Traffic, RX Traffic, and ODU in the form abcdef, where: **a=<u>Unit Faults</u>:** 0=No Faults 1=Power Supply Fault, +5 volts 2=Power Supply Fault, +12 volts 3=Power Supply Fault, -5 volts 4=Power Supply Fault, +23 volts 5=Power Supply Fault, -12 volts 9=Ref PLL Lock F=EEPROM Checksum error 6,7,8,A,B,C,D,E are reserved for future expansion **bb**=fault codes for Slot#1 can be Tx or Rx Traffic status **cc**=fault codes for Slot#2 can be Tx or Rx Traffic status **dd**=fault codes for Slot#3 can be Tx or Rx Traffic status **ee**=fault codes for Slot#4 can be Tx or Rx Traffic status **<u>TX Traffic status</u>:** 00=TX Traffic OK 01=No Clock from Terrestrial Interface 03=TX FIFO Slip 06=TX Synthesizer Lock 07=AUPC Upper Limit Reached 09=AIS Detected on Incoming Data 0B=Bipolar violation on G.703 Interface 0F=TX EEPROM Checksum Error 12=Power supply fault, +5 volts 13=Power supply fault, -5 volts 14=Power supply fault, +12 volts 15=Power supply fault, -12 volts 16=Power supply fault, +23 volts the rests are reserved for future expansion **<u>RX Traffic status</u>:** 0=RX Traffic OK 1=Demodulator Unlocked 3=AGC Alarm – signal out of range 5=RS Frame SYNC alarm 7=EDMAC Frame SYNC alarm 8=RX 1st LO Synthesizer Lock 9=RX 2nd LO Synthesizer Lock A=Buffer Under B=Buffer Overflow D=Eb/No alarm E=AIS detected on incoming data F=RX EEPROM checksum error 10=Demod FPGA not programmed 11=Turbo FPGA not programmed 12=Power supply fault, +5 volts 13=Power supply fault, -5 volts 14=Power supply fault, +12 volts 15=Power supply fault, -12 volts 16=Power supply fault, +23 volts 17=QDI Deframer Unlocked 18=Buffer Clock Activity the rests are reserved for future expansion **f=<u>ODU status</u>: (for CDM-QxL L-Band unit only)** 0=No ODU Faults 1=BUC PLL 3=BUC Current 5=BUC Voltage 7=LNB Current, 9=LNB Voltage, B=BUC Temperature, D=BUC Checksum	N/A	FLT?	FLT=abbccddeefgh (see Description of Arguments) g=Change in fault status since last poll. h=Change in unit configuration since last poll (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Software Information	N/A	variable	Query only. Complete unit software information: **Example**: FRW= Boot: FW/11246-1-,1.1.1,11/11/04 Bulk1: FW/11245-,1.1.1,11/11/04 FW/11247-1-,1.1.1,11/11/04 FW/11248-1-,1.1.1,11/17/04 FW/11249-1-,1.1.1,09/27/04 FW/11250-1-,1.1.1,11/08/04 FW/11251-1-,1.1.1,11/16/04 FW/11252-1-,1.1.1,06/25/04 FW/11253-1-,1.1.1,10/21/04 FW/11254-1-,1.1.1,11/18/03 Bulk2: FW/11245A,1.1.1,11/11/04 FW/11247-1A,1.1.1,11/11/04 FW/11248-1B,1.1.1,11/17/04 FW/11249-1B,1.1.1,09/27/04 FW/11250-1-,1.1.1,11/08/04 FW/11251-1-,1.1.1,11/16/04 FW/11252-1-,1.1.1,06/25/04 FW/11253-1-,1.1.1,10/21/04 FW/11254-1-,1.1.1,11/18/03	N/A	FRW?	FRW=x…x (see Description of Arguments)
Software Image	IMG=	1 byte, value of 1 or 2	Command or Query. Current active software image in the form x, where: 1=Bulk Image #1 currently active 2=Bulk Image #2 currently active	IMG= IMG? IMG* IMG# IMG^	IMG?	IMG=x (see Description of Arguments)
Temperature of the Base Unit	N/A	3 bytes	Query only. Unit returns the value of the internal base unit temperature, in the form of sxx (degrees C), where: s=sign (+ or – character) xx=value **Example**: ITP=+26	N/A	ITP?	ITP=sxx (see Description of Arguments)
