CDM-760

CDM-760 Advanced High-Speed Trunking Modem
Installation and Operation Manual

For Firmware Version 1.7.3 or Higher

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

Part Number MN-CDM760 / CD-CDM760 Revision 4

Errata A for MN-CDM760 Rev 4

Comtech EF Data Documentation Update

CDM-760

CDM-760 Advanced High-Speed Trunking Modem
Installation and Operation Manual
For Firmware Version 1.7.3 or Higher

Part Number MN-CDM760/CD-CDM760
Revision 4

Subject:	Update Preface, added South Korean EMC notice
Errata Part Number:	ER-CDM760-EA4 (*Errata documents are not revised)*
CO Number:	C-0036739
Comments:	See attached page(s). The new information will be included in the next released revision of the manual.

Restricted Access Location

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

Battery Warning

CAUTION
Risk of explosion if battery is replaced by an incorrect type.Dispose of used batteries according to the instructions.

Operating Environment

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

- AMBIENT TEMPERATURES LESS THAN 0° C (32° F) OR MORE THAN 50° C (122° F).
- PRECIPITATION, CONDENSATION, OR HUMID ATMOSPHERES OF MORE THAN 95% RELATIVE HUMIDITY.
- UNPRESSURIZED ALTITUDES OF MORE THAN 2000 METRES (6561.7 FEET).
- EXCESSIVE DUST.
- FLAMMABLE GASES.
- CORROSIVE OR EXPLOSIVE ATMOSPHERES.

South Korean Electromagnetic Compatibility

A급 기기 (업무용 정보통신기기)

이 기기는 업무용으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 만약 잘못판매 또는 구입하였을 때에는 가정용으로 교환하시기 바랍니다.

B급 기기 (가정용 정보통신기기)

이 기기는 가정용으로 전자파적합등록을 한 기기로서 주거지역에서는 물론 모든지역에서 사용할 수 있습니다.

Unofficial translation:
Class A: EMC Registration is done on this equipment for business use only (Class A). Product seller and user should notice that this equipment is not for household use.

Class B: EMC Registration is done on this equipment mainly for household use (Class B) and also can be used in all areas.

Errata B for MN-CDM760 Rev 4

Comtech EF Data Documentation Update

CDM-760

CDM-760 Advanced High-Speed Trunking Modem
Installation and Operation Manual
For Firmware Version 1.7.3 or Higher

Part Number MN-CDM760/CD-CDM760
Revision 4

Subject: Firmware Images Notice

Errata Part Number: ER-CDM760-EB4 (*Errata documents are not revised)*

CO Number: C-0037046

Comments: Attn: CEFD Customer
Thank you for your purchase of Comtech's High Speed CDM-760 modem. Your modem has been pre-loaded with two (2) firmware images.

Image 1: is FW version 1.6.3 and should be used if you are using the modem's optional Packet Processor. It is the default firmware the modem will boot with if you do nothing.

Image 2: is FW version 1.7.4 and can be used if the modem does not have a packet processor installed. You may use Image 1) FW version 1.6.3 (default) if you choose, but certain features such as support for ASI data interface and DVB-S2X MODCODs will be unavailable unless you boot to image 2. It is not suggested to run Image 2 FW version 1.7.4 with the packet processor enabled.

CDM-760

CDM-760 Advanced High-Speed Trunking Modem
Installation and Operation Manual

For Firmware Version 1.7.3 or Higher

Part Number MN-CDM760/CD-CDM760
Revision 4

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

TABLE OF CONTENTS

FIGURES

TABLES

BLANK PAGE

PREFACE

About this Manual

This manual gives installation and operation information for the Comtech EF Data CDM-760 Advanced High-Speed Trunking Modem. This document is intended for anyone who installs or operates the CDM-760.

Conventions and References

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.

Warnings, Cautions and Notes

A WARNING INFORMS YOU ABOUT A POSSIBLE HAZARD THAT MAY CAUSE DEATH OR SERIOUS INJURY.

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

A NOTE gives you important information about a task or the equipment.

A REFERENCE directs you to additional information about a task or the equipment.

Recommended Standard Designations

The Electronic Industries Association (EIA) designations supersede the Recommended Standard (RS) designations. References to the old designations may be shown when depicting actual text (e.g., RS-232) displayed on front panel menus, Web Server pages, serial remote interfaces, Telnet Command Line Interfaces (CLIs), or unit rear panels. All other references in the manual refer to EIA designations.

CAUTION – You should carefully review the following information.

Safety and Compliance

Electrical Safety and Compliance

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

Electrical Installation

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

Class I Pluggable Equipment Type A-Protective Earthing

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

In Finland:
"Laite on liitettävä suojakoskettimilla varustettuun pistorasiaan"

In Norway:
“Apparatet må tilkoples jordet stikkontakt”

In Sweden:
“Apparaten skall anslutas till jordat uttag”

Galvanic Isolator Use

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

Restricted Access Location

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

Battery Warning

CAUTION
Risk of explosion if battery is replaced by an incorrect type.Dispose of used batteries according to the instructions.

Operating Environment

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

- AMBIENT TEMPERATURES LESS THAN 0° C (32° F) OR MORE THAN 50° C (122° F).
- PRECIPITATION, CONDENSATION, OR HUMID ATMOSPHERES OF MORE THAN 95% RELATIVE HUMIDITY.
- UNPRESSURIZED ALTITUDES OF MORE THAN 2000 METRES (6561.7 FEET).
- EXCESSIVE DUST.
- FLAMMABLE GASES.
- CORROSIVE OR EXPLOSIVE ATMOSPHERES.

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

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

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

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

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

- Use coaxial cable that is of good quality for connections to the L-Band Type ‘N’ Rx (receive) female connector.
- Use Type 'D' connectors that have back-shells with continuous metallic shielding. Type ‘D’ cabling must have a continuous outer shield (either foil or braid, or both). The shield must be bonded to the back-shell.
- Operate the unit with its cover on at all times.

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

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

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

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

European Union RoHS Directive (2002/95/EC)

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

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

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

CE Mark

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

Product Support

For all product support, please call:

+1.240.243.1880

+1.866.472.3963 (toll free USA)

Comtech EF Data Headquarters

http://www.comtechefdata.com

Comtech EF Data Corp.

2114 West 7th Street

Tempe, Arizona USA 85281

+1.480.333.2200

Warranty Policy

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

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

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

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

Limitations of Warranty

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

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

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

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

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

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

Exclusive Remedies

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

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

Chapter 1. INTRODUCTION

1.1 Overview

Figure 1-1. CDM-760 Advanced High-Speed Trunking Modem

The CDM-760 Advanced High-Speed Trunking Modem (**Figure 1-1**) accommodates Internet Service Provider (ISP) and Telco backhaul links using advanced space segment saving capabilities while minimizing the need for unnecessary overhead. The CDM-760's high-performance architecture allows efficient networking and transport over satellite links while supporting a wide range of applications and network topologies.

The CDM-760 offers an expansive, ultra wide range of symbol rates (100 ksps to 150 Msps) and data rates (100 kbps to 314 Mbps or, when run in a duplex setting, 628 Mbps or 300 Msps). Coupling these speeds with the native Super Jumbo Frame (SJF) Ethernet interface, the CDM-760 supports Ethernet frames from 64 bytes to >10,000 bytes, and processes Ethernet frames >600,000 packets/second, or >1.2 Million packets/second when run in a duplex setting.

DVB-S2 has been widely accepted as one of the most spectrally efficient standards-based waveforms. Expanding on the efficient DVB-S2 EN 302 307 standards, the CDM-760 furthers spectral efficiency with its DVB-S2-EB1, DVB-S2-EB2 Efficiency Boost, and DVB-S2 Extended (DVB-S2X) technology waveforms:

- DVB-S2-EB1 affords a 10% to 35% increase in efficiency over the DVB-S2 standard without an increase in power or occupied bandwidth. The CDM-760 accomplishes this task by virtually doubling the number of available ModCods and introducing three new spectral rolloff (ROF) figures (5%, 10%, and 15%).
- DVB-S2-EB2 further increases throughput for 16APSK and 32APSK constellations and adds 64APSK constellations to the modem.
- The DVB-S2 Extended (DVB-S2X) specification features reduced rolloff options, additional ModCods, and greater efficiency when compared to DVB-S2.

Additionally:

- The CDM-760 implements Adaptive Coding and Modulation (ACM) operation. This allows link margin to be converted to user capacity during non-faded conditions by taking advantage of the actual signal-to-noise ratio rather than calculated worst case signal-to-noise.
- The CDM-760 uses Generic Stream Encapsulation (GSE), thereby increasing throughput by using minimal overhead. In G.703 synchronous mode, you can implement monitor and control over the satellite with no additional overhead. When using Ethernet bridge mode, less than 1% overhead is used for encapsulation.
- The CDM-760 offers Automatic Uplink Power Control (AUPC) to further improve link availability. AUPC is an algorithm that changes the TX power of either side of the link in order to compensate for fade conditions. AUPC communications between the modems is transparent to the user and uses less than 0.1% overhead in the satellite data link.
- Radio Frequency Interference (RFI) is the largest single issue that impacts Quality of Service for satellite operators. Comtech EF Data’s MetaCarrier® Carrier Identification (CID) technology is used to embed and detect carrier identification on video and data satellite carriers. This technology, which is a standard feature on the CDM-760, was adopted by the DVB organization and is now a DVB (DVB-CID) and ETSI (TS 103 129) standard to assist in the control of satellite interference.
- The CDM-760’s optional K4 GZIP lossless compression engine performs real-time compression of Ethernet traffic and is capable of running at the full rate of the modem. It offers 52% to 59% compression rates at random packet sizes using the Calgary Corpos bitstream. K4 GZIP can greatly increase the throughput of the satellite link, or reduce required bandwidth.
- The CDM-760 leverages Comtech EF Data’s DoubleTalk® Carrier-in-Carrier® “Adaptive Cancellation” technology. With the ability to overlay Tx and Rx carriers, Carrier-in-Carrier (CnC) allows you to establish an optimal balance between bandwidth and power, enabling the best possible use of the satellite resource and reducing operating expenses (OPEX).
- The optional High-Speed Packet Processor enables efficient IP networking and transport over satellite with a processing engine capable of handling >190,000 PPS simplex and >350,000 PPS duplex. The Packet Processor performs header compression and Quality of Service (QoS) ensuring the highest quality of service with minimal jitter and latency for real-time traffic, priority treatment of mission-critical applications and maximum bandwidth efficiency.
- The CDM-760 is software upgradeable, enabling support of future standards and waveforms.

1.2 Features

1.2.1 Physical Description

The CDM-760 Advanced High-Speed Trunking Modem is constructed as a 1RU-high rack-mounting chassis. Handles at the front allow easy placement into and removal from a rack. The unit can be free-standing if desired.

Physically, the modem is modular in design and is comprised of four major card assemblies, with an internal expansion slot on the modem card that accepts other option cards such as Carrier-in-Carrier (CnC) and K4 GZip lossless compression. Two Plug-In Interface Card (PIIC) slots are provided on the modem rear panel to implement a variety of data interface options; this space is also available to accommodate the optional High-Speed Packet Processor card.

1.2.1.1 Standard Assemblies

Assembly	Description	Where Installed
PL-0000596	Chassis (AC)	In chassis (top cover access)
PL-0021161	Main Card Baseband Card (includes Ethernet Interfaces)	
PL-0021262	Modulator Encoder Card / RF Front End	
PL-0021263	Digital Demodulator / Decoder Card	
PL-0000626	PIIC Motherboard Assembly	
KT-0000150	AC Power Supply for modem (not BUC)	

1.2.1.2 Optional Assemblies

Assembly	Description	Where Installed
PL-0000572	Carrier-in-Carrier Card	In chassis (top cover access), modem card plug-in
KT-0020958	High-Speed Packet Processor	In chassis (top cover access) – Kit replaces PIICs, PIIC motherboard, plug-in card; provided faceplate replaces PIIC Slots 1 and 2 chassis covers.
PL-0000635	K4 GZip Lossless Compression Card	In chassis (top cover access), modem card plug-in
IC-0000058	SFP Optical Gigabit Ethernet Data Interface	Rear Panel **J7 | Optical** port
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module	Real Panel PIIC Slots 1 and 2
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module	Real Panel PIIC Slots 1 and 2
KT-0000256	SFP OC-3 Single Mode PIIC Module	Real Panel PIIC Slots 1 and 2
KT-0000257	SFP OC-3 Multi Mode PIIC Module	Real Panel PIIC Slots 1 and 2
PL-0022015	DVB ASI (Asynchronous Serial Interface) PIIC Module	Real Panel PIIC Slots 1 and 2
KT-0000168	Rear-Mounting Support Bracket (4")	At rear sides of chassis, and rack rear mounting rails
KT-0000195	Rear-Mounting Support Bracket (10")	At rear sides of chassis, and rack rear mounting rails
FP/SL0006	Bearingless Side Railings	On sides of chassis

1.2.2 Dimensional Envelope

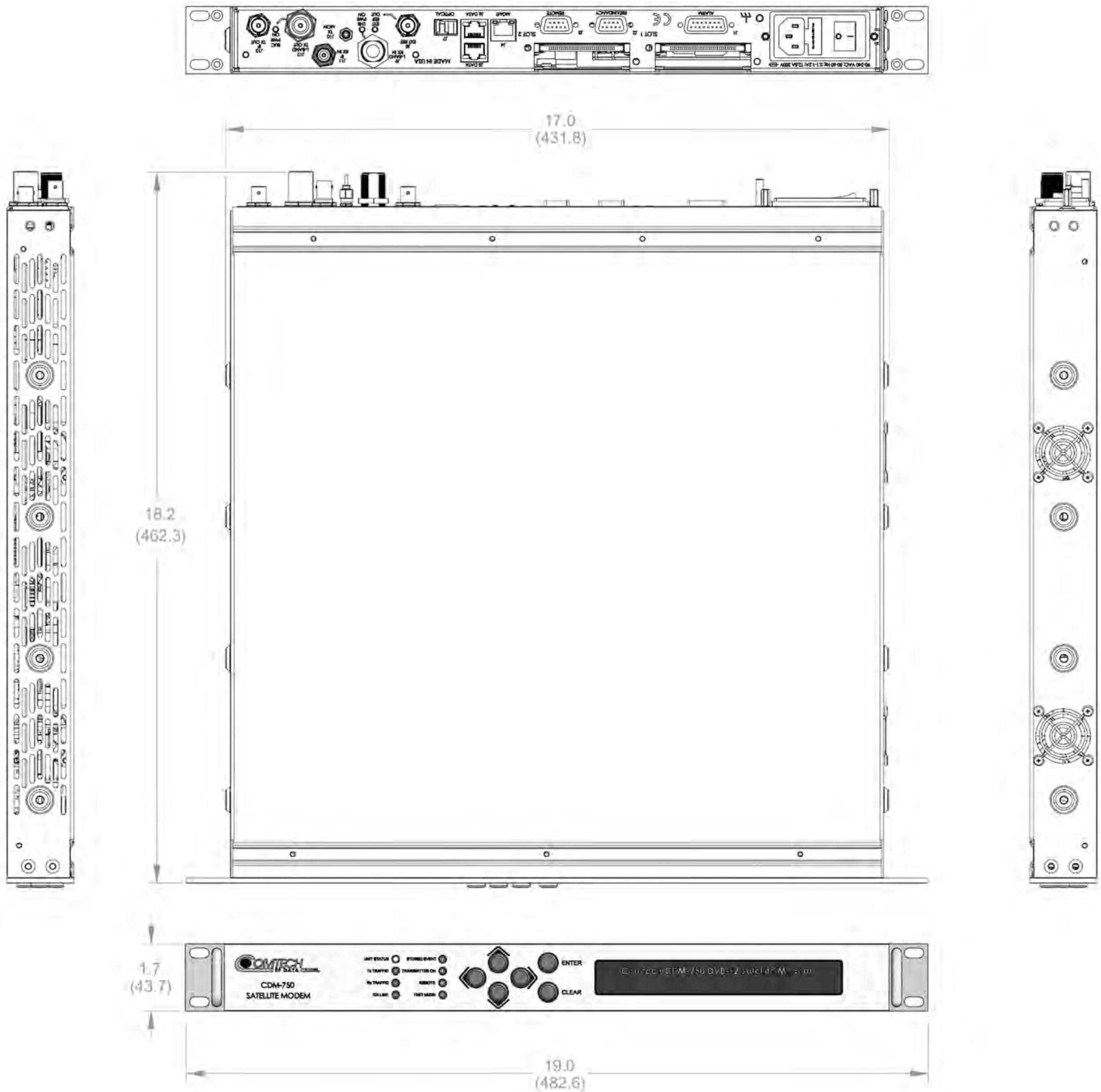


Figure 1-2. CDM-760 Dimensional Envelope

1.2.3 Physical Features

1.2.3.1 Front Panel Features

- **Chapter 2. INSTALLATION**
- **Chapter 6. FRONT PANEL OPERATION**

The LED indicators, keypad, and VFD (**Figure 1-3**) are described in detail in **Chapter 6. FRONT PANEL OPERATION**.

Figure 1-3. CDM-760 Front Panel View

1 **LED Indicators**
The LEDs show a summary status of modem operation.

2 **Keypad**
The keypad has six individual keys. The keys have a positive 'click' action that gives tactile feedback. Use the keypad to enter data.

3 **Vacuum Fluorescent Display (VFD)**
The VFD shows data, menus, prompts and messages. The VFD is an active display with adjustable brightness. It shows two lines of 40 characters each. Nested menus show all available options and prompts that guide you in carrying out required actions.

4 **Rack Handles**
In a rack enclosure, these handles help you install and remove the unit.

1.2.3.2 Rear Panel Features

- **Chapter 2. INSTALLATION**
- **Chapter 3. REAR PANEL CONNECTIONS**

CAUTION
CORRECT GROUNDING PROTECTION IS REQUIRED TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE. You must make sure the ground stud on the rear panel of the unit is always connected to the protective earth.

External cables are attached to connectors provided on the rear panel of the unit (**Figure 1-4**).

(TOP) Standard AC Unit (w/optional PIIC)
(MIDDLE) AC Unit (w/optional High-Speed Packet Processor)
(BOTTOM) Optional 48V DC Unit

Figure 1-4. CDM-760 Rear Panel View

1.2.3.2.1 Rear Panel Standard Features

Utility and Traffic Data Interfaces:

- (1X) **J1|ALARM** DB-15M connector for Form C unit alarms, analog Es/No, and Tx Mute.
- (1X) **J3|REMOTE** DB-9F 'EIA-232 connector for serial remote control:
- (1X) **J4|MGMT** 10/100/1000 BaseT Fast Ethernet RJ-45 Interface for Ethernet-based management and control purposes (HTTP/Web and SNMP).
- (2X) **J5|DATA** and **J6|DATA** 10/100/1000 BaseT Gigabit Ethernet RJ-45 Interface ports for Ethernet traffic.
- (1X) **J8 | EXT REF** Type 'BNC' female input/output connector for supply of a master reference to the modem.

IF Interfaces:

- (2X) **J9 | L-BAND RX IN** and **J12 | L-BAND TX OUT** Type 'N' female connectors for 50Ω L-Band (950 to 2150 MHz) input/output.
- (2X) **J11 | IF RX IN** and **J13 | IF TX OUT** Type 'BNC' female connectors for 75Ω (standard) or 50Ω (optional) 70/140 MHz input/output.
- (1X) **J10 | TX MON** Type 'SMA' female connector for L-Band signal user monitor output.

Power Interface:

- 100-240 VAC Primary Input Power Supply with Press-fit Fuse Holder

1.2.3.2.2 Rear Panel Optional Features

These Data Interfaces (for optional hardware and/or FAST-enabled operation) are available from Comtech EF Data:

- (1X) Optical Gigabit Ethernet interface via the **J7|OPTICAL** cage, which accepts the optional SFP [Small Form Factor Pluggable] Module.
- (2X) PIIC (Plug-In Interface Card) slots accommodate these data interface options:
  - G.703 E3/T3/STS-1 (34.368/44.768/51.84 Mbps).
  - OC-3 Single Mode and Multi Mode (155.52 Mbps).
  - STS-1 Copper (155.52 Mbps).
  - DVB ASI (Asynchronous Serial Interface) (up to 210 Mbps).
  - Additional PIIC data interface options (HSSI, etc.) will become available upon request.
- (1X) Optional High-Speed Packet Processor card can be installed into the modem chassis space otherwise occupied by the PIICs. This option provides (from left):
  - (1X) **CLI** (Command Line Interface) RJ-11 port for implementing factory commands.
  - (1X) **P0 | MGMT** RJ-45 Gigabit Ethernet routed interface/management port.
  - (4X) **P1 | DATA** through **P4 | DATA** RJ-45 Gigabit Ethernet bridged interface ports.
- (1X) **J2|REDUNDANCY** DB-9M EIA-232 connector for interoperability with a separately purchased Comtech EF Data redundancy switch:
  - For 1:1 redundant applications, the CDM-760 is supported by the CRS-170A Redundancy Switch for L-Band operation, or the CRS-180 Redundancy Switch for 70/140 MHz operation.
  - M:N redundancy support is available using the CRS-500 M:N Redundancy System. The CRS-500 can be used **<u>only</u>** for CDM-760 1:10 operation with the 10/100/1000 BaseT Gigabit Ethernet and G.703 E3/T3/STS-1 data interfaces. The CRS-500 **<u>may not</u>** be used with any other data interface, nor can it be used for redundancy in MultiStream mode.

These Rear Panel Rack Support Brackets Kits are available from Comtech EF Data:

- KT-0000168 4” Rear-Mounting Support Brackets Kit
- KT-0000195 10” Rear-Mounting Support Brackets Kit

This Power Interface Option is available from Comtech EF Data:

- 48 VDC Primary Input Power Supply with Screw-in Fuse Holders.

These **FUTURE** Power Interface Options will be available from Comtech EF Data:

- 24 VDC BUC 90 Watt Power Supply (AC Input or DC Input versions). **FUTURE**
- 48 VDC BUC 150 Watt Power Supply (AC Input or DC Input versions). **FUTURE**

1.2.4 Verification

The CDM-760 includes many test modes and loopbacks for rapid verification of the correct functioning of the unit. Of particular note is the IF loopback, which permits the user to perform a quick diagnostic test without having to disturb external cabling.

During IF loopback, all of the receive configuration parameters are temporarily changed to match those of the transmit side, and an internal IF switch connects the modulator output to the demodulator input. When normal operation is again selected, all of the previous values are restored.

1.2.5 On-site Firmware Updates

Chapter 4. UPDATING FIRMWARE

Field update of the operating system firmware is possible through file upload via satellite or the Ethernet port.

1.2.6 On-site Operational Upgrades

Chapter 5. FAST ACTIVATION PROCEDURE

Field activation of software-based options is possible through Comtech's FAST (Fully Accessible System Topology) Feature upgrade process.

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

<table>
<tr><th>Description and Comments</th><th>Option Installation Method</th></tr>
<tr><td>ACM (Advanced Coding and Modulation) Point-to-Point</td><td rowspan="14">FAST</td></tr>
<tr><td>AUPC (Automatic Uplink Power Control)</td></tr>
<tr><td>150 Msps Rx symbol rate</td></tr>
<tr><td>150 Msps Tx symbol rate</td></tr>
<tr><td>Rx QPSK Demodulation</td></tr>
<tr><td>Rx 8-PSK Demodulation</td></tr>
<tr><td>Rx 16APSK Demodulation</td></tr>
<tr><td>Rx 32APSK and 64APSK Demodulation</td></tr>
<tr><td>Tx QPSK Modulation</td></tr>
<tr><td>Tx 8-PSK Modulation</td></tr>
<tr><td>Tx 16APSK Modulation</td></tr>
<tr><td>Tx 32APSK and 64APSK Modulation</td></tr>
<tr><td>DVB-S2 Efficiency Boost version X (DVB-S2-EBx)</td></tr>
<tr><td>DVB-S2 Extended (DVB-S2X)</td></tr>
<tr><td>Carrier-in-Carrier (CnC)</td><td rowspan="3">FAST & Hardware</td></tr>
<tr><td>K4 GZip Lossless Compression</td></tr>
<tr><td>Optical Gigabit Ethernet Interface</td></tr>
<tr><td>G.703 Data Interface E3/T3/STS-1 (34.368/ 44.768/51.84 Mbps)</td><td rowspan="5">Hardware</td></tr>
<tr><td>STM-1 Copper Data Interface (155.52 Mbps)</td></tr>
<tr><td>OC-3 Single Mode Data Interface (155.52 Mbps)</td></tr>
<tr><td>OC-3 Multi Mode Data Interface (155.52 Mbps)</td></tr>
<tr><td>High-Speed Packet Processor</td></tr>
</table>

1.2.7 Monitor and Control Interfaces

- **Chapter 6. FRONT PANEL OPERATION**
- **Chapter 7. ETHERNET INTERFACE OPERATION**
- **Chapter 8. SERIAL INTERFACE OPERATION**

The unit is managed through multiple interfaces providing options for both in-band (over satellite) and out-of-band monitor and control.

1.3 CDM-760 Specifications

1.3.1 System Specifications

Symbol/Date Rate Range	Programmable in 1 sps increments
DVB-S2	QPSK: 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 to 150 Msps / 261.9 Mbps max
	8-PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 to 120 Msps / 314.2 Mbps max
	16-APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 to 90 Msps / 313.5 Mbps max
	32-APSK: 3/4, 4/5, 5/6, 8/9, 9/10 to 72 Msps / 313.7 Mbps max
DVB-S2-EB1	QPSK: 1/2, 8/15, 17/30, 3/5, 19/30, 2/3,127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 150 Msps / 261.9 Mbps max
	8-PSK: 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 5/6, 31/36, 8/9, 9/10 to 120 Msps / 314.2 Mbps max
	16-APSK: 19/30, 2/3,127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 90 Msps / 313.5 Mbps max
	32-APSK: 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 72 Msps / 313.7 Mbps max
DVB-S2-EB2	QPSK: 1/2, 8/15, 17/30, 3/5, 19/30, 2/3,127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 150 Msps / 261.9 Mbps max
	8-PSK: 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 5/6, 31/36, 8/9, 9/10 to 120 Msps / 314.2 Mbps max
	16-APSK: 19/30, 2/3,127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 90 Msps / 313.5 Mbps max
	32-APSK: 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10 to 72 Msps / 313.7 Mbps max
	64-APSK: 4/5, 5/6, 31/36, 8/9, 9/10 to 54 Msps / 281.9 Mbps max
DVB-S2X	QPSK: ¼, 13/45, 1/3, 2/5, 9/20, ½, 11/20, 3/5, 2/3, ¾, 4/5, 5/6, 8/9, 9/10 to 150 Msps / 268.3 Mbps max
	8-PSK: 5/9L, 26/45L, 3/5, 23/36, 2/3, 25/36, 13/18, ¾, 5/6, 8/9, 9/10 to 120 Msps / 321.5Mbps max
	16-APSK: 1/2L, 5/9L, 26/45, 3/5, 3/5L, 28/45, 23/36, 2/3L, 2/3, 25/36, 13/18, ¾, 7/9, 4/5, 5/6, 77/90, 8/9, 9/10 to 90 Msps / 321 Mbps max
	32-APSK: 2/3L, 32/45, 11/15, ¾, 7/9, 4/5, 5/6, 8/9, 9/10 to 72 Msps / 320.6 Mbps max
	64-APSK: 32/45L, 11/15, 7/9, 4/5, 5/6 to 54 Msps / 266.6 Mbps max
FECFrame	Standard (64,800 bits) or Short (16,200 bits)
Pilots	On or Off
Alpha (Rolloff)	20%, 25% or 35% (in DVB-S2 mode) 5%, 10%, 15%, 20%, 25% or 35% (in DVB-S2-EBx mode or DVB-S2X mode)
Management	Front panel keypad / display EIA-232 /485, or 10/100/1000 BaseT with, SNMP, Telnet, HTTP
Firmware Update	Ethernet management port
Frequency Stability	Internal, stability ±0.06 ppm
Form C	Modulator, demodulator and Unit fault
Configuration Retention	Non-volatile memory; Returns upon power up
External Reference I/O	Reference Selections: Internal 10 MHz, External Input 1, 2, 5, 10 MHz at -6dBm to +10dBm (nominal 50/75Ω, BNC female connector)
	Output Selection: (internal 10 MHz) at 2.7 volts peak-to-peak ± 0.4 volts, low impedance output
	Tx and Rx IF and L-Band synthesizers phase lock to the reference.

1.3.2 Environmental and Physical

Temperature	**Operating**	0 to 50ºC (32 to 122ºF)
	Storage	-40 to 70ºC (-40 to 158ºF)
Humidity		95% maximum, non-condensing
Power Supply Input	**AC**	100-240 VAC, 50/60 Hz
	Optional 48V DC	43-60 VDC
Power Consumption	**120 VAC @ 60 Hz**	88W, 93 VA typical
	230 VAC @ 50 Hz	88W, 133 VA typical
	Optional 48 VDC	85W typical
Dimensions		1.75 (1 RU) H x 19.0 W x 18.65 D inches (4.4 H x 48.3 W x 47.4 D cm)
Weight		15 lbs (6.8 kg)
AC Receptacles		Includes restraint for standard IEC-320 inlet

1.3.3 Base Unit Connectors

Alarm Connector	DB-15 male: Form C; Tx, Rx and unit faults; External Tx Carrier Off; IQ test point
Unit Management	DB-9 male with EIA-232 and RS 485 2W/4W
	RJ-45 Ethernet (Maximum Ethernet packet size 10,240 bytes including Ethernet header & CRC)
Tx & Rx IF Connectors	70/140 MHz: BNC
	L-Band: Type 'N' female
L-Band Monitor	Type 'SM**A** female
Traffic Data Interface	2X RJ45 10/100/1000 BaseT Ethernet
	1X Optical Gigabit Ethernet (optional) **Note**: All Data GigE interfaces have a maximum Ethernet packet size of 1632 bytes including Ethernet header & CRC

1.3.4 Test Functions

Data Test Pattern	2^10-1, 2^15-1 and 2^23-1 compatible with BERT on applicable interfaces
CW	Modulation disabled and CW signal is transmitted
SSB Carrier	Provides suppressed carrier and suppressed sideband
Loopback	Full Duplex only

1.3.5 Modulator (Dual IF)

70 / 140 MHz	50 to 180 MHz in 100 Hz steps, maximum symbol rate is within IF limits
Impedance / Connector	75 Ω / BNC Female. Return Loss ≥ 18 dB
Output Power	0 to -25 dBm, 0.1 dB steps (70/140 MHz)
Power Accuracy	±0.5 dB of nominal at 25°C. Within ±0.5 dB from 25°C value at same frequency
L-Band	950-2150 MHz in 100 Hz steps, modulator maximum symbol rate is within IF limits
Impedance / Connector	50Ω, Type N Female. Return Loss ≥ 15 dB
Output Power	-0 to -40 dBm, 0.1 dB steps
Power Accuracy	±0.5 dB of nominal at 25°C, ±0.5 dB from 25°C value at same frequency

L-Band Monitor **Port Impedance** **Port Connector** **Port Level** **Port Isolation** **Monitor Frequency**	 50 Ω (available in modulator only or modem configuration) SMA Female -27 dBm ± 3dBm 20 dB min 70/140 MHz: 900+70/140 MHz, L-Band: same.			
Harmonics and Spurs	< 60 dBc/4kHz, modulated carrier. Excludes spectral mask area.			
External Tx Carrier Off	TTL Low signal			
Quadrature Phase Error and Amplitude Imbalance	Sideband 35 dB below unmodulated carrier			
Spectral Inversion	Normal or Inverted			
Carrier Phase Noise	**Frequency Offset**	**dBc/Hz**	**Frequency Offset**	**dBc/Hz**
	10 Hz	-36	10 kHz	-86
	100 Hz	-66	100 kHz	-96
	1 kHz	-76	1 MHz	-96
BUC 10 MHz Reference (FUTURE)	**Frequency Offset**	**dBc/Hz**	**Frequency Offset**	**dBc/Hz**

1.3.6 Demodulator (Dual IF)

70 / 140 MHz **Impedance / Connector** **Desired Carrier Input Power** **Maximum Composite Level**	50 to 180 MHz in 100 Hz steps 75 Ω / BNC Female. Return loss 15 dB min Min. = -58 +10_{log} (SR in Msps) dBm. Max. = -23 + 10_{log} (SR in Msps) dBm, See Figure 1-5 +10 dBm
L-Band **Impedance / Connector** **Desired Carrier Input Power** **Maximum Composite Level**	950-2150 MHz in 100 Hz steps, demodulator 50Ω, Type N Female. Return loss 10 dB min Min. = -70 + 10_{Log} (SR in Msps) dBm. Max. = -20 + 10_{Log} (SR in Msps) dBm, See Figure 1-6 +20 dBm
Acquisition Range	For SR < 1Msps, +/- 0.1 * SR, For SR >= 1 Msps, +/- 100 KHz

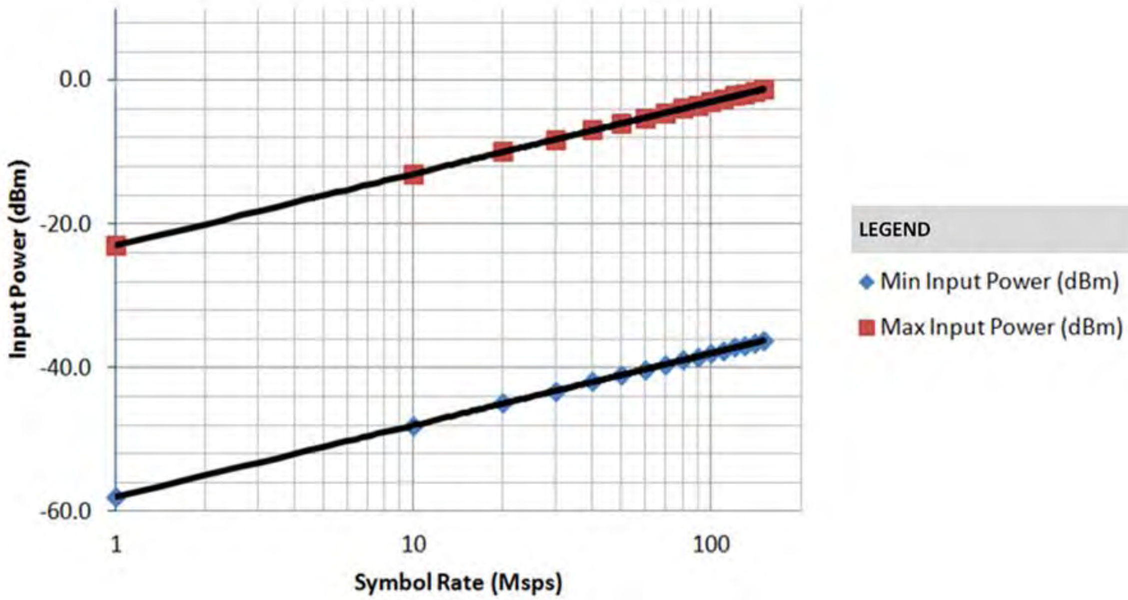


Figure 1-5. 70/140 MHz Input Level vs. Symbol Rate

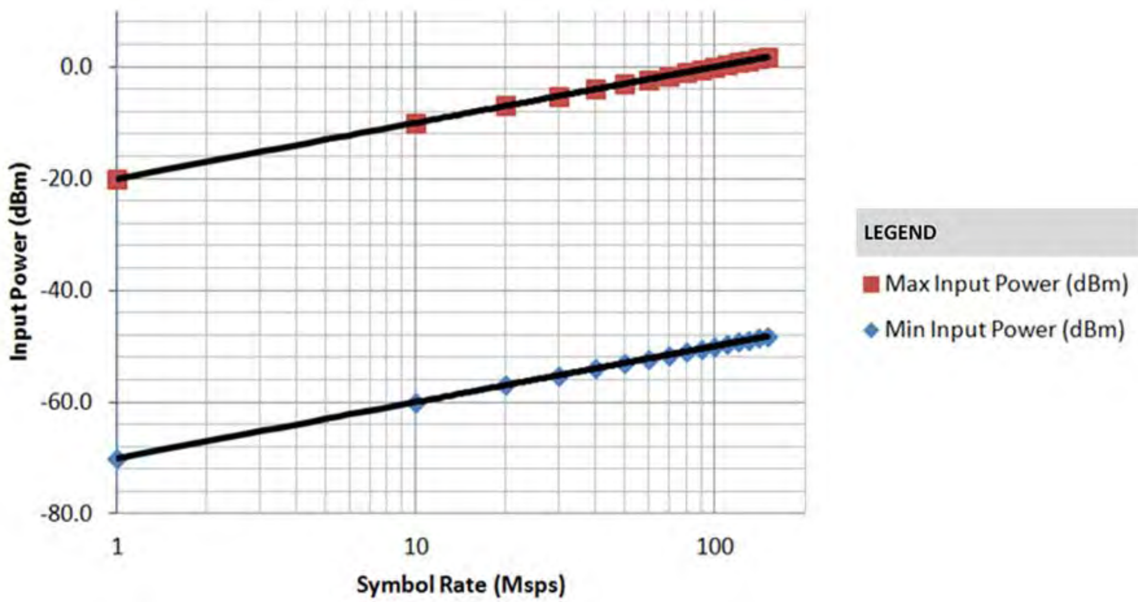


Figure 1-6. L-Band Input Level vs. Symbol Rate

1.3.6.1 Es/No Performance

- **Chapter 6. FRONT PANEL OPERATION, Tables 6-3 through 6-5**
- **Appendix B. EsNo MEASUREMENT**

- **As per DVB-S2 QEF PER 10-7 Specifications (Normal Frames)**
- **Applies with one like-modulated carrier spaced 1.3 x Symbol Rate and 10 dB higher than the desired carrier**
- **Conditions are 30 Msps and Pilots ON**

DVBS2, Normal Block, Pilot ON, QEF (PER 1E-7) AWGN Linear Channel								
MOD	**FEC**	**Min SR (Msps)**	**Max SR (Msps)**	**Min DR (Mbps)**	**Max DR (Mbps)**	**Spec Eff (Bits/Hz)**	**QEF Eb/No**	**QEF Es/No**
QPSK	1/4	0.1	150	0.05	72	0.48	0.9	-2.3
	1/3	0.1	150	0.06	96	0.64	0.8	-1.1
	2/5	0.1	150	0.08	115.5	0.77	0.9	-0.2
	1/2	0.1	150	0.10	144.80	0.97	1.4	1.2
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
	3/4	0.1	150	0.15	217.80	1.45	2.6	4.2
	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	2/3	0.1	120	0.19	232.30	1.94	3.9	6.8
	3/4	0.1	120	0.22	261.40	2.18	4.7	8.1
	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.20	2.62	7.0	11.2
16APSK	2/3	0.1	90	0.26	231.80	2.58	5.2	9.3
	3/4	0.1	90	0.29	260.60	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4	11.3
	5/6	0.1	90	0.32	290.00	3.22	6.8	11.9
	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	9/10	0.1	90	0.35	313.50	3.48	8.0	13.4
32APSK	3/4	0.1	72	0.36	260.90	3.62	7.5	13.1
	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
	5/6	0.1	72	0.40	290.20	4.03	8.6	14.7
	8/9	0.1	72	0.43	309.80	4.30	9.8	16.1
	9/10	0.1	72	0.44	313.70	4.36	10.0	16.4

DVB-S2-EB1 / EB2*, Normal Block, Pilot ON, QEF (PER 1E-7) AWGN Linear Channel								
MOD	**FEC**	**Min SR (Msps)**	**Max SR (Msps)**	**Min DR (Mbps)**	**Max DR (Mbps)**	**Spec Eff (Bits/Hz)**	**QEF Eb/No (* = EB2)**	**QEF Es/No (* = EB2)**
QPSK	1/4	0.1	150	0.05	72.00	0.48	0.9	-2.3
	53/180	0.1	150	0.06	85.50	0.57	1 / 0.9*	-1.4 / -1.5*
	1/3	0.1	150	0.06	96.00	0.64	0.8	-1.1
	11/30	0.1	150	0.07	106.50	0.71	1.0	-0.5
	2/5	0.1	150	0.08	115.50	0.77	0.9	-0.2
	77/180	0.1	150	0.08	123.00	0.82	1.2	0.3
	83/180	0.1	150	0.09	133.50	0.89	1.3	0.8
	1/2	0.1	150	0.10	145.50	0.97	1.3	1.2
	8/15	0.1	150	0.10	154.50	1.03	1.6	1.7
	17/30	0.1	150	0.11	165.00	1.10	1.7	2.1
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	19/30	0.1	150	0.12	183.00	1.22	1.9	2.8
	2/3	0.1	150	0.13	193.50	1.29	2.2	3.3
	127/180	0.1	150	0.14	205.50	1.37	2.4	3.8
	3/4	0.1	150	0.15	217.50	1.45	2.6	4.2
	4/5	0.1	150	0.16	232.50	1.55	3.0	4.9
	5/6	0.1	150	0.16	243.00	1.62	3.3	5.4
	31/36	0.1	150	0.17	250.50	1.67	3.7	5.9
	8/9	0.1	150	0.17	258.00	1.72	4.0	6.4
	9/10	0.1	150	0.18	262.50	1.75	4.2	6.6
8PSK	17/30	0.1	120	0.16	196.80	1.64	3.8	5.9
	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	19/30	0.1	120	0.18	220.80	1.84	3.9	6.5
	2/3	0.1	120	0.19	232.80	1.94	3.9	6.8
	127/180	0.1	120	0.21	246.00	2.05	4.7 / 4.5*	7.8 / 7.6*
	3/4	0.1	120	0.22	261.60	2.18	4.7	8.1
	4/5	0.1	120	0.23	278.40	2.32	5.3	9.0
	5/6	0.1	120	0.24	290.40	2.42	5.8	9.6
	31/36	0.1	120	0.25	300.00	2.50	6.3	10.3
	8/9	0.1	120	0.26	310.80	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.40	2.62	7.0	11.2
16APSK	19/30	0.1	90	0.24	219.60	2.44	5.3 / 5*	9.2 / 8.9*
	2/3	0.1	90	0.26	231.30	2.57	5.2 / 5.1*	9.3 / 9.2*
	127/180	0.1	90	0.27	244.80	2.72	5.7 / 5.5*	10 / 9.8*
	3/4	0.1	90	0.29	261.00	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4 / 6.3*	11.3 / 11.2*
	5/6	0.1	90	0.32	289.80	3.22	6.8 / 6.7*	11.9 / 11.8*
	31/36	0.1	90	0.33	299.70	3.33	7.6 / 7.2*	12.8 / 12.4*
	8/9	0.1	90	0.34	309.60	3.44	7.8 / 7.6*	13.2 / 13*
	9/10	0.1	90	0.35	313.20	3.48	8 / 7.9*	13.4 / 13.3*
32APSK	127/180	0.1	72	0.34	245.52	3.41	7.2 / 7*	12.5 / 12.3*
	3/4	0.1	72	0.36	260.64	3.62	7.5 / 7.3*	13.1 / 12.9*
	4/5	0.1	72	0.39	278.64	3.87	8.1 / 8*	14 / 13.9*
	5/6	0.1	72	0.40	290.16	4.03	8.6 / 8.4*	14.7 / 14.5*
	31/36	0.1	72	0.42	299.52	4.16	9.2 / 8.9*	15.4 / 15.1*
	8/9	0.1	72	0.43	309.60	4.30	9.8 / 9.4*	16.1 / 15.7*
	9/10	0.1	72	0.44	313.92	4.36	10 / 9.8*	16.4 / 16.2*
64APSK *	4/5	0.1	54	0.46	250.02	4.63	NA / 10.4*	NA / 17.1*
	5/6	0.1	54	0.48	260.28	4.82	NA / 11.1*	NA / 17.9*
	31/36	0.1	54	0.50	268.92	4.98	NA / 11.5*	NA / 18.5*
	8/9	0.1	54	0.52	278.10	5.15	NA / 12.3*	NA / 19.4*
	9/10	0.1	54	0.52	281.88	5.22	NA / 12.7*	NA / 19.9*