Number of Unread Stored Events	N/A	3 bytes	Query only. Unit returns the number of stored Events, which remain Unread, in the form of xxx. **Example**: NUE=126 **Note:** This means unread over the remote control.	N/A	NUE?	NUE=xxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Number of Unread stored Statistics (Modem Only)	N/A	3 bytes	Query only. Unit returns the number of stored Statistics, which remain Unread, in the form xxx.	N/A	NUS?	NUS=xxx (see Description of Arguments)
TX Power Level Increase (Modem only)	N/A	3 bytes	Query only. Returns the increase in TX power level, in dB (from the nominal setting) due to the action of AUPC, in the form x.x: Range is 0.0 to 9.9 dB. Responds x.x if AUPC is disabled. **Example**: PLI=2.3	N/A	PLI?	PLI=x.x (see Description of Arguments)
Remote Eb/No (Modem only)	N/A	4 bytes	Query only. Returns the value of Eb/No of the remote demod in the form xx.x, where: xx.x=02.0 to 16.0 Responds 99.9=remote demod unlock Responds xx.x if EDMAC is disabled. **Example**: REB=12.4 **Note:** For values > 16.0 dB, the reply will be 16.0	N/A	REB?	REB=xx.x (see Description of Arguments)
RX Frequency Offset	N/A	6 bytes	Query only. Unit returns the value of the measured frequency offset of the carrier being demodulated, in the form sxxx.x, where: s=sign (+ or – character) xxx.x=value (range from 0 to 200 kHz, 100 Hz resolution) Returns +999.9 if the demodulator is unlocked **Example**: RFO=+002.3 (2.3 kHz)	N/A	RFO?	RFO=sxxx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Retrieve next 5 unread stored Events	N/A	80 bytes	Query only. Unit returns the oldest 5 Stored Events, which have not yet been read over the remote control, in the form {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}, where Sub-body = ABCCddmmyyhhmmss, where: A being the fault/clear indicator F=Fault C=Clear I =Info B being the fault type where: 1=Unit 2=RX Traffic on Slot#1 3=RX Traffic on Slot#2 4=RX Traffic on Slot#3 5=RX Traffic on Slot#4 6=TX Traffic on Slot#1 7=TX Traffic on Slot#2 8=TX Traffic on Slot#3 9=TX Traffic on Slot#4 A=ODU B=Power ON/OFF, or log cleared **CC is Fault Code numbers, as in FLT?** Or Infor Code, which is: 0=Power Off 1=Power On 2=Log Cleared 3=Global Config Change 4=Redundancy Config Change If there are less than 5 events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNE*.	N/A	RNE?	RNE={CR}ABCCddmmyyhhmmss{CR}ABCCddmmyyhhmmss{CR}ABCCddmmyyhhmmss{CR}ABCCddmmyyhhmmss{CR}ABCCddmmyyhhmmss (see Description of Arguments)
Retrieved next 5 unread Stored Statistics (Modem Only)	N/A	130 bytes	Query only. Unit returns the oldest 5 Stored Statistics, which have not yet been read over the remote control, in the form {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body=AA.ABB.BC.CD.Dddmmyyhhmmss, where: AA.A Minimum Eb/No during sample period BB.B=Average Eb/No during sample period C.C=Max. TX Power Level Increase during sample period D.D=Average TX Power Level during sample period ddmmyyhhmmss=date/time stamp If there are no new events, the unit replies with RNS* If there are less than 5 statistics to be retrieved, the remaining positions are padded with zeros.	N/A	RNS?	RNS={CR} AA.ABB.BC.CD.Dddmmyyhhmmss{CR} AA.ABB.BC.CD.Dddmmyyhhmmss{CR} AA.ABB.BC.CD.Dddmmyyhhmmss{CR} AA.ABB.BC.CD.Dddmmyyhhmmss{CR} AA.ABB.BC.CD.Dddmmyyhhmmss (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
RX Signal Level	N/A	4 bytes	Query Only. Unit returns the value of the RX signal Level, in dBm, between –20 and –99 dBm, in the form ccxx, where: cc=code: GT=Greater Than; LT=Less Than; = is equal to xx=value (the '-' sign is implied) **Example**: RSL=LT99 (RX signal level is less than –99 dBm) RSL===41 (RX signal level is equal to –41 dBm)	N/A	RSL?	RSL=ccxx (see Description of Arguments)
Serial Number of Base Unit	N/A	9 bytes	Query only. Used to query the 9-digit serial number of the Qx base unit in the form: xxxxxxxxx	N/A	SNM?	SNM=xxxxxxxxx (see Description of Arguments)
Serial Number of Modulator or Demodulator	N/A	9 bytes	Query only. Used to query the modulator or demodulator module 9-digit serial number. It returns its S/N in the form xxxxxxxxx	N/A	SNO?	SNO=xxxxxxxxx (see Description of Arguments)
Serial Number of turbo module	N/A	9 bytes	Query only. Used to query the 9-digit serial number of the Turbo Codec module.	N/A	SNT?	SNT=xxxxxxxxx (see Description of Arguments)
Software Revision	N/A	34-37 bytes	Query only. Units returns the value of the internal software revision installed in the unit, in the form: Boot:x.y.z Bulk1:x.y.z Bulk2:x.y.z or Boot:x.y.zz Bulk1:x.y.zz Bulk2:x.y.zz	N/A	SWR?	SWR=Boot:x.y.zz Bulk1:x.y.zz Bulk2:x.y.zz (see Description of Arguments)
Temperature of Modulator	N/A	3 bytes	Query only. It returns the value of the internal module temperature, in the form of sxx (degrees C), where: s=sign (+ or – character) xx=value **Example**: TMP=+26	N/A	TMP?	TMP=sxx (see Description of Arguments)
Unit Type	N/A	11 bytes	Query only. Type of plug-in identified in the form aw,bx,cy,dz, where: <u>a,b,c,d</u> <u>w,x,y,z</u> 0=unoccupied 0=unoccupied 1=transmit 1=70/140 MHz 2=receive 2=L-Band 3=Reserved 4=Reserved aw=Slot#1, bx=Slot#2, cy=Slot#3, dz=Slot#4 **Example**: WHO=00, 11, 21, 00, (Slot#1=empty, Slot#2=Tx, Slot#3=Rx, Slot#4=empty. Both Tx and Rx are 70/140 MHz modules)	N/A	WHO?	WHO=aw,bx,cy,dz (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Unit ID	N/A	7 bytes	Query only. Unit returns information concerning the base unit identification and the option field in the form abcdefg, where: a=Redundancy option, where: 0=None; 1=1:1 mode; 2=1:2 mode; 3=1:3 mode. **Notes:** 1. If a=3, capable of supporting also1:2 and 1:1. 2. If a=2, capable of supporting 1:1 as well. b=CnC First Instance rate option, where: 0=None, 1=128 Kbps to 512Kbps, 2=128Kbps to 1Mbps, 3=128Kbps to 2.5Mbps, 4=128Kbps to 5Mbps, 5=128Kbps to 10Mbps, 6=128Kbps to 20Mbps. c=CnC Second Instance rate option: 0=None, 1=128 Kbps to 512Kbps, 2=128Kbps to 1Mbps, 3=128Kbps to 2.5Mbps, 4=128Kbps to 5Mbps, 5=128Kbps to 10Mbps, 6=128Kbps to 20Mbps. d=Unit Type 0=70/140MHz unit 1=L-Band unit with one 24V power supply 2=L-Band unit with one 48V power supply 3=L-Band unit with two 24V power supplies 4=L-Band unit with two 48V power supplies e=D&I++ option 0=None 1=One modem only 2=Two modems f=spare g=spare	N/A	UID?	UID=abcdefg (see Description of Arguments)