DVB-S2X (in addition to DVB-S2 ModCods), Normal Block, Pilot ON, QEF (FER 1E-5) AWGN Linear Channel								
MOD	**FEC**	**Min SR (Msps)**	**Max SR (Msps)**	**Min DR (Mbps)**	**Max DR (Mbps)**	**Spec Eff (Bits / Hz)**	**QEF Eb/No (* = EB2)**	**QEF Es/No (* = EB2)**
QPSK	13/45	0.1	150	0.06	83.14	0.55	0.8	-1.8
	9/20	0.1	150	0.09	130.20	0.87	1.0	0.4
	11/20	0.1	150	0.11	159.40	1.06	1.4	1.7
8PSK	5/9-L	0.1	120	0.16	193.18	1.61	2.9	5.0
	26/45-L	0.1	120	0.17	200.96	1.67	3.2	5.4
	23/36	0.1	120	0.19	222.37	1.85	3.8	6.5
	25/36	0.1	120	0.20	241.84	2.02	4.3	7.3
	13/18	0.1	120	0.21	251.57	2.10	4.5	7.7
16APSK	1/2-L	0.1	90	0.19	173.29	1.93	3.5	6.3
	8/15-L	0.1	90	0.21	184.94	2.05	3.7	6.8
	5/9-L	0.1	90	0.21	192.71	2.14	3.8	7.1
	26/45	0.1	90	0.22	200.47	2.23	4.4	7.9
	3/5	0.1	90	0.23	208.24	2.31	4.7	8.3
	3/5-L	0.1	90	0.23	208.24	2.31	4.1	7.7
	28/45	0.1	90	0.24	216.01	2.40	4.7	8.5
	23/36	0.1	90	0.25	221.83	2.46	4.7	8.6
	2/3-L	0.1	90	0.26	231.54	2.57	4.5	8.6
	25/36	0.1	90	0.27	241.25	2.68	5.3	9.6
	13/18	0.1	90	0.28	250.96	2.79	5.5	10.0
	7/9	0.1	90	0.30	270.38	3.00	6.1	10.9
	77/90	0.1	90	0.33	297.56	3.31	7.1	12.3
32APSK	2/3-L	0.1	72	0.32	231.73	3.22	6.5	11.6
	32/45	0.1	72	0.34	247.28	3.43	6.8	12.2
	11/15	0.1	72	0.35	255.05	3.54	7.1	12.6
	7/9	0.1	72	0.38	270.60	3.76	7.8	13.5
64APSK	32/45-L	0.1	54	0.41	222.01	4.11	8.4	14.5
	11/15	0.1	54	0.42	228.99	4.24	9.0	15.3
	7/9	0.1	54	0.45	242.95	4.50	9.5	16.0
	4/5	0.1	54	0.46	249.93	4.63	9.7	16.4
	5/6	0.1	54	0.48	260.39	4.82	10.3	17.1

1.3.7 Adaptive Coding and Modulation (ACM)

ACM Operational Mode	Functional in DVB-S2, DVB-S2-EB1/EB2, or DVB-S2X network specification modes
Symbol Rate Range	1 to 150 Msps
Interface	10/100/100BaseT Ethernet, with auto-sensing 10/100/1000 and auto-crossover detection or optional Optical Gigabit Ethernet interface
Remote Es/No reporting	Automatically reported from remote modem
Max span of data rate	0.1 to 314 Mbps (entire range of modem capability)
Switch point (decreasing Es/No)	Corresponds to Es/No (plus impairments) at QEF (~PER = 10^{-7})
Max fading rate	Configurable Target Es/No margin from 0.0 to 4.5 dB

Max ModCod update rate	Updates to the MODCOD can happen up to 4 times per second (no restriction on distance between MODCODs)
Configurable parameters	Minimum and Maximum ModCod
	Remote Demodulator Unlock options: • Maintain current ModCod • Go to minimum ModCod
	Es/No Target Margin: 0.0 to 4.5 dB0 in 0.1 dB steps
	Modulation Type Impairment selection: • Impairment for QPSK, 8PSK, 16APSK, 32APSK, and 64APSK: 0 to 9.9 dB in 0.1 dB steps • Impairment for QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK≤ 64APSK
Monitored parameters	Tx and Rx ModCods
	Local and Remote Es/No: (-3.0 dB to +22.0dB, 0.1dB resolution)
	Configuration and monitor menus displaying data rate, modulation and code rate update dynamically with ModCod

1.3.8 DoubleTalk® Carrier-in-Carrier® (CnC)

Operating Mode	Requires the two carriers in a duplex circuit to share a common frequency. Different symbol rates are allowed.
Symbol Rate Range	0.1Msps to 63 Msps
CnC Ratio	Ratio of Interferer Carrier Power to Desired Carrier Power (in dB). Positive values represent a stronger Interferer Carrier, and negative values represent a stronger Desired Carrier. Range is +7 dB to -7 dB.
Symbol Rate Ratio	3:1 Tx/Rx or Rx/Tx
Inbound/Outbound frequency uncertainty	±100kHz
Delay range	0 - 300 ms (230 - 290 ms factory default)
Es/No Degradation (dB) measured at 0.0 dB CnC Ratio	QPSK, 0.3 dB 8-PSK, 0.3 dB 16-APSK, 0.4 dB 32-APSK, 0.6 dB
Monitor Functions	Delay, in milliseconds
	Frequency offset (between outbound interferer and desired inbound): 100 Hz resolution
	CnC ratio, in dB (ratio of absolute power, outbound interferer to desired inbound)
CnC Monitor Accuracy	± 1.0 dB for symmetric symbol rate

1.3.9 Regulatory Compliance

"CE" as follows:	EN 55022 Class A (Emissions) EN 50082-1 (Immunity) EN 60950 (Safety)	EN 61000-3-2 EN 61000-3-3 EN 61000-4-2 EN 61000-4-4 EN 61000-4-5	EN 61000-4-6 EN 61000-4-8 EN 61000-4-9 EN 61000-4-11 EN 61000-4-13
FCC	FCC Part 15 Subpart B		
RoHS Compliance	Yes		

Chapter 2. INSTALLATION

2.1 Unpack and Inspect the Equipment

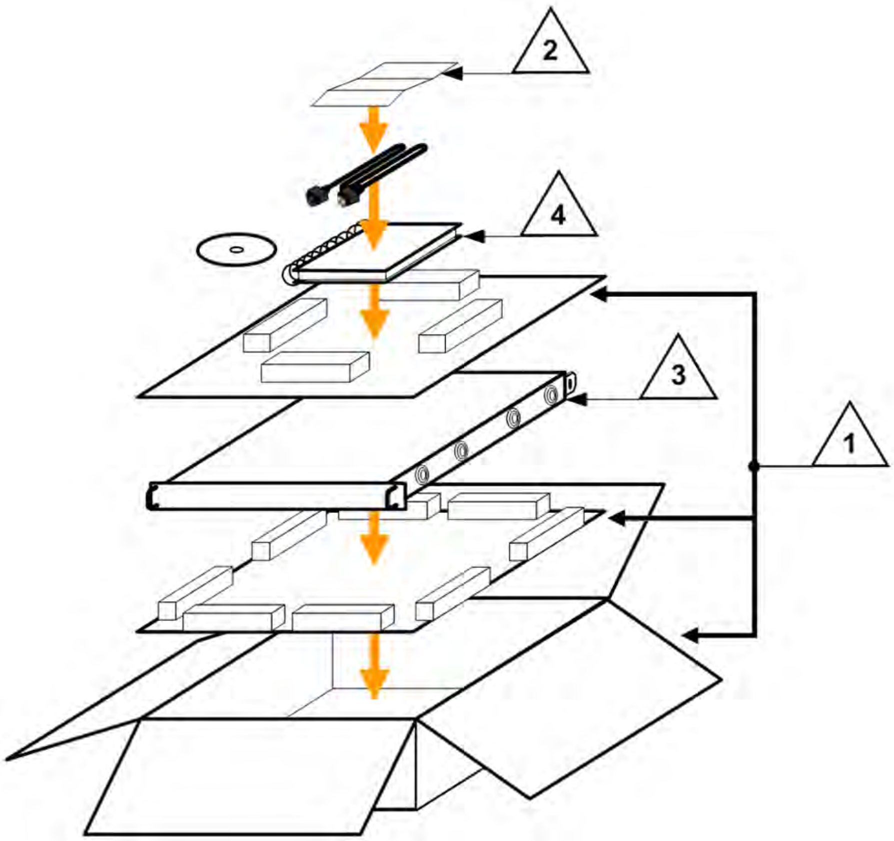


Figure 2-1. Unpack and Inspect the Shipment

The CDM-760 Advanced High-Speed Trunking Modem, its optional Installation and Operation Manual (otherwise available online at http://www.comtechefdata.com), and its power cord were packaged and shipped in a reusable cardboard carton containing protective foam spacing.

CAUTION
THIS EQUIPMENT CONTAINS PARTS AND ASSEMBLIES SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING THE EQUIPMENT.

Once opened, inspect the shipment:

Step	Task
1	Keep all shipping materials.
2	Check the packing list to make sure the shipment is complete.
3	Inspect the equipment for damage. If damage exists, immediately contact the carrier and Comtech EF Data to submit a damage report.
4	Read the manual.

2.2 Install the Unit Into a Rack Enclosure

Install the CDM-760 in its assigned position in the rack enclosure (**Figure 2-2**).

Use, as required:

- A standard rack-mounted shelf;
- User-supplied screws to secure the front panel to the rack enclosure threaded front mounting rails;
- Comtech EF Data’s optional KT-0000168 (4”) or KT-0000195 (10”) Rear Support Brackets Kit (**Figure 2-3**).
- Comtech EF Data’s optional FP/SL0006 Bearingless Rack Slide Set (**Figure 2-4**).

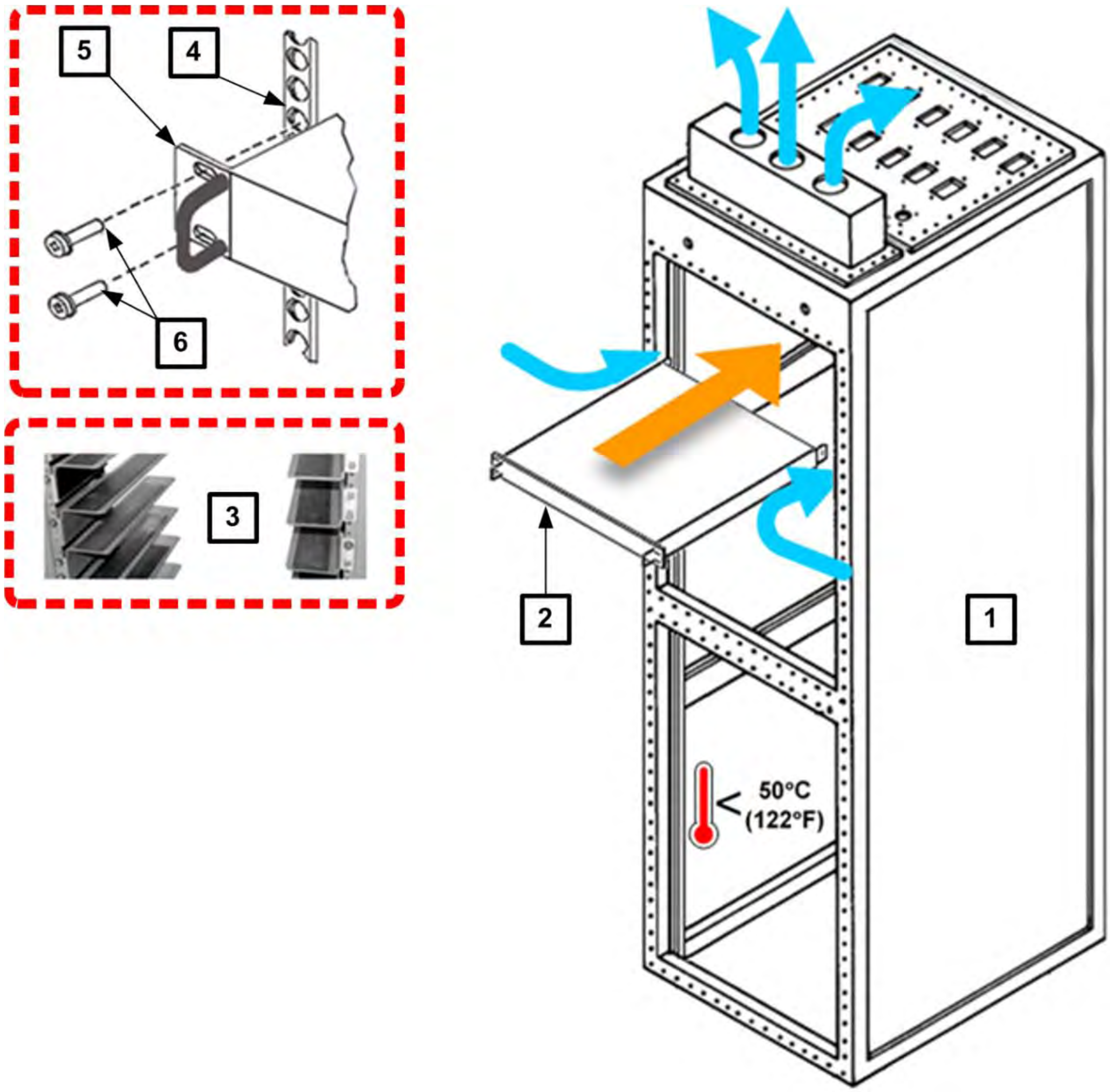
For information about custom rack enclosures, contact Comtech EF Data Product Support.

CAUTION
CORRECT GROUNDING PROTECTION IS REQUIRED TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

You must make sure the ground stud on the rear panel of the unit is always connected to the protective earth.

SUFFICIENT AIR VENTILATION IS REQUIRED:
Make sure there is adequate air ventilation clearance inside the enclosure, especially at the side. In a rack system where there is high heat discharge, provide forced-air cooling with top- or bottom-mounted fans or blowers.

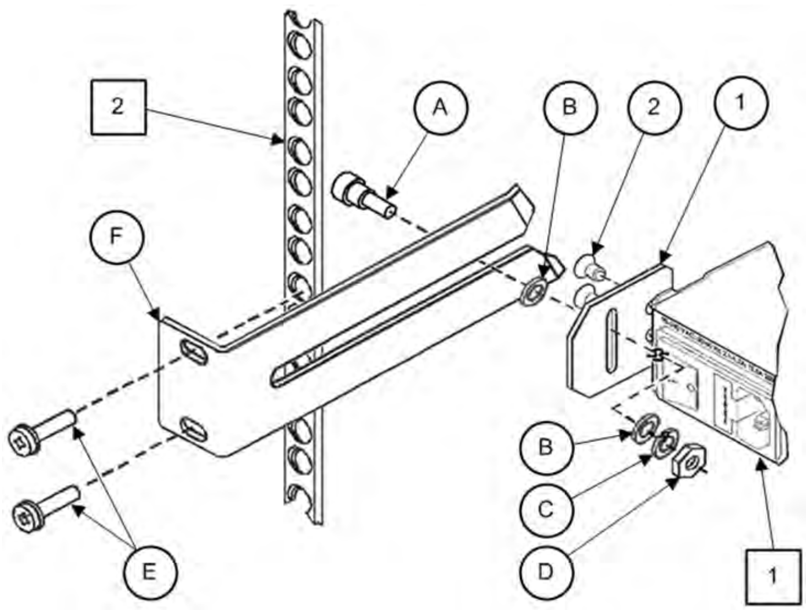
MAXIMUM AIR TEMPERATURE:
Make sure the air temperature inside the enclosure never exceeds 50°C (122°F).



Feature	Description
1	Custom Rack Enclosure
2	CDM-760 Unit
3	Standard Rack Shelving
4	Rack Enclosure Threaded Front Rail (typical)
5	Unit Front Panel
6	User-supplied Screws

Figure 2-2. Install the Unit Into a Rack Enclosure

2.2.1 Install the Optional Rear Support Brackets Kit



Feature	Description
1	Back of Unit
2	Rack Enclosure Threaded Rear Mounting Rail (typical)

KT-0000XXX Primary Rear Support Brackets Kit				
Item	Quantity		CEFD Part Number	Description
	KT-0000168	KT-0000195		
1	2	2	FP-0000913	Plate, Adapter
2	4	4	HW/10-32X3/8FLT	Screw, #10 Flat Head
3	1	–	KT/6228-2	4" Rear Support Bracket Kit
	–	1	KT/6228-3	10" Rear Support Bracket Kit

KT/6228-X Rear Support Bracket Kit				
Item	Quantity		CEFD Part Number	Description
	KT/6228-2	KT/6228-3		
A	2	2	HW/10-32SHLDR	Screw, #10 Shoulder
B	4	4	HW/10-32FLT	Washer, #10 Flat
C	2	2	HW/10-32SPLIT	Washer, #10 Split
D	2	2	HW/10-32HEXNUT	Nut, #10 Hex
E	4	4	HW/10-32x1/2RK	Bolt, #10 Rack Bracket
F	2	–	FP/6138-2	Bracket, Rear Support – 4"
	–	2	FP/6138-3	Bracket, Rear Support – 10"

Figure 2-3. Install the Optional Rear Support Brackets Kit

Tools needed to install the optional KT-0000168 (4”) or KT-0000195 (10”) Brackets Kit:

- A medium Phillips™ screwdriver
- A 5/32-inch SAE Allen™ Wrench
- An adjustable Crescent™ wrench.

Do these steps to install the brackets kit (**Figure 2-3**):

Step	Description
1	Assemble the Adapter Plates to the back sides of the CDM-760 chassis using the #10 Flat Head Screws.
2	Assemble the #10 Shoulder Screws through the Adapter Plate mounting slots using the #10 Flat Washers, #10 Split Washers, and #10 Hex Nuts.
3	Mount the Rear Support Brackets to the rack enclosure threaded rear mounting rails using the #10 Rack Bracket Bolts.
4	Slide the CDM-760 into the front of the rack enclosure. Make sure that the #10 Shoulder Screws properly engage into the slots of the Rear Support Brackets.

2.2.2 Install the Optional Bearingless Rack Slide Set

CEFD Part Number	Description
FP/SL0006	Bearingless Rack Slide Set – 26”

Figure 2-4. Install the Optional Bearingless Rack Slide Set

The optional FP/SL0006 Bearingless Rack Slide Set may be installed into the equipment rack enclosure and onto the sides of the CDM-760.

Do these steps to install the slide set (**Figure 2-4**):

Step	Task
1	Use the provided mounting hardware to install one slide onto each side of the CDM-760 chassis.
2	Use the provided mounting hardware to install the slide rail components into each interior side of the rack enclosure.
3	Mount the unit into the front of the rack enclosure. Ensure that the slides properly engage the enclosure-mounted slide rails.
4	Continue to slide the modem into the rack enclosure to its final operating position. You may then use four user-supplied screws to secure the modem to the enclosure’s threaded front mounting rails (through the modem front panel mounting slots).

Chapter 3. REAR PANEL CONNECTIONS

3.1 Cabling Connection Types

The cable and connector types described in this section are commonly used in many CEFD products. This unit may not use all of these types. Each cable type is typically dedicated to a specific mode of operation.

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

3.1.1 Coaxial Cable Connections

Coupling Type	Connector Type	
	Plug	Jack
Bayonet (Type 'BNC' shown)		
Threaded (Type 'N' shown)		

Figure 3-1. Coaxial Connector Examples

The types of coaxial cables used by Comtech EF Data are '**BNC**', '**TNC**', '**N**', '**F**', and '**SMA**'. Coaxial cables (plugs) and their mating connectors (jacks/sockets) are available in two coupling styles – **Bayonet** or **Threaded**:

- **Bayonet Coupling Style:** The jack has a pair of guideposts that accommodate the plug's lockdown slots. This lockdown design provides secure assembly without over-tightening the connection.

- **Threaded Coupling Style:** The jack features external threads. The plug shell features internal threads, and has either a knurled outer surface to permit hand-tightening of the connection, or hex flats to accommodate torqued installation.

Connection Instructions:

- **Bayonet Coupling Connections:** Use the plug slots to guide, then slide the plug onto the jack posts. Then, turn the plug clockwise until the jack posts are fully seated within the plug slot.
- **Threaded Coupling Connections:** Engage the plug onto the jack threads, and then turn the plug clockwise until it is fully threaded onto the jack. Do not over-tighten the connection.

3.1.1.1 Type 'BNC'

BNC plugs and jacks feature a **Bayonet Coupling** design.


3.1.1.2 Type 'TNC'

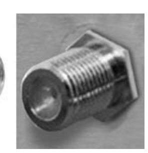
TNC plugs and jacks feature a **Threaded Coupling** design similar to Type 'N', Type 'F,' and Type 'SMA' connectors.


3.1.1.3 Type 'N'

Type 'N' connectors feature a **Threaded Coupling** design similar to Type 'TNC', Type 'F', and Type 'SMA' connectors.


3.1.1.4 Type 'F'

Type 'F' connectors feature a **Threaded Coupling** design similar to Type 'TNC', Type 'N', and Type 'SMA' connectors.

3.1.1.5 Type 'SMA' (Subminiature Version 'A')

Type 'SMA' connectors feature a **Threaded Coupling** design similar to Type 'TNC', Type 'N', and Type 'F' connectors.


3.1.2 D-Subminiature Cable Connections

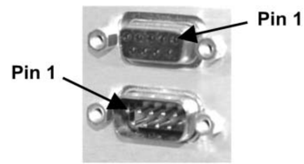
Type 'D' Connection Type	Example
Chassis Receptacles: **Female (top)** **Male (bottom)**	
Type 'D' Cable with Jack Screws **(female shown)**	

Figure 3-2. D-Subminiature Connector Examples

D-Subminiature connectors are also called **Type 'D'** or '**D-Sub**' connectors. The connector pair features multiple rows of pins (male side) coupled to mating sockets (female side). The cable plug and chassis receptacle each feature a D-shaped profile that interlock to ensure proper pin orientation and connector seating.

Either chassis receptacle gender features two jack nuts for secure assembly of the cable plug to the chassis receptacle.

Whether its gender is male or female, the cable plug features two jack screws for secure connection to the jack nuts provided on the mating chassis receptacle. The jack screws may be hand tightened or tightened with a standard flat-blade screwdriver.

Connection Instructions: Orient the plug to the receptacle in the proper position. Press firmly into place. Use the jack screws to secure the plug to the receptacle jack nuts. Do not over-tighten.

About connector pinout tables: Figure 3-2 identifies the Pin 1 location for either gender connector. Unless noted otherwise, the connector pinout tables provided in this manual arrange/order information (i.e., the Pin # column/row) based on this orientation.

3.1.3 RJ-45, RJ-48 Cable Connections

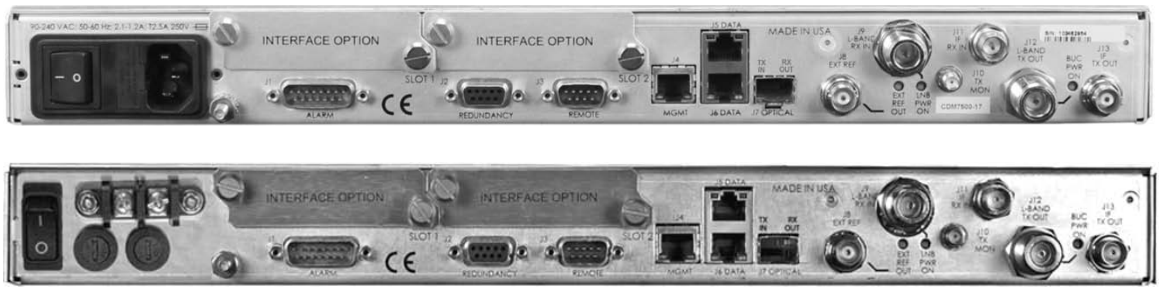
The plug for an RJ-45 or RJ-48 cable features a flexible tab. The RJ-45 or RJ-48 jack features a mating slot. This design configuration assures proper installation and pin orientation.

Connection Instructions: Press down the tab on the cable plug, and then insert the plug into the RJ-4*x* jack. The connection is complete when the tab 'clicks' into position inside the jack.

3.2 CDM-760 Cabling Connections

The rear panel connectors (**Figure 3-3**) provide all necessary external connections between the unit and other equipment.

- **For full information about the optional PIICs (Plug-In Interface Cards) and their traffic data interface connectors, see Appendix C. PIIC OPTIONS.**
- **For full information about the optional High-Speed Packet Processor and its management and traffic data interface connectors, see Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR.**



(TOP) Standard AC Unit
(BOTTOM) Optional 48V DC Unit (FUTURE)

Figure 3-3. CDM-760 Cabling Connections

Table 3-1. CDM-760 Rear Panel Connectors

Group Name (See Sect.)	Ref Des	Name	Connector Type	Function
IF Connector Group (3.2.1)	J9	L-BAND RX IN	Type 'N' female	IF Input
	J11	IF RX IN	BNC female (70/140MHz band)	
	J12	L-BAND TX OUT	Type 'N' female	IF Output
	J13	IF TX OUT	BNC female (70/140MHz band)	
	J10	TX MON	Type 'SMA' female	Monitor L-Band Output
Utility Connector Group (3.2.2)	J1	ALARM	15-pin Type 'D' male	Form C Alarms (relay closures)
	J2	REDUNDANCY	9-pin Type 'D' female	Connection to External 1:1 Redundancy Switch
	J3	REMOTE	9-pin Type 'D' male	Serial Remote Interface (EIA-485/232)
	J4	MGMT	RJ-45 female	10/100/1000 BaseT M&C
	J8	EXT REF	BNC female	External Reference Input / Output
Terrestrial Data Connector Group (3.2.3)	J5	DATA (GBEI1)	RJ-45 female	10/100/1000 BaseT Gigabit Ethernet traffic
	J6	DATA (GBEI2)		
	J7	OPTICAL	SFP (Small Form Factor Pluggable) Module cage	Accepts optional hot-pluggable SFP 1000Base-SX 850mm Transceiver Module
	N/A	INTERFACE OPTION SLOT 1	PIIC (Plug-In Interface Card) slots	Accepts optional data interface modules (e.g., G.703 E3/T3/STS-1, OC-3 Single / Multi Mode. STM-1 Copper, etc.)
	N/A	INTERFACE OPTION SLOT 2		

3.2.1 IF Connector Group

CAUTION
THERE MAY BE DC VOLTAGES PRESENT ON THE TYPE 'N' RX AND TX IF CONNECTORS, UP TO A MAXIMUM OF 48 VOLTS.

3.2.1.1 Rx Connectors


The **J9 | L-BAND RX IN** Type 'N' connector features an LED labeled "LNB PWR ON". When a Low-Noise Block Down Converter (LNB) is installed in an L-Band configuration, the LED lights amber to indicate the presence of DC voltage.

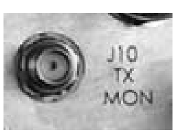
Ref Des	Name	Connector Type	Description	Direction (I/O)
J9	L-BAND RX IN	Type 'N' female	Rx IF signal, L-Band	I
J11	IF RX IN	BNC	Rx IF signal, 70/140 MHz band **Note:** 75Ω default, 50Ω optional	

3.2.1.2 Tx Connectors


The **J12 | L-BAND TX OUT** Type 'N' connector features an LED labeled "BUC PWR ON". **Reserved for FUTURE use:** When a Block Up Converter (BUC) is installed in an L-Band configuration, the LED glows amber to show the presence of DC voltage.

Ref Des	Name	Connector Type	Description	Direction (I/O)
J12	L-BAND TX OUT	Type 'N' female	Tx IF signal, L- band	O
J13	IF TX OUT	BNC	Tx IF signal, 70/140 MHz band **Note:** 75Ω default, 50Ω optional	

3.2.1.3 J10 | TX MON Connector, Type 'SMA'



The Type 'SMA' female **J10 | TX MON** connector provides a user monitor output for the L-Band signal.

Ref Des	Name	Connector Type	Description	Direction (I/O)
J10	TX MON	Type 'SMA' female	Monitor L-Band Tx IF Output	O

3.2.2 Utility Connector Group

3.2.2.1 J1 | ALARM Connector, DB-15M

The **J1 | ALARM** 15-pin Type 'D' male (DB-15M) connector provides the unit alarms interface.

The connector pinouts are as follows:

Pin #	Name	Signal Function	Direction (I/O)
1	GND	Ground	Gnd
9	EXT-OFF	Ext Carrier Off, active low. Capability to mute modem's Tx IF (Low=Mute) (Has internal pull-up in the Modem). Compatible with LVTTL or relay pull down.	I
2	AGC **(NOT AVAILABLE)**	AGC Voltage (Rx signal level, 0 to 10 volts, monotonic)	O
10	N/C	No Connection	–
3	RX-Q	Rx Q Channel (Constellation monitor)	O
11	RX-I	Rx I Channel (Constellation monitor)	O
4	UNIT-COM	Unit Fault	I/O
12	UNIT-NO	Unit Fault (Energized, No Fault)	I/O
5	UNIT-NC	Unit Fault (De-energized, Faulted)	I/O
13	TX-COM	Tx Traffic	I/O
6	TX-NO	Tx Traffic (Energized, No Fault)	I/O
14	TX-NC	Tx Traffic (De-energized, Faulted)	I/O
7	RX-COM	RX Traffic	I/O
15	RX-NO	Rx Traffic (Energized, No Fault)	I/O
8	RX-NC	Rx Traffic (De-energized, Faulted)	I/O

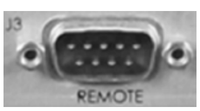
3.2.2.2 J2 | REDUNDANCY Connector, DB-9F

The **J2 | REDUNDANCY** 9-pin Type 'D' female (DB-9F) connector provides the 1:1 control interface. It provides serial communications to transfer configuration information from the Primary to the Backup modem, and a Fault/Clock signal to signal the switch when a fault occurs. It is intended ***only*** for connection to a CRS-170A or CRS-180 1:1 Redundancy Switch.

The connector pinouts are as follows:

Pin #	Name	Signal Function	Signal Type
5	MDM_COM_OUT_ENA	Enable "Mdm_Comm_Out" signal	LVTTL Output
9	12VOLT_OUT	+12 Volts at 300 ma	12V 300 ma
4	ONLINE	Commands modem to be Online/Offline (Use pull-up on Modem side input)	LVTTL Input
8	SER_DATA	Fault Serial Data Signal from modem	LVTTL Output
3	TX_IF_MUTE_B	Capability to mute modem's Tx IF (Low=Mute) (Use pull-up on Modem side input)	LVTTL Input
7	SER_CLK	Fault Serial Clock Signal 64KHz	LVTTL Output
2	MDM_COM_IN	UART comm to modem from controller (9600 to115.2BUAD)	LVTTL Input
6	MDM_COM_OUT	UART comm. from modem to controller (9600 to115.2BUAD)	LVTTL Output
1	GND	Chassis Ground	Gnd

3.2.2.3 J3 | REMOTE Connector, DB-9M



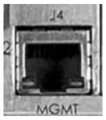
The **J3 | REMOTE** 9-pin Type 'D' male (DB-9M) connector provides the remote control interface via an M&C computer or terminal device. It is user selectable for either EIA-232 or EIA-485.

The connector pinouts are as follows:

Pin #	Description	Direction (I/O)
1	Ground	–
6	EIA-485 Receive Data B *	I
2	EIA-232 Transmit Data	O
7	EIA-485 Receive Data A *	I
3	EIA-232 Receive Data	I
8	EIA-485 Transmit Data B	O
4	Reserved - do not connect to this pin	–
9	EIA-485 Transmit Data A	O
5	Ground	–

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

3.2.2.4 J4 | MGMT Connector, RJ-45F



The RJ-45 female **J4 | MGMT** connector is an auto-sensing, auto-crossover port. It is reserved for use as 10/100/1000 Ethernet-based remote management and control (M&C).

The connector pinouts are as follows:

Pin #	Description	Direction (I/O)
1	TRP1+	I/O
2	TRP1-	I/O
3	TRP2+	I/O
4	TRP3+	I/O
5	TRP3-	I/O
6	TRP2-	I/O
7	TRP4+	I/O
8	TRP4-	I/O

3.2.2.5 J8 | EXT REF (External Reference) Connector, BNC

The **J8 | EXT REF** Type 'BNC' female input/output connector is used to supply a master reference to the entire chassis. The internal 10 MHz reference is phase locked to this input, if selected. The frequency references on the internal PWB's are locked to this input, when it is used.

This connector features an LED labeled "**EXT REF OUT**" that lights amber to indicate the presence of an outgoing signal. The LED is dark when the external reference signal is incoming.

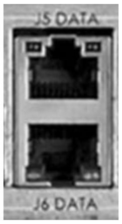
When External Reference is not used, the unit will output the internal 10 MHz reference (stability ±06 ppm).

Ref Des	Name	Connector Type	Description	Direction (I/O)
J8	EXT REF OUT	BNC	External Reference	I/O

3.2.3 Terrestrial Data Connector Group

3.2.3.1 J5 | DATA, J6 | DATA Connections, RJ-45F

DO NOT MIX products of different speeds (e.g., 10BaseT on J5, 100BaseT on J6, and GigE on J7), or different duplex operation (e.g., half duplex on J5 and full duplex on J7). Doing so can cause a degradation in speed/performance of the data link traffic.



The RJ-45 female **J5 | DATA** and **J6 | DATA** connections are auto-sensing, auto-crossover ports used for 10/100/1000 BaseT Gigabit Ethernet data traffic.

The typical connector pinout is as follows:

Pin #	Description	Direction (I/O)
1	TRP1+	I/O
2	TRP1-	I/O
3	TRP2+	I/O
4	TRP3+	I/O
5	TRP3-	I/O
6	TRP2-	I/O
7	TRP4+	I/O
8	TRP4-	I/O

3.2.3.2 J7 | OPTICAL Connection, 1000Base-SX Cage

DO NOT MIX products of different speeds (e.g., 10BaseT on J5, 100BaseT on J6, and GigE on J7), or different duplex operation (e.g., half duplex on J5 and full duplex on J7). Doing so can cause a degradation in speed/performance of the data link traffic.

The **J7 | OPTICAL** Gigabit Traffic connection is available by FAST-enabling this interface; the CDM-760 then accepts the optional Optical Gigabit Ethernet Interface module, an industry-standard SFP (Small Form Factor Pluggable) interface.

3.2.3.2.1 Optional Optical Gigabit Ethernet Interface (P/N IC-0000058)

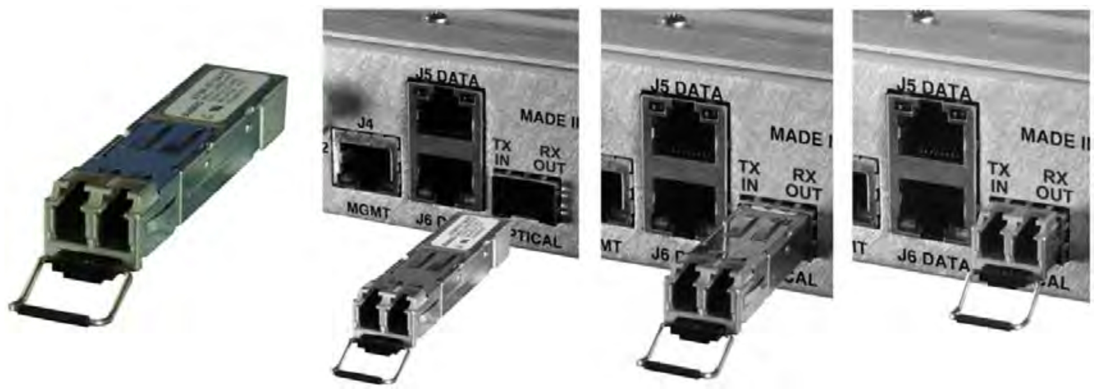


Figure 3-4. Typical SFP Module Installation

The optional Optical Gigabit Ethernet Interface (CEFD P/N IC-0000058) is an 850mm multi-mode transceiver module with LC-Duplex fiber optic connectors. It meets SFP Multi-Source Agreement (MSA) SFF-8074i and SFF-8472 Rev. 9.3. Note the following:

Typical link distance for 1000BaseSX	Cable Requirement
550m	50/125 mm cable
275m	62.5/125 mm cable

Install the module as shown in **Figure 3-4**. Note that this type of installation is typical for installation of an optional SFP module, whether in the CDM-760 chassis **J7 | OPTICAL** port, or using the optional STM-1 Copper or OC-3 Single/Multi Mode PIIC module kits.

3.2.3.3 Optional PIIC Data Interface Slots

Appendix C. PIIC OPTIONS

Figure 3-5. PIIC Data Interface Slots

The CDM-760 rear panel features two slots that accommodate optional PIIC (Plug-in Interface Card) traffic data modules (**Figure 3-5**).

3.2.3.3.1 Install an Optional PIIC Data Module

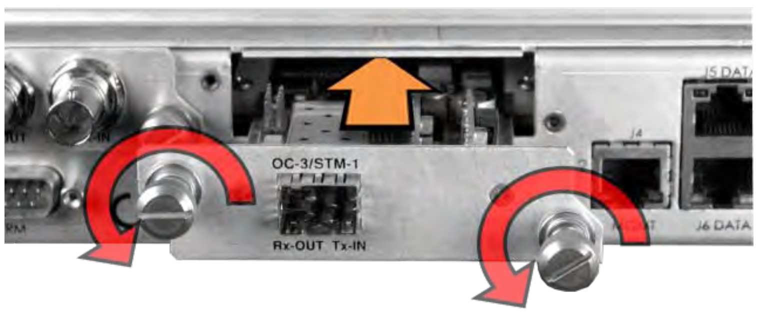


Figure 3-6 Install a PIIC Data Module

Available Optional PIIC Traffic Data Modules	
CEFD Kit / Assembly	**Description**
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module
KT-0000256	SFP OC-3 Single Mode PIIC Module
KT-0000257	SFP OC-3 Multi Mode PIIC Module
PL-0022015	DVB ASI Asynchronous Serial Interface PIIC Module

For traffic data types not listed, contact Comtech EF Data Product Support about additional PIIC module availability.

Step	Task
1	Remove either PIIC slot blank panel by loosening the captive thumbscrews.
2	Install either PIIC module into position using the chassis' internal card guides. Slide the module straight back into the chassis until it is firmly plugged into its mating receptacle.
3	Tighten the captive thumbscrews of the module.

3.2.3.4 Optional High-Speed Packet Processor Connections

Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR

Figure 3-7. Optional High-Speed Packet Processor

You may order the CDM-760 factory-equipped with the optional High-Speed Packet Processor card. It is also available as a field upgrade using CEFD Kit KT-0020958. The card installs into the modem rear panel chassis space otherwise occupied by the PIICs (**Figure 3-7**). This option provides (from left):

- (1X) **CLI** (Command Line Interface) RJ-11 port for implementing factory commands.
- (1X) **P0 | MGMT** RJ-45 Gigabit Ethernet routed interface/management port.
- (4X) **P1 | DATA** through **P4 | DATA** RJ-45 Gigabit Ethernet bridged interface ports.

3.3 Ground and Power Connections

3.3.1 Chassis Ground Interface

Figure 3-8. Chassis Ground Interface

Use the #10-32 stud, located adjacent to the power interface (Figure 3-8), for connecting a common chassis ground among equipment.

CAUTION
CORRECT GROUNDING PROTECTION IS REQUIRED TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE. YOU MUST MAKE SURE THE GROUND STUD ON THE REAR PANEL OF THE UNIT IS ALWAYS CONNECTED TO PROTECTIVE EARTH.

The AC power interface provides the safety ground.

3.3.2 115V/230V Alternating Current (AC) Power Interface (Standard)

Feature	Description
1	On / Off Switch
2	Press-fit Fuse Holder
3	IEC Three-prong Connector

AC Power Specifications	
Input Power	48 watts (typical with TPC/LDPC Codec and CnC module installed), 68 watts (max)
	280 watts (typical TPC/LDPC Codec, CnC module and 48 volt BUC [**FUTURE**] supply installed), 300 watts (max)
Input Voltage	100V to 240V AC, +6%/-10%, autosensing (total absolute max. range is 90V to 264V AC)
Connector Type	IEC
Fuse Protection	**Line and neutral fusing** **(2X) 5mm x 20mm Slow-blow type fuses:** T4A (250V AC operation)

Figure 3-9. AC Power Interface

3.3.2.1 AC Operation – Apply Power

Figure 3-10. Apply AC Power to the unit

To apply AC power to the unit (Figure 3-10), do these steps:

Step	Task
1	Plug the provided AC power cord female end into the unit.
2	Plug the AC power cord male end into the user-supplied power source.
3	Switch the unit ON.

3.3.2.2 AC Operation – Replace the Fuses

For AC operation, the unit uses two common 5mm x 20mm Slow-blow fuses – one each for line and neutral connections. The fuses are contained on the rear panel in a fuse holder that is press-fit into the body of the IEC power module (**Figure 3-11**).

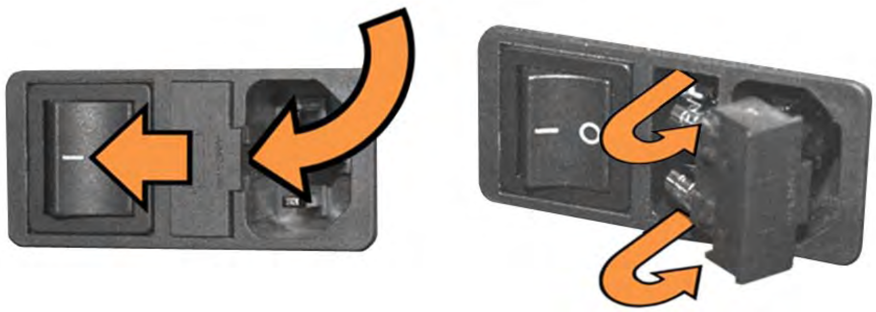


Figure 3-11. Replace the AC Fuses

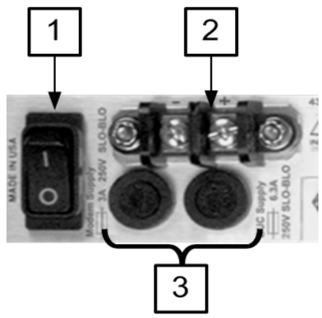
WARNING!
DEATH OR PERSONAL INJURY POSSIBLE
DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING!

CAUTION
ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING. SEE FIGURE 3-9 FOR THE AC FUSE SPECIFICATIONS.

To replace the AC fuses (Figure 3-11), do these steps:

Step	Task
1	Disconnect the power supply.
2	Unseat the fuse holder from the IEC power module: • Use the slot to pry the holder outward from the IEC power module. • Pull the holder straight out, and then swing the holder away from the module.
3	Remove and replace the fuses as necessary.
4	Re-seat the fuse holder in the IEC power module.