C.6.5 Bulk Commands and Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Global Configuration	MGC=	138 bytes, with numerical entries, fixed values and delimiters	Command or Query. Global Configuration of CDM-QX on a module Slot basis if not grouped as a modem or on a modem basis if grouped. If the module is a Tx and ungrouped as modem, the Rx field will be filled with ‘x’, and vice-versa.The format is: abcdddd.ddddefghhhhh.hhhijkk.klmnoppp.ppqrstuvvvvvvvAAAA.AAAABCDEEEEE.EEEFGHIIIJJ.JKLMNOPPPPPPPQRSSSSTUUUUUUUUUUUUVWXYYYZZZ.ZZZaaabbbbbbbb where: (see argument list below)	MGC= MGC? MGC* MGC# MGC$ MGC^	MGC? MGC?n	MGC=abcdddd.ddddefghhhhh.hhhijkk.klmnoppp.ppqrstuvvvvvvvAAAA.AAAABCDEEEEE.EEEFGHIIIJJ.JKLMNOPPPPPPPQRSSSSTUUUUUUUUUUUUVWXYYYZZZ.ZZZaaabbbbbbb Where n=0 to 9 Returns the MGC portion of 1 of 10 stored configurations (see Description of Arguments)

a=Unit Interface Type	same as ITF
b=T1 Line Build-out	same as LBO
c=Unit framing mode	same as FRM
dddd.dddd=Tx Frequency	same as TFQ
e=Tx FEC Type	same as TFT
f=Tx Modulation Type	same as TMD
g=Tx FEC Rate	same as TCR
hhhhh.hhh=Tx Data Rate	same as TDR
i=Tx Spectrum Inversion	same as TSI
j=Tx Scrambler State	same as TSC
kk.k=Tx Power Level	same as TPL
l=Tx Clock Source	same as TCK
m=Tx Data Invert	same as TDI
n=Tx Carrier State	same as TXO
o=AUPC Enable	same as AUP
ppp.pp=AUPC Parameter Setup	same as APP
q=Warm-up Delay	same as WUD
r=Tx Common Output state	same as TXC
s=Tx Reed-Solomon (n, k) value	same as TRS
t=Tx roll-off (alpha) factor	same as TXA
u=Tx Data Clock Invert	same as TCI
vvvvvvv=Expansion Bytes	
AAAA.AAAA=RX Frequency	same as RFQ
B=RX FEC Type	same as RFT
C=RX Modulation Type	same as RMD
D=RX FEC Rate	same as RCR
EEEEE.EEE=RX Data Rate	same as RDR
F=RX Spectrum Inversion	same as RSI
G=RX Descrambler State	same as RDS
H=RX Data Invert	same as RDI
III=RX Sweep Width	same as RSW
JJ.J=Eb/No Alarm Point	same as EBA
K=RX Buffer Clock Source	same as BCS
L=RX Reed-Solomon (n, k) values	same as RRS
M= RX Buffer Size	same as RBS
N=RX Data Clock Invert	same as RCI
O=Rx roll-off (alpha) factor	same as RXA
PPPPPPP=Expansion Bytes	
Q=External Reference Bytes	same as ERF
R=EDMAC Framing Mode	same as EFM
SSSS=EDMAC Slave Address	same as ESA
T=Unit Test Mode (Read only)	same as TST
UUUUUUUUUUUU=Unit Alarm Mask	same as MSK
V=RTS/CTS Control	same as RTS
W=Statistics Sampling Interval	same as SSI
X=CnC Mode	same as CNM
YYY=CnC Frequency Offset	same as CCF
ZZZ.ZZZ=CnC Min/Max Search Delay	same as CSD
aaa=CnC Re-Acquisition time	same as CRA
bbbbbbbb=Epansion Bytes	
Fill unused expansion bytes with ‘x’	

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments		Response to Command	Query (Instruction Code and Qualifier)	Response to Query
OGC Outdoor Unit Global Configuration	OGC=	50 bytes	Command or Query. ODU Global Configuration in the form aabcdexxxxhhhiiiijjjjjkxxxxxxlmnnnooopppppqxxxxxx, where:		OGC= OGC? OGC* OGC# OGC^	OGC?	OGC= aabcde xxxxhhhiiiijjjjjkxxxxxxlmnnn ooopppppqxxxxxx (see Description of Arguments) Where: n=0 to 9 Returns the OGC portion of 1 of 10 stored configurations (see Description of Arguments)
			aa=BUC Address b=BUC FSK comms enable c=BUC Power Control d=BUC 10 MHz Freq Ref Enable e=BUC TX Output Enable xxxx=expansion bytes hhhh=BUC Low Alarm Limit iiii=BUC High Alarm Limit jjjjjk=BUC LO frequency, mix sign xxxxxx=expansion bytes l=LNB Power Control m=LNB 10 MHz Freq Ref Enable nnn=LNB Low Alarm Limit ooo=LNB High Alarm Limit pppppq=LNB LO Freq, mix sign xxxxxx=expansion bytes Any unavailable parameters will be filled with xxx.	same as BAD same as BCE same as BPC same as BFR same as BOE same as BCL same as BCH same as BLO same as LPC same as LFR same as LCL same as LCH same as LLO			

C.6.6 BUC Commands and Queries – CDM-QxL ONLY

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BUC Address	BAD=	2 bytes, value of 01 to 15	Command or Query. Indicates the Block Up Converter (BUC) Address in the form xx, where: xx is a value between 01 and 15 **Example**: BAD=03 **Note:** This command is only valid when the FSK and BUC power are enabled.	BAD= BAD? BAD* BAD# BAD^	BAD?	BAD=xx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BUC Comms Enable	BCE=	1 byte, value of 0,1	Command or Query. Enables or disables communications, via the FSK link, with an externally connected BUC in the form x, where: 0=Disabled 1=Enabled **Example**: BCE=0 (Disabled)	BCE= BCE? BCE* BCE# BCE^	BCE?	BCE=x (see Description of Arguments)
BUC High Current Limit	BCH=	4 bytes	Command or Query. BUC High Current Limit in the form xxxx, where: xxxx is a value between 500 and 3200 mA. **Example**: BCH=3100	BCH= BCH? BCH* BCH# BCH^	BCH?	BCH=xxxx (see Description of Arguments)
BUC Low Current Limit	BCL=	4 bytes	Command or Query. BUC Low Current Limit in the form xxxx, where: xxxx is a value between 100 and 3000 mA **Example**: BCL=0600	BCL= BCL? BCL* BCL# BCL^	BCL?	BCL=xxxx (see Description of Arguments)
BUC Current	N/A	4 bytes	Query only. Indicates the value of the BUC Current, in the form: xxxx, where: xxxx is between 0 and 9999, units MA. If not available, response is 0000 **Example**: BDC=3100	N/A	BDC?	BDC=xxxx (see Description of Arguments)
BUC Voltage	N/A	4 bytes	Query only. Indicates the value of the BUC voltage, in the form xx.x,, where: xx.x is a value between 0 and 64.0 If not available, response is 00.0 **Example**: BDV=43.6 (BUC DC voltage is 43.6 volts)	N/A	BDV?	BDV=xx.x (see Description of Arguments)
BUC 10 MHz Reference	BFR=	1 byte, value of 0,1	Command or Query. Enables or disables the 10 MHz frequency reference to the BUC in the form x, where: 0=Disabled 1=Enabled	BFR= BFR? BFR* BFR# BFR^	BFR?	BFR=x (see Description of Arguments)
BUC LO Frequency	BLO=	6 bytes	Command or Query. BUC transmit LO frequency information in the form xxxxxs, where : xxxxx is the LO frequency in the range of 3000 to 65000 MHz All 0's (000000) disables the feature S is the sign for the mix (+ or – character) Terminal Frequency= BUC LO TFQ **Example**: BLO=12000+ (BUC LO is 12 GHz, low-side mix)	BLO= BLO? BLO* BLO# BLO^	BLO?	BLO=xxxxxs (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BUC Output Enable	BOE=	1 byte, value of 0,1	Command or Query. **Note:** Valid when the BUC FSK comms and BUC power are *enabled*. Indicates BUC Output enable in the form x, where: 0=Off (Output Disabled) 1=On(Output Enabled) **Example**: BOE=1 (BUC Output is Enabled)	BOE= BOE? BOE* BOE# BOE^	BOE?	BOE=x (see Description of Arguments)