3.3.3 48V Direct Current (DC) Power Interface (Optional)



Feature	Description
1	On / Off Switch
2	Power Terminal Block
3	Screw-in Fuse Holders / Receptacles

DC Power Specifications	
Input Power	48 watts (typical with TPC/LDPC Codec and CnC module installed), 68 watts (max)
	280 watts (typical TPC/LDPC Codec, CnC module and 48 volt BUC [**FUTURE**] supply installed), 300 watts (max)
Input Voltage	43-60 VDC Nominal 36-60 VDC Maximum
Connector Type	Terminal Block
Fuse Protection	(2X) 5mm x 20mm Slow-blow type fuses: **Modem Fuse:** 3Amp/250Volts **BUC Fuse:** 6.3 Amp/250 Volts

Figure 3-12. DC Power Interface

3.3.3.1 DC Operation – Apply Power

Figure 3-13. Apply DC Power to the unit

To apply DC power to the unit (Figure 3-13), do these steps:

Step	Task
1	Connect the user-supplied (+) and (–) DC power leads to their respective terminals. *Number 18 AWG minimum wires are recommended.*
2	Connect the user-supplied DC power leads to the user power source.
3	Switch the unit ON.

3.3.3.2 DC Operation – Replace the Fuses

For DC operation, the unit requires two different fuses. The fuses are located on the rear panel in the individual screw-in receptacles found below the terminal block (**Figure 3-14**).

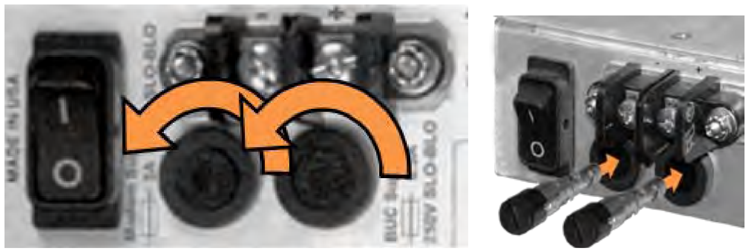


Figure 3-14. Replace DC Fuses

WARNING!
DEATH OR PERSONAL INJURY POSSIBLE
DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING!

CAUTION
ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING. SEE **FIGURE 3-12** FOR THE DC FUSE SPECIFICATIONS.

To replace the DC fuses (Figure 3-14), do these steps:

Step	Task
1	Disconnect the power supply.
2	Unscrew either fuse holder from its receptacle.
3	Remove and replace the fuse(s): • Use T3A (3 Amp) 250V fuses for modem operation (left-hand receptacle). • Use T6.3A (6.3 Amp) 250V fuses when a Block Up Converter (BUC) is installed (right-hand receptacle).
4	Screw either fuse holder into its receptacle

Notes:

Chapter 4. UPDATING FIRMWARE

4.1 Overview

4.1.1 Important Considerations Before Proceeding

1) **Before attempting any Ethernet FTP upload, read this important section about conditional firmware update requirements.**
2) **Make sure to operate the CDM-760 with its latest available firmware. If your modem is running an obsolete firmware version, these restrictions apply as to how you may proceed with the firmware update process:**

FW UPDATE PATH	FW UPDATE PROCESS USES…	NEXT FW GATEWAY YOU MUST UPDATE TO BEFORE UPDATING TO A LATER FW
1.1.1	FTP CLIENT (Filezilla)	1.2.1
From 1.2.1 to 1.3.1	FTP PUT F0020627.TAR	1.3.1
From 1.3.1 to CURRENT	FTP PUT F0020627.ZIP **–OR–** UPLOAD ZIPFILE USING THE CDM-760 HTTP (WEB SERVER) INTERFACE ADMIN | UPGRADE PAGE	CURRENT

See Appendix A. OBSOLETE FIRMWARE FTP UPDATE PROCEDURES for the FTP upload procedure you must follow in order to update your obsolete modem firmware to the current available firmware.

4.1.2 About Firmware File Acquisition and Modem Update

The CDM-760 Advanced High Speed Trunking Modem is factory-shipped with its latest version of operating firmware. If you need to update the modem firmware, you may download the firmware update archive file from the Comtech EF Data Web site (www.comtechefdata.com). You may also receive the file via e-mail from Comtech EF Data Product Support.

You may perform the firmware update, without opening the CDM-760, remotely over satellite, or you may directly connect a user-supplied Microsoft Windows-based PC, running the latest version of Java, either to the CDM-760 rear panel **J4 | MGMT** RJ-45 M&C port or, when the optional High-Speed Packet Processor is **installed and enabled**, the **P0 | MGMT** RJ-45 M&C port.

Do these steps:

1. Download the firmware update archive file via the Internet to the User PC. *Except as noted in Appendix A, the tasks outlined in Sects.* ***4.2*** *and* ***4.3*** *are the same regardless of the firmware version running.*
2. Use Windows Command-line to transfer, via File Transfer Protocol (FTP), the extracted firmware ZIP file from the User PC to the CDM-760 standby firmware image. You may alternately use the CDM-760 HTTP (Web Server) Interface **ADMIN | UPGRADE** page 'automated upgrade' feature to transfer the ZIP file.
3. Use the CDM-760 Front Panel or the HTTP Interface **ADMIN | UPGRADE** page to configure the modem to operate using the updated firmware image.

You are not able to use the HTTP Interface to change the Modem IP Address.

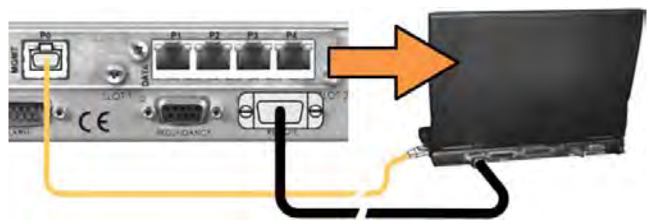
- **Chapter 6. FRONT PANEL OPERATION**
- **Chapter 7.5 HTTP (Web Server) INTERFACE**
- **Chapter 8. SERIAL INTERFACE OPERATION**

4.2 Get Started: Prepare for the Firmware Download

4.2.1 Required User-supplied Items

You will need a Microsoft Windows-based PC equipped with available serial and Ethernet ports, a compatible Web browser (e.g., Internet Explorer), and a terminal emulator program (e.g., Tera Term or HyperTerminal).

4.2.1.1 CDM-760 to PC Connections



For the SERIAL interface, use a 9-pin serial cable to connect the **J3 | REMOTE** port to the User PC serial port.

For the ETHERNET interface, use a CAT5e Ethernet cable to connect the CDM-760 to the User PC Ethernet port:

- Use an Ethernet hub, switch, or direct cable connection to connect the CDM-760 rear panel **J4 | MGMT** 10/100/1000 Fast Ethernet port to an Ethernet port on the User PC.
- **Alternately**, when the optional High-Speed Packet Processor is **installed and enabled**, use an Ethernet hub, switch, or direct cable connection to connect the Packet Processor's **P0 | MGMT** RJ-45 M&C port to an Ethernet port on the User PC.

4.2.1.2 Configure the Terminal Emulator Program

Be sure your terminal emulator settings match the settings displayed on the CDM-760 Front Panel SELECT: Configuration → Remote → Remote Control: Serial or Ser+Ethernet screens.

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

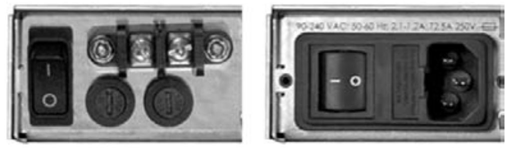
On the User PC – Open the terminal emulator program, and then configure the program's serial port communication and terminal display operation:

- Baud Rate = 38400 bps
- Data Bits = 8
- Stop bits = 1
- Parity = NO
- Local Echo = ON
- Port Flow Control = NONE
- Display New Line Rx/Tx = CR

4.2.1.3 Get the CDM-760 Management IP Address and Firmware Information

Do these steps:

1. On the CDM-760 – Turn on the power.



(Left) Optional CDM-760 48V DC Unit
(Right) Standard CDM-760 115V/230V AC Unit

2. Use any of the following methods to obtain the CDM-760 Ethernet Management IP Address and firmware information:
   a. **Use the CDM-760 Front Panel menus:**
      - **Ethernet Management IP Address** – Use the **SELECT: Configuration → IP → Addresses** screen, as shown in this example:

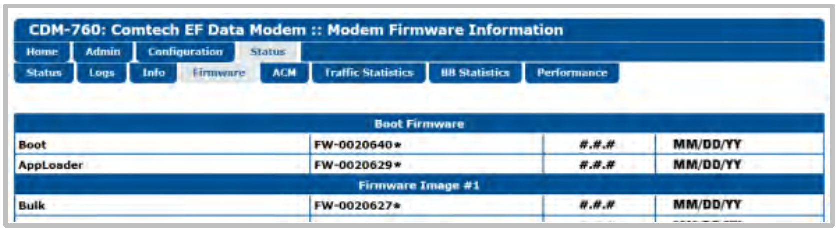
```
IP:192.168.001.011/24   MAC:0006B00286F5
Gateway:192.001.001.100                (◄►)
```

You are not able to use the HTTP Interface to change the Modem IP Address.

      - **Firmware Information** – Use the **SELECT: Utility → Firmware → Info → Image#1 or Image#2 screens, as shown in this example:**

```
Image #1 Bulk                 12/19/13
FW-0020627A                  1.2.1 (♦)
```

   b. **Use the CDM-760 Serial Remote Control Interface** (via the User PC / terminal emulator program):
      - **Ethernet Management IP Address** – Use the **<0/IPA**? query.
      - **Firmware Information** – Execute one of the following queries:
        - **Condensed** – **<0/SWR?** (displays firmware versions)
        - **Detailed** – **<0/FRW?1** (for Image 1) or **<0/FRW?2** (for Image 2) (displays complete firmware load information)
   c. **Use the HTTP Interface** (via the User PC Web Browser; accessible once the CDM-760 Ethernet Management IP Address is known):
      - **Firmware Information** – Use the **Status | Firmware** page, as shown in this example:



4.2.1.4 Make a Temporary Folder (Subdirectory) on the User PC

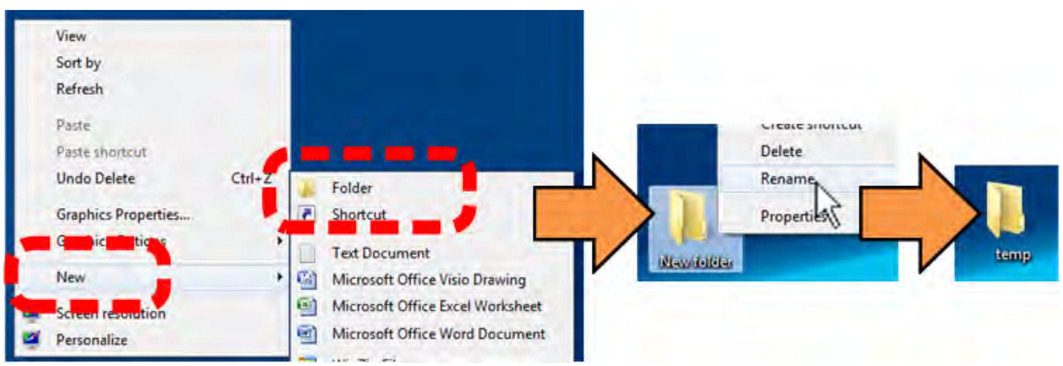
The temporary folder is where you store the firmware archive download. There are several ways you can make a temporary folder on a Windows PC:

- To use the Windows Desktop, see Section 4.2.1.4.1.
- To use Windows Explorer, see Section 4.2.1.4.2.
- To use the Run and Browse windows, see Section 4.2.1.4.3.
- To use Windows Command-line or the Command Prompt, see Section 4.2.1.4.4.

1) These examples specify drive letter "**c:**". You can use any valid, writable drive letter.
2) Typical for many of the tasks that follow, type the command as instructed and then press **Enter**.

After you make the temporary folder, proceed to Section 4.3 to download and extract the firmware files.

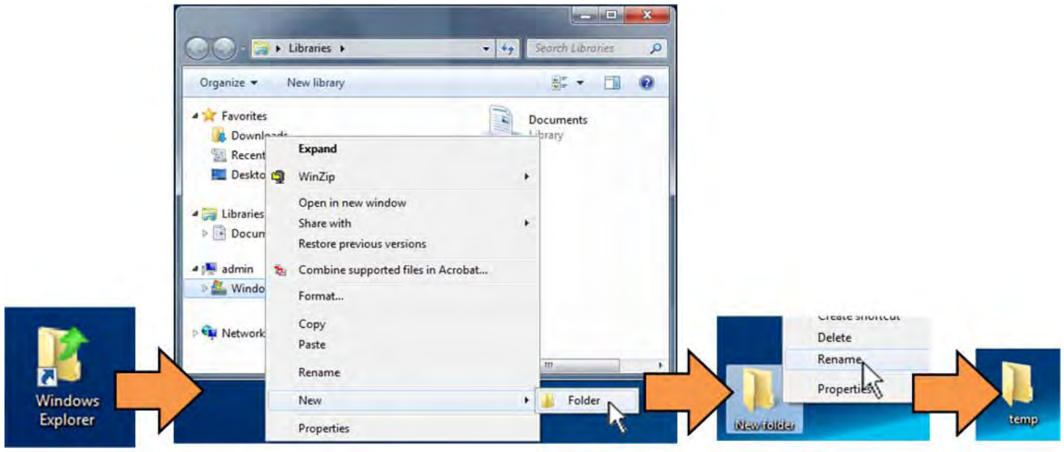
4.2.1.4.1 Use Windows Desktop to Make a Folder



Do these steps:

1. Right-click anywhere on the desktop to open the popup submenu.
2. Select **New > Folder** to make the new, temporary folder on the desktop.
3. Right-click on the new folder and then select **Rename** from the popup submenu. Rename this folder to "CDM760" or some other convenient, unused name.

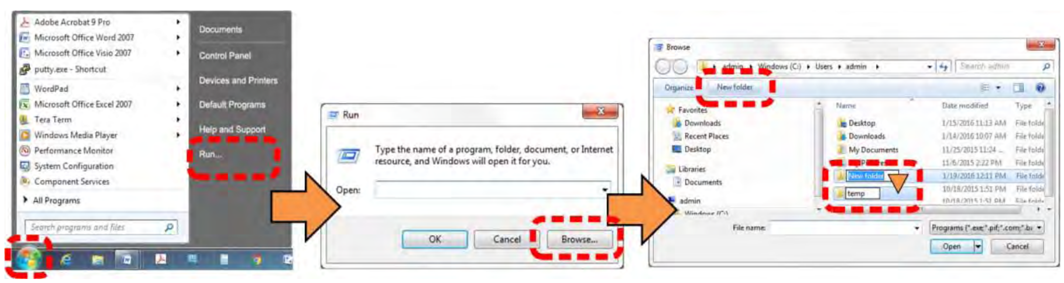
4.2.1.4.2 Use Windows Explorer to Make a Folder



Do these steps:

1. Left-double-click the Windows Explorer icon on the Windows Desktop.
2. Depending in your Windows OS version: select **File > New > Folder**, or click your Folder Destination (e.g., **Windows (C:))** and then **New Folder** to make the new, temporary folder in the active location.
3. Right-click the **New Folder** folder name, and then **Rename** this folder to “CDM760" or some other convenient, unused name.

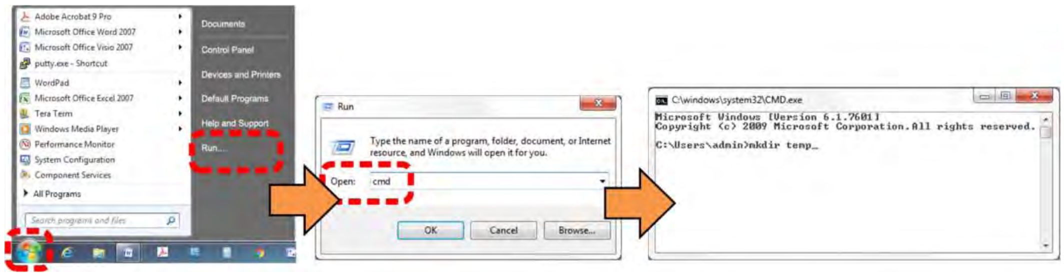
4.2.1.4.3 Use the Run and Browse Windows to Make a Folder



Select **Start** on the Windows taskbar and then do these steps:

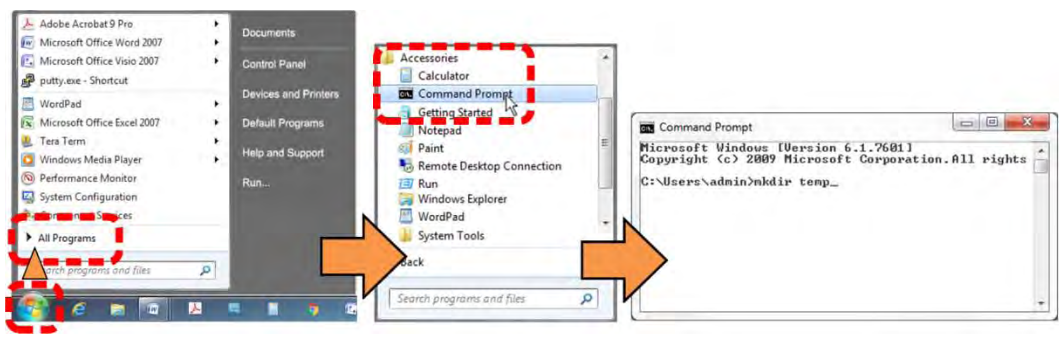
1. Click **Run…** to open the **Run** window.
2. Click **Browse…** to open the **Browse** window.
3. Click **New Folder**. This can be an icon or a text label, depending on the Windows OS version.
4. Right-click the **New Folder** folder name, and then **Rename** this folder to “CDM760” or some other convenient, unused name.

4.2.1.4.4 Use Windows Command-line or Command Prompt to Make a Folder



Select **Start** on the Windows taskbar and then do these steps:

1. Click **Run...** to open the **Run** window (or, depending on Windows OS version prior to Windows 95, click the **MS-DOS Prompt** icon from the Main Menu).
2. Open a Command-line window:
   - For Windows 95 or Windows 98 – type “command”.
   - For any Windows OS versions later than Windows 98 – type “cmd” or “command”.
   - Alternately, from **Start**, select the **All Programs > Accessories** popup submenu, and then select **Command Prompt**:



3. From the c:\> prompt, type either “mkdir CDM760” or “md CDM760” (both “mkdir” and “md” mean “make directory”), and then press **Enter**.

There will now be a “CDM760” folder created and available for placement of the firmware file download.

4.3 Download and Extract the Firmware Update Files

Do these steps:

1. Go online to www.comtechefdata.com.
2. On the Main page – Under **Support Information** or the **Support** tab, select the **Software Downloads** hyperlink.
3. On the **Software Downloads** page – Click **Download Flash and Software Update Files**.
4. On the **Flash Updates Index** page – Select the **(Select a Product Line) Satellite Modems** hyperlink.
5. On the **Satellite Modems** product page – Select the **CDM-760** product hyperlink.
6. Select the appropriate firmware archive EXE or ZIP file download hyperlink (see Section 4.1.1).

- **About Firmware Numbers, File Versions, and Formats:** The Comtech EF Data Web site catalogues its firmware update files by product type (e.g., router, modem, etc.), the specific model, and optional hardware configurations. The CDM-760 firmware download hyperlink appears as **F0020627x_Vyyy**, where '**x**' denotes the revision letter, and "**yyy**" represents the firmware version (e.g., V173 = Version 1.7.3).

  The naming and file format of the firmware archive files for Firmware Versions 1.4.1 and later differs from the naming and file format of the firmware files provided for Firmware Version 1.3.1 and earlier! See Appendix A. OBSOLETE FIRMWARE FTP UPDATE PROCEDURES for instructions on updating CDM-760 modems running FW Vers. 1.1.1 through 1.3.1.

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

  Some firewalls do not allow the download of self-extracting ***.exe** files. Download the ***.zip** file instead, and extract the firmware files from the archive download with the Windows-based archive application, or a user-supplied file archiver and compression utility program such as *PKZIP for Windows, WinZip,* or *ZipCentral*. **Comtech EF Data does not provide this utility program.** (*PKZIP for DOS* is not supported due to file naming conventions.)

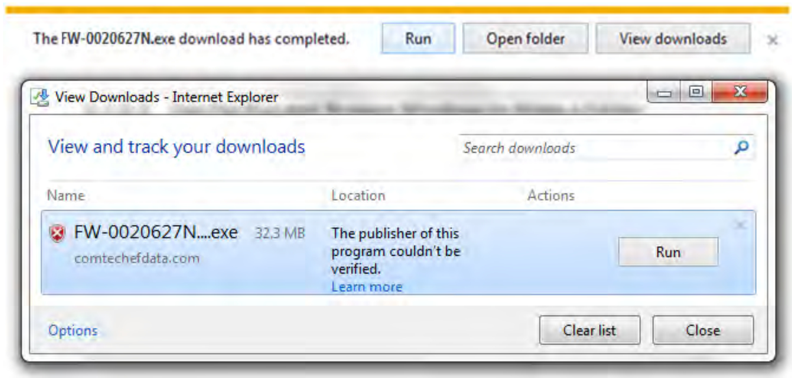
- For detailed information on handling archived files, refer to your utility program Help documentation.

7. Once you select the EXE or ZIP hyperlink, the **File Download** dialogue opens on your browser and prompts an action. You may otherwise click **[Cancel]** to quit the file download process. Note the following:

   - For EXE files:

     - Click **[Run]** to open the self-extractor dialogue window. Use **[…]** (Browse) to select your destination folder. Click **[Extract]** to extract the files. Your results display as per this example – click **[OK]** to close. Your files are now available for transfer to the CDM-760.

     - Click **[Save]** to download the EXE file to your Downloads folder. Once the download is complete the dialogue prompts you to either **[Run]** the self-extracting file, or to open or view the Windows Downloads folder for further action.



- For ZIP files:

  - Click **[Open]** to open the archive file. Use the WinZip features to select the files for extraction to your destination folder.
  - Click **[Save]** to download the ZIP file to your Windows Downloads folder. Once the download is complete the dialogue prompts you to either **[Open]** the archive file, or to open or view the Windows Downloads folder for further action.

8. If not already done with **File Download > Open**, you must extract the firmware files from the downloaded ***.exe** or ***.zip** archive file with the user-supplied utility program: Double-click on the archive file name, and then follow the prompts provided by the user-supplied utility program. Extract all files and save them in the directory you created.
9. Confirm availability of the firmware files in the temporary folder. There are several ways you can view the contents of the temporary folder on a Windows-based PC:
   - To use the Windows Desktop, see Section 4.3.1.
   - To use Windows Command-line or Command Prompt, see Section 4.3.2.

   After you confirm the firmware files are in the folder, proceed to Section 4.4 to upload the firmware update to the CDM-760.

4.3.1 Use Windows Desktop to View Folder Contents

From the Windows Desktop:

1. Double-left-click the Windows Explorer icon, and then double-left-click as needed to locate, and then open, the “CDM760” folder (directory) created earlier on the Windows Desktop.
2. Use the **Browse** window (**Start > ...Run > Browse**) to locate, and then double-click to open, the “CDM760” folder.

4.3.2 Use Windows Command-line to View Folder Contents

Using Command-line or Command Prompt:

1. Type “**cd c:\CDM760**” at the Windows Command-line prompt to change to the temporary folder (directory) created earlier using Command-line.
2. Type “**dir**” to list the files extracted to the temporary folder from the downloaded archive file.

4.4 Upload the Firmware Files and Update the CDM-760 Unit

4.4.1 Important Considerations

If you proceed with the CDM-760 Ethernet FTP Upload Procedure, this section assumes that:

- **Your CDM-760 is connected to a user-supplied, Windows-based PC running the latest version of Java, and:**
  - **The PC Ethernet port is connected to the CDM-760 rear panel J4 | MGMT RJ-45 port (alternately, if the optional High-Speed Packet Processor is <u>installed and enabled</u>, the P0 | MGMT RJ-45 port) with a user-supplied hub, switch, or direct Ethernet cable connection.**
  - **The PC is running a compatible Web browser (for operation of the HTTP Interface).**
  - **The PC serial port is connected to the CDM-760 rear panel J3 | REMOTE serial port with a standard user serial cable.**
  - **The PC is running a terminal emulation program (for operation of the CDM-760 Serial Remote Control Interface).**
- **You have noted the CDM-760 Ethernet Management IP Address using either the CDM-760 Front Panel or the Serial Remote Control Interface. (You may also use the HTTP Interface Admin | Access page to view the configured IP Address as needed. Note that you cannot use the HTTP Interface to change the Modem IP Address.)**
- **You have downloaded (or otherwise received from Comtech EF Data) the latest available firmware update, and you have extracted the firmware files into an accessible temporary folder (e.g., C:\CDM760) on the User PC.**
- **You have configured modem remote control for “Ethernet” or “Ser+Ethernet” – confirm by viewing the Front Panel SELECT: Configuration → Remote screen:**

```
Remote Control:Ser+Ethernet
        Inband:Disable                (◆)
```

- **Typical for all tasks that follow – type the command <u>without quotes</u>, and then press Enter to execute.**

4.4.2 Use Windows Command-line to FTP Upload the Firmware Files (Ethernet-based Firmware Update Procedure)

1. To proceed, you should already have noted the Management IP Address (“xxx.xxx.xxx.xxx”) for the CDM-760 as instructed in Section 6.2.3.
2. Use Windows Command-line to send a ping command. To ping the unit, type “ping xxx.xxx.xxx.xxx” at the Windows Command-line prompt. The response should confirm whether the unit is connected and communicating correctly with the User PC.
3. Make note of the *active* firmware image that the CDM-760 is running at present:

- From the CDM-760 Front Panel, use the arrow keys to view the **SELECT: Utility → Firmware** screen. The top line of this screen displays the running active image as "**ActiveImage:1**" or "**ActiveImage:2**". The FTP upload procedure will overwrite the *standby* image.

4. Use Command-line to transfer (FTP) the files from the User PC to the CDM-760:
   - Make sure you are active in the proper working folder (directory) created earlier – if not, type "**cd CDM760**".
   - Type "**ftp xxx.xxx.xxx.xxx**" (where '**xxx.xxx.xxx.xxx**' is the CDM-760 Ethernet Management IP Address).
   - If Command-line prompts you for a user name, one is not required. Press **Enter** to continue.
   - The Command-line prompt changes to "**ftp>**". Type "**put F0020627.zip F0020627.zip**" at the prompt (without quotes) to begin the file transfer.

     See Appendix A. OBSOLETE FIRMWARE FTP UPDATE PROCEDURES for instructions on updating CDM-760 modems running FW Vers. 1.1.1 through 1.3.1.

     The file transfer process takes about 10 minutes – **do not power off the PC or modem during this time**. As the upgrade process continues, the modem Front Panel displays:

```
Programming ModemApp
XXX% Complete
```

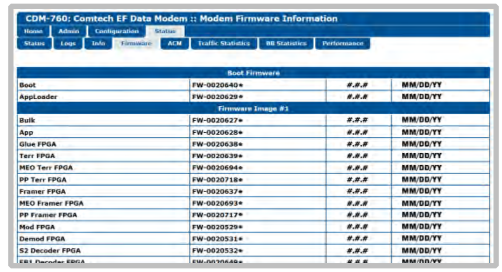
```
Loading FPGA XX of XX
XXX% Complete
```

   - Once the file transfers, Command-line displays the upload result, similar to:

```
200 Port command okay
150 Opening data connection for STOR (192.168.1.1,-9944)
226 File received OK – XXXXXXX bytes in XX.XXX sec
001 Flash programming Successful‼
ftp: XXXXXXX bytes sent in XX.XXSeconds XXX.XXXKbytes/sec.
```

   - Type "**bye**" to terminate the FTP session, and then close the Command-line window.

5. Use one of these methods to verify that the PC-to-Modem FTP file transfer was successful:
   - **Use the CDM-760 Front Panel** – After reboot, confirm that the Modem Firmware Version that displays on the CDM-760 Front Panel VFD top-level screen matches the firmware version just loaded.
     - You may also review the **SELECT: Utility → Firmware → Info → Image#1** and **Image#2** screens for detailed firmware information.
   - **Use the HTTP Interface** – Review the firmware version on the **Home** page, or the Image 1 and Image 2 folder contents on the **Status | Firmware** page:



- **Use the Serial Remote Control Interface** – Execute one of the following queries:
  - o Abbreviated – **<0/SWR?** (*displays firmware versions*)
  - o Detailed – **<0/FRW?1** (for Image 1) or **<0/FRW?2** (for Image 2) (*displays complete firmware load information*)

4.4.3 Use the HTTP Interface to Perform the Ethernet FTP Upload Procedure

For Firmware Version 1.4.1 and later, the Administrator may use the **Admin | Upgrade** page to manage the CDM-760 Firmware Upgrade process.

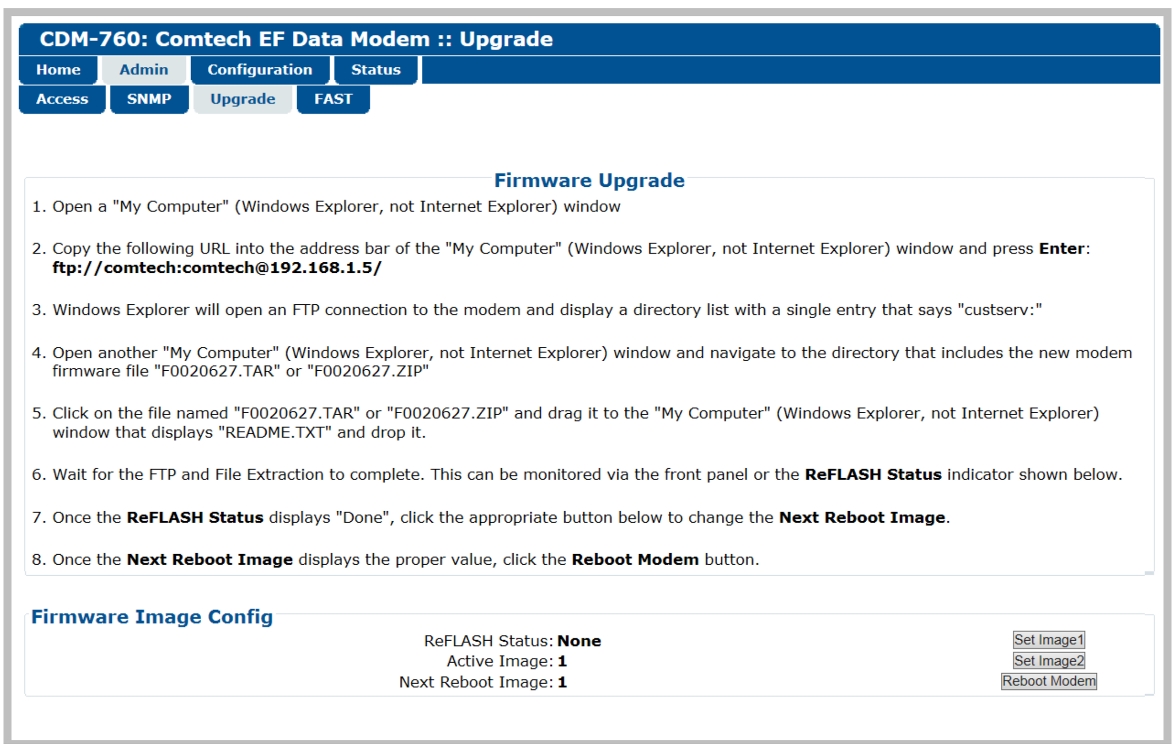


Figure 4-1. HTTP Interface Admin | Upgrade page

Do the steps displayed in the *Firmware Upgrade* section of this page to transfer the extracted firmware update image ZIP file (available from www.comtechefdata.com or Comtech EF Data Product Support) from the User PC to the modem's Flash memory.

Note that Steps 6 through 8 prompt you to use the *Firmware Image Config* section of this page to finalize the process.

4.4.4 Select the Updated Firmware for Modem Operation

Do these steps:

1. Use the CDM-760 Front Panel to make note of the current Active Image on the **SELECT: Utility → Firmware** screen:

```
Firmware Images: ActiveImage: 2
     Info    Select              (◄ ►)
```

   Then, on the bottom line, use the ◄► arrow keys to select **Select**. Press **ENTER** to continue:

```
Current Active Image is #2
 Next reboot, will use Image: #1    (▲▼)
```

2. In order to select the Image that was just updated to be 'active' the next time you reboot the modem, you must set that firmware image as the Current Active Image. Use the ▲ ▼ arrow keys to select **1** or **2**. (In this example, Image #1 was just updated so, therefore, **1** is your required choice.) Press **ENTER**.

   Alternately, click **[Set Image1]** or **[SetImage2]** in the *Firmware Image Config* section of the HTTP Interface **Admin | Upgrade** page:

3. The modem next verifies the checksums of all the files that are being updated:

```
Calculating checksums on selected Image.
              Please Wait
```

   This process takes several minutes. **Do not turn off the modem during this time.** When the process is complete, this message displays:

```
   Selected Image has been written.
 Reboot Modem or <ENTER> to Continue.
```

   Press **ENTER** to continue using the modem, or reboot the modem so that, once operations resumes, the modem is running the Current Active (Firmware) Image.

4.4.5 Reboot the Modem

Reboot the CDM-760 using one of the following methods:

- *For a hard reboot* – Use the rear panel ON/OFF switch (or otherwise disconnect the modem power source), and then reconnect the modem power.
- *For a soft reboot* – Click **[Reboot Modem]** in the *Firmware Image Config* section of the HTTP Interface **Admin | Upgrade** page.

Note that, if booting into a new image *and* the Top Card Application has been changed, an additional step occurs as the CDM-760 downloads to a different flash memory. This additional upload takes approximately two minutes.

Once the modem reboots, the Web browser prompts you to re-enter the User Name and Password in order to resume use of the HTTP Interface.

The CDM-760 is now operating with its latest firmware. The firmware update process is now complete.

Chapter 5. FAST ACTIVATION PROCEDURE

5.1 FAST Overview

The CDM-760 Advanced High-Speed Trunking Modem incorporates a number of optional features. In order to permit a lower initial cost, you may purchase the unit enabled with only the desired features.

If you wish to upgrade the functionality of a unit at a later date, Comtech EF Data provides **F**ully **A**ccessible **S**ystem **T**opology (**FAST**), which permits the purchase and activation of options through special authorization codes. You may contact Comtech EF Data Product Support to purchase these unique, register-specific Fast Access Codes, and then load these codes into the unit using the modem front panel keypad.

See Table 1-1 in Chapter 1. INTRODUCTION or Sect. 6.2.8.1 in Chapter 6. FRONT PANEL OPERATION for listings of the available FAST and FAST-accessible hardware options.

FAST System Theory: FAST facilitates on-site upgrade of the operating feature set without removing a unit from the setup. FAST technology allows you to order a unit precisely tailored for the initial application. When your service requirements change, you can upgrade the topology of the unit to meet these requirements within minutes. This accelerated upgrade is possible because of FAST's extensive use of the programmable logic devices incorporated into Comtech EF Data products.

FAST Implementation: Comtech EF Data implements the FAST system in the modem at the factory. 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 – first, upon entry of the FAST Access Code through the modem front panel keypad, and then by setting the desired operational parameters via the front panel, remote control, or HTTP (Web Server) interfaces.

FAST Accessible Options: You may order hardware options for installation either at the factory, or you can install and activate them on-site. The FAST Access Code that you purchase from Comtech EF Data enables configuration of the available hardware.

5.2 About FAST Options

The FAST options are linked to three option registers:

- Register 1 is for Data Rate, ACM, and CnC options;
- Register 2 is for Modulation and Demodulation types, Optical Interface, and AUPC options.
- Register 3 is for the K4 GZip lossless compression and decompression, Net Spec (DVB-S2, DVB-S2-EB1/EB2X Network Specification), and DPD options.

Note the following:

- When a FAST Access Code is obtained from Comtech EF Data, it will be for a **specific register**.
- The CnC and K4 GZip FAST options require installation of the respective option card into the internal modem board.

5.3 FAST Activation Procedure

5.3.1 FAST Activation Using the CDM-760 Front Panel

See Chapter 6. FRONT PANEL OPERATION for complete information about using this product management interface.

Do these steps:

1. Before contacting Comtech EF Data Product Support to order FAST feature upgrades, obtain and record the modem's baseboard serial number:
   a. Use the front panel ◄► arrows keys to navigate to the **SELECT: FAST** menu, and then press **ENTER**.
   b. The modem's 9-digit "Baseboard S/N" is displayed on the left hand side of the bottom line, as shown in this example:

```
FAST:    Options   Demo-Mode   CnC  (◄ ►)
Baseboard S/N 012345678    Hw Rev##.##
```

   c. Record the Serial Number: ____
2. To view currently installed FAST features, do these steps from the top-level **SELECT: FAST** menu:
   a. Use the ◄► arrows keys to select **OPTIONS**, and then press **ENTER**:

```
FAST    1: Set  View 2: Set  View
OPTIONS 3: Set  View              (◄ ►▲▼)
```

   b. Use the ◄► arrows keys to select **View** for the *desired register #*, and then press **ENTER**.
   c. Use the ▲ ▼ arrow keys to scroll through the list of available FAST options. Options are identified as '**Installed**' or '**Not Installed**'. Any option listed as '**Not Installed**' may be purchased as a FAST upgrade.

3. Contact Comtech EF Data Product Support to order features:
   a. Provide the modem's 9-digit Baseboard Serial Number to the representative.
   b. Identify and purchase the desired FAST option(s).Obtain the invoice, the register-specific 20-digit FAST Access Code(s), and the FAST option activation instructions.

When you purchase a FAST Access Code from Comtech EF Data, it will be for a <u>specific option register</u>. The FAST options are linked to the three option registers explained in Sect. 5.2.

4. Enter the FAST Access Code(s):
   a. Press **CLEAR** to return to the **SELECT: FAST → Options → (Register #) Set** menu.
   b. Use the arrow keys (◄ ► ▲ ▼) to *carefully* enter your register-specific 20-character FAST Access Code.

```
FAST: Set register1: Enter code below
00000000000000000000 then [ENTER]   (◄ ►▲▼)
```

   c. Press **ENTER** to execute the FAST upgrade. The modem responds with "**Configured Successfully**" if the **FAST** upgrade is accepted; the modem then resets to its newly-incorporated default configuration. However, if an invalid code is entered, the following message displays:

```
Failure to configure. Re-enter code.
88888888888888888888 then [ENTER]   (◄ ►▲▼)
```

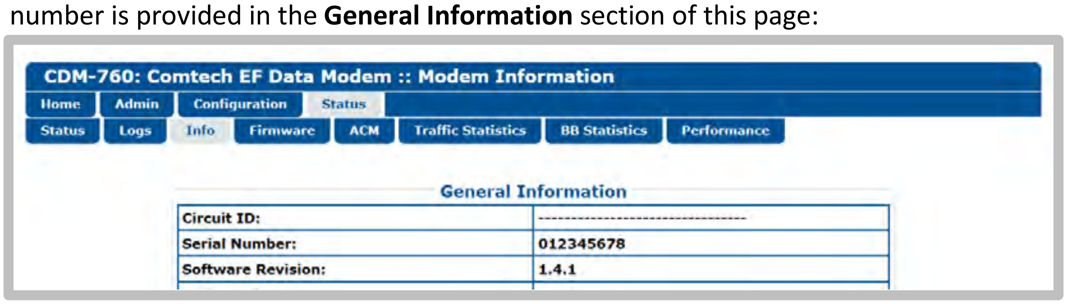
   Repeat the FAST Access Code entry procedure. Should the code entry error persist, contact Comtech EF Data Product Support for further assistance.

5.3.2 FAST Activation Using the CDM-760 HTTP (Web Server) Interface

See Chapter 7. ETHERNET INTERFACE OPERATION for complete information about using this product management interface.

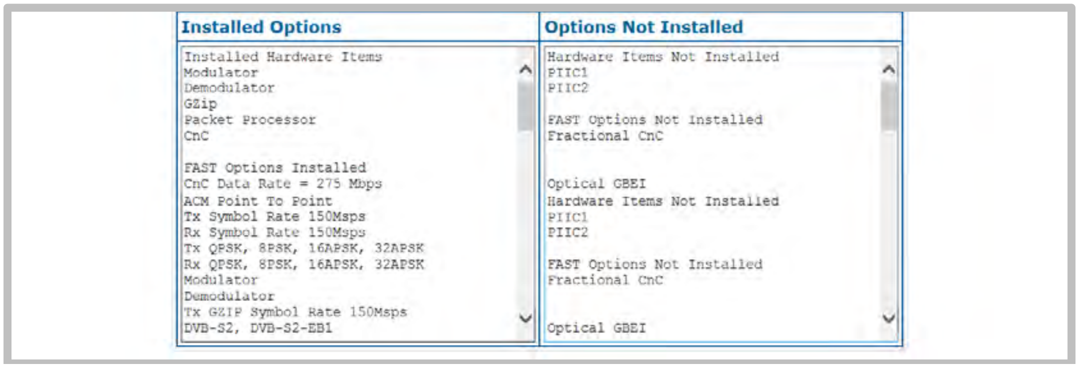
Do these steps:

1. Before contacting Comtech EF Data Product Support to order FAST feature upgrades, obtain and record the modem's baseboard serial number:
   a. Log in to the CDM-760 HTTP Interface, and open the '**Status | Info**' page. The serial number is provided in the **General Information** section of this page:

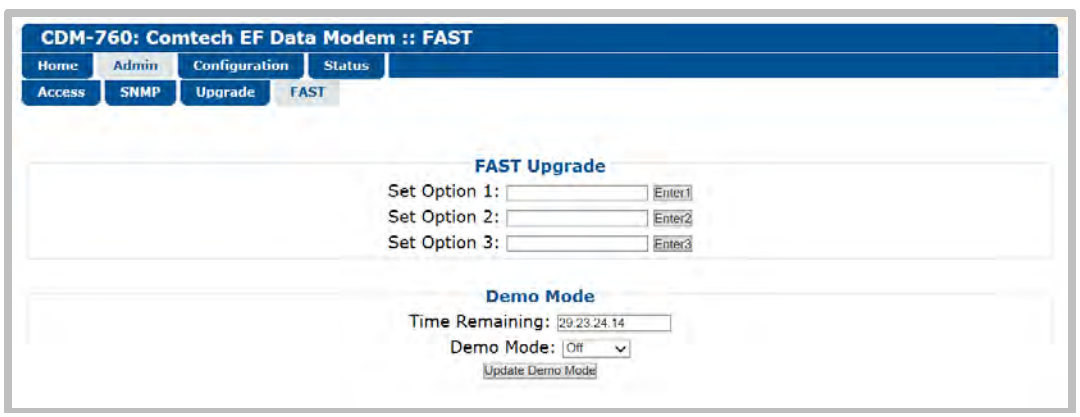


   b. Record the Serial Number: ____

2. To view currently installed FAST features, log in to the CDM-760 HTTP Interface and open the '**Status | Info'** page. The FAST information appears in the **Installed Options** and **Uninstalled Options** sections of this page, as this example shows:



3. Contact Comtech EF Data Product Support to order features:
   a. Provide the modem's 9-digit Baseboard Serial Number to the representative.
   b. Identify and purchase the desired FAST option(s).
   c. Obtain the invoice, the ***register-specific*** 20-digit FAST Access Code(s), and the FAST option activation instructions.
4. Enter the FAST Access Code(s):
   a. Log in to the CDM-760 HTTP Interface, and open the '**Admin | FAST**' page:



   b. Enter the register-specific 20-digit FAST Access Code(s) carefully into the associated text field(s) ("Option" as used here is the same as "Register"). The modem responds with "Configured Successfully" if the FAST upgrade is accepted; the modem then resets to its newly-incorporated default configuration. However, if an invalid code is entered, the message "Invalid!" will display in the text field. Repeat the FAST Access Code entry procedure. Should the code entry error persist, contact Comtech EF Data Product Support for further assistance.

Chapter 6. FRONT PANEL OPERATION

6.1 Overview

Figure 6-1. CDM-760 Front Panel View

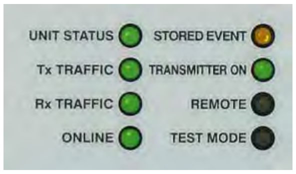
Figure 6-1 shows the CDM-760 front panel operational features:

1 **LED Indicators –** These eight LEDs show the summary status of key modem operations.

2 **Keypad –** Use the keypad to **ENTER** data. The keypad has six individual keys. The keys have a positive 'click' action that gives tactile feedback.

3 **Vacuum Fluorescent Display (VFD)** – The VFD shows data, menus, prompts, and messages. The VFD is an active display with adjustable brightness. It shows two lines of 40 characters each. Nested menus show options and prompts that guide you in carrying out required actions.

6.1.1 LED Indicators



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

Table 6-1. LED Function

LED	State	Cause
UNIT STATUS	Green	No Unit Faults or Traffic (Tx or Rx) Faults.
	Amber	A Unit, Tx, or Rx Alarm exists.
	Red	A Unit, Tx or Rx Fault exists (Example: PSU fault).
Tx TRAFFIC	Green	The Tx Traffic path hardware and firmware are not faulted.
	Off	The Tx Traffic path hardware and/or firmware are faulted.
Rx TRAFFIC	Green	Tx Traffic is passing normally (demodulator and decoder are locked, everything is OK).
	Off	An Rx Traffic fault exists (the demodulator may still be OK). A demodulator unlock is a fault, even though it is likely due to a missing carrier.
ONLINE	Green	The Unit is **online** and carrying traffic.
	Off	The Unit is **offline** (standby). The offline state is forced by an externally-connected 1:1 or 1:N redundancy system.
STORED EVENT	Amber	There is a Stored Event in the log. View stored events from the front panel, the remote control interface, or the CDM-760 HTTP (Web Server) Interface.
	Off	There are no Stored Events.
TRANSMITTER ON	Green	The Tx IF is ON.
	Off	The Tx IF is OFF.
REMOTE	Amber	The Unit is in Remote Mode. This means that remote monitoring and control is available. (Local monitoring and control is always available.)
	Off	The Unit is in Local Mode. This means that remote monitoring is possible, but remote control is not available.
TEST MODE	Amber	A Test Mode is selected. (Example: IF Loopback)
	Off	No Test Mode is selected.

6.1.2 Keypad

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

ENTER key – You may use the **ENTER** key as follows:

- From the opening screen, press **ENTER** once to go to the SELECT: (main) menu.
- Press **ENTER** to access the nested menu for a selected function, or to execute (save) a configuration change.

CLEAR key – You may use the **CLEAR** key as follows:

- From the opening screen, press **CLEAR** once to go to the **SELECT:** (main) menu.
- Press **CLEAR** to back out of a selection or to cancel a configuration change that you have not yet executed using **ENTER**.
- Press **CLEAR** to return to the previous menu screen.
- Press **CLEAR** repeatedly to return to the opening screen.

◄► **Left, Right keys** – On any menu screen, press the left or right key to move among available selections, or to move the cursor position

▲▼ **Up, Down keys** – Press the up or down key to scroll through settings that are available at the cursor position.

You may also use the up or down key to change the alphanumeric selection at the cursor position. Alphanumeric selections typically include numbers for configuration data and letters for text strings.

6.1.3 Vacuum Fluorescent Display (VFD)

The unit has a Vacuum Fluorescent Display (VFD). The VFD is an active display showing two lines of 40 characters each. It produces a blue light with a user-adjustable brightness. Compared to a Liquid Crystal Display (LCD), it provides superior viewing characteristics and does not suffer problems of viewing angle or contrast.

6.1.3.1 Opening Screen

The opening screen appears when you first apply power to the unit:

```
Comtech CDM-760 Advanced High-Speed
Trunking Modem     ver. X.X.X
```

This screen identifies the product and the version number of the installed firmware (e.g., **ver. 1.7.3**).

From the opening screen, press any key to display the top-level **SELECT:** (main) menu. To return to the opening screen from anywhere in the menus, press the **CLEAR** key repeatedly.

6.1.3.2 Screen Saver

The screen saver protects the VFD from possible image burn-in. After one hour of showing the same screen, the screen saver activates:

```
Circuit ID: ---------------------------
Demodulator not locked CnC is OFF Press an
```

The screen saver message moves from right to left across the screen, and then repeats. The top line shows the user-definable Circuit ID. The bottom line shows the demodulator lock status message[1] and CnC status, followed by the **Press any key....** prompt. Press any key to return to the previous menu.

6.1.3.3 Cursor Behavior

On most menu screens a flashing block cursor blinks at the rate of once per second. This cursor shows the selected parameter, number, or field.

```
Freq: 200.0000 MHz
                                   (◄►)
```

If a block cursor would obscure a selected parameter, the block cursor becomes an underline cursor automatically.

```
Freq:1200.0000 MHz
                                   (◄►)
```

[1] either **Demodulator not locked** or the circuit Eb/No value when the demodulator is locked

6.2 CDM-760 Front Panel Menus

The primary and nested menus available from the CDM-760 front panel are described in this section.

The actual choices displayed in the submenus depend on which FAST options are enabled. Where a FAST option affects a menu, this is explained in the sections that follow in this chapter.

Table 6-2. CDM-760 Front Panel Menus

Menu Branch	Display	Description
Opening Screen	Comtech CDM-760 Advanced High-Speed Trunking Modem ver X.X.X	Press **ENTER** to access the **SELECT:** (main) menu or, from any other screen, press **CLEAR** repeatedly to return to this screen. This top-level (splash) screen identifies the modem and its running firmware version.
Select (main)	**SELECT:** Configuration Monitor Test Store/Ld 0Utility ODU FAST	Use to access all monitor and control submenus.
Configuration	**CONFIG:** NetSpec Tx Rx Intf CnC Comp DPD Remote IP Mask Ref MEO	Select to fully configure the modem.
Monitor	**Monitor:** Live-Alarms Stored-Events ACM Rx-Params CnC Stats Buffer MEO DPD	Use to monitor the status of the modem and view the log of stored events for the modem.
Test	**TEST:** Mode BERT Comp LED	Use to configure the modem into one of several test modes or to configure/monitor the BER Tester.
Store/Ld	**Configuration #0 thru #9:** Load Store	Use to store and load (recall) up to 10 different modem configurations.
Utility	**Utilities:** Set-RTC Display EventLog CID AGC 1:1 1:N Circuit-ID Firmware	Use to perform miscellaneous functions, such as setting the Real-Time Clock, adjusting the display brightness, etc.
ODU	**ODU:** BUC PwrSupply+Ref **(FUTURE)** LNB PwrSupply+Ref FSK-control (**FUTURE**)	When installed and available, use to configure Outdoor Unit (BUC – Block Up Converter or LNB – Low-Noise Block Down Converter) operations.
FAST	**FAST:** Options Demo-Mode CnC	Use to verify installed options and configure different **Fully Accessible System Topology** options, e.g., extended data rates, interfaces, etc. Contact Comtech EF Data Product Support for details.

6.2.1 SELECT: (Main) Menu

When the modem is running with Carrier-in-Carrier installed and turned ON, you will see the blinking "CnC" symbol, shown here, at the far right of the top line of the SELECT: (main), SELECT: Monitor, and SELECT: TEST menu screens. If you do not see this symbol, it means that Carrier-in-Carrier is either not installed, or it is installed but turned OFF.

```
SELECT: Configuration  Monitor  Test
      Store/Ld  Utility  ODU  FAST    (◄►)
```

Use the ◄ ► arrow keys to select a menu branch. Press **ENTER**.

The **SELECT:** (main) menu provides the access entry point for all other modem configuration, monitor, and control operations. These menu branches and their submenus are described in the sections that follow.

6.2.2 SELECT: Configuration

```
CONFIG: NetSpec  Tx  Rx  Intf   CnC   Comp
        Remote  IP  Mask  Ref   MEO   (◄►)
```

Use the ◄ ► arrow keys to select a submenu. Press **ENTER**.

CONFIG Submenu	Description
NetSpec	**(Network Specification)** Use to configure the top level network specification mode (DVB-S2 Open Standard, DVB-S2-EB1/EB2 High Efficiency, or DVB-S2X Extended waveform and ModCod selections), and also to select between Normal and Medium Earth Orbit (MEO) operating modes.
Tx	**(Transmit)** Use to define the Tx configuration of the unit on a per-parameter basis.
Rx	**(Receive)** Use to define the Rx configuration of the unit on a per-parameter basis.
Intf	**(Interface)** Use to configure the operating status of the installed optional Plug-in Interface Cards (**PIICs**), optional **J7 | OPTICAL** port, or the optional High-Speed Packet Processor, plus the operating speed of Gigabit Ethernet Interface Ports GBEI1 (**J5 | DATA**) and GBEI2 (**J6 | DATA**).
CnC	**(DoubleTalk Carrier-in-Carrier)** Use to select DoubleTalk Carrier-in-Carrier (CnC) options.
Comp	Use to configure optional K4 GZip lossless compression and decompression operation.
DPD	**(Dynamic Predistortion)** Use to select Dynamic Predistortion mode and parameters.
Remote	**(Remote Control)** Use to define whether the unit can be controlled remotely via IP, serial, or both, and to configure the serial remote parameters. **NOTE: Local Mode is always enabled.**
IP	Use to configure various IP parameters, including IP address/range and gateway addresses, and to view MAC addresses.
Mask	Use to treat certain operational criteria as faults or alarms, or to mask (ignore) the conditions.
Ref	Use to select and configure the Frequency Reference as External or Internal, and to fine-adjust the Internal Hi-Stability 10 MHz Reference.
MEO	Use to select and configure the MEO (Medium Earth Orbit) and AHO (Antenna Handover) features

6.2.2.1 (CONFIG:) NetSpec

```
Network Spec:   DVB-S2-EB1
Operating Mode: MEO-TxRx-Rem                (⬍)
```

Use the ◀ ▶ arrows keys to select **Network Spec** or **Operating Mode.** Press **ENTER**.

6.2.2.1.1 (CONFIG: NetSpec) Network Spec

Network Spec (Network Specification) determines the top-level operating mode of the modem (this impacts both the Tx and Rx paths).

Use the ▲▼ arrow keys to select **DVB-S1** (Open Network Standard Operation), **DVB-S2-EB1 or DVB-S2-EB2** (Comtech EF Data's Efficiency Boost Rev. 1 or Rev. 2 Closed Network Standard Operation), or DVB-S2X (DVB-S2 Extended). Press **ENTER**.

Note that **DVB-S2-EB1**, **DVB-S2-EB2**, and **DVB-S2X** offer more ModCod and spectral rolloff (ROF) selections. list the available modulation and code rate combinations. This table has some roundoff of the last number in the Data Rate Range columns.

When you select a Network Specification other than what is active, the front panel displays this message:

```
Configuring Network Specification
          Please Wait
```

6.2.2.1.2 (CONFIG: NetSpec) Operating Mode

Operating Mode defines how the modem operates, when deployed with traditional geostationary satellites or as used in a Tx/Rx or Rx-only capacity on MEO (Medium Earth Orbit) satellites.

Use the ▲▼ arrow keys to select the desired mode. Press **ENTER**. Note the following:

Selection	Use when the modem is operating...
Normal	...on a satellite that is in geosynchronous orbit.
MEO-TxRx-Hub*	...on a MEO orbit satellite used at the **gateway/hub site** for both Transmit and Receive.
MEO-TxRx-Rem*	...on a MEO orbit satellite used at the **remote site** for both Transmit and Receive.
MEO-RxOnly*	...on a MEO orbit satellite used at the **hub or remote site** as an Rx-only demodulator.

*You must have a G.703 PIIC plugged into PIIC Slot #1 for any MEO Operational Modes to be accessible. If a G.703 PIIC is not installed in PIIC Slot #1, then this option will not be visible.

When you select an Operating Mode other than what is active, the front panel displays this message:

```
Configuring Operating Mode
        Please Wait
```

6.2.2.2 (CONFIG:) Tx

```
Tx: Mod  Data  Freq  Power  ACM  WANBuff
Data 155520.000kbps 060140.976ksps    (◄►)
```

On the top line, use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**. The *read-only* bottom line shows the operating data rate (in kbps) and symbol rate (in ksps).

6.2.2.2.1 (CONFIG: Tx) Mod

```
ModCod=8PSK     8/9     Frame:Normal
Pilots:On                           (◄►)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: Tx) Mod → ModCod, 0/0 (FEC)

Use the ◀ ▶ arrow keys to toggle between selecting the ModCod or FEC.

For ModCod – Use the ▲▼arrow keys to make your selection. Valid settings are **QPSK**, **8PSK**, **16APSK**, **32APSK**, or **ACM**.

The 16APSK, 32APSK, and ACM (Adaptive Coding and Modulation) settings require that the unit is already configured to permit these modulation types.

Select **ACM** for ACM Mode. In this mode, the modulator uses the ACM parameters (selected in the **CONFIG: Tx → ACM** menu) and the remote Es/No modem reading to automatically set the modulation type and FEC.

For FEC – Use the ▲▼arrow keys to make your selection. Press **ENTER**. ModCods and coding are valid for the listed network specifications as follows:

Network Spec	QPSK	8PSK	16APSK	32APSK	64APSK
DVB-S2	1/2, 3/5, 3/4, 4/5, 5/6, 8/9, 9/10	3/5, 2/3, 3/4, 5/6, 8/9, 9/10	2/3, 3/4, 4/5, 5/6, 8/9, 9/10	3/4, 4/5, 5/6, 8/9, 9/10	---
DVB-S2-EB1	1/2, 8/15, 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	---

Network Spec	QPSK	8PSK	16APSK	32APSK	64APSK
DVB-S2-EB2	1/2, 8/15, 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	4/5, 5/6, 31/36, 8/9, 9/10
DVB-S2X	¼, 13/45, 1/3, 2/5, 9/20, ½, 11/20, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10	5/9L, 26/45L, 3/5, 23/36, 2/3, 25/36, 13/18, 3/4, 5/6, 8/9, 9/10	1/2L, 5/9L, 26/45, 3/5, 3/5L, 28/45, 23/36, 2/3L, 2/3, 25/36, 13/18, 3/4, 7/9, 4/5, 5/6, 77/90, 8/9, 9/10	2/3L, 32/45, 11/15, 3/4, 7/9, 4/5, 5/6, 8/9, 9/10	32/45L, 11/15, 7/9, 4/5, 5/6
ACM	Auto	Auto	Auto	Auto	Auto

(CONFIG: Tx) Mod → Frame

You should consider the use of Short Block Framing only when there is a concern about data latency. In all other circumstances, Normal Block Framing should be used. See Figure C-4 Single Hop Latency in Appendix G. ADAPTIVE CODING AND MODULATION (ACM) OPTION for an illustration of how Normal and Short Block Framing affects overall system latency.

Use the ▲▼ arrow keys to select **Normal** (default) or **Short Block**. Press **ENTER**.

Note the following:

Setting	FECFRAME Bits Enabled	Remarks
Normal	64,800	This is the default (standard) setting.
Short	16,200	Short Block Framing performs 0.2 db to 0.3 db **worse** in terms of required Es/No for all ModCods.

(CONFIG: Tx) Mod → Pilot

Use the ▲▼ arrow keys to select Pilots as **On** or **Off**, then press **ENTER**:

- **On** enables the insertion of pilot symbols into the physical layer frame
- **Off** disables this insertion

When Pilot is **On**, pilots are always placed at the average power point of any constellation.

6.2.2.2.2 (CONFIG: Tx) Data

```
Tx Data Rate        Tx Symbol Rate
                                  (◄►)
```

Use the ◄ ► arrow keys to select **Tx Data Rat**e or **Tx Symbol Rate**. Press **ENTER**.

(CONFIG: Tx) Data → Tx Data Rate

PREREQUISITE:
You must make sure the modem is in Single Stream Mode, with only the Ethernet interfaces active before you can set the Tx Data Rate.

If the minimum data rate is zero (MIN_DR=000000.000), then the modem is in Single Stream Mode with only the Ethernet interfaces active:

```
  ETH_DR    +  MIN_DR   =   TOT_DR
009653.266  000000.000  009653.266 kbps
```

The data rate cannot be changed while the modem is in MultiStream Mode. If the minimum data rate is not zero, then the modem is in MultiStream Mode:

```
   ETH_DR   +    MIN_DR   =    TOT_DR
 019484.479   034883.520   054367.999Kbps
```

See Section 6.2.2.4.1 about entering or exiting MultiStream Mode.

Equation Example (top line) – For the **ETH_DR + MIN_DR = TOT_DR** (RO) equation:

- **ETH_DR = Ethernet Data Rate**
  This is always TOT_DR – MIN_DR. It is all data associated with the Ethernet data interfaces.
- **MIN_DR = Minimum Data Rate**
  This *read-only* value is always zero (000000.000) when the unit is in Single Stream Mode and only Ethernet Data Type is enabled. In MultiStream Mode, the **MIN_DR** is the aggregate of all active non-Ethernet interfaces, plus the MultiStream overhead. This overhead is 1.5% of the aggregate non-Ethernet data in Normal Block Mode, and 5% in Short Block Mode.
- **TOT_DR = Total Data Rate**
  This *read-only* value is the aggregate data rate of the modem. It relates to the Tx symbol rate and spectral efficiency (ModCod) settings.

The MIN_DR and TOT_DR values are *read-only*. You cannot edit these values.

On the bottom line, change the **ETH_DR** value. Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

<u>Data Rate Values</u>:
The maximum limits for the Data Rate are based on a symbol rate range from 0.1 to 150 Msps. The actual minimum and maximum data rates are dependent on Network Spec, Framing mode, Interface type, Modulation type and FEC Code Rate settings. The upper range of the data rate is also affected by the **FAST option(s)** installed.

The **Data Rate** adjusts automatically if changes made to any of the higher-priority parameters cause the data rate to become invalid.

Table 6-3, **Table 6-4**, and **Table 6-5** list the available modulation and code rate combinations. These tables have some roundoff of the last number in the Data Rate Range columns.

(CONFIG: Tx) Data → Tx Symbol Rate

You <u>can</u> change the Tx Symbol Rate while the modem is in MultiStream Mode. The modulator turns the Tx Carrier OFF while programming.

```
Tx Symbol Rate = 30000.000 ksps
                                    (◄►⬍)
```

Use the ◀ ▶ arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

The Data Rate value changes as you change the Symbol Rate value. The value of the Data Rate depends upon the code rate, modulation type, and mode type.

When you change the modulation, code rate, or other parameters, the modem attempts to maintain the same Symbol Rate as long as it is still in range when you change one of the other parameters. The modem rejects any data or symbol rate change that is not in the valid range. You must first change the Modulator Code Rate or mode when the modem rejects a new rate.

Table 6-3, **Table 6-4**, and **Table 6-5** list the available modulation and code rate combinations. These tables have some roundoff of the last number in the Data Rate Range columns.

Table 6-3. DVB-S2 Symbol Rate / Data Rate Range for Standard FECFrame

DVBS2, Normal Block, Pilot ON, QEF (PER 1E-7) AWGN Linear Channel								
MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits/Hz)	QEF Eb/No	QEF Es/No
QPSK	1/4	0.1	150	0.05	72	0.48	0.9	-2.3
	1/3	0.1	150	0.06	96	0.64	0.8	-1.1
	2/5	0.1	150	0.08	115.5	0.77	0.9	-0.2
	1/2	0.1	150	0.10	144.80	0.97	1.4	1.2
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
	3/4	0.1	150	0.15	217.80	1.45	2.6	4.2
	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	2/3	0.1	120	0.19	232.30	1.94	3.9	6.8
	3/4	0.1	120	0.22	261.40	2.18	4.7	8.1
	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.20	2.62	7.0	11.2
16APSK	2/3	0.1	90	0.26	231.80	2.58	5.2	9.3
	3/4	0.1	90	0.29	260.60	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4	11.3
	5/6	0.1	90	0.32	290.00	3.22	6.8	11.9
	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	9/10	0.1	90	0.35	313.50	3.48	8.0	13.4
32APSK	3/4	0.1	72	0.36	260.90	3.62	7.5	13.1
	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
	5/6	0.1	72	0.40	290.20	4.03	8.6	14.7
	8/9	0.1	72	0.43	309.80	4.30	9.8	16.1
	9/10	0.1	72	0.44	313.70	4.36	10.0	16.4

Table 6-4. DVB-S2-EB1/EB2 Symbol Rate / Data Rate Range for Standard FECFrame

DVB-S2-EB1 / EB2*, Normal Block, Pilot ON, QEF (PER 1E-7) AWGN Linear Channel								
MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits/Hz)	QEF Eb/No (* = EB2)	QEF Es/No (* = EB2)
QPSK	1/4	0.1	150	0.05	72.00	0.48	0.9	-2.3
	53/180	0.1	150	0.06	85.50	0.57	1 / 0.9*	-1.4 / -1.5*
	1/3	0.1	150	0.06	96.00	0.64	0.8	-1.1
	11/30	0.1	150	0.07	106.50	0.71	1.0	-0.5
	2/5	0.1	150	0.08	115.50	0.77	0.9	-0.2
	77/180	0.1	150	0.08	123.00	0.82	1.2	0.3
	83/180	0.1	150	0.09	133.50	0.89	1.3	0.8
	1/2	0.1	150	0.10	145.50	0.97	1.3	1.2
	8/15	0.1	150	0.10	154.50	1.03	1.6	1.7
	17/30	0.1	150	0.11	165.00	1.10	1.7	2.1
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	19/30	0.1	150	0.12	183.00	1.22	1.9	2.8
	2/3	0.1	150	0.13	193.50	1.29	2.2	3.3
	127/180	0.1	150	0.14	205.50	1.37	2.4	3.8
	3/4	0.1	150	0.15	217.50	1.45	2.6	4.2
	4/5	0.1	150	0.16	232.50	1.55	3.0	4.9
	5/6	0.1	150	0.16	243.00	1.62	3.3	5.4
	31/36	0.1	150	0.17	250.50	1.67	3.7	5.9
	8/9	0.1	150	0.17	258.00	1.72	4.0	6.4
	9/10	0.1	150	0.18	262.50	1.75	4.2	6.6
8PSK	17/30	0.1	120	0.16	196.80	1.64	3.8	5.9
	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	19/30	0.1	120	0.18	220.80	1.84	3.9	6.5
	2/3	0.1	120	0.19	232.80	1.94	3.9	6.8
	127/180	0.1	120	0.21	246.00	2.05	4.7 / 4.5*	7.8 / 7.6*
	3/4	0.1	120	0.22	261.60	2.18	4.7	8.1
	4/5	0.1	120	0.23	278.40	2.32	5.3	9.0
	5/6	0.1	120	0.24	290.40	2.42	5.8	9.6
	31/36	0.1	120	0.25	300.00	2.50	6.3	10.3
	8/9	0.1	120	0.26	310.80	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.40	2.62	7.0	11.2
16APSK	19/30	0.1	90	0.24	219.60	2.44	5.3 / 5*	9.2 / 8.9*
	2/3	0.1	90	0.26	231.30	2.57	5.2 / 5.1*	9.3 / 9.2*
	127/180	0.1	90	0.27	244.80	2.72	5.7 / 5.5*	10 / 9.8*
	3/4	0.1	90	0.29	261.00	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4 / 6.3*	11.3 / 11.2*
	5/6	0.1	90	0.32	289.80	3.22	6.8 / 6.7*	11.9 / 11.8*
	31/36	0.1	90	0.33	299.70	3.33	7.6 / 7.2*	12.8 / 12.4*
	8/9	0.1	90	0.34	309.60	3.44	7.8 / 7.6*	13.2 / 13*
	9/10	0.1	90	0.35	313.20	3.48	8 / 7.9*	13.4 / 13.3*
32APSK	127/180	0.1	72	0.34	245.52	3.41	7.2 / 7*	12.5 / 12.3*
	3/4	0.1	72	0.36	260.64	3.62	7.5 / 7.3*	13.1 / 12.9*
	4/5	0.1	72	0.39	278.64	3.87	8.1 / 8*	14 / 13.9*
	5/6	0.1	72	0.40	290.16	4.03	8.6 / 8.4*	14.7 / 14.5*
	31/36	0.1	72	0.42	299.52	4.16	9.2 / 8.9*	15.4 / 15.1*
	8/9	0.1	72	0.43	309.60	4.30	9.8 / 9.4*	16.1 / 15.7*
	9/10	0.1	72	0.44	313.92	4.36	10 / 9.8*	16.4 / 16.2*
64APSK *	4/5	0.1	54	0.46	250.02	4.63	NA / 10.4*	NA / 17.1*
	5/6	0.1	54	0.48	260.28	4.82	NA / 11.1*	NA / 17.9*
	31/36	0.1	54	0.50	268.92	4.98	NA / 11.5*	NA / 18.5*
	8/9	0.1	54	0.52	278.10	5.15	NA / 12.3*	NA / 19.4*
	9/10	0.1	54	0.52	281.88	5.22	NA / 12.7*	NA / 19.9*

Table 6-5. DVB-S2X Symbol Rate / Data Rate Range for Standard FECFrame

DVB-S2X (in addition to DVB-S2 ModCods), Normal Block, Pilot ON, QEF (FER 1E-5) AWGN Linear Channel								
MOD	**FEC**	**Min SR (Msps)**	**Max SR (Msps)**	**Min DR (Mbps)**	**Max DR (Mbps)**	**Spec Eff (Bits / Hz)**	**QEF Eb/No (* = EB2)**	**QEF Es/No (* = EB2)**
QPSK	13/45	0.1	150	0.06	83.14	0.55	0.8	-1.8
	9/20	0.1	150	0.09	130.20	0.87	1.0	0.4
	11/20	0.1	150	0.11	159.40	1.06	1.4	1.7
8PSK	5/9-L	0.1	120	0.16	193.18	1.61	2.9	5.0
	26/45-L	0.1	120	0.17	200.96	1.67	3.2	5.4
	23/36	0.1	120	0.19	222.37	1.85	3.8	6.5
	25/36	0.1	120	0.20	241.84	2.02	4.3	7.3
	13/18	0.1	120	0.21	251.57	2.10	4.5	7.7
16APSK	1/2-L	0.1	90	0.19	173.29	1.93	3.5	6.3
	8/15-L	0.1	90	0.21	184.94	2.05	3.7	6.8
	5/9-L	0.1	90	0.21	192.71	2.14	3.8	7.1
	26/45	0.1	90	0.22	200.47	2.23	4.4	7.9
	3/5	0.1	90	0.23	208.24	2.31	4.7	8.3
	3/5-L	0.1	90	0.23	208.24	2.31	4.1	7.7
	28/45	0.1	90	0.24	216.01	2.40	4.7	8.5
	23/36	0.1	90	0.25	221.83	2.46	4.7	8.6
	2/3-L	0.1	90	0.26	231.54	2.57	4.5	8.6
	25/36	0.1	90	0.27	241.25	2.68	5.3	9.6
	13/18	0.1	90	0.28	250.96	2.79	5.5	10.0
	7/9	0.1	90	0.30	270.38	3.00	6.1	10.9
	77/90	0.1	90	0.33	297.56	3.31	7.1	12.3
32APSK	2/3-L	0.1	72	0.32	231.73	3.22	6.5	11.6
	32/45	0.1	72	0.34	247.28	3.43	6.8	12.2
	11/15	0.1	72	0.35	255.05	3.54	7.1	12.6
	7/9	0.1	72	0.38	270.60	3.76	7.8	13.5
64APSK	32/45-L	0.1	54	0.41	222.01	4.11	8.4	14.5
	11/15	0.1	54	0.42	228.99	4.24	9.0	15.3
	7/9	0.1	54	0.45	242.95	4.50	9.5	16.0
	4/5	0.1	54	0.46	249.93	4.63	9.7	16.4
	5/6	0.1	54	0.48	260.39	4.82	10.3	17.1

6.2.2.2.3 (CONFIG: Tx) Freq (Frequency)

```
Freq:1200.0000 MHz  Spectrum:Normal
Txα:.20  GoldCode:000000              (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: Tx) Freq → Freq

Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

(CONFIG: Tx) Freq → Spectrum

Use the ▲▼ arrow keys to select **Inverted** or **Normal**. Press **ENTER**.

The modem itself determines the Tx spectral inversion while in CnC mode. You cannot change the spectral inversion selection while CnC mode is ON. The modem rejects any attempt at changes.

(CONFIG: Tx) Freq →Txα (Tx Alpha Filter Rolloff Factor)

Use the ▲▼ arrow keys to set the **Txα.** Press **ENTER**. Valid settings are:

Mode	Txα (Tx Alpha Filter Rolloff Factor) (%)	Default
DVB-S2	.20, .25, .35	.20 (20%)
DVB-S2-EB1	.05, .10, .15, .20, .25, .35	
DVB-S2X	.05, .10, .15, .20, .25, .35	.20 (20%)

(CONFIG) Tx: Freq→GoldCode (Gold-n Index Code)

CRITICAL!
Make sure that the Tx GoldCode value matches the Rx GoldCode value of the distant end modem.

The GoldCode indicates the Physical Layer spreading sequence number. Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**. Valid settings are:

Minimum	Maximum	Default
000000	262141	000000

6.2.2.2.4 (CONFIG: Tx) Power

```
Tx: Carrier:On          Level:-25.0dBm
 PowerControl: Manual AUPC              (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER.**

(CONFIG: Tx) Power → Carrier

Use the ▲▼ arrow keys to select **On** or **Off**.

(CONFIG: Tx) Power → Level

Use the ◄ ► arrow keys to select a **digit,** and then use the ▲▼ arrow keys to change that digit. Press **ENTER.** Valid settings are:

Tx Frequency Range	Power Levels
50 to 180 MHz	0 to –25 dBm
950 to 2250 MHz (L-Band)	0 to –40 dBm

(CONFIG: Tx) Power → PowerControl

Use the ◄ ► arrow keys to select **Manual or AUPC.** Press **ENTER.**

(CONFIG: Tx) Power → PowerControl → Manual

Select **Manual** to set the modem's output power level to be the same as the Tx power level value configured with **(CONFIG: Tx)Power→Level**.

(CONFIG: Tx) Power → PowerControl → AUPC

Select **AUPC** to place the modem in AUPC (Automatic Uplink Power Control) Mode.

AUPC is a means to automatically adjust the Tx power of the modem based on user-defined parameters and feedback from the far-end demodulator's Es/No level. When this option is purchased, AUPC directs the modem itself to take control of the output power within the AUPC operating parameters configured with **(CONFIG: Tx) Power → AUPC** (see next).

(CONFIG: Tx) Power → AUPC

```
AUPC: Target:06.0 dB   LCL:Nom   RCL:Nom
Nominal:-25.0 dBm  Range:03.0 dBm     (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.
Use this menu to define AUPC minimum and maximum operating boundaries. AUPC adjusts the modulator's power in order to match a desired Es/No level.

AUPC Compensation Rate: As with any closed-loop control system, the loop parameters must be chosen to ensure stability at all times. Several features are incorporated to ensure that the AUPC system does overshoot, or oscillate:

- **In Normal (GEO, or geosynchronous satellite) operating mode,** the rate at which corrections are made to the output power is fixed at 1X/second. 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 Eb/No, and other processing delays in the modems.
- **In MEO (Medium Earth Orbit satellite) operating mode,** the rate at which a message is processed and the modem acts on the message, is 1X/250 ms. This takes into account the lower round trip delay.
- If the comparison of actual and target Eb/No yields a result that requires a change in output power, the first correction made will be 80% of the calculated step, <u>up to a maximum change of 1 dB/message</u> (1X/second in Normal Mode and up to 4X/second in MEO Mode). 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.

The maximum change per message (1X/second in GEO mode and 1X/250 ms in MEO Mode) will be 1 dB. Any request for more than 1 dB of power delta will take more than one update period to perform. This is to keep the demodulator from unlocking due to an instantaneous power change.

AUPC and ACM: AUPC and ACM operate autonomously:

- AUPC drives the modem to a Tx power level that meets the target Es/No at the remote site.
- ACM transmits the "best fit" ModCod for the current Es/No.

Because AUPC and ACM function independently, there should be no reason to link them, as one does not affect the other. In fact, run independently, each feature safeguards the other's function from a loss of lock.

(CONFIG: Tx) Power → AUPC → Target

This is the Target Es/No value that you wish to keep constant at the remote modem. Use the ▲▼ arrow keys to set the value. Press **ENTER**. Valid settings are:

Range		Step Size
Minimum	Maximum	
0.0 dB	23.5 dB	0.1 dB

If the current Es/No exceeds this value, the AUPC control decreases the local modem's Tx output power but never drops below the configured **Nominal** value.

If the far side modem's Es/No falls below this value, the AUPC control increases the local modem's Tx output power but never exceeds the **Nominal value + Range**.

For example: When you set the **Nominal** value to **-25.0 dBm** and the **Range** value to **03.0 dBm**, then the maximum Tx power that AUPC drives the modem to will be **-22 dBm**.

(CONFIG: Tx) Power → AUPC → LCL or RCL (Local or Remote Carrier Loss)

This setting directs AUPC how to react to **LCL** (Local Carrier Loss) or **RCL** (Remote Carrier Loss). Because proper functionality of AUPC requires both modems to communicate over the satellite link, you must determine what power level the modem should be set for in case the link is lost and there is no local or remote demodulator lock.

Use the▲▼ arrow keys to select **Nom** or **Max**. Press **ENTER**. Note the following:

Selection	Function
Nom	**(Nominal)** This sets the modem's output power level to the configured **Nominal** setting. As per the **(CONFIG: Tx) Power → AUPC → Target** example, just as the **Nom** selection sets the Tx power to be -25.0 dB, the **Max** output power selection then transmits a -22.0 dB carrier.
Max	**(Maximum)** This sets the modem's output power level to be **Nominal + Range** when the modems are not communicating.

1) 'Nom' is the suggested LCL and RCL selection, as it will be the lowest output power level.
2) While selecting 'Max' may be better for carrier recovery, it can also lead to transmission of excessive power when the issue is not Uplink Fade (such as a remote site power outage).

(CONFIG: Tx) Power → AUPC → Nominal

Consider "Nominal" to be the modem's lowest possible Tx power needed to achieve the required Es/No at the remote site.

If the **Nominal** level is not set in ideal conditions, it will cause overdriving of the link during ideal conditions. Comtech EF Data strongly suggests that you enter this value when both sides of the link are in clear sky condition. This gives you the lowest possible Tx output power, and is ideal for setting the **Nominal** level.

The **Nominal** level can be set at any output power level the modem allows for the mode of operation it is in, as long as the **Nominal + Range** sum does not exceed the total output power range of the modem.

As per the (CONFIG: Tx) Power → AUPC → Target example, a **Nominal** setting of -25 dB and a **Range** of 3 dBm gives the modem a **Nominal + Range = -22 dBm.** This is acceptable. However, if the **Nominal** setting is -2 dBm, and the **Range** is set to 3 dBm, then this instructs the modem to transmit at **Nominal + Range = +1 dBm**, which is not acceptable; the modem will therefore reject this entry.

Valid settings are:

IF Frequency	Total Output Power Range of CDM-760		
	Minimum	Maximum	Step Size
70 / 140 MHz (50-180 MHz in 100 Hz Steps)	0 dBm	-25 dBm	0.1 dBm
L-Band (950-2150 MHz in 100 Hz steps)	0 dBm	-40 dBm	0.1 dBm

(CONFIG: Tx) Power → AUPC → Range

The **Range** defines how much the modem is permitted to increase the Tx output level beyond the **Nominal** level while under AUPC control. Set the **Range** to accommodate any output power level the modem allows for under its current mode of operation, on the condition that the **Nominal + Range** sum does not exceed the total output power range of the modem.

Use the ▲▼ arrow keys to set the value. Press **ENTER**. Valid settings are:

Range		Step Size
Minimum	Maximum	
0.00 dB	40.0 dB	0.1 dB

6.2.2.2.5 (CONFIG: Tx) ACM (Adaptive Coding and Modulation)

Appendix G. ADAPTIVE CODING AND MODULATION (ACM) OPTION

```
ACM Config: Min/Max-ModCod  Unlock-Action
Target-EsNo-Margin Degradation          (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: Tx) ACM Config→Min/Max-ModCod

To force the system to run at a fixed ModCod, set the Min and Max ModCod to equal values.

CAUTION
Other FAST options that are installed for Modulation and Symbol Rate may limit the Max ModCod value.

```
Min Modcod: QPSK 1/2
Max Modcod: 32APSK 9/10
```

Set the ModCod range to configure the modem's transmit capability.

Use the ◄ ► arrow keys to select **Min Modcod** (top line) or **Max Modcod** (bottom line). Press **ENTER**. Then, use the ▲▼ arrow keys to set the ModCod. Press **ENTER**.

Table 6-3, **Table 6-4**, and **Table 6-5** list the permitted ModCod, modulation, and code rate combinations. These tables have some roundoff of the last number in the Data Rate Range columns.

(CONFIG: Tx) ACM Config→Unlock-Action

```
When distant-end demodulator loses lock:
Go to min Tx ModCod (Maintain,Min)   (▲▼)
```

The modem sends and receives ACM messages roughly every 250 milliseconds. This Unlock-Action occurs when the remote demodulator loses lock and the modem misses three consecutive ACM messages.

Use the ▲▼ arrow keys to select an action. Press **ENTER**.

Comtech EF Data recommends that you use “Min” as the go-to option. This is important, because the ACM system depends on the feedback of the SNR metric from the remote demodulator to find the optimum ModCod.

(CONFIG: Tx) ACM Config→Target-EsNo-Margin

```
Target Es/No Margin = 1.0 dB (0.0 – 4.5)
                                (◄►▲▼)
```

Use the ▲▼ arrow keys to select a margin value. Press **ENTER**. Valid settings are:

Range		Step Size	Default
Minimum	Maximum		
0.0 dB	4.5 dB	0.1 dB	1.0 dB

The ACM system is designed to switch based on thresholds that correspond to a QEF of $1E^{-7}$ PER for each ModCod. The Target Es/No Margin value is used as a tool to compensate for fade. This margin is ADDED to the QEF published specification to all ModCods. The QEF specification for a ModCod *plus* the Target Es/No margin *plus* the Modulation Degradation for a modulation type sets the “shift up” and “shift down” points for the ACM operation.

Using this table as a guide for calculating the Target Es/No Margin:

Symbol Rate Range (Msps)	Messaging/ Processing (ms)	GEO Round Trip Time (ms)	MEO Round Trip Time (ms)	Total GEO Comms (ms)	Total MEO Comms (ms)
1.0<SR<5.0	1016	560	150	1756	1166
5.0<SR<15.0	303	560	150	863	453
15.0<AR	267.8	560	150	827.8	417.8

This table gives the total time, in milliseconds, needed to calculate the Target Es/No Margin. Using the correct symbol rate range, multiply the MAXIMUM FADE in dB/sec by the time needed to process an ACM message.

For Example: An ACM system is running on a Ku-Band GEO satellite with a symbol rate of 5Msps. There is a maximum fade rate of 1.5 dB/sec on this link.

Using this table, note that a 5 Msps link on a GEO satellite requires a minimum processing time of 863 ms. With a maximum fade rate of 1.5dB/sec this means 0.863 * 1.5 = 1.2945 dB. Target Es/No Margin therefore needs to be set at 1.3 dB at MINIMUM in order to ensure that, in the maximum fade scenario, demod lock is not lost and faulty data does not pass.

The ACM algorithm has an extremely fast ACM messaging system – the CDM-760 sends ACM messages to the far side transmitter every 100 ms. As fast as the ACM messages are transmitted, there are many other factors in an ACM environment to consider that impact the overall service. These factors can generally be divided into two categories: *message processing*, and *round trip time*:

- ***Message processing*** accounts for all ACM messaging, demodulator processing, ACM switching engine, and time between ACM messages;
- ***Round trip time*** is simply the trip over a satellite and back.

This example shows why a very fast 100ms ACM message requires 863ms of total latency:

1 Last ACM message was just sent Time (T = -1 ms)

2 T=0: *Worst fade conditions begin*

3 T = 100 ms: *ACM message is sent to far side transmitter*

4 T = 100 + 280 ms: (*GEO) ACM message lands at far side transmitter over 1 satellite hop*

5 T= 380 + 50 ms: *Far side transmitter processes and begins to send new lower ModCod*

6 T= 430 + 280 ms: Ne*w lower ModCod lands at demod over 2nd satellite hop*

7 T= 710 + 53 ms: (5 Msps) *The new ModCod is being processed by decoder*

8 T = 763 + 100 ms: *This ModCod must be valid for 100 ms until next ModCod arrives*

9 T = 863 ms: *This is the maximum latency this ACM circuit requires per the Symbol Rate used and the satellite (GEO) used.*

As outlined, even with a very fast 100 ms ACM messaging system, there are still significant elements that play a part in the overall latency of the ACM system. All elements must be taken into account in order to keep the demodulator locked and the data error free.

(CONFIG: Tx) ACM Config→Degradation

```
Degradation: QPSK=0.0   8PSK=0.0
            16QAM=1.0 32APSK=2.0    (◄►▲▼)
```

Add a level of signal margin to the QEF switch points in ACM operation. Do this by adding a degradation value for each modulation type. This degradation value increases the Es/No that is required to switch to a ModCod having a degradation value > 0.0.

The use of degradation values can help make sure that switching to a higher-order modulation does not cause errors. Systems with higher levels of phase noise or non-linearities can impact higher-order modulation schemes such as 16APSK and 32APSK more dramatically than QPSK or 8PSK operation. These systems can benefit from using degradation values to prevent errors.

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**. Then, use the ◄ ► arrow keys to select a digit, and the ▲▼ arrow keys to change that digit. Press **ENTER**.

The factory default for all settings is **0.0.**

6.2.2.2.6 (CONFIG: Tx) WANBuff

```
WAN Buffer Length:200 mSec
                                    (◄►▲▼)
```

Use the ▲▼ arrow keys to set the value of the WAN Buffer Length. Press **ENTER**. Valid settings are:

Range		Step Size	Default
Minimum	Maximum		
20 ms	400 ms	10 ms	200 mSec

Use a WAN buffer to absorb high capacity bursts of traffic that could overrun the WAN Ethernet data rate of the modem. These bursts of data are often very short and exceed the data rate of the modem on a burst basis but, viewed over time, may not exceed the Ethernet WAN rate on average. The WAN buffer acts as an elastic holding area for the data, so that the modem can send the traffic out at a smooth, fixed data rate.

The WAN Buffer Length defines the maximum ingress buffer depth for Ethernet traffic. It only impacts Ethernet traffic either in Single Stream Ethernet Only Mode or MultiStream Mode.

No synchronous traffic passes through the WAN buffer. As the WAN Buffer Length is set in milliseconds (ms), its actual depth in bits is determined by multiplying the data rate of the Ethernet capacity by the time in ms.

For example: The modem is set to Single Stream Mode with a data rate of **10 Mbps**. The WAN Buffer Length is set for **200 ms**. Therefore, **10 Mbps * 0.2 sec = 2 Mb** WAN Buffer Length.

1) If you are in MultiStream Mode, the buffer depth is calculated using only the Ethernet data rate – not the aggregate data rate.
2) The WAN Buffer is a FIFO (First In First Out) buffer, not a circular buffer. This means that, as long as the Ethernet ingress to the modem does not exceed the Ethernet Data Rate of the modem, the buffer will always remain relatively empty and there will be NO ADDED LATENCY. The buffer will begin to fill and you will experience added latency <u>only</u> when the Ethernet traffic ingress to the modem exceeds the egress of the Ethernet data rate.
3) By enabling Flow Control, the modem begins to send Pause Frames to any device connected to the Ethernet Data Interfaces at approximately 87% capacity. Pause Frames cease to be sent to the Ethernet Interfaces when the WAN Buffer Full Status drops below 75% capacity. See (CONFIG: INTF)(GBEIX)→ FlowControl in **Section 6.2.2.4.2** for more information about Flow Control.

6.2.2.3 (CONFIG:) Rx

```
 Rx: Mod  Data  Freq  EsNo
Data 155520.000kbps 060140.976ksps    (◄►)
```

On the top line – Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

The *read-only* bottom line shows the operating data rate (in kbps) and symbol rate (in ksps).

The Data rate displays "00000.000kbps" when the demodulator is unlocked.

6.2.2.3.1 (CONFIG: Rx) Mod

This screen displays "Demodulator Is Not Locked" if the demodulator is unlocked.