BUC Output Power Level	N/A	4 bytes	Query only. BUC output power level in the form xxx, where xxx is the value in watts. Returns 00.0 when FSK and BUC power are not enabled. **Example**: BOL=08.3 (BUC reports output is 8.3 watts)	N/A	BOL?	BOL=xx.x (see Description of Arguments)
BUC PLL Alarm	N/A	1 byte, value of 0,1	Query only. **Note:** Valid only when the FSK and BUC power are turned **On**. Sets BUC PLL lock state in the form x, where: 0=Unlocked 1=Locked **Example**: BPA=1 (BUC PLL is locked)	N/A	BPA?	BPA=x (see Description of Arguments)
BUC Power Control	BPC=	1 byte, value of 0,1	Command or Query. Sets BUC power in the form x, where: 0=Disable BUC DC Power 1=Enable BUC DC Power	BPC= BPC? BPC* BPC# BPC^	BPC?	BPC=x (see Description of Arguments)
BUC Software Version	N/A	3 bytes	Query only. **Note:** Valid only when the FSK and BUC power are turned **On**. Indicates the BUC software version in the form x.x. **Example**: BSV=1.1 (Software version 1.1)	N/A	BSV?	BSV=x.x (see Description of Arguments)
BUC Temperature	N/A	4 bytes	Query only. **Note:** Valid only when the FSK and BUC power are turned **On**. Indicates BUC temperature, in the form sxxx, where: s=sign (+ or – character) xx=value If not available, response is –99 **Example**: BUT=-13 (BUC temperatures is -13°C)	N/A	BUT?	BUT=sxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Terminal Tx Frequency	N/A	10 bytes	Query only. Terminal Tx Frequency, where frequency = BUC LO ± TFQ Resolution = 100 Hz Returns 00000.0000 if BUC LO is zero **Example**: TTF=14250.9872	N/A	TTF?	TTF=xxxxx.xxxx (see Description of Arguments)

C.6.7 LNB Commands and Queries – CDM-QxL ONLY

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
LNB High Current Limit	LCH=	3 bytes	Command or Query. LNB higher alarm limit for current, in the form of xxx, where: xxx is the current value between 50 and 600 mA.	LCH= LCH? LCH* LCH# LCH^	LCH?	LCH=xxx (see Description of Arguments)
LNB Low Current Limit	LCL=	3 bytes	Command or Query. LNB lower alarm limit for current, in the form xxx, where: xxx is the current value between 10 and 400 mA.	LCL= LCL? LCL* LCL# LCL^	LCL?	LCL=xxx (see Description of Arguments)
LNB Current	N/A	3 bytes	Query only. Indicates the value of the LNB Current, in the form xxx, where: xxx is between 0 and 999, units mA. If not available, response is 000. **Example**: LDC=210 (LNB DC current is 210 mA)	N/A	LDC?	LDC=xxx (see Description of Arguments)
LNB Voltage	N/A	4 bytes	Query only. Indicates the value of the LNB Voltage, in the form xx.x, where: xx.x is between 0 and 20.0 If not available, response is 00.0 **Example**: LDV=18.1 (LNB DC voltage is 18.1 volts)	N/A	LDV?	LDV=xx.x (see Description of Arguments)
LNB Frequency Reference Enable	LFR=	1 byte, value of 0, 1	Command or Query. Sets LNB Frequency Reference in the form x, where: 0=Disable LNB Reference 1=Enable LNB Reference	LFR= LFR? LFR* LFR# LFR^	LFR?	LFR=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