```
ModCod=8PSK   8/9   Frame:Normal
Pilots:On                         (◄►)
```

This *read-only* screen identifies the active modulation type, coding, Framing Mode, and Pilot setting.

ModCods and coding are valid for the listed network specifications as follows:

Network Spec	QPSK	8PSK	16APSK	32APSK	64APSK
DVB-S2	1/2, 3/5, 3/4, 4/5, 5/6, 8/9, 9/10	3/5, 2/3, 3/4, 5/6, 8/9, 9/10	2/3, 3/4, 4/5, 5/6, 8/9, 9/10	3/4, 4/5, 5/6, 8/9, 9/10	---

Network Spec	QPSK	8PSK	16APSK	32APSK	64APSK
DVB-S2-EB1	1/2, 8/15, 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	---
DVB-S2-EB2	1/2, 8/15, 17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	17/30, 3/5, 19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	19/30, 2/3, 127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	127/180, 3/4, 4/5, 5/6, 31/36, 8/9, 9/10	4/5, 5/6, 31/36, 8/9, 9/10
DVB-S2X	1/4, 13/45, 1/3, 2/5, 9/20, 1/2, 11/20, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10	5/9L, 26/45L, 3/5, 23/36, 2/3, 25/36, 13/18, 3/4, 5/6, 8/9, 9/10	1/2L, 5/9L, 26/45, 3/5, 3/5L, 28/45, 23/36, 2/3L, 2/3, 25/36, 13/18, 3/4 7/9, 4/5, 5/6, 77/90, 8/9, 9/10	2/3L, 32/45, 11/15, 3/4, 7/9, 4/5, 5/6, 8/9, 9/10	32/45L, 11/15, 7/9, 4/5, 5/6

Framing modes are as follows:

Displayed Setting	FECFRAME Bits Enabled
Normal	64,800 (standard)
Short (Short Block)	16,200

Pilots are either **On** or **Off**.

6.2.2.3.2 (CONFIG: Rx) Data

```
Rx Data Rate    Rx Symbol Rate
                                          (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER.**

(CONFIG: Rx) Data → Rx Data Rate

The Data rate displays "00000.000kbps" when the demodulator is unlocked.

```
Rx Data Rate = 155520.001 kbps
```

The **Rx Data Rate** here is *read-only*. It shows the total aggregate data rate of the locked demodulator.

The Data rate displays “00000.000kbps” when the demodulator is unlocked.

(CONFIG: Rx) Data → Rx Symbol Rate

```
Rx Sym Rate = 060140.976 ksps
                                       (◄►▲▼)
```

Set the **Rx Symbol Rate** to match the Tx Symbol Rate of the distant end modulator. Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**. After the receive path is locked, the Rx menus show the applicable data rate, modulation type, code rate, pilots ON/OFF, FEC frame length spectral inversion, etc.

6.2.2.3.3 (CONFIG: Rx) Freq (Frequency)

```
Freq:1200.0000 MHz  Spectrum:Normal
Rxα:.20  GoldCode:000000              (◄►)
```

The **Spectrum Inversion** status is *read-only*. The active status displays as either **Normal** or **Inverted**.

The active **Rxα** (Rx Alpha Filter Rolloff Factor) status is *read-only*. The displayed value depends on the active network specification:

Network Specification	Rxα (Rx Alpha Filter Rolloff Factor) (%)
DVB-S2	.20, .25, .35
DVB-S2-EB1	.05, .10, .15, .20, .25, .35
DVB-S2X	.05, .10, .15, .20, .25, .35
Demodulator Unlocked	N/A

Otherwise, use the ◄ ► arrow keys to select a parameter. Press **ENTER.**

(CONFIG: Rx) Freq → Freq

Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER.**

(CONFIG: Rx) Freq → GoldCode (Gold-n Index Code)

CRITICAL!
Make sure that the Rx GoldCode value matches the Tx GoldCode value of the distant end modem.

The GoldCode indicates the Physical Layer spreading sequence number. Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**. Valid settings are:

Minimum	Maximum	Default
000000	262141	000000

6.2.2.3.4 (CONFIG: Rx) EsNo

```
Receive EsNo Alarm Point = -03.0 dB
                              (◄►▲▼)
```

Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER.**

If the Rx Es/No falls below this value and the fault is NOT masked, the modem generates a receive traffic fault.

6.2.2.4 CONFIG: Intf (Configure Interface)

- Appendix C. OPTIONAL PIIC (PLUG-IN INTERFACE CARD) MODULES
- Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR

1) The acronyms "GbE" and "GigE" both refer to "Gigabit Ethernet." They are used interchangeably throughout the front panel interface.
2) The selections here will vary, depending both on the presence of the PIIC or High-Speed Packet Processor hardware options and whether Single Stream or MultiStream Operating Mode is in use.

When the PIIC interface slot card is installed:

```
GBEI1  GBEI2  Optical  PIIC1    PIIC2
Auto   Off    NONE    G703-E3  G703-Off
```

When the optional High-Speed Packet Processor card is installed:

```
GBEI1   GBEI2   Optical  PacketProcessor
Off     Off     NONE     Enabled
```

Use this screen to see the installation status and configured state of each interface. This screen consists of five columns when the standard PIIC slot card is installed or four columns when the optional High-Speed Packet Processor card is installed.

The top line of each column displays an available interface; the screen shows the installation and configuration status for that interface directly below.

On the bottom line – Use the ◄ ► arrow keys to select a configurable interface. Press **ENTER**.

Table 6-6 provides detailed information for the menu selections and their conditional availability.

Table 6-6. Config: Intf Screen

Interface (Top line)	Indication (Bottom Line)	Description
Gigabit Ethernet: GBEI1 port (J5 | DATA) and GBEI2 port (J6 | DATA) *(Inoperable when the optional Packet Processor is ENABLED)*	**Off**	The GbE interface is Off. The PHY is down. The interface is in Tri-state mode and all LED indicators are non-functioning.
	Auto	The GbE interface is On. The PHY is up. Both the port speed and Full/Half Duplex communications are auto-negotiated.
	10/H	The GbE interface is On. The PHY is up. The port speed is 10 Base-T with Half Duplex communications.
	10/F	The GbE interface is On. The PHY is up. The port speed is 10 Base-T with Full Duplex communications.
	100/H	The GbE interface is On. The PHY is up. The port speed is 100 Base-T with Half Duplex communications.
	100/F	The GbE interface is On. The PHY is up. The port speed is 100 Base-T with Full Duplex communications.
	1000/F	The GbE interface is On. The PHY is up. The port speed is 1000 Base-T with Full Duplex communications.
Optional Optical Ethernet port (J7 | OPTICAL)	**NONE**	The interface is either disabled via FAST Option or there is no SFP module present.
	Off	The interface is enabled via FAST Option, and the SFP is present but it is not in use.
	On	The interface is enabled via FAST Option and in use, and the SFP is present. All communications via this port is 1000 Base-T (GbE), auto-negotiating **only**.
Optional Plug-In Interface Card Slots: PIIC1 (Slot1) and PIIC2 (Slot 2) *(Not available when the optional Packet Processor is INSTALLED)*	**NONE**	No PIIC module is physically installed in the slot.
	XXXX-Off	**Example: OC3-Off** means that an OC-3 PIIC module is installed in the slot but it is not being used.
	XXXX-YY	**Example: G703-E3** means that a G.703 E3/T3/STS-1 PIIC module is installed and is active with a selected data type of E3 (valid selections are E3, T3 and S1 (STS-1)).
Optional High-Speed Packet Processor	**Disabled**	The optional Packet Processor is installed but not yet active (enabled for operation).
	Enabled	The optional Packet Processor is enabled for operation.

6.2.2.4.1 Single Stream Mode or MultiStream Mode Operation

Single Stream Mode is the conventional method for transporting a single type of traffic data over the satellite. MultiStream Mode allows more than one type of traffic data to be active at the same time.

For Single Stream Mode:

- A single PIIC module is installed and active, and all other interfaces are either **NONE** (not installed) or **OFF** (installed, but not active), OR:
- Any combination of Gigabit Ethernet is enabled, but all PIIC slots are either **NONE** (not installed) or **OFF** (installed, but not active). Gigabit Ethernet combination examples are:
  - **GBEI1** / **J5 | DATA** port
  - **GBEI2** / **J6 | DATA** port
  - **Optical** / **J7 |OPTICAL** port

The modem treats the three Gigabit Ethernet data interfaces as a single data interface type, no matter how many are active.

For MultiStream Mode:

- MultiStream Mode is an internal multiplexing (MUX) and de-multiplexing (De-MUX) of data interface types. This allows two or more data traffic types to simultaneously coexist in a single carrier.
- One or more of the GbE interfaces MUST be active in order to **ENTER** or exit from MultiStream Mode. Therefore, at least one of the GbE interfaces must be active at the same time that at least one of the PIIC slots is active (e.g., PIIC1=G703-E3). The **CONFIG: Intf** screen display example shows the modem in MultiStream Mode.
- Adaptive Coding and Modulation (ACM) is not functional in MultiStream Mode. All other WAN optimization features are functional in MultiStream Mode.
- Because MultiStream Mode is a MUX of different data types, there is overhead associated with the total MUX structure. This associated overhead is 1.5% of the aggregate non-Ethernet data in Normal Block Mode, and 5% in Short Block Mode.

  For example: You are running a link in Normal Block Mode that is using MultiStream to aggregate Ethernet traffic and two G.703 E3 (34.368 Mbps) connections. The computation of the modem Tx link's configuration for minimal support is therefore:

  (34.368 + 34.368)* 1.015 = 69.768 Mpbs

  Any data rate that is ABOVE this minimum data rate is given to the GbE interfaces. Using this computation example, if the modem Tx is set to 100 Mbps, then the remaining 30.232 Mbps is allocated to the Ethernet traffic type:

  100Mbps – 69.767Mpbs = 30.232Mbps

- The best practice for **Entering** or **Exiting** MultiStream Mode is to do these steps:

A. ENTER MULTISTREAM MODE

Step	Task
1	Use the CONFIG: Intf menu to select any combination of GbE interface operation: GBEI1 / J5 | DATA port, GBEI2 / J6 | DATA port, or Optical / J7 |OPTICAL port.

Step	Task
2	Make sure that both interface slots (PIIC1 and PIIC2) are set as either NONE (not installed) or OFF (not active). You will know the total Tx data rate that the modem permits after completing this step. Make sure this Tx data rate is sufficient for transmitting the intended aggregate interface type services.
3	Configure the modem settings for MultiStream Mode operation: a) Select the Tx parameters for the carrier that will act as the aggregate carrier of all interface types to be transmitted. b) Choose the correct ModCods, Pilots, Symbol Rate, etc., to make sure that the total Tx uplink is sufficient for all of the interface types that will be multiplexed together.
4	Return to the **CONFIG: Intf** menu and make sure one or both of the PIIC data interface traffic types can operate. If the configured Tx data rate capacity is not sufficient for the PIIC selection, the modem rejects this setting. If this happens, start again at Step 1 to correct the configuration.

B. EXIT MULTISTREAM MODE

Step	Task
1	Use the ◀ ▶ arrow keys to select the **CONFIG: Intf** menu.
2	Make sure that both interface slots (**PIIC1** and **PIIC2**) are set either to **Off** (not active) or **NONE** (not installed).
3	Make sure that both GbE interfaces (**GBEI1** and **GBEI1**) are set as **Off** (not active).
4	Make sure that the **Optical** interface (**J7 | OPTICAL** port SFP module) is set as **NONE** (not installed).
5	Configure one PIIC interface, or any combination of the GbE interfaces, to operate.
6	Use the ◀ ▶ arrow keys to select the **CONFIG: Tx → Data → Tx Data Rate** menu. Make sure the Tx Data Rate **MIN_DR** variable displays "**000000.000**".

After the Tx side of the link is configured, do these next steps to configure the Rx side for Single Stream or MultiStream Mode:

Step	Task
1	**Configure the Rx Symbol Rate.** Use the ◀ ▶ arrow keys to select the **CONFIG: Rx→ Data→ Rx Symbol Rate** menu. Set the Rx Symbol Rate to match the far side modem Tx Symbol Rate.
2	**Set the Rx GoldCode (Gold-n Index Code).** Use the ◀ ▶ arrow keys to select the **CONFIG: Rx→Freq** menu. Set the Rx GoldCode to match the far side modem Tx GoldCode.

Step	Task
3	Make sure that the interfaces selected during the Tx configuration are configured and operating properly.

6.2.2.4.2 (CONFIG: INTF) (GBEIX)

1) The GBEIX menus are nonfunctional when the optional High-Speed Packet Processor is installed and enabled. Functionality is available when Packet Processor operation is disabled or when the standard PIIC slots card is installed.
2) M&C for the High-Speed Packet Processor is provided on the CDM-760 HTTP Interface. See Chapter 7. ETHERNET INTERFACE OPERATION for full information about using this interface for Packet Processor operations.

```
GBEIX: Type:Auto    Status:NoLink    (◄►)
 FlowControl:Disabled  Learning:Disabled
```

Where the letter '**X**' in **GBEIX** represents the base unit interface – GBEI**1** (**J5 | DATA** port) or GBEI**2** (**J6 | DATA** port): Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (GBEIX) → Type

Take care when using this menu, as a mismatch can cause random packet loss and connection drops.

Use the ▲▼ arrow keys to select a port configuration parameter. Press **ENTER**.
Note the following:

CDM-760 Port Configuration Selection	External Equipment Capability	External Equipment Port Setting
Off	Disabled	Disabled
Auto	10 Base-T, 10/100/1000 Base-T	Auto
1000BASE-T Full	1000 Base-T (GbE)	Full Duplex**
100BASE-T Full	100 Base-T	Full Duplex
100BASE-T Half	100 Base-T	Half Duplex
10BASE-T Full	10 Base-T	Full Duplex
10BASE-T Half	10 Base-T	Half Duplex

** Forced 1000 Base-T Full Duplex is a non-standard mode of operation. Comtech EF Data strongly recommends that you ALWAYS run 1000 Base-T (GbE) ports in Auto Negotiate mode.

(CONFIG: INTF) (GBEIX) → Status

This *read-only* column displays the port's current operating speed when you set the speed to Auto. "NoLink" indicates that the modem detects no valid Ethernet device connection for the port.

(CONFIG: INTF) (GBEIX) → FlowControl

The use of Flow Control or Pause Frames is useful when ALL devices connected to the modems are set to honor Pause Frames. When used properly, Flow Control acts as a traffic valve in an ACM environment.

Use the ▲▼ arrow keys to set Flow Control as **Enabled** or **Disabled**. Press **ENTER**.

When Flow Control is **Enabled**, the modem begins to send Pause Frames once the WAN buffer is approximately 87% full. Pause Frames are sent to ALL ports. Pause Frames will cease to be sent to the Ethernet interfaces when the WAN Buffer Fill Status drops below 75% full.

If ANY device directly connected to the base unit Ethernet ports (GBEI1 / **J5 | DATA**, GBEI2 / **J6 | DATA** or **J7 | OPTICAL**) does not honor Pause Frames, you should set Flow Control as **Disabled**, as the interconnected device will not back off in an overflow condition and may cause all traffic on the Tx **and** Rx links to become congested. All overflow traffic will be discarded.

Also note that, when the **Remote InBand** is set to **Enabled** (see **Section 6.2.2.9.2 CONFIG: Remote →Inband**), any device connected to the base unit management port (**J4 | MGMT**) must also honor Pause Frames to properly ensure system operation.

6.2.2.4.2.1 MAC Learning Operational States

(CONFIG: INTF) (GBEIX) → Learning

Use the ▲▼ arrow keys to set MAC Learning as **Disabled** or **Enabled**. Press **ENTER**.

- With MAC Learning **Disabled**, the modem passes any traffic **Entering** from the GBEI (LAN) interface to the satellite (WAN) side of the link, while traffic coming in from the satellite (WAN) side of the link is passed on to the GBEI (LAN) interface. There is no filtering of traffic, and the modem connection looks like a "wire."
- With MAC Learning **Enabled**, the Destination MAC and Source MAC are "learned" by the modem. If the modem sees a destination MAC on its LAN side that it recognizes as belonging to the LAN side, it will not transmit the frame. If the modem sees a destination MAC on its WAN side that it recognizes as belonging to the WAN side, it will not transmit it to the LAN side. If the modem sees a Source MAC on its LAN side, it learns that going forward. Any Destination MAC it does NOT know, it will send across to the other side.

The MAC Learning process is further explained:

Frame going from LAN to WAN (Tx):

Source MAC	Destination MAC	Action
Don't care	Unknown	Packet sent to WAN, Source MAC is learned to exist on LAN
Don't care	Known to exist on LAN side	Packet NOT sent to WAN, Source MAC is learned to exist on LAN
Don't care	Known to exist on WAN side	Packet is sent to WAN, Source MAC is learned to exist on LAN
Don't care	Broadcast or Multicast MAC	Packet is sent to WAN, Source MAC is learned to exist on LAN

Frame going from WAN to LAN (Rx):

Source MAC	Destination MAC	Action
Don't care	Unknown	Packet is sent to LAN, Source MAC is learned to exist on WAN
Don't care	Known to exist on LAN side	Packet is sent to LAN, Source MAC is learned to exist on WAN
Don't care	Known to exist on WAN side	Packet is NOT sent to LAN, Source MAC is learned to exist on WAN
Don't care	Broadcast or Multicast MAC	Packet is sent to LAN, Source MAC is learned to exist on WAN

The second process that is performed, with MAC Learning **Enabled**, is "aging". This is why MAC Leaning is also referred to as "learning and aging". When a MAC Address is seen by the modem, it is "learned" to exist as described previously. This learned address remains learned and continues to exist in the modem's Content Addressable Memory (CAM) table for 5 minutes. If the MAC Address is not seen traversing through the product during this five minute period, the table entry is "aged" out, and the MAC Address is no longer known to the modem and must be re-learned. If, however, the MAC Address is seen within the CAM table's five minute timer, the MAC Address remains in the table and the Aging Clock resets once more to five minutes.

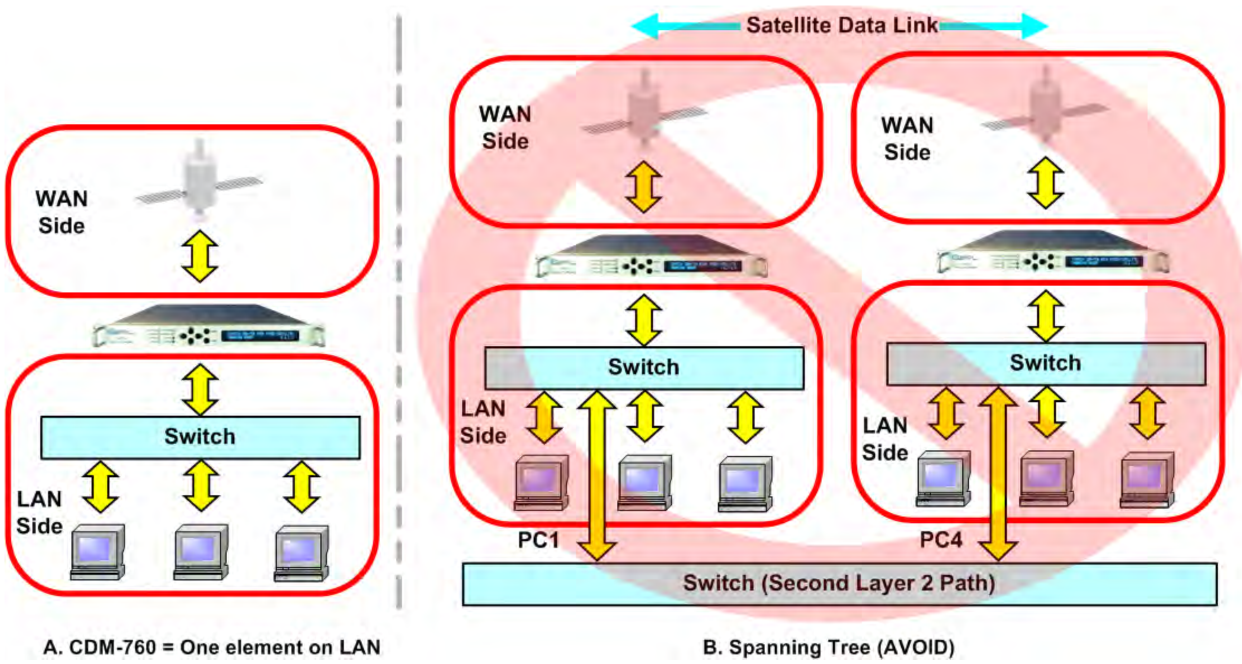


Figure 6-2. MAC Learning Operations

As **Figure 6-2** shows, it is important to note that enabling MAC Learning allows you to reduce the amount of traffic over the satellite link when the modem is one element on the LAN (Detail 'A'). However, should a second Layer 2 path exist to the far side equipment – this condition is known as "Spanning Tree" (Detail 'B') – this will cause data flow failure. In a "Spanning Tree" state, the MAC Address of a device – such as PC1 in the figure – appears to exist on both the WAN and LAN sides of the modem. This corrupts the modem's CAM table and causes its failure.

6.2.2.4.3 (CONFIG: INTF) (Optical)

If the **CONFIG: Intf** menu displays **NONE**, then the optional Optical Gigabit Ethernet Interface SFP is either NOT plugged into the **J7 | OPTICAL** socket, or the Optical Gigabit Ethernet Interface FAST Option is not activated. See **Section 3.2.3.2** for further information about this optional interface.

6.2.2.4.4 CONFIG:) INTF (PIIC1 / PIIC2)

You can access these menus only when the standard PIIC slots card is installed and the modem senses the presence of an optional PIIC module.

6.2.2.4.4.1 (CONFIG:) INTF (PIICX=G703)

You can access these menus only when a PIIC G.703 E3/T3/STS-1 module is installed in its PIIC slot.

```
PIICX: Type:STS1  ClkSource  Mask
 BufSize:32.0mS Center:No  Fill:99%   (◄►)
```

On the top line, the letter '**X**' in **PIICX** represents the slot number (PIIC**1** or PIIC**2**) containing the optional interface. Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=G703) → Type

Use the ▲▼ arrow keys to select **NONE**, **T3**, **E3** or **STS1**. Press **ENTER**.

In Single Stream Mode, a G.703 PIIC interface with a setting of T3, E3 or STS1 fixes the modem data rate to the correct speed. The symbol rate is linked to this fixed data rate, so that it adjusts automatically when changes occur to the modulation, coding, pilots or Tx frame block size.

The activated symbol rate or CnC FAST Option must be compatible with the symbol or data rate for the selected interface.

(CONFIG: INTF) (PIICX=G703) → ClkSource

```
ClkSource: ExtClock:1 MHz
 TxClock:TX CLK   RxClock:RX SAT      (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=G703) → ClkSource → ExtClock

Set the expected clock rate for the external clock source on the **J8 | EXT REF** BNC connector. Use the ▲▼ arrow keys to select **1 MHz**, **2 MHz**, **5 MHz**, **10 MHz**, **20 MHz**, **34.368 MHz** (E3), **44.736 MHz** (T3), or **51.840 MHz** (STS1). Press **ENTER**.

(CONFIG: INTF) (PIICX=G703) → ClkSource → TxClock

Lock the Tx symbol rate of the modulator to the applicable clock source. Use the ▲▼ arrow keys to select **EXT CLK**, **RX SAT**, or **TX CLK**. Press **ENTER**.

Comtech EF Data strongly suggests that you select TX CLK, unless a high-stability EXT CLK is present and timing of the network requires all devices to be locked to the EXT CLK.

(CONFIG: INTF) (PIICX=G703) → ClkSource → RxClock

Set the clock source by which Rx data is clocked out of the G.703 interface to the external baseband equipment. Use the ▲▼ arrow keys to select **RX SAT**, **INT CLK**, **TX CLK**, or **EXT CLK**. Press **ENTER**.

Comtech EF Data strongly suggests that you select RX SAT, unless a high-stability EXT CLK is present and timing of the network requires all devices to be locked to the EXT CLK.

(CONFIG: INTF) (PIICX=G703) → Mask

```
Mask: TxPll:Fault
InpSigLoss:Alarm                 more…. (◄►)
```

```
Mask: ExtClkAct:Fault
ExtClkInRange:Alarm              more…. (◄►)
```

```
Mask: RxPLL:Fault  RxOF:Fault
      RxUF:Alarm                        (◄►)
```

These menus set how the modem reports interface alarm or fault states. Use the ◄ ► arrow keys to select **TxPll**, **InpSigLoss**, or **more…** to go to the next screens. There, use the ◄ ► arrow keys to select **ExtClkAct**, **ExtClkInRange**, **RxPll**, **RxOF**, or **RxUF**. Press **ENTER**. Note the following:

Selection (Alarm)	Description
TxPLL	The **Tx Clock PLL** is high or low, meaning that the Tx Clock Source is significantly different than the rate of the transmitted data.
InpSigLoss	**Input Signal Loss** means that the PIIC G.703 interface **TX-IN** connector finds no traffic.
ExtClkAct	**External Clock Activity** means that the External Clock is selected by either the TxClock or RxClock, but no clock is present on **J8 | EXT REF**.

Selection (Alarm)	Description
ExtClkInRange	**External Clock In Range** means that the External Clock is set by the TxClock or RxClock, but the rate of the clock on **J8 | EXT REF** does not agree with the rate expected by the modem.
RxPLL	The **Rx Clock PLL** is railed high or low, meaning that the Rx Clock Source is significantly different than the rate of incoming data.
RxOF	**Rx Overflow** means that the demodulator traffic is too fast for the RxClock clock setting. This causes the buffer to overflow and to re-center, losing data in the process.
RxUF	**Rx Underflow** means that the demodulator traffic is too slow for the clock RxClock setting. This causes the buffer to underflow and to re-center, losing data in the process.

If ExtClkAct IS NOT in an Alarm or Fault condition but the ExtClkInRange ***IS*** in Alarm or Fault condition, this means that the clock source rate and the modem's programmed External Clock rate are different.

Use the ▲▼ arrow keys to set the report state for each selection as **Alarm**, **Fault**, **Mask**, or **Fault-Tx On**. (The **RxPll**, **RxOF**, and **RxUF** selections provide only **Alarm**, **Fault**, and **Mask**.) Press **ENTER**. Note the following:

Mask State	Front Panel LED 'UNIT STATUS' Color	Fault State	Causes Redundancy Switch	Mutes Tx Carrier	Front Panel VFD Visible Location
Alarm	Amber	None	No	No	Monitor: Live Alarms menu
Fault	Red	J1 Alarm Connector	Yes	Yes	Monitor: Stored-Events Log
Mask	None	None	No	No	None: **A masked event is not logged and is not seen in any menu.**
Fault-Tx On	Red	J1 Alarm Connector	Yes	No	Monitor: Stored-Events Log

(CONFIG: INTF) (PIICX=G703) → BufSize (Rx Buffer Size)

```
Rx Buffer Size: 02.0 ms
                              (◄►)
```

Use the ▲▼ arrow keys to change the Rx Buffer Size time value. Press **ENTER**. Valid settings are:

Range		Step Size
Minimum	**Maximum**	
2 ms	75 ms	0.5 ms

(CONFIG: INTF) (PIICX=G703) → Center (Rx Buffer Re-Center)

```
PIICX: Type:E3 ClkSource Mask
BufSize:32.0ms  Center:No  Fill=50%   (◄►)
```

The Fill Status is a *read-only* status of buffer depth, reported as a percentage:

- If the Fill Status is **decreasing** (approaching 0%), then the Rx traffic is arriving too slowly for the Rx Clock setting, causing a **data underflow**.
- If the Fill Status is **increasing** (approaching 100%), then the Rx traffic is arriving too quickly for the Rx Clock setting, causing a **data overflow**.

If this value indicates a data underflow or overflow, then use the ▲▼ arrow keys to select **Yes** to re-center the Rx Buffer depth to 50%.

6.2.2.4.4.2 (CONFIG:) INTF (PIICX=OC3/STM1)

You can access this menu only when a PIIC OC3/STM1 module is installed in a PIIC slot.

```
PIICX: Type:OC3/STM1 ClkSource Mask
BufSize:32.0ms  Center:No  Fill=50%   (◀▶)
```

On the top line, the letter '**X**' in **PIICX** represents the slot number (**PIIC1** or **PIIC2**) containing the optional interface. Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=OC3/STM1) → Type

Use the ▲▼ arrow keys to select **NONE** or **OC3/STM1**. Press **ENTER**.

You can access these menus only when the standard PIIC slots card is installed and the modem senses the presence of an optional PIIC module.

In Single Stream Mode, an OC3/STM1 PIIC interface with a setting of OC3/STM1 fixes the modem data rate to the correct speed. The symbol rate is linked to this fixed data rate, so that it adjusts automatically when changes occur to the modulation, coding, pilots, or Tx frame block size.

The activated symbol rate or CnC FAST Option must be compatible with the symbol or data rate for the selected interface.

(CONFIG: INTF) (PIICX=OC3/STM1) → ClkSource

```
ClkSource: TXClock: TX CLK
           RXClock: RX SAT              (◀▶)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=OC3/STM1) → ClkSource → TXClock

Lock the Tx symbol rate of the modulator to the applicable clock source. Use the ▲▼ arrow keys to select **RX SAT** or **TX CLK**. Press **ENTER**.

Comtech EF Data strongly suggests that you select TX CLK, unless a high-stability EXT CLK is present and timing of the network requires all devices to be locked to the EXT CLK.

(CONFIG: INTF) (PIICX=OC3/STM1) → ClkSource → RXClock

Set the clock source by which Rx data is clocked out of the OC3/STM1 interface to the external baseband equipment. Use the ▲▼ arrow keys to select **RX SAT** or **TX CLK**. Press **ENTER**.

Comtech EF Data strongly suggests that you select RX SAT, unless a high-stability EXT CLK is present and timing of the network requires all devices to be locked to the EXT CLK.

(CONFIG: INTF) (PIICX=OC3/STM1) → Mask

```
Mask: TxPll:Fault
InpSigLoss:Alarm              more…. (◄►)
```

```
Mask: RxPLL:Fault  RxOF:Fault
      RxUF:Alarm                     (◄►)
```

These menus set how the modem reports interface alarm or fault states. Use the ◄ ► arrow keys to select **TxPll** or **InpSigLoss** or **more...** to go to the next screen. There, use the ◄ ► arrow keys to select **RxPll**, **RxOF**, or **RxUF**. Press **ENTER**.

Note the following:

Selection (Alarm)	Description
TxPLL	The **Tx Clock PLL** is railed high or low, meaning that the Tx Clock Source is significantly different than the rate of the transmitted data.
InpSigLoss	**Input Signal Loss** means that the PIIC OC3/STM1 module **TX-IN** connector finds no traffic.
RxPLL	The **Rx Clock PLL** is railed high or low, meaning that the Rx Clock Source is significantly different than the rate of incoming data.
RxOF	**Rx Overflow** means that the demodulator traffic is too fast for the RxClock clock setting. This causes the buffer to overflow and to re-center, losing data in the process.
RxUF	**Rx Underflow** means that the demodulator traffic is too slow for the clock RxClock setting. This causes the buffer to underflow and to re-center, losing data in the process.

Use the ▲▼ arrow keys to set the report state for each selection as **Alarm**, **Fault**, **Mask**, or **Fault-Tx On**. (The **RxPll**, **RxOF**, and **RxUF** selections provide only **Alarm**, **Fault**, and **Mask**.) Press **ENTER**. Note the following:

Mask Type	Unit Status LED Color	Fault State	Causes Redundancy Switch	Mutes Tx Carrier	Visible Location
Alarm	Amber	None	No	No	Monitor: Live Alarms menu

Mask Type	Unit Status LED Color	Fault State	Causes Redundancy Switch	Mutes Tx Carrier	Visible Location
Fault	Red	J1 Alarm Connector	Yes	Yes	Monitor: Stored-Events log
Mask	None	None	No	No	None: **A masked event is not logged and is not seen in any menu.**
Fault-Tx On	Red	J1 Alarm Connector	Yes	No	Monitor: Stored-Events log

(CONFIG: INTF) (PIICX=OC3/STM1) → BufSize (Rx Buffer Size)

Use the ▲▼ arrow keys to change the Rx Buffer Size time value. Press **ENTER**. Valid settings are:

Range		Step Size
Minimum	Maximum	
2 ms	75 ms	0.5 ms

(CONFIG: INTF) (PIICX=OC3/STM1) → Center (Rx Buffer Re-Center)

```
PIICX: Type:OC3/STM1 ClkSource Mask
BufSize:32.0ms   Center:No   Fill=50%  (◄►)
```

The Fill Status is a *read-only* status of buffer depth, reported as a percentage:

- If the Fill Status is **decreasing** (approaching 0%), then the Rx traffic is arriving too slowly for the Rx Clock setting, causing a **data underflow**.
- If the Fill Status is **increasing** (approaching 100%), then the Rx traffic is arriving too quickly for the Rx Clock setting, causing a **data overflow**.

If this value indicates a data underflow or overflow, then use the ▲▼ arrow keys to select **Yes** to re-center the Rx Buffer depth to 50%.

6.2.2.4.4.3 (CONFIG:) INTF (PIICX=ASI)

You can access these menus only when a PIIC ASI module is installed in its PIIC slot.

```
PIICX: TxMode  RxMode  ClkSource  Mask
BufSize:32.0mS  Center:No  Fill:99%   (◄►)
```

On the top line, the letter '**X**' in **PIICX** represents the slot number (PIIC1 or PIIC2) containing the optional interface. Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.2.4.4.3.1 (CONFIG: INTF) (PIICX=ASI) → TxMode

```
TxMode:ASI-Norm  Frame:TS-188  ReStamp:Off
DataRate:100000.000 kbps
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → TxMode → TxMode

Use the ▲▼ arrow keys to select **ASI-Off**, **ASI-Norm**, or **ASI-Adv**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → TxMode → Frame

Use the ▲▼ arrow keys to select **None**, **TS-188**, or **TS-204**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → TxMode → ReStamp

Use the ▲▼ arrow keys to select **Off** or **On**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → TxMode → DataRate

Use the ▲▼ arrow keys to select a **Data Rate** from **1000.000** to **216000.000 kbps**. Press **ENTER**.

6.2.2.4.4.3.2 (CONFIG: INTF) (PIICX=ASI) → RxMode

```
RxMode:ASI-Norm  Frame:TS-188  Type:Stream
DataRate:100000.000 kbps
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → RxMode → RxMode

Use the ▲▼ arrow keys to select **ASI-Off** or **ASI-Norm**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → RxMode → Frame

Use the ▲▼ arrow keys to select **None**, **TS-188**, or **TS-204**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → RxMode → Type

Use the ▲▼ arrow keys to select **Burst** or **Stream**. Press **ENTER**.

(CONFIG: INTF) (PIICX=ASI) → RxMode → DataRate

Use the ▲▼ arrow keys to select a **Data Rate** from **1000.000** to **216000.000 kbps**. Press **ENTER**.

6.2.2.4.4.3.3 (CONFIG: INTF) (PIICX=ASI) → Mask

```
TxPll:Fault                TxFrmSync:Alarm
InpSigLoss:Alarm                     more…  (◄►)
```

```
RxPLL:Fault    RxUF:Fault    RxOF:Fault
                                            (◄►)
```

These menus set how the modem reports interface alarm or fault states. Use the ◄ ► arrow keys to select **TxPll**, **InpSigLoss**, **TxFrmSync**, or **more...** to go to the next screens. From there, use the ◄ ► arrow keys to select **RxPll**, **RxUF**, or **RxOF**. Press **ENTER**. Note the following:

Selection (Alarm)	Description
TxPLL	The **Tx Clock PLL** is high or low, meaning that the Tx Clock Source is significantly different than the rate of the transmitted data.
TxFrmSync	**Tx Frame Sync** is not achieved, meaning the PIIC ASI interface is unable to synchronize to the incoming data frames.
InpSigLoss	**Input Signal Loss** means that the PIIC ASI interface **TX-IN** connector finds no traffic.
RxPLL	The **Rx Clock PLL** is railed high or low, meaning that the Rx Clock Source is significantly different than the rate of incoming data.
RxOF	**Rx Overflow** means that the demodulator traffic is too fast for the RxClock clock setting. This causes the buffer to overflow and to re-center, losing data in the process.
RxUF	**Rx Underflow** means that the demodulator traffic is too slow for the clock RxClock setting. This causes the buffer to underflow and to re-center, losing data in the process.

Use the ▲▼ arrow keys to set the report state for each selection as **Alarm**, **Fault**, **Mask**, or **Fault-Tx On**. (The **RxPll**, **RxOF**, and **RxUF** selections provide only **Alarm**, **Fault**, and **Mask**.) Press **ENTER**. Note the following:

Mask State	Front Panel LED 'UNIT STATUS' Color	Fault State	Causes Redundancy Switch	Mutes Tx Carrier	Front Panel VFD Visible Location
Alarm	Amber	None	No	No	Monitor: Live Alarms menu
Fault	Red	J1 Alarm Connector	Yes	Yes	Monitor: Stored-Events Log
Mask	None	None	No	No	None: **A masked event is not logged and is not seen in any menu.**
Fault-Tx On	Red	J1 Alarm Connector	Yes	No	Monitor: Stored-Events Log

6.2.2.4.4.3.4 (CONFIG: INTF) (PIICX=ASI) → BufSize (Rx Buffer Size)

Use the ▲▼ arrow keys to change the Rx Buffer Size time value. Press **ENTER**. Valid settings are:

Range		Step Size
Minimum	Maximum	
2 ms	75 ms	0.5 ms

6.2.2.4.4.3.5 (CONFIG: INTF) (PIICX=ASI) → Center (Rx Buffer Re-Center)

```
PIICX: TxMode  RxMode  ClkSource  Mask
BufSize:32.0mS  Center:No  Fill:99%   (◄►)
```

The Fill Status is a *read-only* status of buffer depth, reported as a percentage:

- If the Fill Status is **decreasing** (approaching 0%), then the Rx traffic is arriving too slowly for the Rx Clock setting, causing a **data underflow**.
- If the Fill Status is **increasing** (approaching 100%), then the Rx traffic is arriving too quickly for the Rx Clock setting, causing a **data overflow**.

If this value indicates a data underflow or overflow, then use the ▲▼ arrow keys to select **Yes** to re-center the Rx Buffer depth to 50%.

6.2.2.4.5 (CONFIG: INTF) PacketProcessor

```
Packet Processor: Enabled
                                     (▲▼)
```

Use the ▲▼ arrow keys to select the installed optional High-Speed Packet Processor's operation as **Enabled** or **Disabled**. Press **ENTER**.

6.2.2.5 (CONFIG:) CnC (Carrier-in-Carrier)

Appendix J. DOUBLETALK CARRIER-IN-CARRIER (CNC) OPTION

```
CnC: Mode:Off Min Search Delay:230 ms
 Max Search Delay:290 ms              (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.2.5.1 (CONFIG: CnC) Mode

CnC operation requires installation of the DoubleTalk Carrier-in-Carrier module. With no module installed, CnC Mode is forced Off and this submenu is inoperable. You must also purchase one of several available FAST options to provide capability to a maximum of 155 Mbps.

Use the ▲▼arrow keys to select CnC operation as **Off** or **On**. Press **ENTER**.

6.2.2.5.2 (CONFIG: CnC) Min / Max Search Delay

To reduce the time taken for the CnC algorithm to converge, you can restrict the range of delay the search uses. Factory default values for satellite operation are set to a minimum of 230 ms and a maximum of 290 ms. Once CnC has found the exact delay the value can be further reduced, but care should be taken to allow sufficient range to accommodate changes in path delay due to Doppler.

To change the CnC Min or Max Search Delay: Use the ◀ ▶ arrow keys to select the delay number to edit using the arrow keys, and then edit the value of each number by using the ▲▼ arrow keys. Press **ENTER**.

If CnC is being bench-tested with two units in a back-to-back configuration, the minimum delay should be set to 0 ms, and the maximum to 20 ms. This takes into account the lack of satellite delay.

6.2.2.6 CONFIG: Comp

K4 GZip Lossless Compression and Decompression is an optional feature that requires installation of the Compression Card in the modem.

```
Compression: Disabled
Decompression: Disabled                  (◀▶▲▼)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

6.2.2.6.1 (CONFIG: Comp) Compression

Compression enables or disables the Tx compression path (LAN to Satellite). Tx Compression (LAN to Satellite) requires activation of this FAST Option. Tx compression rate FAST Options may be purchased and activated by the symbol rate, so maximum data rates will depend on modulation and coding schemes used.

The CDM-760 uses a very fast, hardware-based (FPGA and ASIC) compression engine. In most cases you do not need to worry about any limitations of the compression engine. If, however, you are running a very high speed link and you are running exclusively small Ethernet Frames in non-Packet Processor mode, or small IP datagrams with the optional High-Speed Packet Processor card, refer to this table for the maximum limitations of the compression engine:

Ethernet Frame Size (bytes)	Limitation	Frames/Second Limitation	Data Rate at Limitation (Mbps)
64	Frames/Second	293,000	150
128	Frames/Second	293,000	300
>133	Modem Data Rate	N/A	314

Use the ▲▼ arrow keys to set Compression as **Enabled** or **Disabled**. Press **ENTER**.

When **Compression** is **Enabled**, ALL traffic on all active ports and all active PIIC interfaces will be routed through the compression card and will be compressed. The Tx side of the modem will be symbol rate-limited by the lesser of the FAST-activated Tx or Tx compression symbol rate. All other FAST Options (e.g., CnC data rate) will still apply.

6.2.2.6.2 (CONFIG: Comp) Decompression

Decompression enables or disables the Rx decompression path (Satellite to LAN). Rx decompression is not a FAST Option, and it does not require activation with a FAST Access Code.

Use the ▲▼ arrow keys to set Decompression as **Enabled** or **Disabled**. Press **ENTER**.

When **Decompression** is **Enabled**, Rx decompression works at all data rates regardless of the FAST-activated Tx compression. The decompression setting must match the far side CDM-760 Tx compression setting. A mismatch causes all data to be dropped.

6.2.2.7 (CONFIG:) DPD (DYNAMIC PREDISTORTION)

Appendix L. DYNAMIC PREDISTORTION (DPD) OPTION

```
DPD: Mode:Off      MinSearchDelay:230 ms
  MaxSearchDelay:290 ms                 (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.2.7.1 (CONFIG: DPD) Mode

DPD operation requires installation of the DoubleTalk Carrier-in-Carrier module. With no module installed, DPD Mode is forced Off and this submenu is inoperable. You must also purchase the DPD FAST option.

Use the ▲▼arrow keys to select CnC operation as **Off** or **On**. Press **ENTER**.

6.2.2.7.2 (CONFIG: DPD) Min / Max Search Delay

To reduce the time taken for the predistorter to fully converge, you can restrict the range of delay the search uses. Factory default values for satellite operation are set to a minimum of 230 ms and a maximum of 290 ms. Once DPD has found the exact delay, the value can be further reduced, but care should be taken to allow sufficient range to accommodate changes in path delay due to Doppler.

To change the DPD Min or Max Search Delay: Use the ◀ ▶ arrow keys to toggle between the minimum or maximum delay value, and then use the ▲▼ arrow keys to edit that value. Press **ENTER**.

> ⓘ If DPD is being bench-tested with two units in a back-to-back configuration, the minimum delay should be set to 0 ms, and the maximum to 20 ms. This takes into account the lack of satellite delay.

6.2.2.8 (CONFIG:) Comp

> ⓘ K4 GZip Lossless Compression and Decompression is an optional feature that requires installation of the Compression Card in the modem.

```
Compression: Disabled
Decompression: Disabled                (◀▶▲▼)
```

Use the ◀ ▶ arrow keys to select **Compression** or **Decompression**. For either, use the ▲▼ arrow keys to select operation as **Disabled** or **Enabled**. Press **ENTER**.

6.2.2.9 (CONFIG:) Remote

```
Remote Control=Serial+Ethernet
        Inband=Disable
```

Use the ◀ ▶ arrow keys to select **Remote Control** or **InBand**. Press **ENTER**.

6.2.2.9.1 (CONFIG: Remote) Remote Control

Use the ▲▼ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: Remote) Remote Control → Local

Select **Local** to limit monitor and control (M&C) of the unit only to the modem front panel.

> ⓘ Local control (front panel operation) is always available, regardless of which setting is selected on this menu.

(CONFIG: Remote) Remote Control → Serial or Ser+Ethernet

```
Interface= RS-485-2W      (232,485-2,485-4)
  Address= 0001          38400 baud   (◀▶▲▼)
```

- Select **Serial** to allow EIA-232/485 or Telnet remote access to the modem.
- Select **Ser+Ethernet** (Serial+Ethernet) to allow all methods of remote access to the modem.
- Use the ◀ ▶ arrow keys to select **Interface**, **Address**, or **(Baud rate)**. Press **ENTER**. Then:

- For **Interface**, use the ▲▼ arrow keys to select **RS-232**, **RS-485-2W**, or **RS-485-4W**.
- For **Address**, note the following:
  - **For RS-232 (aka EIA-232)** – The Address is fixed at 0000 and is not editable.
  - **For RS-485-2W or RS-485-4W (aka EIA-485 2-Wire or 4-Wire)** – Use the ◀ ▶ arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Address **0000** is reserved for universal addressing. The permitted address range is **0001** to 9**999**.
- For **Baudrate**, use the ▲▼ arrow keys to select **2400**, **4800**, **9600**, **19200**, **38400**, or **57600** baud.

Character format is not selectable. It is fixed at 8-N-1.

Press **ENTER.**

(CONFIG: Remote) Remote Control → Ethernet

Select **Ethernet** to enable remote SNMP, Telnet, or Web Server Interface M&C of the modem.

6.2.2.9.2 (CONFIG: Remote) InBand

InBand Modem Control allows remote Ethernet access via the Gigabit Ethernet data interfaces. Use the ▲▼ arrow keys to **Enable** or **Disable** this feature. Press **ENTER**.

1) This feature is functional only with the base unit Gigabit Ethernet data interfaces. See Chapter 7. ETHERNET INTERFACE OPERATION for operations associated with the optional High-Speed Packet Processor Gigabit Ethernet data interfaces.
2) When you enable InBand, the modem establishes an internal Layer 2 connection between all active Ethernet data ports (GBEI1/J5 | GBEI2/J6 | Optical GBEI/J7) and the management port (J4 | MGMT). For this reason, when you enable InBand control, you should never make a physical connection from any Ethernet data port to the physical management port – this will cause a networking loop and create a broadcast storm. Similarly, when you enable InBand, you may not physically connect the IP traffic data ports and management port to a single external switch, as this will cause the same networking loop/broadcast storm condition. When you need InBand control in tandem with external control, you must separate the physical connection for the IP traffic data ports and the management port with a router or two independent networks.

6.2.2.10 (CONFIG:) IP

```
IP Config:
   Addresses   SNMP                       (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.2.10.1 (CONFIG: IP) Addresses

```
IP:192.168.001.001/24   MAC:0006B00286F5
Gateway:192.001.001.100                   (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

CAUTION
Carefully review the following information:

1) Depending on the IP Address mask ("/24" in this example) certain IP addresses are reserved for Network Address and Broadcast Addresses. These addresses are the lowest and highest IP addresses allowable in the mask, and are not allowed to be used as the modem's IP address. In this case, the Network Address is 192.168.1.0 and the Broadcast Address is 192.168.1.255. Entry of a Network or Broadcast Address will be rejected by the modem.
2) The following IP addresses may NOT be entered as the modem's IP Address; because they are used internally, they violate common networking practice, and they will cause network issues:

IP Address/Range	Reason this IP Address cannot be used
0.0.0.0	Non-routable address per RFC 1122
127.0.0.0 – 127.255.255.255	127.X.X.X reserved for loopback addresses
169.245.0.X	Internal IP Subnet used by modem
169.245.1.X	Internal IP Subnet used by modem
224.0.0.0 – 239. 255.255.255	Multicast IP Address range
240.0.0.0 – 255. 255.255.255	Experimental IP Address range
All others	Cannot be the lowest or highest address allowable in the subnet mask unless the mask is /32

3) The following rules apply to the subnet mask and must be held to as they violate common networking practice and will cause network issues:

IP Address/Range	Mask / Subnet Range
128.X.X.X – 191.X.X.X	Classful network: Subnet Make must be ≥16 bits
192.X.X.X – 223.X.X.X	Classful network: Subnet Make must be ≥24 bits
All others	Subnet Mask must be 8-30 bits or 32

(CONFIG: IP) Addresses → IP:

To configure the IP Address for the Ethernet M&C J4 | MGMT port: Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

(CONFIG: IP) Addresses→MAC:

The unit MAC address is *read-only* and is not selectable or editable.

(CONFIG: IP) Addresses → Gateway:

The Gateway Address is the default next hop address used by the M&C to send traffic to the Ethernet M&C **J4 | MGMT** port when sending a datagram to an IP address outside of its subnet mask or Address/Range. This address must be defined within the M&C's subnet address/range.

Use the ◀ ▶ arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

6.2.2.10.2 (CONFIG: IP) SNMP

```
SNMP:
   Communities       Traps                 (◀▶)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: IP) SNMP → Communities

```
SNMP Communities:
   Read     Write                          (◀▶)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: IP) SNMP → Communities → Read

```
SNMP Read Community:
Public                      (20 chars)    (◀▶▲▼)
```

On the bottom line – Use the ◀ ▶ arrow keys to select the alphanumeric character to edit, and then use the ▲▼ arrow keys to edit that character.

Note that 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 tilde '~' (ASCII code 126).

Press **ENTER** once you compose the SNMP Read Community string. All trailing spaces are removed from the string upon entry.

(CONFIG: IP) SNMP → Communities → Write

```
SNMP Write Community:
Private                     (20 chars)    (◀▶▲▼)
```

On the bottom line – Use the ◀ ▶ arrow keys to select the alphanumeric character to edit, and then use the ▲▼ arrow keys to edit that character.

Note that 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 tilde '~' (ASCII code 126).

Press **ENTER** once you compose the SNMP Write Community string. All trailing spaces are removed from the string upon entry.

(CONFIG: IP) SNMP → Traps

```
Traps:   Community   Version
            IP-Addr#1  IP-Addr#2      (◀▶)
```

Use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

(CONFIG: IP) SNMP → Traps → Community

```
SNMP Traps Community:
Comtech                 (20 chars)   (◀▶▲▼)
```

On the bottom line – Use the ◀ ▶ arrow keys to select the alphanumeric character to edit, and then use the ▲▼ arrow keys to edit that character.

Note that 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 tilde '~' (ASCII code 126).

Press **ENTER** once you compose the SNMP Traps Community string. All trailing spaces are removed from the string upon entry.

(CONFIG: IP) SNMP → Traps → Version

```
SNMP Traps Version:
   SNMP-ver1    (ver1,ver2)            (◀▶)
```

Use the ◀ ▶ arrow keys to select **SNMP-ver1** or **SNMP-ver2**. Press **ENTER**.

(CONFIG: IP) SNMP → Traps → IP-Addr#X

```
Trap IP addr #X:
   000.000.000.000                    (◀▶▲▼)
```

On the top line – The letter '**X**' in **IP-Addr#X** represents Trap IP Address #**1** or Trap IP Address #**2**.

On the bottom line – Use the ◀ ▶ arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

To disable Traps, set both Trap IP Addresses to `000.000.000.000`.

6.2.2.11 (CONFIG:) Mask

```
Masks: RxAGC:Fault  EsNo:Fault  LNB:Alarm
  Ref:Fault                 more...  (◀▶▲▼)
```

```
Masks: DeCompInv:Alarm   AUPC:Fault
       EthLink: Alarm
```

These menus set how the modem masks alarm or fault states. Use the ◀ ▶ arrow keys to select **RxAGC**, **EsNo**, **LNB**, **Ref**, or **more...** to go to the next screen. There, use the ◀ ▶ arrow keys to select **DeCompInv, AUPC**, or **EthLink**. Press **ENTER**. Note the following:

Selection (Mask)	Description	Available Mask State			
		A	F	M	F/T
RxAGC	This indicates that the Receive Input power level is either too high or too low and the Automatic Gain Control to normalize this signal level has railed high or low, as the signal level is outside of the specification provided in Section 1.3.6	X	X	X	
EsNo	This indicates that the minimum Es/No (set in Section 6.2.2.3.4) has been reached and the local demodulator Es/No level is at or below this threshold.	X	X	X	
LNB	This indicates that the high or low current limits for the LNB have been met.	X	X	X	
Ref	If an external reference is selected (Section 6.2.2.12.1), this indicates that the external reference being asserted to the modem does not meet that selection.	X	X	X	
DeCompInv	This indicates that the decompression (On/Off) as selected (Section 6.2.2.6.2) does not match the incoming data: i.e., Decompression is ON but the data is not compressed, or Decompression is OFF but the data appears to be compressed.	X	X	X	
AUPC	This indicates that the Tx output power has reached the **Nominal + Range** sum (upper limit) and the modem can no longer increase its Tx output power, but the remote reported Es/No is still lower than the Target Es/No.	X		X	X
EthLink	This indicates that an Ethernet Interface is selected using the CONFIG: Intf menu (Section 6.2.2.4) as the active interface, but an Ethernet cable with Ethernet traffic has not been detected on this physical port.	X	X	X	X

For each mask selection, use the ▲▼ arrow keys to set the available mask state as noted in the previous table. Press **ENTER**. Note the following:

Mask Type	Unit Status LED Color	Fault State	Visible Location
Alarm	Amber	None	Monitor: Live Alarms menu
Fault	Red	J1 Alarm Connector	Monitor: Stored-Events log

Mask Type	Unit Status LED Color	Fault State	Visible Location
Mask	None	None	None: **A masked event is not logged and is not seen in any menu.**
Fault-Tx On	Red	J1 Alarm Connector	Monitor: Stored-Events log

6.2.2.12 (CONFIG:) Ref

```
Modem Reference: Internal
Internal Ref Fine Adjust:-001          (♦)
```

Use the ◄ ► arrows keys to select **Modem Reference** or **Internal Ref Fine Adjust.** Press **ENTER**.

6.2.2.12.1 (CONFIG: Ref) Modem Reference

Use the ▲▼ arrow keys to select a parameter. Press **ENTER**.

Note the following:

- Select **Internal** mode to frequency-lock the modem to the high stability ±0.06 ppm 10 MHz internal oscillator.
- Select **Internal+O/P** (Internal with Output) mode to use the 10 MHz internal reference an output on the rear panel **J8 | EXT REF** BNC connector. This mode is useful when you desire to use a single frequency reference for both the modem and another piece of equipment in the system. When selecting this mode, a green LED adjacent to the connector illuminates to alert you that the connector, normally used as input, now has an output signal present.
- Select the **Ext 1 MHz**, **Ext 2 MHz**, **Ext 5 MHz**, or **Ext 10 MHz** mode to frequency-lock the modem to an injected external reference on the rear panel **J8 | EXT REF** BNC connector.

6.2.2.12.2 (CONFIG: Ref) Internal Ref Fine Adjust

With the Internal 10 MHz Reference selected, very fine adjustment of the Internal 10 MHz Reference is possible. The adjustment value is retained in EEPROM memory, and is therefore not lost when the NVRAM is cleared.

Use the ◄ ► arrow keys to select a digit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER**.

Changes made to the adjustment value take effect immediately, not after the ENTER key is pressed.

6.2.2.13 (CONFIG:) MEO (Medium Earth Orbit)

This menu is not available when in Normal (Geostationary) operation (Section 6.2.2.1.2 (CONFIG: NetSpec) Operating Mode).

```
AntId:0 AntStat:0 SatId:None Mute:0
Handover:00
```

This *read-only* screen displays information generated by the ACU (Antenna Controller Unit). Press **ENTER** or **CLEAR** to return to the previous menu. Note the following:

Parameter	Description
AntId	This is the identification number of the antenna that is linked with the modem.
AntSat	This is the status of the antenna that is linked with the modem.
SatId	This is the identification number of the satellite that is linked with the modem.
Mute	This is the status of the BUC that is linked with the modem.
Handover	This is the number of seconds remaining in the antenna handover window

6.2.3 SELECT: Monitor

```
Monitor: Live-Alarms Stored-Events ACM
Rx-Params CnC Stats Buffer MEO DPD (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.3.1 (Monitor:) Live-Alarms

```
Live Alarms:  Unit   Transmit   Receive
                                    (♦)
```

Use the ◄ ► arrow keys to select as parameter. Press **ENTER**.

6.2.3.1.1 (Monitor: Live-Alarms) Unit, Transmit, or Receive

```
Live Press <ENTER> for Details
Unit:---+---+-------------------
```

```
Live Press <ENTER> for Details
Tx: -------
```

```
Live Press <ENTER> for Details
Rx: ++------------
```

Press **ENTER** and use the ◄ ► arrow keys to move across the "-" and "+" characters. Each character represents a possible alarm. The "-" character indicates the element in question is NOT in alarm. The "+" symbol indicates the element is in an alarm (fault) state.

Possible alarms are as follows:

Type	Alarm	State
Unit	**MainPs X.X**	Main Board Power Supply Fault (3.3V, 1.5V, 1.2V, 1.8V, 1.0V, 2.5V, 1.25V)
	MdmBdPs X.X	Modem Board Power Supply Fault (5.8V, 3.8V, 2.8V, 3.3V, 1.5V, 1.2V)
	Pwr Cal	Transmit power is not factory calibrated. Contact CEFD Product Support.
	FPGA Load	An FPGA could not be configured.
	Ref Unlock	Unit could not lock to external reference clock input.
	Unit Temp	Unit has exceeded operating temperature.
	Unit Fault	A general unit fault.
	PIIC1 ExtClk Act	A PIIC interface has been selected and the clock is set to lock to an External Clock (as with G.703 or other Synchronous PIIC cards), however no clock signal is detected.

Type	Alarm	State
Unit (cont.)	**PIIC1 ExtClk Out of Range**	A PIIC interface has been selected and the clock is set to lock to an External Clock (as with G.703 or other Synchronous PIIC cards), however the clock signal does not match the expected clock rate.
	PIIC2 ExtClk Act	A PIIC interface has been selected and the clock is set to lock to an External Clock (as with G.703 or other Synchronous PIIC cards), however no clock signal is detected.
	PIIC2 ExtClk Out of Range	A PIIC interface has been selected and the clock is set to lock to an External Clock (as with G.703 or other Synchronous PIIC cards), however the clock signal does not match the expected clock rate.
	Log File Fault	The file that is used to save all logging data regarding modem parameters is missing or corrupt.
	Int 250 PLL	The modem's internal 250MHz clock is out of range or has failed.
	Int 900 PLL	The modem's internal 900MHz clock is out of range or has failed.
	MEO Mdm: Mdm Comms	The modem has been set to run in MEO mode and the communication between the remote Tx/Rx modem and remote Rx demod is timing out or is getting corrupt / unexpected.
	MEO Over Air comms	The modem has been set to run in MEO mode and the communication between the remote Tx/Rx modem and hub / gateway Tx/Rx modem is timing out or is getting a corrupt / unexpected response.
	MEO ACU Comms	The modem has been set to run in MEO mode and the communication between the remote Tx/Rx modem and the ACU is timing out or is getting a corrupt / unexpected response.
	Ethernet Link Down	One or more of the Modem's Gig-E Ethernet ports (J5, J6, J7) is enabled but the modem does not detect any connection to another device (switch / router / PC etc.).
Tx (Transmit)	**Internal DAC Clk PLL**	The modem's internal DAC clock out of range or has failed
	Internal Tx LO PLL	The modem's internal Tx clock out of range or has failed
	PIIC1 Sym Clk PLL	A PIIC interface has been selected but the symbol clock rate that is being derived from the data does not match the modem SR programmed.
	PIIC2 Sym Clk PLL	A PIIC interface has been selected but the symbol clock rate that is being derived from the data does not match the modem SR programmed.
	PIIC1 Input Signal Low	An OC-3 data interface was selected but the optical SFP module has determined that the optical signal level is low.
	PIIC2 Input Signal Low	An OC-3 data interface was selected but the optical SFP module has determined that the optical signal level is low.
Rx (Receive)	**Demod Unlocked**	Demod is not locked to a signal.
	Rx Level	Receive Power Level has tripped AGC alarm point.
	CnC Unlocked	Carrier-in-Carrier is enabled but not locked.
	Internal ADC Clk PLL	The modem's internal ADC clock out of range or has failed
	EsNo Threshold	Receive EsNo is below configured alarm point.
	Internal Rx LO PLL	Receive Phase Lock Loop fault.
	PIIC1 Buffer Overflow	A PIIC interface has been selected but the data rate coming into the PIIC card exceeds the expected data rate of the user configured PIIC data rate.
	PIIC1 Buffer Underflow	A PIIC interface has been selected but the data rate coming into the PIIC card is less than the expected data rate of the user configured PIIC data rate.

Type	Alarm	State
Rx (Receive) (cont.)	**PIIC1 Buffer CLK PLL**	A PIIC interface has been selected but the data rate coming into the PIIC card is either too high, too low or has too much jitter to generate a consistent clock for the modem
	PIIC2 Buffer Overflow	A PIIC interface has been selected but the data rate coming into the PIIC card exceeds the expected data rate of the user configured PIIC data rate.
	PIIC2 Buffer Underflow	A PIIC interface has been selected but the data rate coming into the PIIC card is less than the expected data rate of the user configured PIIC data rate.
	PIIC2 Buffer CLK PLL	A PIIC interface has been selected but the data rate coming into the PIIC card is either too high, too low or has too much jitter to generate a consistent clock for the modem
	Decompress Invalid	The modem is receiving data and there is a mismatch between what the far end is configured for compression (enable/disable) and the alarmed demod decompression (enable/disable).
	LNB Current	The modem has exceeded the high or low current levels as programmed by the user.
	LNB Voltage	The modem detects that the LNB power connection is either OPEN or SHORT.
	Bad/Missing ACM Packet	The modem's internal local / distant ACM messaging is either missing or corrupt.

6.2.3.2 (Monitor:) Stored-Events

```
Event 005:255  12:11:36  25/04/14   (◄►▲▼)
Rx:   +--------------             Clr:N
```

An example of a Stored Events screen is shown here. Use the ◄ ► arrow keys to select the Event number or the **Clr:** option.

6.2.3.2.1 (Monitor: Stored-Events) Event

The event log can store up to 255 events. Use the ▲▼ arrow keys to scroll from Event 001 to Event 255. When an event occurs, the modem time- and date-stamps the fault and stores it in the event log. Similarly, when the fault condition clears, the modem records this as well.

Note that, in accordance with European convention, the log shows the date in **DAY-MONTH-YEAR** format and displays the time in military (24-hour) format.

The Stored Event reporting format follows the same symbol indications and meaning as explained in **Section 6.2.3.1 (Monitor:) Live-Alarms → Unit, Transmit, or Receive**.

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

6.2.3.2.2 (Monitor: Stored-Events) Clr (Clear Event Log Buffer)

```
Event 001:001   16:21:58  25/04/14   (◄►▲▼)
Info:Log ERASED                       Clr:Y
```

Use the ▲▼ arrow keys to select **Y** (Yes) to clear the Stored Events buffer. The default is **N** (No). Press **ENTER** to clear the buffer, or press **CLEAR** to back out of the command and return to the previous menu.

If there are faults present on the unit at this time, the modem will again time-stamp the faults and generate new log entries.

6.2.3.3 (Monitor:) ACM (Adaptive Coding and Modulation Parameters)

```
Tx Modcod=8PSK   8/9      RemEsNo:+20.0 db
Rx Modcod=8PSK   8/9      LocEsNo:+19.9 db
```

This *read-only* screen provides the active ACM Mode information:

Parameter	Description
Tx Modcod	Displays the Tx ModCod.
RemEsNo	Displays the EsNo reported by the remote modem.
Rx Modcod	Displays the Rx ModCod.
LocEsNo	Displays the EsNo of the local unit.

6.2.3.4 (Monitor:) Rx-Params (Rx Parameters)

When the demodulator is not locked, this *read-only* screen appears as follows:

```
   Demodulator
      Unlocked          RxLevel=     dBM
```

Otherwise:

```
Rx-Params: EsNo=>23.5 dB  ΔF=+005.0  kHz
ModCod: QPSK 1/2         RxLevel= -31dBM
```

Note the following:

Parameter	Description
Es/No	The value of the Es/No calculated by the demodulator. Es/No is the Energy per Symbol received (Es) divided by the Noise Spectral Density (No). Note that the Es/No reading assumes that a linear, non-distorted carrier is being received. If a carrier is operating at or near saturation and there are nonlinear distortions, the Es/No reading may be inaccurate, especially when demodulating 16APSk and 32APSK carriers.

Parameter	Description
ΔF	The frequency offset of the received carrier, in kHz, with a displayed step size of 100 Hz.
Rx-Level	A dBm reading indicating the signal level of the desired receive carrier, with a displayed step size of 0.5dB.
ModCod	The current ModCod.

6.2.3.5 (Monitor:) CnC (Carrier-in-Carrier Parameters)

```
CnC-Params:   Freq-offset=-123.4kHz
     Ratio:+1dB        Delay=230.4ms
```

When enabled and locked, this *read-only* screen displays the CnC performance data:

- The **Monitor: CnC** screen refreshes once every second.
- CnC parameters must fall within the tolerances specified in **Section 1.3.8 DoubleTalk™ Carrier-in-Carrier® (CnC)**.
- Ideal operation occurs when the CnC **Ratio** is 0 db. Ratios that are lower or higher – approaching ±7 dB – will cause degradation. Ratios beyond ±7 dB may cause complete unlock of circuit.
- The **Delay** in a properly working CnC link is typically between 230 ms and 290 ms. Delay when bench-testing CnC operation is typically less than 100 µs.

6.2.3.6 (Monitor:) Stats (Statistics)

Statistics are reported for base unit operation only. M&C for the High-Speed Packet Processor is provided on the CDM-760 HTTP Interface. See Chapter 7. ETHERNET INTERFACE OPERATION for full information about using this interface for Packet Processor operations.

```
IP   BasebandFraming   Compression
                                 (◄►)
```

Use the ◄ ► arrow keys to select **IP, BasebandFraming**, or **Compression**. Press **ENTER**.

6.2.3.6.1 (Monitor: Stats) IP

```
IPstats: WAN    Total    Last10s    (◄►▲▼)
Bytes to WAN    0.0E+00  0.0E+00    Clr:N
```

An example of an IP statistics screen is shown here. Use the ◄ ► arrow keys on the top line to select the **IPstats** port selection; then, on the bottom line, select the port-specific operational statistics or the **Clr:** option.

(Monitor: Stats) IP → View Statistics

First, on the top line – Use the ▲▼ arrow keys to select the **IPstats:** port:

IPstats Port Selection	Ref Rear Panel Connector
GigE 1	**J5 | DATA** port
GigE 2	**J6 | DATA** port
WAN	N/A
M&C	**J4 | MGMT** M&C 10/100 port
Opt	**J7 | OPTICAL** port

Next, on the bottom line – Use the ▲▼ arrow keys to browse the available IPstats (operational statistics) for the selected port:

Port Selection (top line)					Statistic (bottom line)	Description
GigE1	GigE2	WAN	M&C	Opt		
X	X			X	Packets from LAN	Number of acceptable Ethernet Packets received on selected port from the LAN
X	X			X	Packets to LAN	Number of Ethernet Packets sent to LAN from selected port
X	X			X	Bytes from LAN	Number of acceptable Bytes received on selected port from LAN
X	X			X	Bytes to LAN	Number of Bytes sent to LAN from selected Port
		X			Bytes to WAN	Total number of Bytes sent to WAN from GigE 1, GigE 2, M&C, and Opt. This is post compression (if enabled) and <u>includes</u> encapsulation and compression overhead.
		X			Packets from WAN	Total number of Ethernet Packets received on WAN destined for GigE 1, GigE 2, M&C, and Opt
		X			Bytes from WAN	Total number of Bytes received on WAN destined for GBEI1, GBEI2, Optical, and M&C. This is prior to decompression (if enabled) and <u>includes</u> encapsulation and compression overhead.
		X			Packets to WAN	Total number of Ethernet Packets sent to WAN from GBEI1, GBEI2, Optical, and M&C
			X		Packets to M&C	Total number of Ethernet Packets sent to M&C from WAN and from GBEI1, GBEI2, and Optical (does not count packets from the **J4 | MGMT** port)
			X		Packets from M&C	Total number of Ethernet Packets sent from M&C to WAN and to GBEI1, GBEI2, and Optical (does not count packets to the **J4 | MGMT** port)

Typical for each parameter, the tally of Bytes or Packets sent/received is displayed in scientific notation in two columns:

Column	Description
Total	The total number of Bytes or Packets sent/received since the statistics log was last cleared.
Last10S	The total number of Bytes or Packets sent/received in the last 10 seconds.

You may use the ◀ ▶ arrow keys on the bottom line to select the value displayed in the **Total** or **Last10S** column, and press **ENTER** to view that item's nested screen. Press **ENTER** or **CLEAR** to return to the previous menu.

(Monitor: Stats) IP → Clr (Clear Statistics Buffer)

Use the ▲▼ arrow keys to select **Y** (Yes) to clear the IP statistics buffer. The default is **N** (No). Press **ENTER** to clear the buffer, or press **CLEAR** to back out of the command and return to the previous menu.

6.2.3.6.2 (Monitor: Stats) BasebandFraming

```
Baseband Framing:                          (◄►▲▼)
Tx Count (QPSK 3/5)          0.0E+00    Clr:N
```

On the bottom line: Use the ◄ ► arrow keys to select between the operational statistics or the **Clr** option.

(Monitor: Stats) BasebandFraming → View Statistics

Typical for each parameter display, the tally of frames is displayed in scientific notation on the bottom line of the display.

You may then use the ▲▼ arrow keys to browse through the desired operational statistics:

Parameter	Description
Tx Count	The total number of Baseband Frames transmitted with this Modulation and Coding since the last clear.
Rx Count	The total number of Baseband Frames received with this Modulation and Coding since the last clear.
RxErrFrms	The total number of Baseband Frames received that contained errors with this Modulation and Coding since the last clear.
Rx Frames Drpped	The total number of Baseband Frames received at 16APSK or 32APSK but dropped because the FAST Access Code for 16APSK or 32APSK is not enabled (since the last clear).

The following statistics are available when DVB-S2 is the active Network Spec.

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (QPSK 1/4)	Rx Count (QPSK 1/4)	RxErrFrms (QPSK 1/4)	16APSK Rx Frames Drppd
Tx Count (QPSK 1/3)	Rx Count (QPSK 1/3)	RxErrFrms (QPSK 1/3)	32APSK Rx Frames Drppd
Tx Count (QPSK 2/5)	Rx Count (QPSK 2/5)	RxErrFrms (QPSK 2/5)	
Tx Count (QPSK 1/2)	Rx Count (QPSK 1/2)	RxErrFrms (QPSK 1/2)	
Tx Count (QPSK 3/5)	Rx Count (QPSK 3/5)	RxErrFrms (QPSK 3/5)	
Tx Count (QPSK 2/3)	Rx Count (QPSK 2/3)	RxErrFrms (QPSK 2/3)	
Tx Count (QPSK 3/4)	Rx Count (QPSK 3/4)	RxErrFrms (QPSK 3/4)	
Tx Count (QPSK 4/5)	Rx Count (QPSK 4/5)	RxErrFrms (QPSK 4/5)	
Tx Count (QPSK 5/6)	Rx Count (QPSK 5/6)	RxErrFrms (QPSK 5/6)	
Tx Count (QPSK 8/9)	Rx Count (QPSK 8/9)	RxErrFrms (QPSK 8/9)	
Tx Count (QPSK 9/10)	Rx Count (QPSK 9/10)	RxErrFrms (QPSK 9/10)	
Tx Count (8PSK 3/5)	Rx Count (8PSK 3/5)	RxErrFrms (8PSK 3/5)	
Tx Count (8PSK 2/3)	Rx Count (8PSK 2/3)	RxErrFrms (8PSK 2/3)	
Tx Count (8PSK 3/4)	Rx Count (8PSK 3/4)	RxErrFrms (8PSK 3/4)	
Tx Count (8PSK 5/6)	Rx Count (8PSK 5/6)	RxErrFrms (8PSK 5/6)	

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (8PSK 8/9)	Rx Count (8PSK 8/9)	RxErrFrms (8PSK 8/9)	
Tx Count (8PSK 9/10)	Rx Count (8PSK 9/10)	RxErrFrms (8PSK 9/10)	
Tx Count (16APSK 2/3)	Rx Count (16APSK 2/3)	RxErrFrms (16APSK 2/3)	
Tx Count (16APSK 3/4)	Rx Count (16APSK 3/4)	RxErrFrms (16APSK 3/4)	
Tx Count (16APSK 4/5)	Rx Count (16APSK 4/5)	RxErrFrms (16APSK 4/5)	
Tx Count (16APSK 5/6)	Rx Count (16APSK 5/6)	RxErrFrms (16APSK 5/6)	
Tx Count (16APSK 8/9)	Rx Count (16APSK 8/9)	RxErrFrms (16APSK 8/9)	
Tx Count (16APSK 9/10)	Rx Count (16APSK 9/10)	RxErrFrms (16APSK 9/10)	
Tx Count (32APSK 3/4)	Rx Count (32APSK 3/4)	RxErrFrms (32APSK 3/4)	
Tx Count (32APSK 4/5)	Rx Count (32APSK 4/5)	RxErrFrms (32APSK 4/5)	
Tx Count (32APSK 5/6)	Rx Count (32APSK 5/6)	RxErrFrms (32APSK 5/6)	
Tx Count (32APSK 8/9)	Rx Count (32APSK 8/9)	RxErrFrms (32APSK 8/9)	
Tx Count (32APSK 9/10)	Rx Count (32APSK 9/10)	RxErrFrms (32APSK 9/10)	

The following statistics are available when DVB-S2-EB1 or DVB-S2-EB2 is the active Network Spec. Note that the ModCods appended with “EB2” are available only when DVB-S2-EB2 is selected.

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (QPSK 1/4)	Rx Count (QPSK 1/4)	RxErrFrms (QPSK 1/4)	16APSK Rx Frames Drppd
Tx Count (QPSK 53/180)	Rx Count (QPSK 53/180)	RxErrFrms (QPSK 53/180)	32APSK Rx Frames Drppd
Tx Count (QPSK 1/3)	Rx Count (QPSK 1/3)	RxErrFrms (QPSK 1/3)	64APSK Rx Frames Drppd
Tx Count (QPSK 11/30)	Rx Count (QPSK 11/30)	RxErrFrms (QPSK 11/30)	
Tx Count (QPSK 2/5)	Rx Count (QPSK 2/5)	RxErrFrms (QPSK 2/5)	
Tx Count (QPSK 77/180)	Rx Count (QPSK 77/180)	RxErrFrms (QPSK 77/180)	
Tx Count (QPSK 83/180)	Rx Count (QPSK 83/180)	RxErrFrms (QPSK 83/180)	
Tx Count (QPSK 1/2)	Rx Count (QPSK 1/2)	RxErrFrms (QPSK 1/2)	
Tx Count (QPSK 8/15)	Rx Count (QPSK 8/15)	RxErrFrms (QPSK 8/15)	
Tx Count (QPSK 17/30)	Rx Count (QPSK 17/30)	RxErrFrms (QPSK 17/30)	
Tx Count (QPSK 3/5)	Rx Count (QPSK 3/5)	RxErrFrms (QPSK 3/5)	
Tx Count (QPSK 19/30)	Rx Count (QPSK 19/30)	RxErrFrms (QPSK 19/30)	
Tx Count (QPSK 2/3)	Rx Count (QPSK 2/3)	RxErrFrms (QPSK 2/3)	
Tx Count (QPSK 127/180)	Rx Count (QPSK 127/180)	RxErrFrms (QPSK 127/180)	
Tx Count (QPSK 3/4)	Rx Count (QPSK 3/4)	RxErrFrms (QPSK 3/4)	
Tx Count (QPSK 4/5)	Rx Count (QPSK 4/5)	RxErrFrms (QPSK 4/5)	
Tx Count (QPSK 5/6)	Rx Count (QPSK 5/6)	RxErrFrms (QPSK 5/6)	
Tx Count (QPSK 31/36)	Rx Count (QPSK 31/36)	RxErrFrms (QPSK 31/36)	
Tx Count (QPSK 8/9)	Rx Count (QPSK 8/9)	RxErrFrms (QPSK 8/9)	
Tx Count (QPSK 9/10)	Rx Count (QPSK 9/10)	RxErrFrms (QPSK 9/10)	
Tx Count (8PSK 17/30)	Rx Count (8PSK 17/30)	RxErrFrms (8PSK 17/30)	
Tx Count (8PSK 3/5)	Rx Count (8PSK 3/5)	RxErrFrms (8PSK 3/5)	
Tx Count (8PSK 19/30)	Rx Count (8PSK 19/30)	RxErrFrms (8PSK 19/30)	
Tx Count (8PSK 2/3)	Rx Count (8PSK 2/3)	RxErrFrms (8PSK 2/3)	
Tx Count (8PSK 127/180)	Rx Count (8PSK 127/180)	RxErrFrms (8PSK 127/180)	
Tx Count (8PSK 3/4)	Rx Count (8PSK 3/4)	RxErrFrms (8PSK 3/4)	
Tx Count (8PSK 4/5)	Rx Count (8PSK 4/5)	RxErrFrms (8PSK 4/5)	
Tx Count (8PSK 5/6)	Rx Count (8PSK 5/6)	RxErrFrms (8PSK 5/6)	
Tx Count (8PSK 31/36)	Rx Count (8PSK 31/36)	RxErrFrms (8PSK 31/36)	
Tx Count (8PSK 8/9)	Rx Count (8PSK 8/9)	RxErrFrms (8PSK 8/9)	
Tx Count (8PSK 9/10)	Rx Count (8PSK 9/10)	RxErrFrms (8PSK 9/10)	
Tx Count (16APSK 19/30)	Rx Count (16APSK 19/30)	RxErrFrms (16APSK 19/30)	

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (16APSK 2/3)	Rx Count (16APSK 2/3)	RxErrFrms (16APSK 2/3)	
Tx Count (16APSK 127/180)	Rx Count (16APSK 127/180)	RxErrFrms (16APSK 127/180)	
Tx Count (16APSK 3/4)	Rx Count (16APSK 3/4)	RxErrFrms (16APSK 3/4)	
Tx Count (16APSK 4/5)	Rx Count (16APSK 4/5)	RxErrFrms (16APSK 4/5)	
Tx Count (16APSK 5/6)	Rx Count (16APSK 5/6)	RxErrFrms (16APSK 5/6)	
Tx Count (16APSK 31/36)	Rx Count (16APSK 31/36)	RxErrFrms (16APSK 31/36)	
Tx Count (16APSK 8/9)	Rx Count (16APSK 8/9)	RxErrFrms (16APSK 8/9)	
Tx Count (16APSK 9/10)	Rx Count (16APSK 9/10)	RxErrFrms (16APSK 9/10)	
Tx Count (32APSK 127/180)	Rx Count (32APSK 127/180)	RxErrFrms (32APSK 127/180)	
Tx Count (32APSK 3/4)	Rx Count (32APSK 3/4)	RxErrFrms (32APSK 3/4)	
Tx Count (32APSK 4/5)	Rx Count (32APSK 4/5)	RxErrFrms (32APSK 4/5)	
Tx Count (32APSK 5/6)	Rx Count (32APSK 5/6)	RxErrFrms (32APSK 5/6)	
Tx Count (32APSK 31/36)	Rx Count (32APSK 31/36)	RxErrFrms (32APSK 31/36)	
Tx Count (32APSK 8/9)	Rx Count (32APSK 8/9)	RxErrFrms (32APSK 8/9)	
Tx Count (32APSK 9/10)	Rx Count (32APSK 9/10)	RxErrFrms (32APSK 9/10)	
Tx Count (64APSK 4/5) EB2	Rx Count (64APSK 4/5) EB2	RxErrFrms (64APSK 4/5) EB2	
Tx Count (64APSK 5/6) EB2	Rx Count (64APSK 5/6) EB2	RxErrFrms (64APSK 5/6) EB2	
Tx Count (64APSK 31/36) EB2	Rx Count (64APSK 31/36) EB2	RxErrFrms (64APSK 31/36) EB2	
Tx Count (64APSK 8/9) EB2	Rx Count (64APSK 8/9) EB2	RxErrFrms (64APSK 8/9) EB2	
Tx Count (64APSK 9/10) EB2	Rx Count (64APSK 9/10) EB2	RxErrFrms (64APSK 9/10) EB2	

The following statistics are available when DVB-S2-S2X is the active Network Spec.

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (QPSK 1/4)	Rx Count (QPSK 1/4)	RxErrFrms (QPSK 1/4)	16APSK Rx Frames Drppd
Tx Count (QPSK 13/45)	Rx Count (QPSK 13/45)	RxErrFrms (QPSK 13/45)	32APSK Rx Frames Drppd
Tx Count (QPSK 1/3)	Rx Count (QPSK 1/3)	RxErrFrms (QPSK 1/3)	64APSK Rx Frames Drppd
Tx Count (QPSK 2/5)	Rx Count (QPSK 2/5)	RxErrFrms (QPSK 2/5)	
Tx Count (QPSK 9/20)	Rx Count (QPSK 9/20)	RxErrFrms (QPSK 9/20)	
Tx Count (QPSK 1/2)	Rx Count (QPSK 1/2)	RxErrFrms (QPSK 1/2)	
Tx Count (QPSK 11/20)	Rx Count (QPSK 11/20)	RxErrFrms (QPSK 11/20)	
Tx Count (QPSK 3/5)	Rx Count (QPSK 3/5)	RxErrFrms (QPSK 3/5)	
Tx Count (QPSK 2/3)	Rx Count (QPSK 2/3)	RxErrFrms (QPSK 2/3)	
Tx Count (QPSK 3/4)	Rx Count (QPSK 3/4)	RxErrFrms (QPSK 3/4)	
Tx Count (QPSK 4/5)	Rx Count (QPSK 4/5)	RxErrFrms (QPSK 4/5)	
Tx Count (QPSK 5/6)	Rx Count (QPSK 5/6)	RxErrFrms (QPSK 5/6)	
Tx Count (QPSK 8/9)	Rx Count (QPSK 8/9)	RxErrFrms (QPSK 8/9)	
Tx Count (QPSK 9/10)	Rx Count (QPSK 9/10)	RxErrFrms (QPSK 9/10)	
Tx Count (8PSK 5/9L)	Rx Count (8PSK 5/9L)	RxErrFrms (8PSK 5/9L)	
Tx Count (8PSK 26/45L)	Rx Count (8PSK 26/45L)	RxErrFrms (8PSK 26/45L)	
Tx Count (8PSK 3/5)	Rx Count (8PSK 3/5)	RxErrFrms (8PSK 3/5)	
Tx Count (8PSK 23/36)	Rx Count (8PSK 23/36)	RxErrFrms (8PSK 23/36)	
Tx Count (8PSK 2/3)	Rx Count (8PSK 2/3)	RxErrFrms (8PSK 2/3)	
Tx Count (8PSK 25/36)	Rx Count (8PSK 25/36)	RxErrFrms (8PSK 25/36)	
Tx Count (8PSK 13/18)	Rx Count (8PSK 13/18)	RxErrFrms (8PSK 13/18)	
Tx Count (8PSK 3/4)	Rx Count (8PSK 3/4)	RxErrFrms (8PSK 3/4)	
Tx Count (8PSK 5/6)	Rx Count (8PSK 5/6)	RxErrFrms (8PSK 5/6)	
Tx Count (8PSK 8/9)	Rx Count (8PSK 8/9)	RxErrFrms (8PSK 8/9)	
Tx Count (8PSK 9/10)	Rx Count (8PSK 9/10)	RxErrFrms (8PSK 9/10)	
Tx Count (16APSK 1/2L)	Rx Count (16APSK 1/2L)	RxErrFrms (16APSK 1/2L)	
Tx Count (16APSK 8/15L)	Rx Count (16APSK 8/15L)	RxErrFrms (16APSK 8/15L)	

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (16APSK 5/9L)	Rx Count (16APSK 5/9L)	RxErrFrms (16APSK 5/9L)	
Tx Count (16APSK 26/45)	Rx Count (16APSK 26/45)	RxErrFrms (16APSK 26/45)	
Tx Count (16APSK 3/5)	Rx Count (16APSK 3/5)	RxErrFrms (16APSK 3/5)	
Tx Count (16APSK 3/5L)	Rx Count (16APSK 3/5L)	RxErrFrms (16APSK 3/5L)	
Tx Count (16APSK 28/45)	Rx Count (16APSK 28/45)	RxErrFrms (16APSK 28/45)	
Tx Count (16APSK 23/36)	Rx Count (16APSK 23/36)	RxErrFrms (16APSK 23/36)	
Tx Count (16APSK 2/3L)	Rx Count (16APSK 2/3L)	RxErrFrms (16APSK 2/3L)	
Tx Count (16APSK 2/3)	Rx Count (16APSK 2/3)	RxErrFrms (16APSK 2/3)	
Tx Count (16APSK 25/36)	Rx Count (16APSK 25/36)	RxErrFrms (16APSK 25/36)	
Tx Count (16APSK 13/18)	Rx Count (16APSK 13/18)	RxErrFrms (16APSK 13/18)	
Tx Count (16APSK 3/4)	Rx Count (16APSK 3/4)	RxErrFrms (16APSK 3/4)	
Tx Count (16APSK 7/9)	Rx Count (16APSK 7/9)	RxErrFrms (16APSK 7/9)	
Tx Count (16APSK 4/5)	Rx Count (16APSK 4/5)	RxErrFrms (16APSK 4/5)	
Tx Count (16APSK 5/6)	Rx Count (16APSK 5/6)	RxErrFrms (16APSK 5/6)	
Tx Count (16APSK 77/90)	Rx Count (16APSK 77/90)	RxErrFrms (16APSK 77/90)	
Tx Count (16APSK 8/9)	Rx Count (16APSK 8/9)	RxErrFrms (16APSK 8/9)	
Tx Count (16APSK 9/10)	Rx Count (16APSK 9/10)	RxErrFrms (16APSK 9/10)	
Tx Count (32APSK 2/3L)	Rx Count (32APSK 2/3L)	RxErrFrms (32APSK 2/3L)	
Tx Count (32APSK 32/45)	Rx Count (32APSK 32/45)	RxErrFrms (32APSK 32/45)	
Tx Count (32APSK 11/15)	Rx Count (32APSK 11/15)	RxErrFrms (32APSK 11/15)	
Tx Count (32APSK 3/4)	Rx Count (32APSK 3/4)	RxErrFrms (32APSK 3/4)	
Tx Count (32APSK 7/9)	Rx Count (32APSK 7/9)	RxErrFrms (32APSK 7/9)	
Tx Count (32APSK 4/5)	Rx Count (32APSK 4/5)	RxErrFrms (32APSK 4/5)	
Tx Count (32APSK 5/6)	Rx Count (32APSK 5/6)	RxErrFrms (32APSK 5/6)	
Tx Count (32APSK 8/9)	Rx Count (32APSK 8/9)	RxErrFrms (32APSK 8/9)	
Tx Count (32APSK 9/10)	Rx Count (32APSK 9/10)	RxErrFrms (32APSK 9/10)	
Tx Count (64APSK 32/45L)	Rx Count (64APSK 32/45L)	RxErrFrms (64APSK 32/45L)	
Tx Count (64APSK 11/15)	Rx Count (64APSK 11/15)	RxErrFrms (64APSK 11/15)	
Tx Count (64APSK 7/9)	Rx Count (64APSK 7/9)	RxErrFrms (64APSK 7/9)	
Tx Count (64APSK 4/5)	Rx Count (64APSK 4/5)	RxErrFrms (64APSK 4/5)	
Tx Count (64APSK 5/6)	Rx Count (64APSK 5/6)	RxErrFrms (64APSK 5/6)	

(Monitor: Stats) BasebandFraming → Clr (Clear Statistics Buffer)

Use the ▲▼ arrow keys to select **Y** (Yes) to clear the Baseband Framing statistics buffer. The default is **N** (No). Press **ENTER** to clear the buffer, or press **CLEAR** to back out of the command and return to the previous menu.