LNB LO Frequency	LLO=	6 bytes	Command or Query. LNB Receive LO frequency information in the form xxxxxs, where: xxxxx is the LO frequency, in the range of 3000 to 65000 MHz. s is the sign for the mix (+ or – character) All 0's (000000) disables this feature. Terminal Frequency = LNB LO RFQ **Example**: LLO=06000- (LO is 6 GHz, high-side mix)	LLO= LLO? LLO* LLO# LLO^	LLO?	LLO=xxxxxs (see Description of Arguments)
LNB Power Control	LPC=	1 byte, value of 0,1,2	Command or Query. Sets LNB Power Control in the form x, where: 0=Off 1=On, 13V LNB Voltage 2=On, 18V LNB Voltage **Example**: LPC=1 (LNB Power is On, 13V)	LPC= LPC? LPC* LPC# LPC^	LPC?	LPC=x (see Description of Arguments)
Terminal Rx Frequency	N/A	10 bytes	Query only. Terminal Rx Frequency, where frequency = LNB LO ± RFQ Resolution = 100Hz Returns 00000.0000 if LNB LO is zero **Example**: TRF=11650.2249	N/A	TRF?	TRF=xxxxx.xxxx (see Description of Arguments)

C.6.8 Built-in BERT Commands and Queries (BER Tester)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BERT Config Pattern state (applies to module-by-module basis)	BCP=	1 byte	Command or Query. Sets BERT pattern in the form x, where: 0 = space 1 = mark 2 = 1:1 3 = 1:3 4 = 63 5 = 511 6 = 2047 (default) 7 = 2047R (or 2047 Alternate) 8 = Mil 188 9 = 2^15-1 A = 2^20-1 B = 2^23-1	BCP= BCP? BCP* BCP# BCP$ BCP^	BCP?	BCP=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BERT Config Sync Loss Threshold (applies to Rx module)	BCT=	1 byte, value of 0 to 3	Command or Query. Sets BERT config sync loss threshold in the form x, where: 0 = 256 bit errors counted in less than 1000 bits o data 1 = low (100 bit errors in less than 1000 bits of data) 2 = med (250 bit errors in less than 1000 bits of data) 3 = high (20,000 bit errors in less than 100,000 bits of data)	BCT= BCT? BCT# BCT$ BCT^ BCT@	BCT?	BCT=x (see Description of Arguments)
BERT 10E-3 Error Insert (applies to Tx module)	BKE=	1 byte, value of 0, 1	Command or Query. Inserts 10E-3 BER in the form x, where: 0 = Off 1 = On **Example**: BKE=1	BKE= BKE? BKE# BKE$ BKE^ BKE@	BKE?	BKE=x (see Description of Arguments)
BERT Result in bit errors (applies to Rx module)	N/A	7 bytes, numeric	Query only. BERT monitor results in bit errors. If bit errors exceed 9999999, then BRE=9999999.	N/A	BRE?	BRE=xxxxxxx (see Description of Arguments)
BERT Restart Monitor (applies to Rx module)	BRM=	1 byte, value of 1 only	Command only. Restarts or resets the BERT monitor. **Example**: BRM=1	BRM= BRM? BRM# BRM$ BRM^ BRM@	N/A	N/A
BERT Result in average BER	N/A	5 bytes	Query only. Returns the value of the average BER in the form a.b x 10^{-c}, where: First 3 bytes are the value. Last 2 bytes are the exponent. Returns 99999 if there's no sync in BERT monitor. Returns 99.99 if sync loss has occurred. **Example**: BER=4.8E3 (BER = 4.8 x 10^{-3})	N/A	BRR?	BRR=a.bEc (see Description of Arguments)
Built-in BERT state (applies to module-by-module basis)	BST=	1 byte, value of 0 and 1	Command or Query. Sets state of built-in tester (BST) in the form x, where: 0=Off 1=On	BST= BST? BST* BST# BST$ BST^	BST?	BST=x (see Description of Arguments)