6.2.3.6.3 (Monitor: Stats) Compression

```
LanToWan WanToLan
```

Use the ◄ ► arrow keys to select **LanToWan** or **WanToLan**. Press **ENTER**.

(Monitor: Stats) Compression → View Statistics (LanToWan or WanToLAN)

```
Bytes In  0.0E+00  Savings  00%        (↕)
Bytes Out 0.0E+00  Last 10s 00%      CLR:N
```

All statistics are *read-only*. Select **LanToWan** to view the Tx compression statistics of the modulator's transmission path:

Display	Parameter	Description
Top Line	Bytes In	The total number of bytes, displayed in scientific notation, sent to the compressor.
	Savings	The XX% (percentage) value is calculated using the following formula: `100 * (1 - (Bytes Out/Bytes In))`
Bottom Line	Bytes Out	The total number of bytes, displayed in scientific notation, including compression and encapsulation overhead, to be sent over the satellite. Bytes Out is the same as Bytes to WAN (see Section 6.2.3.6.1 (Monitor: Stats) IP).
	Last 10s	Calculated using the exact same formula as Savings (XX%), but uses the Bytes In and Bytes Out for the past 10 seconds so you can see what compression is being accomplished on current data.

Select **WanToLan** to view the Rx decompression statistics of the demodulator reception path.

Display	Parameter	Description
Top Line	Bytes In	The total number of bytes, displayed in scientific notation, including compression and encapsulation overhead, sent to the decompressor.
	Savings	The XX% (percentage) value is calculated using the following formula: **100 * (1 - (Bytes Out/Bytes In))**
Bottom Line	Bytes Out	The total number of bytes, displayed in scientific notation, output from the decompressor. This represents all the traffic received by the modem.
	Last 10s	Calculated using the exact same formula as Savings (XX%), but uses the Bytes In and Bytes Out for the past 10 seconds so you can see what compression is being accomplished on current data.

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

(Monitor: Stats) Compression → Clr (Clear Statistics Buffer)

Use the ▲▼ arrow keys to select **Y** (Yes) to clear the Compression statistics buffer. The default is **N** (No). Press **ENTER** to clear the buffer, or press **CLEAR** to back out of the command and return to the previous menu.

6.2.3.7 (Monitor:) Buffer

```
WAN Buffer Fill Status: 100%
```

This *read-only* screen indicates the fill state of the Modem to WAN or Modem to Satellite Buffer. When the WAN Buffer Fill Status figure is increasing, this indicates that user traffic is exceeding the capacity of the satellite link. If the figure is decreasing, this indicates that there is more satellite capacity than there is user traffic.

When Flow Control is Enabled (see (CONFIG: INTF)(GBEIX)→ FlowControl in Section 6.2.2.4.2), the modem begins to send Pause Frames to any device connected to the Ethernet Data Interfaces at approximately 87% capacity. Pause Frames cease to be sent to the Ethernet Interfaces when the WAN Buffer Full Status drops below 75% capacity.

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

6.2.3.8 (Monitor:) MEO (Medium Earth Orbit)

This menu is not available when in Normal (Geostationary) operation (Section 6.2.2.1.2 (CONFIG: NetSpec) Operating Mode).

```
AntId:0  AntStat:0 SatId:None Mute:0
Handover:00
```

This *read-only* screen indicates the MEO operating state. All status elements are generated by the ACU (Antenna Controller Unit) as follows:

Parameter	Description
AntId	(**Antenna ID**) This is the identification number of the antenna that the modem it is linked with.
AntStat	(**Antenna Status**) This is the status of the antenna that the modem is linked with.
SatId	(**Satellite ID**) This is the identification number of the satellite the modem is linked with.
Mute	This is the status of the BUC (Block Up Converter) that the modem is linked to.
Handover	This is the number of seconds remaining in the antenna handover window.

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

6.2.3.9 (Monitor:) DPD (Dynamic Predistortion Parameters)

```
CnC-Params:   Freq-offset=-123.4kHz
  Compensation:+1dB        Delay=230.4ms
```

When enabled and locked, this *read-only* screen displays the DPD performance data:

- The **Monitor: DPD** screen refreshes once every second.
- DPD parameters must fall within the tolerances specified in **Section 1.3.8 DoubleTalk™ Carrier-in-Carrier® (CnC)**.
- Ideal operation occurs when the CnC **Ratio** is 0 db. Ratios that are lower or higher – approaching ±7 dB – will cause degradation. Ratios beyond ±7 dB may cause complete unlock of circuit.
- The **Delay** in a properly working CnC link is typically between 230 ms and 290 ms. Delay when bench-testing CnC operation is typically less than 100 µs.

6.2.4 SELECT: Test

```
TEST:  Mode  BERT  Comp
                                  (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.4.1 (TEST:) Mode

```
Modem Test Mode:Normal
                                  (▲▼)
```

Use the ▲▼arrow keys to select an available Test Mode. Press **ENTER** to execute.

Available selections are:

Selection	Description
Normal	This clears any test modes or loopbacks, and places the unit back into an operational state.
Tx-CW	**(Transmit CW)** This mode forces the modulator to transmit a pure carrier (unmodulated).
Single Side Band	**This mode should not be enabled over the satellite.** This mode demonstrates the modulator's carrier null, amplitude, and phase balance. A single carrier on one side of the nominal center Tx frequency, offset from the nominal carrier frequency by half of the configured symbol rate.
IQ PN Sequence	This mode transmits random unframed data to the Nyquist filters. Use this to measure spectral mask as there is no correlation due to framing or terrestrial data patterns.
RF-Loop	**(RF Loopback)** Use this mode to perform a satellite loopback. It is almost identical to the IF loop mode, except that all of the receive configuration parameters (except Rx Spectrum Invert) are temporarily changed to match those of the transmit side. However, no internal connection is made. When **Normal** is again selected, all previous values are restored. See **Figure 6-3** for the flow diagram for this test.
IF-Loop	**(IF Loopback)** This mode invokes an internal IF loop. It is a particularly useful test in that it permits you to perform a quick diagnostic test without having to disturb external cabling. Furthermore, all receive configuration parameters are temporarily changed to match those of the transmit side. When **Normal** is again selected, all previous values are restored. See **Figure 6-3** for the flow diagram for this test.
Dig-Loop	**Digital Loopback)** This mode tests the entire interface, transmit baseband circuits, and buffer. It invokes a Digital loopback, which loops data at the output of the framer on the transmit side back into the framer on the receive side. See **Figure 6-3** for the flow diagram for this test.
I/O-Loop	**(I/O Loopback)** This mode invokes two distinct loopbacks: The first 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.

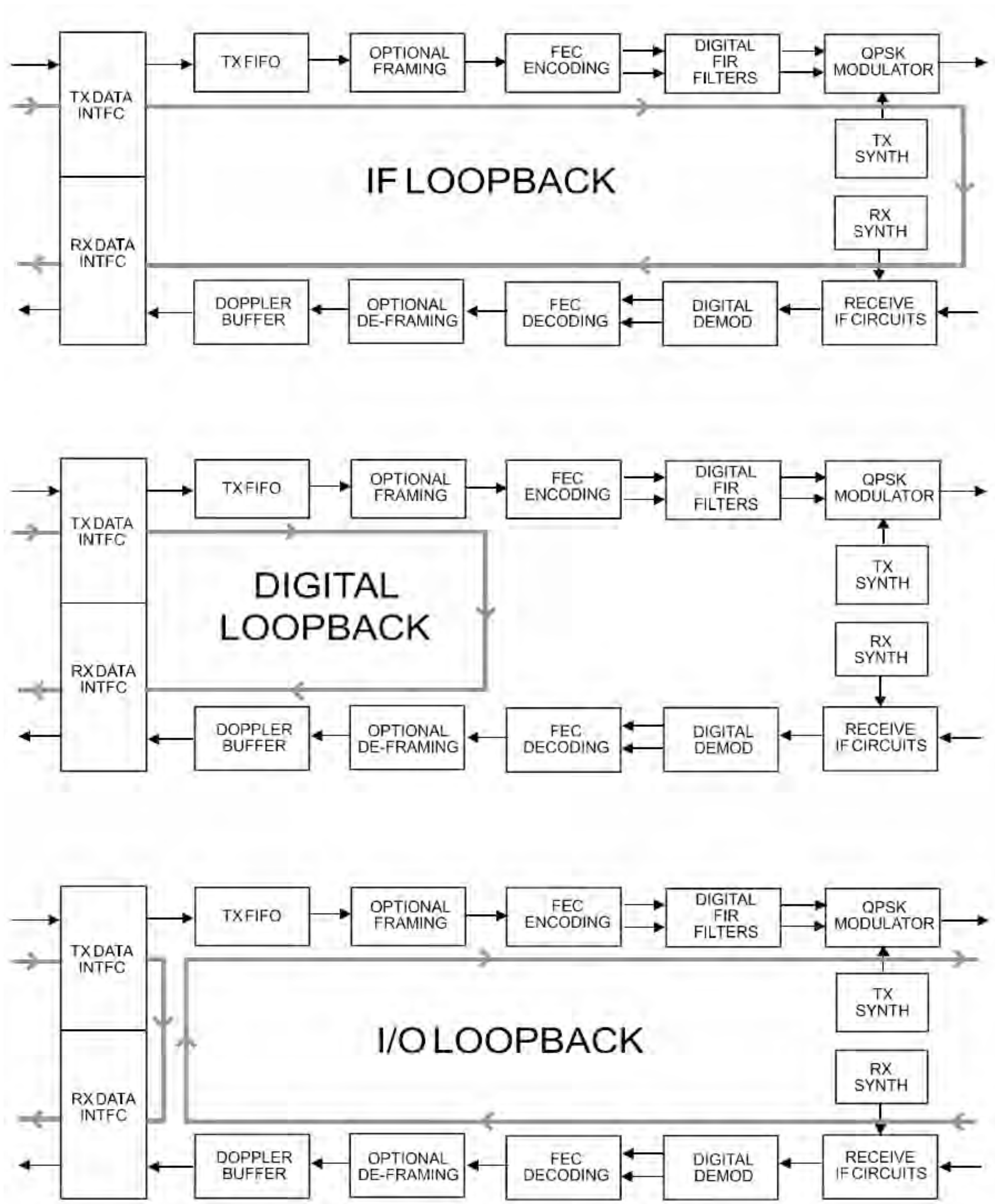


Figure 6-3. Loopback Test Modes

6.2.4.2 (TEST:) BERT

```
BER:No Sync  Count:0.0E+00  Errs:0.0E+00
BERT:On  Patt:2^23-1 Restart ErrIns (◄►)
```

On the top line – Read-only BER (Bit Error Rate) information is provided as follows:

Parameter	Description
BER	This is the current Bit Error Rate of the demod. This BER figure is only available when BERT is ON. When BERT is OFF, or if there is a mismatch in pattern selection, or if there is a substantial issue with the link, this parameter displays “No Sync”.
Count	This is the total number of BERT Pattern bits received by the demodulator since BERT was enabled or since the last **Restart**.
Errs	This is the total number of BERT Pattern bits received in error by the demodulator since BERT was enabled or since the last **Restart**.

On the bottom line – Use the ◄ ► arrow keys to select a function. Then:

Function	Instructions / Description
BERT	Press **ENTER**. Then, use the ▲▼arrow keys to select **ON** or **OFF**. **ON** enables the BERT pattern on the modem Tx and begins the search for the BERT pattern on the demodulator Rx.
Patt	Press **ENTER**. Then, use the ▲▼arrow keys to select a BERT pattern that the modem can be set to transmit and to search for on receive. Selections are **2047, 2^15-1, 2^23-1**. The longest pattern, **2^23-1**, is typically used in testing to ensure a solid data sync.
Restart	Press **ENTER** to reset all counters to 0.0E00.
ErrIns	Press **ENTER** to insert a single bit error that will be reported by the demodulator locked to the BERT pattern.

6.2.4.3 (TEST:) Comp

K4 GZip Lossless Compression and Decompression in an optional feature that requires installation of the Compression Card in the modem.

```
Bypass: Enable
                                      (▲▼)
```

Use the ▲▼arrow keys to select **Enable** or **Disable**. Press **ENTER**. Note the following:

- With **Enable** selected, K4 GZip compression is turned off (bypassed) while running a test (the **TEST MODE** front panel LED Indicator is lit).
- With **Disable** selected, this assumes normal modem operation with K4 GZip compression operable (the **TEST MODE** front panel LED Indicator is not lit).

6.2.4.4 (TEST:) LED

```
Front Panel LED Test: Enabled
                (Enable, Disable)    (▲▼)
```

Use the ▲▼ arrow keys to select **Enable** and then press **ENTER** to execute a diagnostic test on the front panel LED Indicators and the VFD.

The test run checks each LED Indicator, individually and as a group, while generating a series of test patterns on the VFD. Normal operations resume upon completion of the test.

6.2.5 SELECT: Store/Ld (Store/Load)

```
Configuration #2:  Load   Store       (◄►▲▼)
No configuration exists.
```

You can store or load (recall) up to 10 different modem configurations – 0 through 9.

First, select your configuration: Use the ◄ ► arrow keys to navigate to **Configuration #X** (any configuration location 0 through 9) entry. Then, use the ▲▼ arrow keys to select the desired configuration number. Make note of the location status message on the bottom line:

- A location that is available to **Store** a configuration displays the message, "**`No Configuration exists.`**"
- A location that displays the message, "**`A Configuration Exists.`**" is used to **Load** an existing configuration.

Once you select a location, use the ◄ ► arrow keys to **Load** or **Store** the configuration. Press **ENTER**.

When a modem configuration is stored to a location, the modem logs the date and time of this configuration. This information – time in military/24-hour format / date in European convention of **DAY-MONTH-YEAR** – is shown on the bottom line as the location number is edited.

6.2.5.1 Store/Load Override

Whether storing into a location and an existing configuration is already stored at this location, or when loading a configuration into the working memory from a stored location, the message "**`A configuration exists.`**" displays on the bottom line. The system requires you to confirm the request, as it will permanently overwrite existing information:

```
Configuration #2. Override? No (Y,N)   (▲▼)
A Configuration exists.
```

Use the ▲▼arrow keys to select the Override choice – **Y(es)** or **N(o)** – and then press **ENTER**.

6.2.6 SELECT: Utility

```
Utility:   Set-RTC  Display  EventLog
CID  AGC  1:1  1:N  Circuit-ID  Firmware
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.6.1 (Utility:) Set-RTC

```
Edit Real-Time Clock:   dd/mm/yy
  Time: 12:01:02   Date:26/10/14      (◄►▲▼)
```

Time is in military/24-hour format. The date is in the European convention of **DAY-MONTH-YEAR**.

Use the ◄ ► arrow keys to select a digit to edit, and then use the ▲▼arrow keys to change that digit. Press **ENTER.**

6.2.6.2 (Utility:) Display-Brightness

```
Edit Display Brightness:
                100%                   (▲▼)
```

Use the ▲▼ arrow keys to select a suitable brightness level for the VFD (Vacuum Fluorescent Display). The available levels are **25%**, **50%**, **75%** or **100%.** Press **ENTER**.

6.2.6.3 (Utility:) EventLog

```
EventLog Style: FillandStop
```

Use the ▲▼ arrow keys to select the Event Log Style. The available choices are **Fill and Stop** and **Fill and Roll Over**. Press **ENTER**.

Note that:

- **Fill and Stop** allows the unit to record a maximum of 255 events. Once the unit records Event 255, the unit ignores all subsequent events.
- **Fill and Roll Over** allows the unit to continue to record events in a continuous loop beyond Event 255. Once the unit records Event 255, the unit rolls over the event log and continues to log events beginning with Event 1 – overwriting the previous 255 events.

6.2.6.4 (Utility:) CID

Appendix H. CARRIER ID (DVB-CID MetaCarrier®)

```
CID: Lat:33°25.43’N     Long:111°58.28’W
  State:On   Telephone     Message    (◄►)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.6.5 (Utility:) 1:1

```
1:1: Manual/Auto    Force    Status
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(Utility: 1:1) Manual/Auto

```
1:1 Redundancy: Manual
```

Use the ▲▼ arrow keys to select **Manual** or **Auto**. Press **ENTER**. The operational states for 1:1 Redundancy are as follows:

- **Manual –** The currently active modem remains *Online* regardless of any current or future faults. *Online* and *Offline* (Standby) modems remain in this state until you **Force** the switchover.
- **Auto –** The redundancy switch chooses which modem is *Online* based on fault conditions:
  - If the original *Online* modem, Unit ‘A’ becomes faulted, then switch occurs to the *Offline* modem, Unit ‘B’ only if it is fault-free.
  - Switchover back to Unit ‘A’ occurs only if the Standby Unit ‘B’ – now the *Online unit* – becomes faulted and Unit ‘A’ is clear of any faults. Operation cannot revert to the original *Online* modem, Unit 'A, until it clears its faults.

(Utility: 1:1) Force

```
    This Unit is in Standby (1:1 only)
```

This screen identifies the state for, and allows you to execute, a forced switchover as follows:

Message	Description
1:1 redundancy is Not Connected	This message indicates that the modem’s rear panel **J2 | REDUNDANCY** connector is *not* connected to a supported 1:1 redundancy switch such as the CRS-170A or CRS-180.

Message	Description
This Unit is in Standby (1:1 only)	This message indicates that, while this modem is properly connected to a supported 1:1 redundancy switch, it is the *Offline* (standby) unit of the 1:1 pair at present and it cannot be "forced" into the *Online* position. You can only "force" a switch of the *Online* modem into the *Offline* (Standby) position.
Press ENTER key to force Unit into Standby (1:1 only)	This message indicates that this modem *is* connected to a 1:1 switch and the modem *is Online*. Press **ENTER** to force this modem *Offline* and bring the Standby modem *Online*.

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

(Utility: 1:1) Status

```
1:1 Redundancy Status:
1:1 Switch=Not Connected
```

This *read-only* screen displays the status of the 1:1 switch connection:

Message	Description
Not Connected	The modem is either not connected to a supported 1:1 switch, or the connection is faulty.
Connected Offline	The modem is connected to a supported 1:1 switch and is in the "Offline" state.
Connected Online	The modem is connected to a supported 1:1 switch and is in the "Online" state.

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

6.2.6.6 (Utility:) 1:N

```
1:N Redundancy: Disabled
```

Use the ▲▼ arrow keys to select 1:N Redundancy as **Enabled** or **Disabled**. Press **ENTER**.

If the unit is connected to a Comtech EF Data CRS-500 M:N Redundancy System (as part of a 1:N system), this setting must set to Enabled. In all other circumstances (i.e., standalone operation or 1:1 Redundancy), 1:N Redundancy must be set to Disabled.

6.2.6.7 (Utility:) Circuit ID

```
Edit this Modem's Circuit ID:        (◄►▲▼)
------------------------
```

You may create a Circuit ID string, up to a maximum length of 24 characters, on the bottom line of this display.

Use the ◀ ▶ arrow keys to select an alphanumeric character to edit, and then use the ▲▼ arrow keys to change that character. You may use the following characters:

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

Press **ENTER** once you compose your desired Circuit ID string.

6.2.6.8 (Utility:) Firmware

CAUTION
THESE SUBMENUS ARE INTENDED FOR DIAGNOSTIC PURPOSES ONLY. DO NOT CHANGE AN IMAGE UNLESS OTHERWISE DIRECTED BY COMTECH EF DATA PRODUCT SUPPORT.

These submenus permit you to view information about the CDM-760 internal firmware, or to select which image is loaded the next time the unit reboots.

```
Firmware Images: ActiveImage:2
     Info     Select                  (◀ ▶)
```

The modem can store two complete firmware images. The *read-only* top line shows the active firmware image. On the bottom line, use the ◀ ▶ arrow keys to select a parameter. Press **ENTER**.

6.2.6.8.1 (Utility: Firmware Images) Info

```
Firmware Information: ActiveImage:2
   Boot-ROM   Image#1   Image#2       (◀ ▶)
```

The *read-only* top line shows the active firmware image. On the bottom line, use the ◀ ▶ arrow keys to select **Boot-ROM**, **Image#1**, or **Image#2**. Press **ENTER** to view the selected firmware information. Per the following example:

```
Image #1 Bulk:          03/22/13
FW-0020627-             1.1.1           (▲▼)
```

Use the ▲▼ arrow keys to scroll through information of all the constituent firmware blocks that make up the bulk. Press **ENTER** or **CLEAR** to return to the previous menu.

6.2.6.8.2 (Utility: Firmware Images) Select

```
Current Active Image is #1
Next Reboot, will use Image:  #1
```

The *read-only* top line shows the active firmware image. This example shows Image #1 as the Current Active Image.

On the bottom line – Use the ▲▼ arrow keys to select the standby image (in this example, Image #2) if desired. Press **ENTER**. You are then prompted to reboot the unit.

6.2.7 SELECT: ODU (Outdoor Unit)

```
ODU: BUC:PwrSupply+Ref
     LNB:PwrSupply+Ref  FSK-control (◄ ►)
```

Use the ◄ ► arrow keys to select **BUC:PwrSupply+Ref** or **LNB:PwrSupply+Ref.** Press **ENTER**.

FSK-control is reserved for FUTURE use and is non-operational at this time.

6.2.7.1 (ODU:) BUC:PwrSupply+Ref

```
BUC control/monitor:
PSU-and-10MHz            PSUmonitor (◄ ►)
```

Use the ◄ ► arrow keys to select **PSU-and-10MHz**. Press **ENTER**.

PSUmonitor is reserved for FUTURE use and is non-operational at this time.

6.2.7.1.1 (ODU: BUC:PwrSupply+Ref) PSU-and-10MHz

```
BUC: Voltage=Off  10MHz=Off (Off,On)
Alarm limits, from 000 to 500 mA   (◄►⬍)
```

The BUC: Voltage and Alarm Limits controls are reserved for FUTURE use and are non-operational at this time.

Use this menu to enable a high stability 10MHz reference clock with ±0.06 ppm on the rear panel **J12 | L-BAND TX IN** Type 'N' connector.

Use the ▲▼ arrow keys to select the 10MHz Reference as **Off** or **On**. Press **ENTER.**

6.2.7.2 (ODU:) LNB:PwrSupply+Ref

```
LNB control/monitor:
PSU-and-10MHz            PSUmonitor (◄ ►)
```

Use the ◄ ► arrow keys to select **PSU-and-10MHz** or **PSUmonitor**. Press **ENTER**.

6.2.7.2.1 (ODU: LNB:PwrSupply+Ref) PSU-and-10MHz

```
LNB: Voltage=Off  10MHz=Off (Off,On)
Alarm limits, from 000 to 500 mA   (◄►↕)
```

Use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

(ODU: LNB:PwrSupply+Ref) PSU-and-10MHz →Voltage

Use the ▲▼ arrow keys to select **Off**, **13V DC**, **18V DC**, or **25V DC**. Press **ENTER**.

Any setting other than **Off** will configure the rear panel **J9 | L-BAND RX IN** Type 'N' connector.

(ODU: LNB:PwrSupply+Ref) PSU-and-10MHz →10MHz

Use the ▲▼ arrow keys to select **Off** or **On.** Select **On** to enable a high stability 10MHz reference clock with ±0.06 ppm on the rear panel **J9 | L-BAND RX IN** Type 'N' connector. Press **ENTER**.

(ODU: LNB:PwrSupply+Ref) PSU-and-10MHz →Alarm limits

The CDM-760 constantly monitors the LNB power supply source. Use this selection to define an alarm range that alerts you to problems with the LNB.

On the bottom line, first use the ◄ ► arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER.** Valid settings are:

Range		Step Size
Minimum	Maximum	
000 mA	500 mA	1 mA

6.2.7.2.2 (ODU: LNB:PwrSupply+Ref) PSUmonitor

```
LNB Power Supply [On]
      274mA, 18.2V
```

The top line for this *read-only* screen shows whether the LNB is **On** or **Off**:

- If the **LNB** is **On**, the bottom line of this screen displays the present current and voltage readings for the LNB Power Supply.
- If the LNB is **Off**, the bottom line displays **0000mA, 00.0V**.

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

6.2.8 SELECT: FAST

Chapter 5. FAST ACTIVATION PROCEDURE

```
FAST:   Options    Demo-Mode   CnC    (◄ ►)
Baseboard S/N 123456789  HW RevXX.XX
```

FAST (**F**ully **A**ccessible **S**ystem **T**opology) allows you to enable new options in the modem. Contact Comtech EF Data Product Support to purchase a FAST Option and acquire the associated **FAST Access Code**.

The bottom line displays the modem's 9-digit "Baseboard S/N" – you will need to provide this information to Comtech EF Data Product Support when ordering FAST feature upgrades.

On the top line, use the ◄ ► arrow keys to select a parameter. Press **ENTER**.

6.2.8.1 (FAST:) Options

```
FAST    1: Set  View 2: Set  View
OPTIONS 3: Set  View               (◄ ►▲▼)
```

FAST options are grouped under three internal EEPROM registers. Each register requires a unique **FAST Access Code**. It is important, when upgrading, to enter your *register-specific* **FAST Access Code** using the *correct register*. Use the ◄ ► arrow keys to navigate to the **correct** register (1:, 2:, or 3:); use the ◄ ► arrow keys again to either select **View** or, if you have determined which register-specific option requires activation, select **Set**. Press **ENTER.**

(FAST: FAST Options) View (View Options by Register Number)

```
FAST: View options1: 01        (installed)
    150 Msps Rx symbol rate          (▲▼)
```

Use the ▲▼ arrow keys to view the FAST options currently available and installed for that register. The top line shows the active register, the FAST option number, and its installed status. The modem identifies each selected FAST option as "**`installed`**" or "**`not installed`**". The bottom line identifies the FAST option.

(FAST: FAST Options) Set (Activate Options By Register Number)

```
FAST: Set register#:  Enter code below
88888888888888888888  then [ENTER] (◄ ►▲▼)
```

Use this screen to enable new options in the modem on a **per-register** basis. Note the following:

Register No.	Contains the lockdowns for FAST Option Number:	
1	01	150 Mbps Rx symbol rate
	02	150 Mbps Tx symbol rate
	03	ACM Point to Point
	04	275 Mbps Full CnC
2	01	Rx QPSK, 8PSK, 16APSK, 32APSK
	02	Tx QPSK, 8PSK, 16APSK, 32APSK
	03	Optical
	04	AUPC
3	01	150 Msps GZip symbol rate
	02	Net Spec DVB-S2, DVB-S2-EB1, DVB-S2-EB2, DVB-S2X
	03	Digital PreDistortion

It is important that you enter the FAST access code into the correct register. On the top line, for "**Set register#**", '**#**' means the appropriate register #1, #2, or #3.

Contact a Comtech EF Data Product Support representative to order the desired FAST options. Be prepared to provide the Modem Serial Number. Your Comtech EF Data Product Support representative will verify the order and provide an invoice and activation instructions, including a register-specific 20-digit FAST Access Code.

On the bottom line, use the arrow keys (◄ ► ▲ ▼) to *carefully* enter your register-specific 20-character FAST access code.

```
FAST: Set register#: Enter code below
00000000000000000000 then [ENTER]  (◄ ►▲▼)
```

Press **ENTER** to execute the FAST upgrade.

The modem responds with "**Configured Successfully**" if the **FAST** upgrade is accepted; the modem then resets to its newly-incorporated default configuration. However, if an invalid code is entered, the following message displays:

```
Failure to configure. Re-enter code.
88888888888888888888 then [ENTER]  (◄ ►▲▼)
```

Repeat the FAST access code entry procedure. Should the code entry error persist, contact Comtech EF Data Product Support for further assistance.

6.2.8.2 (FAST:) Demo-Mode

```
FAST Options Demo Mode: Off              (▲▼)
Time remaining: 29:23:59:50
```

FAST Options Demo Mode allows access to ALL CDM-760 FAST options for 30 calendar days. On the *top line*, use the ▲▼ arrow keys to select Demo Mode as **Off** or **On**. Press **ENTER**. The *bottom line* displays the **Time remaining** – the time format is **DD:HH:MM:SS** (days, hours, minutes and seconds. Note the following:

- The time count decrements only when Demo Mode is turned **On**. Demo Mode may be turned on and off an unlimited number of times until the full 30 calendar days have expired.
- Once the timer decrements to 00:00:00:00, FAST Options Demo Mode may no longer be enabled. Your modem will still function with the purchased FAST enabled features.

If the Demo Mode timer reaches 00:00:00:00 while the modem is running a FAST feature that is not a purchased FAST feature, the modem will fall into an invalid state, turn off its carrier, and revert all settings to factory default settings.

6.2.8.3 (FAST:) CnC

```
FractionalCnC:Time Remaining: 90:00:00:00
Time Remaining Refills In 364:23:59:31
```

```
Full CnC License is installed.
```

Fractional CnC is common in 1:1 or 1:N redundancy systems where the primary modem is running fully operational (i.e., FAST-activated) CnC, and the backup modem(s) has FAST-activated Fractional CnC.

Fractional CnC allows 90 full calendar days of CnC usage in a calendar year. This lowers the cost of the modem but does not allow for constant, round-the-clock CnC operation.

As per the previous screen examples, if Fractional CnC is not installed in the CDM-760, the modem displays a message that no CnC license is installed and provides “time remaining” and “time remaining refill” timers; or that a Full CnC license is installed and the screen displays **no** timers. Note the following:

- **FractionalCnC: Time Remaining** – This is the amount of time, in the form dd:hh:mm:ss (days: hours:minutes:seconds), that that the modem can be run in CnC mode. This counter decrements under the following conditions:
  - The modem has a FAST-activated Fractional CnC license
  - The modem is powered ON
  - The modem’s Tx is ON
  - The modem is in standalone mode or in 1:1 redundancy configuration and is Online

- o The modem is NOT in Demo Mode. If the timer reaches 00:00:00:00, the modem will turn its Tx Off and the circuit will be down.

- **Time Remaining Refills In** – This is the calendar year counter that resets **FractionalCnCTime Remaining** to its 90 full days of CnC usage when it reaches 00:00:00:00. This counter continually decrements and even accounts for time when the modem is powered **Off**. Once this timer fully decrements, **Time Remaining Refills In** once again resets to 365:00:00:00 and immediately begins to decrement.

1) Fractional CnC:Time Remaining cannot be reset or refilled in the field. Once the timer has run out, your only options are to:
   - Upgrade the modem to fully functional CnC.
   - Wait until "Time Remaining Refills In" reaches 00:00:00:00.
2) Using Fractional CnC is not a normative mode of operation. To best inform you that your modem is running Fractional CnC (i.e., the "FractionalCnC:Time Remaining" counter is actively decrementing), your modem does the following:
   - The RED Unit Status LED on the front panel of the modem will blink on and off.
   - The modem generates an Event in the Event Log every 12 hours indicating that Fractional CnC is running.
   - When connected to a 1:1 redundant switch, the modem generates a phantom fault every 12 hours, allowing the fully operational CnC modem to return online if its fault has cleared.

Notes:

Chapter 7. ETHERNET INTERFACE OPERATION

7.1 Introduction

Ethernet-based Remote Product Management is available through the CDM-760 rear panel **J4 | MGMT** RJ-45 10/100 BaseT Fast Ethernet M&C port or, when the optional High-Speed Packet Processor is **installed and enabled**, the **P0 | MGMT** port.

To proceed with Ethernet-based Remote Product Management (SNMP OR WEB SERVER), assumptions are made that:

- **The CDM-760 is operating with the latest version firmware files.**
- **The CDM-760 is connected to a user-supplied, Windows-based PC, and:**
  - **The PC serial port is connected to the CDM-760 rear panel J3 | REMOTE port with a user-supplied serial cable.**
  - **The PC Ethernet port is connected to either the CDM-760 rear panel J4 | MGMT 10/100 BaseT Ethernet port or the Packet Processor P0 | MGMT port with a user-supplied hub, switch, or direct Ethernet cable connection.**
  - **The PC is running a terminal emulation program (for operation of the CDM-760 Serial Interface) and a compatible web browser (for operation of the HTTP (Web Server) Interface)**.
- **The CDM-760 Management IP Address has been noted using the CDM-760 Serial Interface.**

7.1.1 Ethernet Management Interface Protocols

Ethernet-based remote monitor and control (M&C) of the CDM-760 is available via the User PC through three separately-operated non-secure protocols:

- **Simple Network Management Protocol (SNMP).** This interface requires a user-supplied Network Management System (NMS) and a user-supplied Management Information Base (MIB) File Browser.
- **Telnet Interface.** This interface is accessible using Windows Command-line, or requires that you install a user-supplied terminal emulation program (such as HyperTerminal) on the User PC.
- **HTTP (Web Server) Interface.** This interface requires a compatible user-supplied web browser such as Internet Explorer.

7.2 SNMP Interface

Use of the Ethernet-based SNMP interface is recommended only for advanced users. All other users are strongly encouraged to use the HTTP (Web Server) Interface for monitor and control of the CDM-760.

The Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. An SNMP-managed network consists of three key components:

- **The managed device.** This includes the CDM-760 Advanced High-Speed Trunking Modem.
- **The SNMP Agent.** This is the software that runs on the CDM-760. The CDM-760 SNMP Agent supports both **SNMPv1** and **SNMPv2c**.
- **The user-supplied Network Management System (NMS).** This is the software that runs on the manager.

7.2.1 Management Information Base (MIB) Files

MIB files are used for SNMP remote management of a unique device. A MIB file consists of a tree of nodes called Object Identifiers (OIDs). Each OID provides remote management of a particular function. You should compile these MIB files in a user-supplied MIB Browser or SNMP Network Monitoring System server. The following MIB files are associated with the CDM-760:

MIB File/Name (where 'x' is revision letter)	Description
FW10874-2x.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
FW-0020630x.mib CDM-760 MIB file	MIB file consists of all of the OIDs for management of the modem functions
FW-0020631x .mib CDM-760 Traps MIB file	Trap MIB file is provided for SNMPv1 traps common for modem.

7.2.2 SNMP Community Strings

CAUTION
In SNMP v1/v2c, the SNMP Community String is sent unencrypted in the SNMP packets. The network administrator must make sure that SNMP packets travel only over a secure and private network, if security is important.

The CDM-760 uses Community Strings as a password scheme used to authenticate users and determine access privileges to the SNMP Agent MIBs. Type the SNMP Community String into the user-supplied MIB Browser or Network Node Management software.

Three Community Strings are defined for SNMP access:

- **Read Community** default = public
- **Write Community** default = private
- **Traps Community** default = comtech

For correct SNMP operation, make sure to use the CDM-760 MIB files that are applicable to the version of the CDM-760 modem M&C.

Read your CDM-760 FW Release Notes for information on the required firmware and software compatibility.

7.2.3 SNMP Traps

The modem has the ability to send out SNMP traps when an alarm or a fault occurs in the modem. These include unit, Tx, Rx, and ODU faults. A trap is sent both when a fault occurs and is cleared.

The modem supports both **SNMPv1** traps and **SNMPv2** notifications. You may configure the modem to send either style by using the CDM760SNMPTrapVersion OID:

- The CDM-760 supports the following MIB2 S**NMPv1** traps / **SNMPv2** notifications:

MIB2 SNMPv1 trap: Authentication Failure	5
MIB2 SNMPv2 notifications: Authentication Failure	1.3.6.1.6.3.1.1.5.5

- The CDM-760 supports the following Alarms and Faults **SNMPv1** traps:

cdm760UnitAlarmV1	6247600
cdm760TxTrafficAlarmV1	6247601
cdm760RxTrafficAlarmV1	6247602
cdm760TrapStoredEventAlarm	6247603
cdm760RedundancySwitch	6247604

- The CDM-760 supports the following Alarms and Faults **SNMPv2** notifications:

cdm760TrapUnitAlarm	1.3.6.1.4.1.6247.77.2.1.1.1
cdm760TrapTxAlarm	1.3.6.1.4.1.6247.77.2.1.1.2
cdm760TrapRxAlarm	1.3.6.1.4.1.6247.77.2.1.1.3
cdm760TrapStoredEventAlarm	1.3.6.1.4.1.6247.77.2.1.1.4
cdm760RedundancySwitch	1.3.6.1.4.1.6247.77.2.1.1.5

7.3 Telnet Interface

Chapter 8. SERIAL INTERFACE OPERATION

Figure 7-1. Telnet Interface Example – Windows Command-line

The CDM-760 has a Telnet interface for the purpose of equipment M&C via the Serial Remote Control protocol.

The Telnet interface requires user login at the **Administrator** level and **Read/Write** level. Once logged into the Telnet interface as the Administrator, you have access to the optional serial-based Remote Control Interface. **Figure 7-1** shows an example of the login process.

7.3.1 Using HyperTerminal for Telnet Remote Control Operation

There is a disadvantage when using Windows Command line as a Telnet client with the optional Remote Control protocol. For the messages coming from the Telnet Server, Command line cannot translate a carriage return command (\r) to a carriage return + line feed command (\r\n). Therefore, any multi-line Target-to-Controller response (e.g., the response to the FRW? query) shows as one line, with the latter lines overwriting the previous lines.

To see the full response messages, you can use the HyperTerminal terminal emulation program configured as a Telnet client. **Figure 7-2** shows an example of the login process and remote control operation, when you use HyperTerminal as the interface.

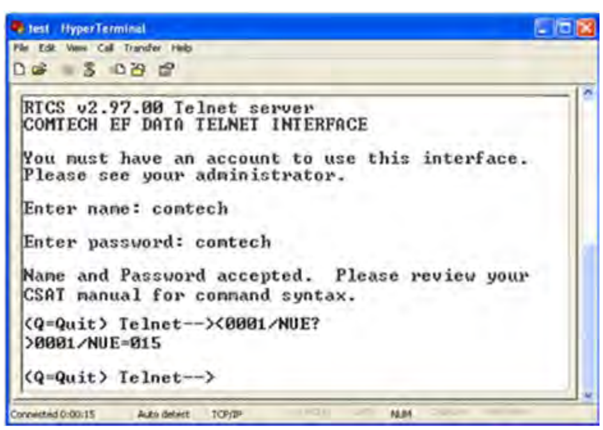


Figure 7-2. Telnet Interface Example – HyperTerminal

7.3.1.1 Configure HyperTerminal for Telnet Remote Control Operation

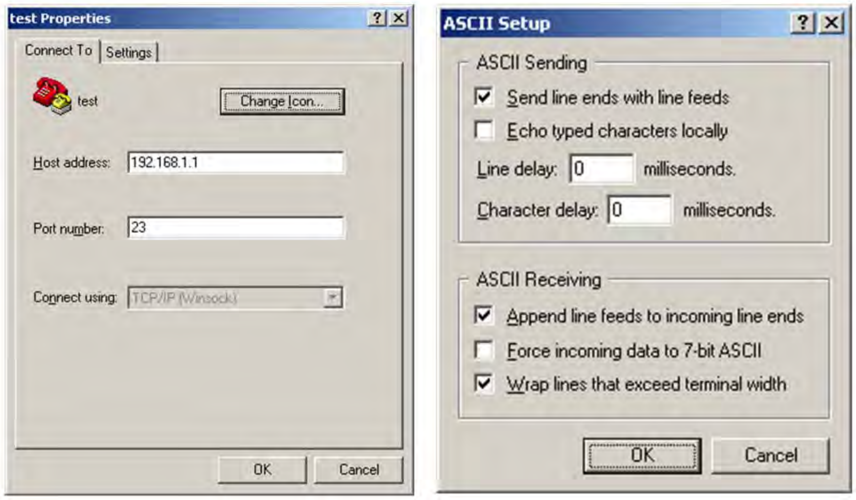


Figure 7-3. Configure HyperTerminal

See Figure 7-3. Do these steps:

1. Make sure to define the Connect To Telnet connection properties correctly (**File → Properties**) (**Figure 7-3**, left):
   a. Enter the CDM-760's Traffic/Management IP Address as the "Host address" (e.g., 192.168.1.1).
   b. Enter TCP Port 23 as the "Port number".
   c. Set "Connect using" to TCP/IP (Winsock) instead of COM1 or COM2.
   d. Click **[OK]** to save your settings.
2. For ASCII Setup (**File → Properties → Settings → ASCII Setup**) (**Figure 7-3**, right):
   a. Check the "Send line ends with line feeds" option in the 'ASCII Sending' section.
   b. Check the "Append line feeds to incoming line ends" option in the 'ASCII Receiving' section.
   c. Click **[OK]** to save your settings.

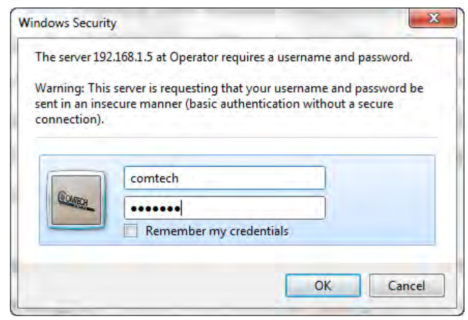
7.4 HTTP (Web Server) Interface

A user-supplied web browser allows the full monitor and control (M&C) of the CDM-760 from its HTTP Interface. This non-secure embedded web application is designed for, and works best with, Microsoft Internet Explorer Version 8.0 or higher.

7.4.1 User Login

Type the CDM-760 Management IP Address (shown here as http://xxx.xxx.xxx.xxx) into the **Address** area of the User PC web browser:

Once you enter a valid IP Address and before the modem grants access to the HTTP Interface, it prompts you for a User Name and Password via the Login Window, similar to the example shown at right.