C.6.9 Spectrum Analyzer Commands and Queries – Rx Module ONLY

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Spectrum Analyzer Center Frequency	SPF=	9 bytes	Command or Query. Tx Frequency in the form xxxx.xxxx, where: 0950.0000 to 1950.0000 MHz (for L-Band units) or 0500.0000 to 0090.0000 and 0100.0000 to 0180.0000 MHz (for 70/140 MHz units) Resolution=100 Hz **Example**: SPF=0050.9872	SPF= SPF? SPF* SPF# SPF$ SPF^ SPF@	SPF?	SPF=xxxx.xxxx (see Description of Arguments)
Spectrum Analyzer Mode	SPM=	1 byte	Command or Query. Sets mode in the form x, where: 0=Off 1=On	SPM= SPM? SPM* SPM# SPM$ SPM^ SPM@	SPM?	SPM=x (see Description of Arguments)
Spectrum Analyzer Span	SPS=	1 byte	Command or Query. Sets span in the form x, where: 0 = 97.65625 kHz 1 = 195.3125 kHz 2 = 390.625 kHz 3 = 781.25 kHz 4 = 1.5625 MHz 5 = 3.125 MHz 6 = 6.25 MHz 7 = 12.5 MHz	SPS= SPS? SPS* SPS# SPS$ SPS^ SPS@	SPS?	SPS=x (see Description of Arguments)

C.6.10 D&I++ (Drop & Insert) Commands and Queries (E1 CCS Only) – Modem <u>ONLY</u>

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Drop & Insert	DNI=	65 bytes	Command or Query. DNI=ddddddddddddddddddddddddddddddddtiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiTL 31 bytes of Drop information: d = 31 bytes defining timeslot locations (or channels) t = Drop type: (0=reserved, 1=reserved, 2=E1-CCS, 3=reserved) 31 bytes of Insert information: I = 31 bytes defining timeslot locations (or channels) T = Insert type: (0=reserved, 1=reserved, 2=E1-CCS, 3=reserved) Timeslot definition: 0 = Unused 1-9 for timeslots 1–9, A=10, B=11, C=12, D=13…V=31. L= reserved (set to 0) **Example:** 123456789ABCDEFGHIJKLMNOPQRSTUV2123456789 ABCDEFGHIJKLMNOPQRSTUV20 Drop channels 1–31 using timeslots 1–31. Same for Insert. **Note:** This command is a bit forgiving in the sense that the modem accepts the command even though the interface type is other than G.703. This was intentional because it's being used with the CRS-300 switch for 1:N redundancy.	DNI= DNI? DNI* DNI# DNI$ DNI^	DNI? DNI?n	DNI=ddddddddddddddddd ddddddddddddddtiiiiiiiiiiiiiiii iiiiiiiiiiiiiiiTL (see Description of Arguments) Returns current D&I configuration. Where n=0 to 9 returns the DNI portion of 1 of 10 stored configurations.
Drop Timeslot	DTS=	3 bytes for command, 31 bytes for query	Command or Query. *(Note different format between command and query.)* Command in the form xyy, where: xx = Channel 01 through 31 y = timeslot: 0-9, A=10, B=11, C=12, D=13,…V=31	DTS= DTS? DTS* DTS# DTS$ DTS^	DTS?	DTS=yyyyyyyyyyyyyyyyyy yyyyyyyyyyyyy Indicating all 31 Drop timeslots values associated with the 31 Tx Satellite channels.
Insert Timeslot	ITS=	3 bytes for command, 31 bytes for query	Command or Query. *(Note different format between command and query.)* Command in the form xyy, where: xx = Channel 01 through 31 y = timeslot: 0-9, A=10, B=11, C=12, D=13,…V=31	ITS= ITS? ITS* ITS# ITS$ ITS^	ITS?	ITS=yyyyyyyyyyyyyyyyyyy yyyyyyyyyyyy Indicating all 31 Insert timeslots values associated with the 31 Rx Satellite channels.

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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