Default Admin User name – **comtech**
Default Admin Password – **comtech**

Type the User Name and Password, and then click **[OK].**

HTTP Login Access Levels are defined as follows:

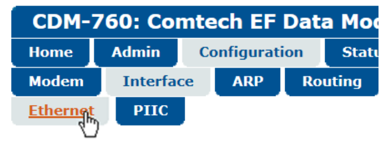
HTTP Login User Access Level		
Admin User	Read/Write User	*Read-only* User
Read/Write (FULL) access to all web pages.	No access to Admin or High-Speed Packet Processor-related web pages.	No access to Admin or High-Speed Packet Processor-related web pages.
	Read/Write (FULL) access for all other web pages	*Read-only* (VIEW) access for all other web pages.

Once you enter a valid **User Name** and **Password**, the HTTP Interface **Home** page displays:

7.4.2 HTTP Interface – Operational Features

7.4.2.1 Navigation

The CDM-760 HTTP Interface features navigation tabs located at the top of each page. Once you click a navigation tab, you may click an available primary page tab. In turn, any nested tabs appear for further selection.



This manual uses a naming format for all pages to indicate the depth of navigation needed to view the subject page: "**Navigation Tab | Primary Page Tab | Nested Tab**".

For example: Interpret "**Configuration | Interface | Ethernet**" to mean "*first* click the top-level **Configuration** navigation tab; *then*, click the **Interface** primary page tab; *finally*, click the nested **Ethernet** tab."

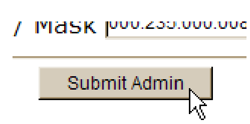
7.4.2.2 Page Sections

Each page features one or more sections. The title at the top of each section describes its operational features. Each section can feature editable fields, action buttons, and *read-only* displays that are specific to that section.

This manual explains the purpose and operation for each web page on a **per-page, per-section** basis.

7.4.2.3 Action Buttons

Action buttons are important in the HTTP Interface. Click an action button to do one of these tasks:

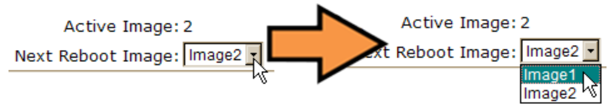


- Permanently **save changes**.
- Reset changed parameters to **remove unsaved changes**.
- **Refresh the page** with current data.

If you edit a field, make sure to click the action button before you leave the page. If you go to another page without first clicking the action button, your changes are <u>not</u> saved.

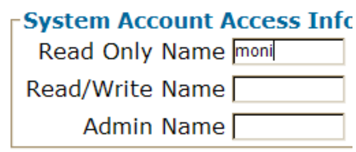
7.4.2.4 Drop-down Lists

A drop-down list lets you choose from a list of selections. Left-click the drop-down button to open the list. Then, left-click on an item to select that choice.



7.4.2.5 Text or Data Entry

Text boxes let you type data into a field. An action button may be associated with a single text box, or a group of text boxes.



For any text box, left-click anywhere inside the box, type the desired information into that field, and be sure to press **[ENTER]** when done. Click the related action button to save the data.

If you edit a field, make sure to click the action button before you leave the page. If you go to another page without first clicking the action button, your changes are <u>not</u> saved.

7.4.3 HTTP Interface – Menu Tree

The **Figure 7-4** menu tree diagram lists the features available through the CDM-760 HTTP Interface. This interface features four navigation tabs (shown in blue). Primary page tabs (green) and nested page tabs (yellow) provide access to individual web pages. Click any navigation tab to continue.

The CDM-760 HTTP Interface pages that are marked with an asterisk (*) are functional only when you activate the optional FAST feature, or accessible to Admin users when the optional High-Speed Packet Processor card is installed and enabled. See Sect. 7.4.3.1 for information about using conditional access pages.

Any page marked with double asterisks (**) is functional only when an auxiliary product such as a PIIC (Plug-In Interface Card) or LNB (Low Noise Block Down Converter) is installed.

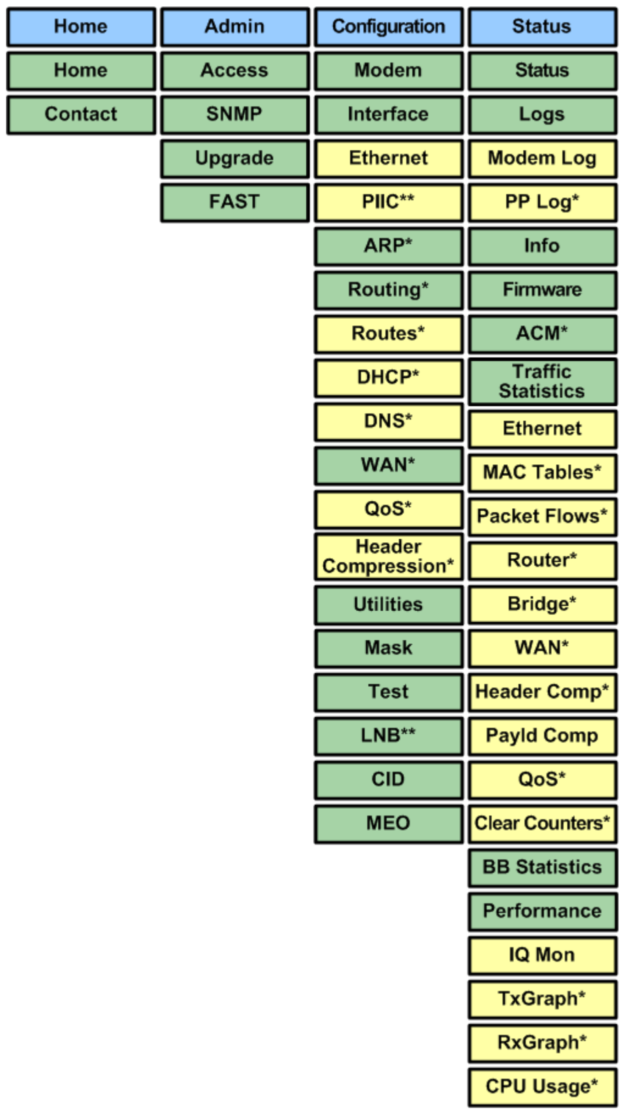


Figure 7-4. CDM-760 HTTP Interface Menu Tree (FW Ver. 1.7.3)

7.4.3.1 Conditional Access to High-Speed Packet Processor Pages

Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR

Carefully review the information in this section.

A large number of pages in the HTTP Interface address operation of the CDM-760 once it is equipped with the optional High-Speed Packet Processor card. These pages are accessible only when this card is **<u>installed and enabled</u>**.

As noted in **Sect. 7.4.1**, access to these pages is further restricted to "Admin" (Administrative) users **only**. If a user with "*Read/Write*" or "*Read-only*" user access privileges attempts to select any Packet Processor-specific page, the error message **"You do not have security privilege to access this area"** displays in the browser window. Access to that page is prohibited.

If the Administrator logs in and attempts to access any Packet Processor-specific page when the optional High-Speed Packet Processor card is **<u>not installed</u>**, the following message displays:

Click **[Back to previous page]** to resume use of the interface.

If the Administrator logs in and attempts to access any Packet Processor-specific page when the optional High-Speed Packet Processor card is **<u>installed</u>** but card operation is **<u>disabled</u>**, the following message displays:

Click **[Back to previous page]** to continue any other available operations, or go to the CDM-760 Front Panel **CONFIG > INTF** screen to set **PacketProcessor** operation as **<u>Enabled</u>** (the modem will automatically reboot).

The HTTP Interface menu tree diagram (**Figure 7-4**) indicates with an asterisk (*) those primary and nested Packet Processor pages having conditional access and operation. Further, each interface page (see **Sect. 7.4.4 HTTP Interface Page Descriptions** subsections) having this restriction features an advisory note similar to this example:

These pages are accessible only to Admin users when the optional High-Speed Packet Processor card is <u>installed and enabled</u>. See Sect. 7.4.3.1 for information about using conditional access pages.

7.4.4 HTTP Interface Page Descriptions

Access to and availability of certain HTTP Interface pages is dependent upon the FAST options purchased and the detected presence of auxiliary or optional products installed and configured for use with the CDM-760. The subsections that follow note such conditional availability.

7.4.4.1 Home Pages

Click the **Home** navigation tab, and then select the **Home** or **Contact** tab to continue.

7.4.4.1.1 Home | Home

Use this page to identify the product and its current operating firmware version.

Click the **Home** navigation or nested page tab to return to this page from anywhere in the HTTP Interface.

Figure 7-5. CDM-760 Home Page

7.4.4.1.2 Home | Contact

Use this page to see the contact information (phone, fax, or Web/e-mail hyperlinks) for Comtech EF Data Product Support.

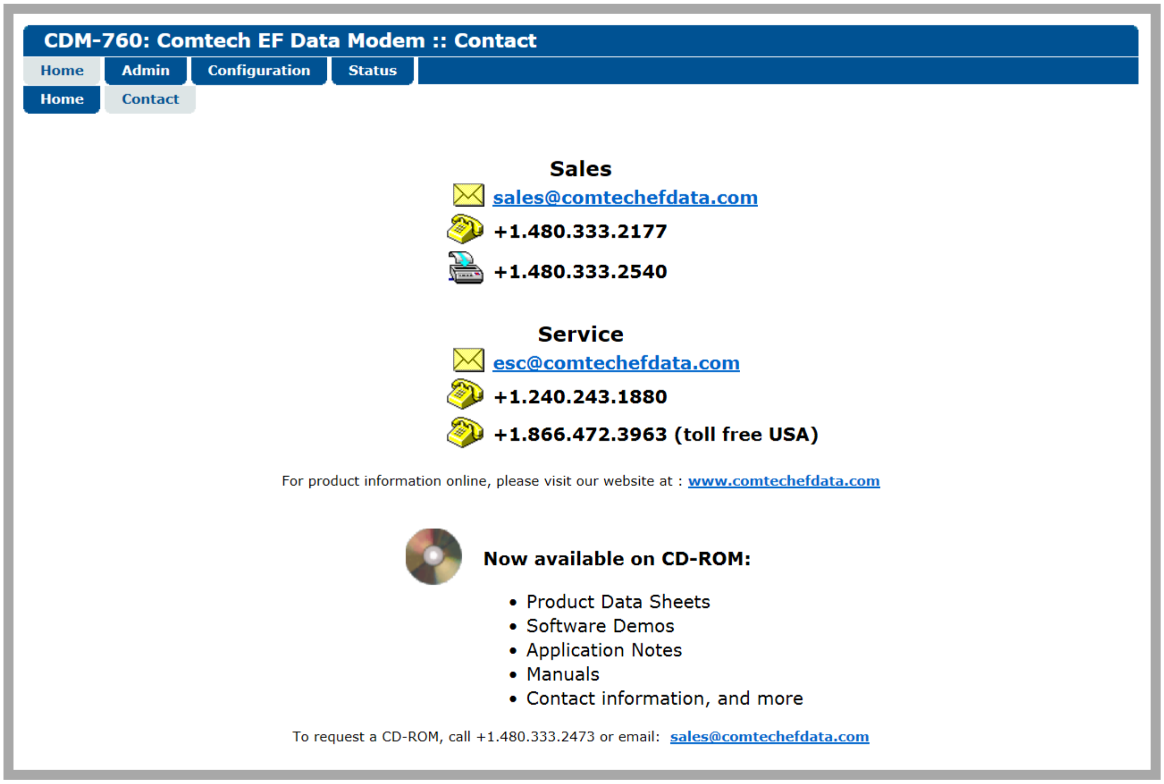


Figure 7-6. Home | Contact Page

7.4.4.2 Admin (Administration) Pages

The Administrator must use these pages to set up user access, manage the modem's firmware, and activate FAST options.

The Admin pages are available only when you log in with the Administrator User Name and Password.

Click the **Admin** navigation tab, and then select the **Access**, **SNMP**, **FAST**, or **Upgrade** tab to continue.

7.4.4.2.1 Admin | Access

The Administrator must use this page to manage the HTTP Interface user access settings.

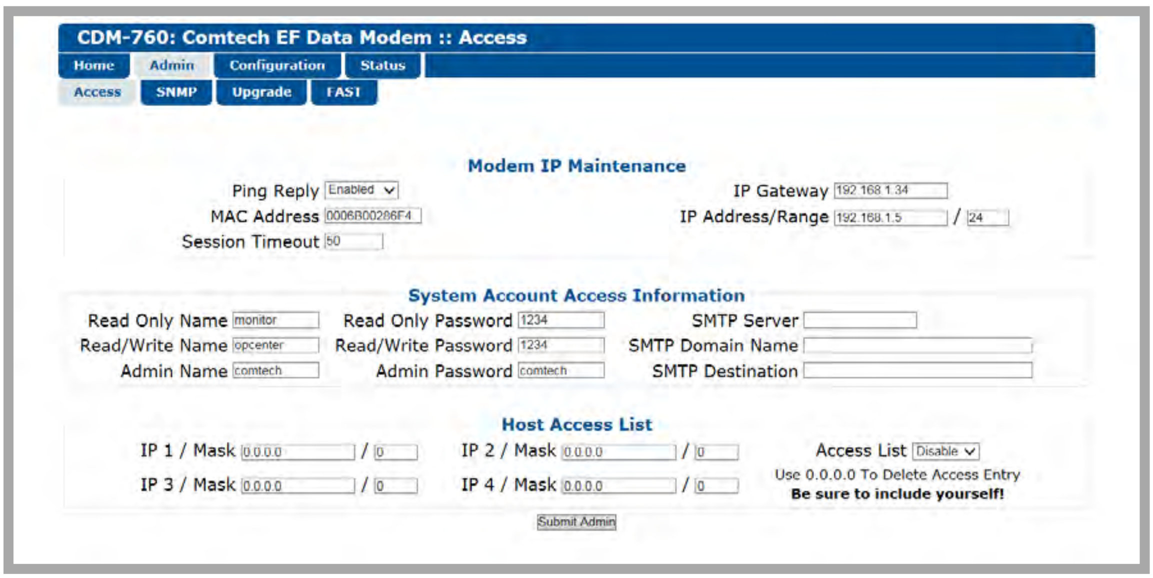


Figure 7-7. Admin | Access Page

Modem IP Maintenance

- Use the **Ping Reply** drop-down list to select **Enabled** or **Disabled**:
  - o Selecting **Enabled** causes the CDM-760 to reply to ping requests.
  - o Selecting **Disabled** causes the CDM-760 to ignore ping requests and no replies are sent to ping requests.
- The **MAC address** for the M&C card on the CDM-760 is *read-only*.
- Enter a **Session Timeout** number, in seconds. This is the time allotted an inactive user session on the HTTP Interface. Any activity (configuration changes, mode settings, etc.) resets and restarts the Session Timeout countdown clock.
- Enter an **IP Gateway** destination address. If a response destination IP address is outside of the CMD-760 M&C subnet, then the CDM-760 forwards M&C responses to this address.
- Enter an **IP Address/Range** (IP address and subnet mask) for the CDM-760 M&C card.

System Account Access Information

At the time of publication, the "SMTP Server", "SMTP Domain Name", and "SMTP Destination" text fields are non-functional.

- Enter a *Read-only*, **Read/Write**, or **Admin Name** and **Password**. A name or password can be any alphanumeric combination with a maximum length of 10 characters. The factory default names/passwords are as follows:
  - *Read-only* monitor/1234
  - **Read/Write** opcenter/1234
  - **Admin** comtech/comtech

Host Access List

The **Host Access List** allows you to define a list of remote client PCs which can connect to the CDM-760 via HTTP and SNMP.

- Enter an **IP** (#) **/ Mask** (IP address and a subnet mask) for each Access List entry.
  For example, if you want to grant access to a remote client PC with an IP Address of 10.10.10.1, and any PC on a subnet of 192.168.10.xxx, then you would define the Access List as:

  IP 1 / Mask: 10.10.10.1/32
  IP 2 / Mask: 192.168.10.0/24

  Make sure 'IP 3 / Mask' and 'IP 4 / Mask' are not 0.0.0.0/0. An entry with 0.0.0.0/0 allows access to any PC.

- Use the **Access List** drop-down list to select **Enable** or **Disable**. When *disabled*, any client PC may connect via HTTP and SNMP.

Click **[Submit Admin]** to save.

7.4.4.2.2 Admin | SNMP

The Administrator must use this page to manage the CDM-760 SNMP (Simple Network Management Protocol) settings.

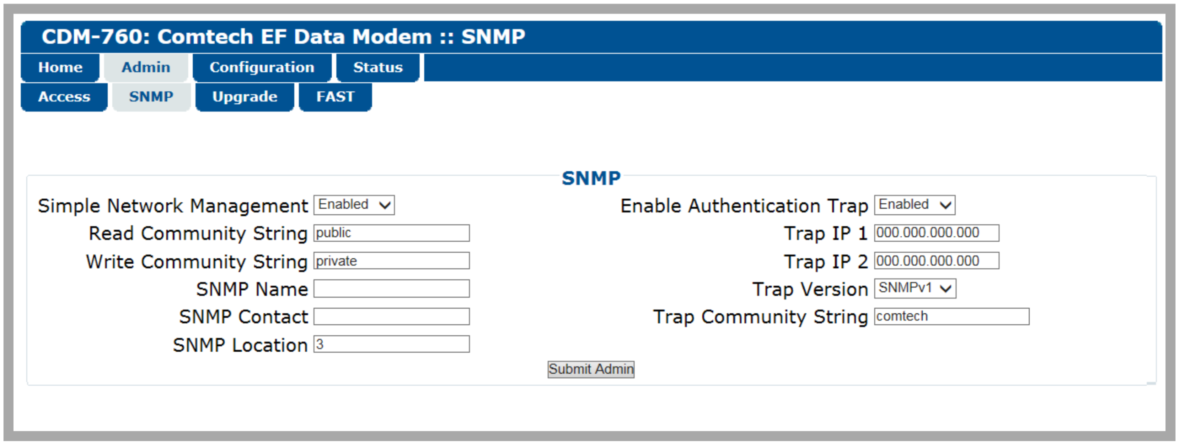


Figure 7-8. Admin | SNMP Page

SNMP

- Use the **Simple Network Management** drop-down list to select **Enabled** or **Disabled**.
- Enter a **Read Community** string. This string can be any combination of characters and a length of 0 to 20 characters. The factory default SNMP Read Community string is **public**.
- Enter a **Write Community** string. This string can be any combination of characters and a length of 0 to 20 characters. The factory default SNMP Write Community string is **private**.
- Enter an **SNMP Contact, Name, and Location.** Each string can be any combination of characters and a length of 0 to 20 characters.
- Use the **Enable Authentication Trap** drop-down list to select **Enabled** or **Disabled**.
- Enter the **Trap IP 1** and **Trap IP 2** addresses, in the form XXX.XXX.XXX.XXX, for the computer that is to receive the traps generated by the CDM-760.
- Use the **Trap Version** drop-down list to select **SNMPv1** or **SNMPv2**.
- Enter a **Trap Community String**. This string can be any combination of characters and a length of 0 to 20 characters. The factory default SNMP Write Community string is **comtech**.

Click **[Submit Admin]** to save.

7.4.4.2.3 Admin | Upgrade

Beginning with Firmware Version 1.4.1, the Administrator may use this page to manage the CDM-760 Firmware Upgrade process.

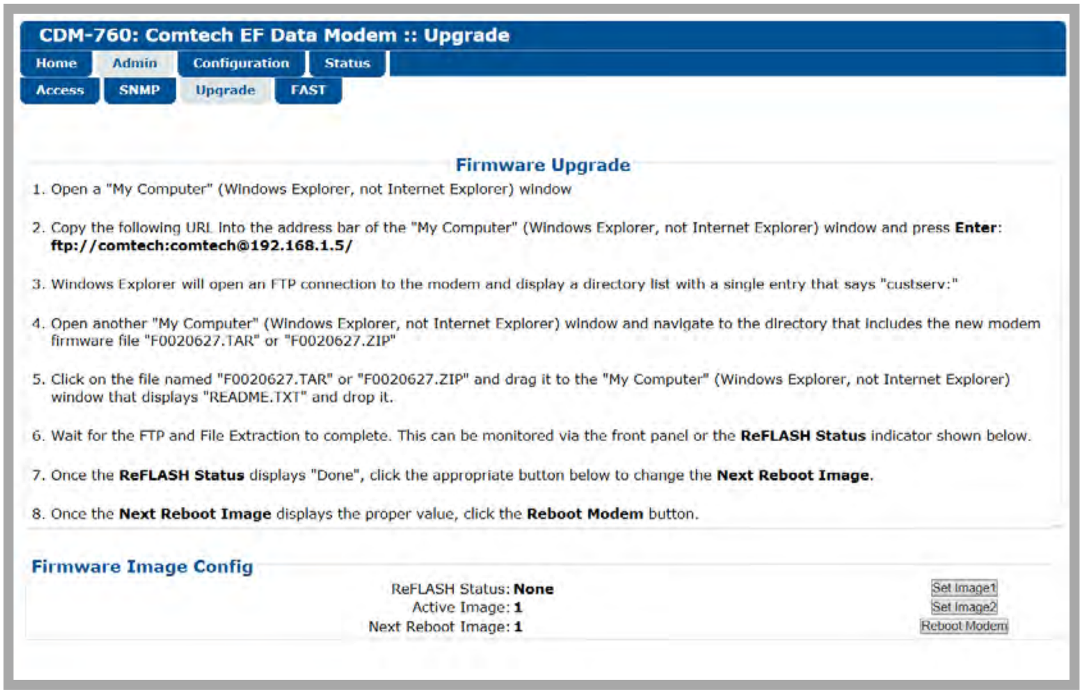


Figure 7-9. Admin | Upgrade Page

Firmware Upgrade

Do the steps displayed in the *Firmware Upgrade* section of this page to transfer the extracted firmware update image ZIP file (available from www.comtechefdata.com or Comtech EF Data Product Support) from the User PC to the modem's Flash memory.

Note that Steps 6 through 8 prompt you to use the **Firmware Image Config** section of this page to finalize the process.

Firmware Image Config

- **ReFLASH Status** – The messages that display here guide you through the file's PC-to-modem transfer process.
- **Active Image** – This *read-only* item displays the active firmware image that is loaded upon power-up/boot up of the unit. Note that the file transfer process overwrites the *non-active* firmware image. In order to make that firmware upgrade as the active image load, you must re-define the Next Reboot Image accordingly.
- **Next Reboot Image** – This *read-only* item displays the active firmware image – 1 or 2 – that is loaded upon power-up/boot up of the unit.
- Click **[Set Image 1]** or **[Set Image 2]** to specify which firmware image is loaded upon power-up (bootup) of the unit.
- Click **[Reboot Modem]** to reboot the CDM-760. You will need to re-enter your user credentials to resume use of the HTTP Interface.

7.4.4.2.4 Admin | FAST

- **Sect. 1.2.5 On-site Operational Upgrades**
- **Chapter 5. FAST ACTIVATION PROCEDURE**
- **Chapter 6. FRONT PANEL OPERATION**

The CDM-760 has a number of optional features that may be activated after the unit's purchase. **F**ully **A**ccessible **S**ystem **T**opology (**FAST**) **Access Codes** are *register-specific* authorization codes that you may purchase from Comtech EF Data, and then activate in the unit using this page. Contact Comtech EF Data Product Support to order the desired options and obtain your unique FAST Access Codes.

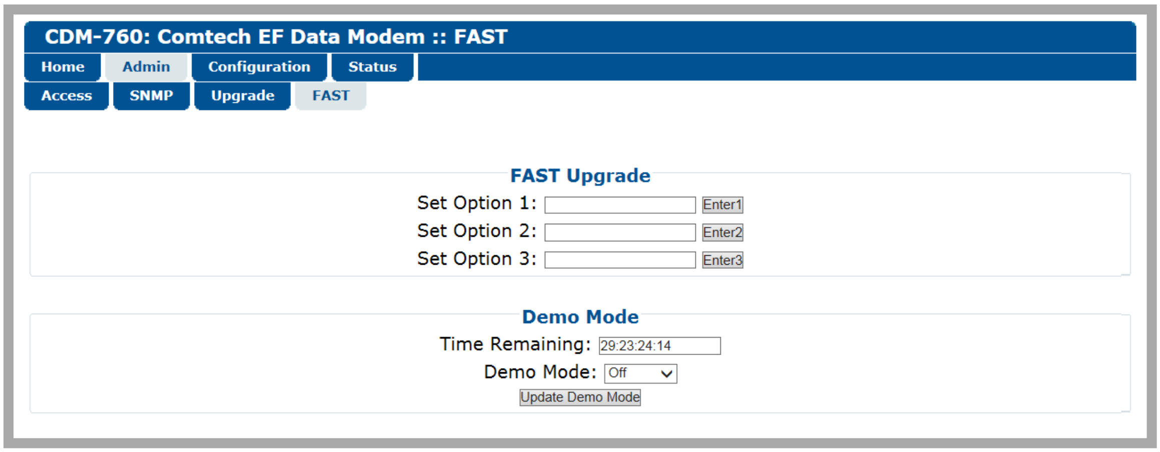


Figure 7-10. Admin | FAST Page

FAST Upgrade

When you obtain a FAST access code from Comtech EF Data, **it will be for a specific option register.** *Carefully* enter each *register-specific* 20-character FAST access code in sequence, and then click **[Enter#]** when done. The modem then displays a message on this page to indicate whether or not the codes were accepted or if the upgrade was successful.

If you enter an invalid FAST code, the modem will reject the code and will not accept machine-to-machine FAST codes for 15 minutes. You may enter FAST codes locally from the modem front panel during this timeframe.

Demo Mode

- **Time Remaining –** FAST Options Demo Mode allows access to **ALL** CDM-760 FAST options for 30 calendar days. This field displays the remaining time in days, hours, minutes, and seconds.
- Use the **Demo Mode** drop-down list to select Demo-Mode as **Off** or **On**. Click **[Update Demo Mode]** to execute the selection.

If an option is running that is not an activated (purchased) FAST Option at the time Demo Mode is turned off, the modem will revert to all settings that were last valid before the modem was put into Demo Mode. If all options running are activated (purchased) FAST Options, the modem will not change its configuration.

7.4.4.3 Configuration Pages

Use these pages to configure all unit parameters. Click the **Configuration** navigation tab, and then select the **Modem**, **Interface**, **ARP**, **Routing**, **WAN**, **Utilities**, **Mask**, **Test**, **LNB**, **CID**, or **MEO** tab to continue.

7.4.4.3.1 Configuration | Modem

The Tx/Rx Interface Types and Framing Modes have higher priority than other parameters. You must configure these settings before setting other parameters.

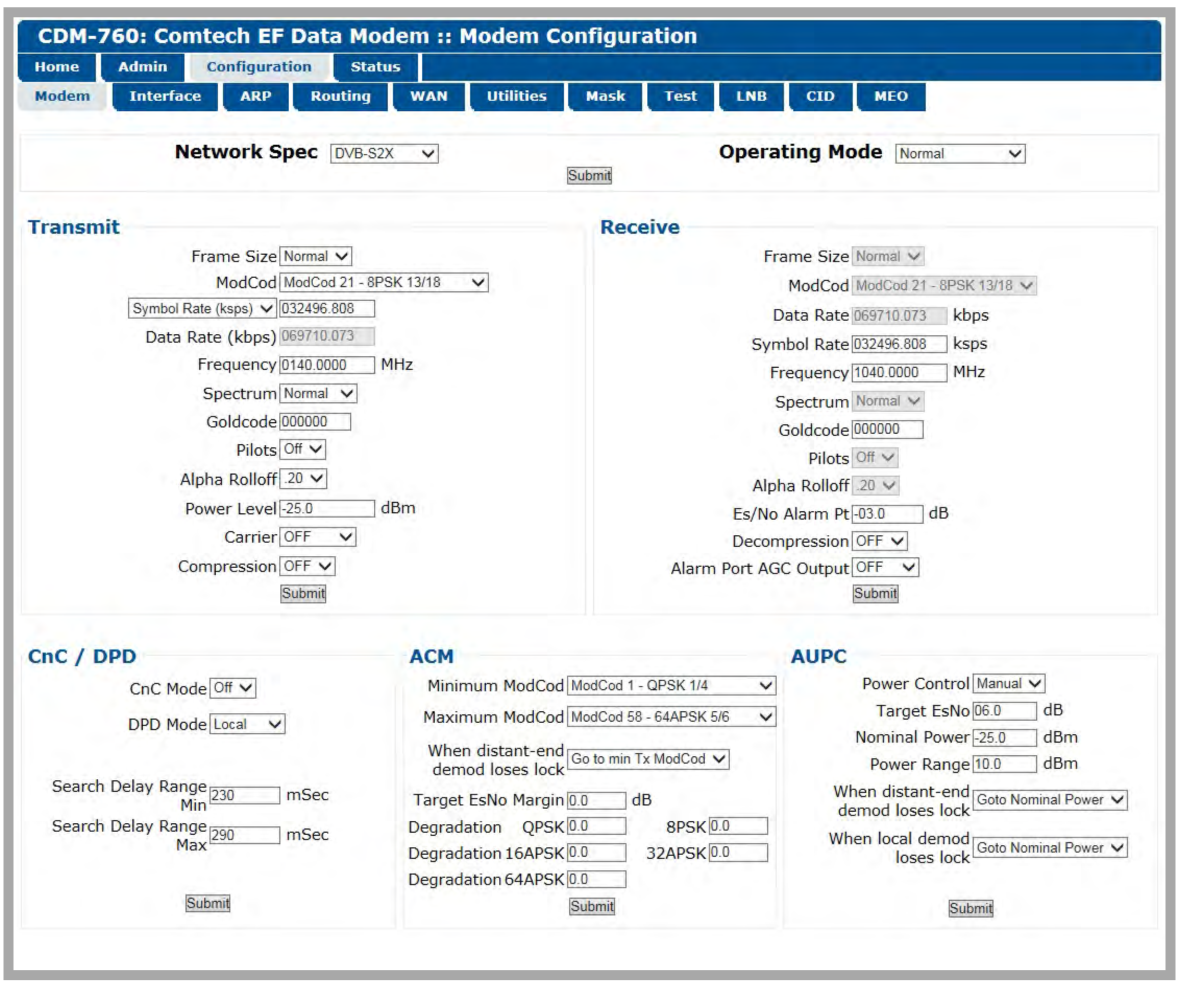


Figure 7-11. Configuration | Modem Page

Configure your settings as needed. Click **[Submit]** to save.

See Chapter 6. FRONT PANEL OPERATION for information about the configuration parameters available on this page:

Operational Feature / Section	Chapter 6 Section Reference
Network Spec	6.2.2.1.1 (CONFIG: NetSpec) Network Spec
Operating Mode	6.2.2.1.2 (CONFIG: NetSpec) Operating Mode
Transmit	6.2.2.2 (CONFIG:) Tx
Receive	6.2.2.3 (CONFIG:) Rx
CnC / DPD	• For CnC operation, see 6.2.2.5 (CONFIG:) CnC (Carrier-in-Carrier) o Also see: Appendix J. DOUBLETALK CARRIER-IN-CARRIER OPTION • For DPD operation, see 6.2.2.7 (CONFIG:) DPD (Dynamic Predistortion) o Also see: Appendix L. DYNAMIC PREDISTORTION OPTION
ACM	6.2.2.2.5 (CONFIG: Tx) ACM (Adaptive Coding and Modulation) • Also see: Appendix G. ADAPTIVE CODING AND MODULATION OPTION
AUPC	6.2.2.2.4 (CONFIG: Tx) Power →PowerControl →AUPC and (CONFIG: Tx) Power →AUPC

7.4.4.3.2 Configuration | Interface Pages

Be sure to read about Single Stream Mode vs. MultiStream Mode Operation in Chapter 6. FRONT PANEL OPERATION before you attempt to use either of the Interfaces pages.

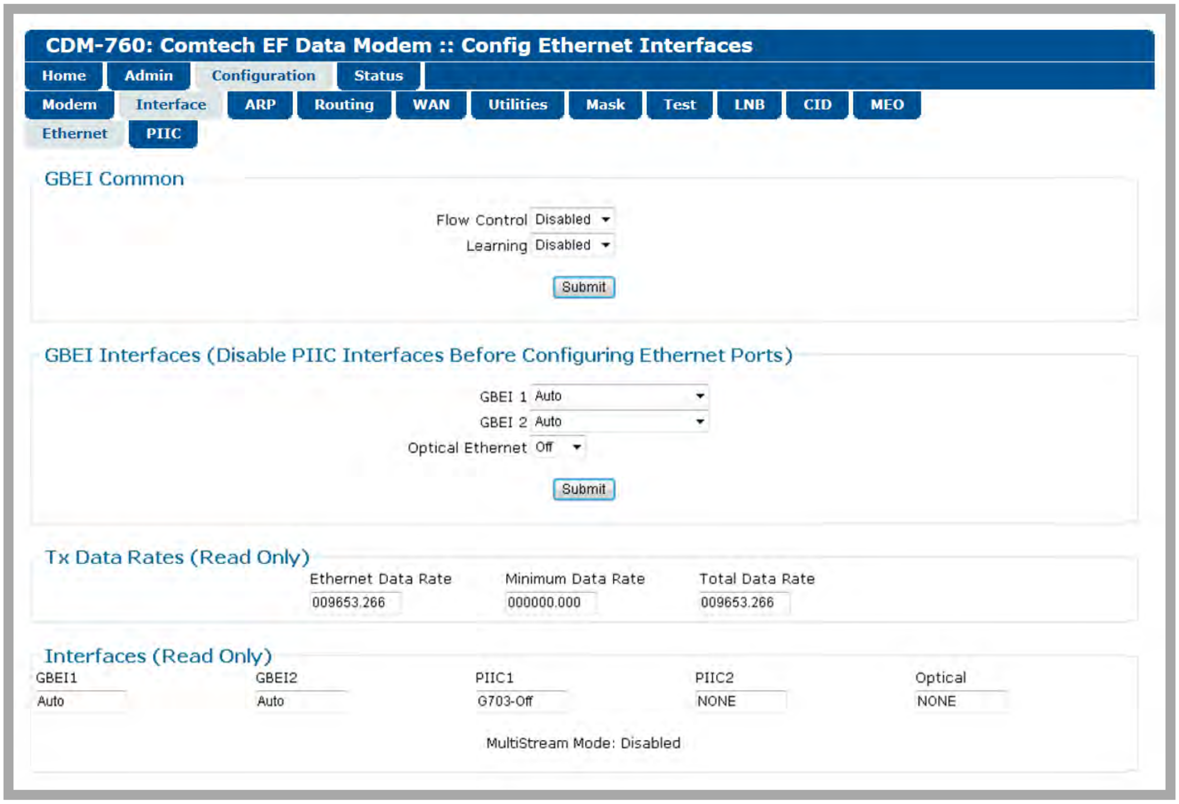
Use the **Interface** pages to configure and monitor the available base unit and optional Ethernet and optional PIIC traffic data interfaces at the CDM-760 rear panel:

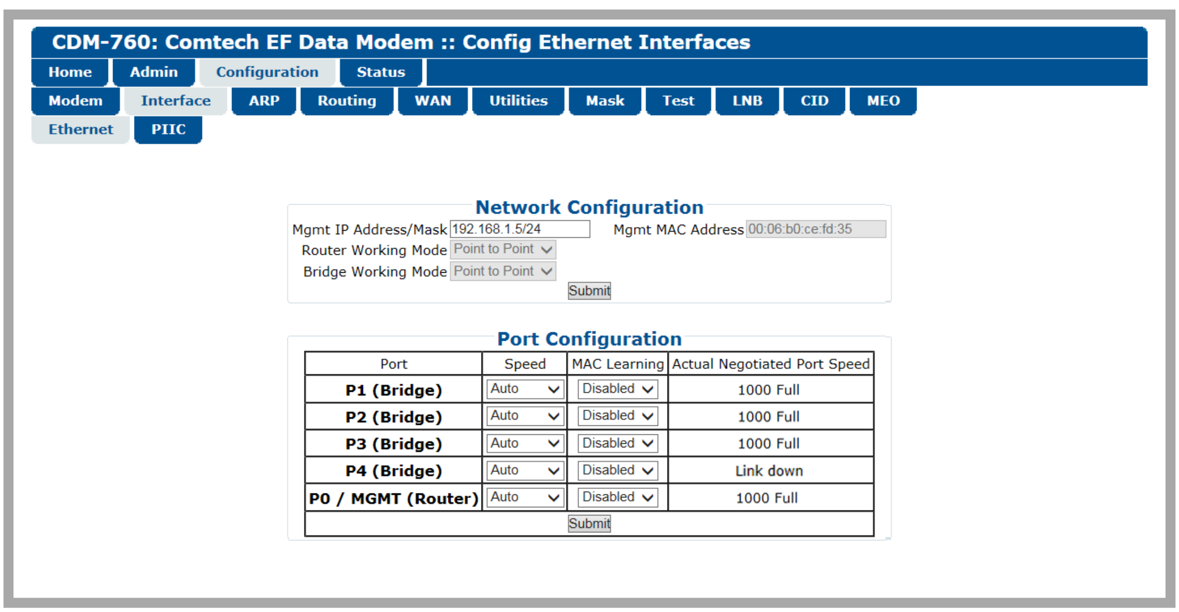
- The **J5 | DATA** Ethernet port
- The **J6 | DATA** Ethernet port
- The **J7 | OPTICAL** port, used with the optional **Optical Ethernet** SFP (Small Form Factor Pluggable) module
- **PIIC Slot 1** (**PIIC1**) and **Slot 2** (**PIIC2**), which accept the optional PIIC modules: G.703 E3/T3/STS-1; OC-3 Single Mode; OC-3 Multi Mode; STM-1 Copper; or DVB ASI
- **High-Speed Packet Processor**

Use of the PIIC slots is unavailable when the Packet Processor is installed. When installed, operation of the rear panel **J4 |MGMT**, **J5 | DATA**, and **J6 | DATA** Ethernet ports are disabled and operation is transferred by the modem to the Packet Processor's **P0 | MGMT**, **P1 | DATA**, **P2 | DATA**, **P3 | DATA**, and **P4 | DATA** Ethernet ports.,

Click the **Interface** primary page tab, and then select the **Ethernet** or **PIIC** tab to continue.

7.4.4.3.2.1 Configuration | Interface | Ethernet





(TOP) Page Appearance w/Functional PIICs Installed
(BOTTOM) Page Appearance w/Optional High-Speed Packet Processor Installed

Figure 7-12. Configuration | Interface | Ethernet Page

Absent the optional High-Speed Packet Processor, the rear panel **GBEI 1** (**J5 | DATA**), **GBEI 2** (**J6 | DATA**) ports and the optional **Optical Ethernet** SFP Module (**J7 | OPTICAL**) are operational and configurable.

Note the following:

GBEI Common

Use the drop-down lists to select **Flow Control** or **Learning** as **Enabled** or **Disabled.**

Click **[Submit]** to save.

GBEI Interfaces (Disable PIIC Interfaces Before Configuring Ethernet Ports)

Use the drop-down lists to select the appropriate mode of operation for the **GBEI 1** (**J5 | DATA**), **GBEI 2 (J6 | DATA)** ports or, when installed, the optional **Optical Ethernet** SFP Module (**J7 | OPTICAL**).

Click **[Submit]** to save.

Tx Data Rates (*read-only*)

See Chapter 6. FRONT PANEL OPERATION Sect. 6.2.2.2. (CONFIG: Tx) Data→Tx Data Rate for detailed information about calculated data rates.

- **Ethernet Data Rate (ETH_DR)** – This is always TOT_DR – MIN_DR. It is all data associated with the Ethernet data interfaces.
- **Minimum Data Rate (MIN_DR) –** This *read-only* value is always zero (000000.000) when the unit is in Single Stream Mode and only Ethernet Data Type is enabled. If the minimum data rate is not zero, then the modem is in MultiStream Mode. In MultiStream Mode, the MIN_DR is the aggregate of all active non-Ethernet interfaces, plus the MultiStream overhead. This overhead is 1.5% of the aggregate non-Ethernet data in Normal Block Mode, and 5% in Short Block Mode.
- **Total Data Rate (TOT_DR)** – This read-only value is the aggregate data rate of the modem. It relates to the Tx symbol rate and spectral efficiency (ModCod) settings.

Interfaces (*read-only*)

This section displays the operating status for all Ethernet and PIIC interfaces. Multi-stream Mode operation is also identified here as **Enabled** or **Disabled**.

Otherwise, when the optional High-Speed Packet Processor is **installed and enabled**, note the following:

Network Configuration

- Enter a valid **Mgmt IP Address/Mask** for the **P0 | MGMT** port, subject to the following restrictions:

Address / Address Range or Rule	Reason
0.0.0.0 – 0.255.255.255	RFC 1700 broadcast messages
127.0.0.0 – 127.255.255.255	RFC 6761 loopback addresses

Address / Address Range or Rule	Reason
169.254.0.XXX	Comtech internal modem use
169.254.1.XXX	Comtech internal modem use
224.0.0.0 – 239.255.255.255	RFC 5771 multicast addresses
240.0.0.0 – 255.255.255.255	RFC 6890 reserves IP address (future)
aaa.XXX.XXX.XXX aaa >= 128 and <= 191 subnet_mask < 16 aaa >= 192 and <= 224 subnet_mask < 24	RFC 791 classful networking addresses
Network bits cannot be all 0s or all 1s – i.e., a subnet with a mask of /24 cannot have an IP address that ends with .0 or .255	Reserved for network address and broadcast address

Click **[Submit]** to save.

- **Mgmt MAC Address** – This *read-only* field displays the modem management port (**P0 | MGMT**) MAC address.
- **Router / Bridge Working Mode** – Managed Switch Working Mode indicates that the User Data Ports (P1 through P4) are in a Managed Switch (Layer 2) mode. At present, Working Mode is limited only to "Point to Point" mode. These drop-down lists are therefore non-functional. DATA Ports P1 through P4 cannot be routed; however, if you require a routed network, you can pass user traffic through the P0 | MGMT port and route the traffic.

Routed traffic will run at a lower PPS rate than bridged traffic. User traffic passing through the P0 | MGMT port cannot exceed 105,000 PPS simplex or 150,000 PPS duplex compared to bridged traffic which can run at >190,000 PPS simplex or >350,000 PPS duplex.

Port Configuration

Use this section to configure the Packet Processor's data traffic and management ports. Click **[Submit]** to save. Note the following:

Column	Description
Port	This column lists the Packet Processor's four available Ethernet data traffic ports (P1 | DATA through P4 | DATA), and the P0 | MGMT port that is reserved for M&C (Monitor and Control) purposes.
Speed	Use the drop-down list to select the port speed/duplex communications as Auto, 100 Full, 100 Half, 10 Full, or 10 Half. You are strongly advised to set all port speeds to Auto whenever possible.
MAC Learning	Use the drop-down list to select MAC Learning as Disabled or Enabled. Chapter 6. FRONT PANEL OPERATION Sect. 6.2.2.4.2.1 MAC Learning Operational States
Actual Negotiated Port Speed	This *read-only* column displays the port's current operating speed when you set the speed to Auto. "Link Down" indicates that the modem detects no valid Ethernet device connection for that port.

1) **All ports are auto-crossover/auto-sensing.**
2) **It is critical that your port settings match the settings of the connected equipment. A mismatch of port settings can cause random packet loss and connection drops.**

7.4.4.3.2.2 Configuration | Interface | PIIC

Use this page to configure the optional G.703 E3/T3/STS-1, OC-3 Single Mode; OC-3 Multi Mode; STM-1 Copper; and DVB ASI PIIC modules, if installed, in PIIC Slots 1 and/or 2.

See Figure 7-13. This page requires installed optional Plug-In Interface Card(s). PIICs are not available when the optional High-Speed Packet Processor is installed; for such applications, this page is non-functional and the message "PIIC Not Installed" displays in the Slot 1 and Slot 2 page sections.

Typical for the **Slot1** and **Slot2** page sections, when a PIIC module is present in either or both slots:

G.703 Configuration

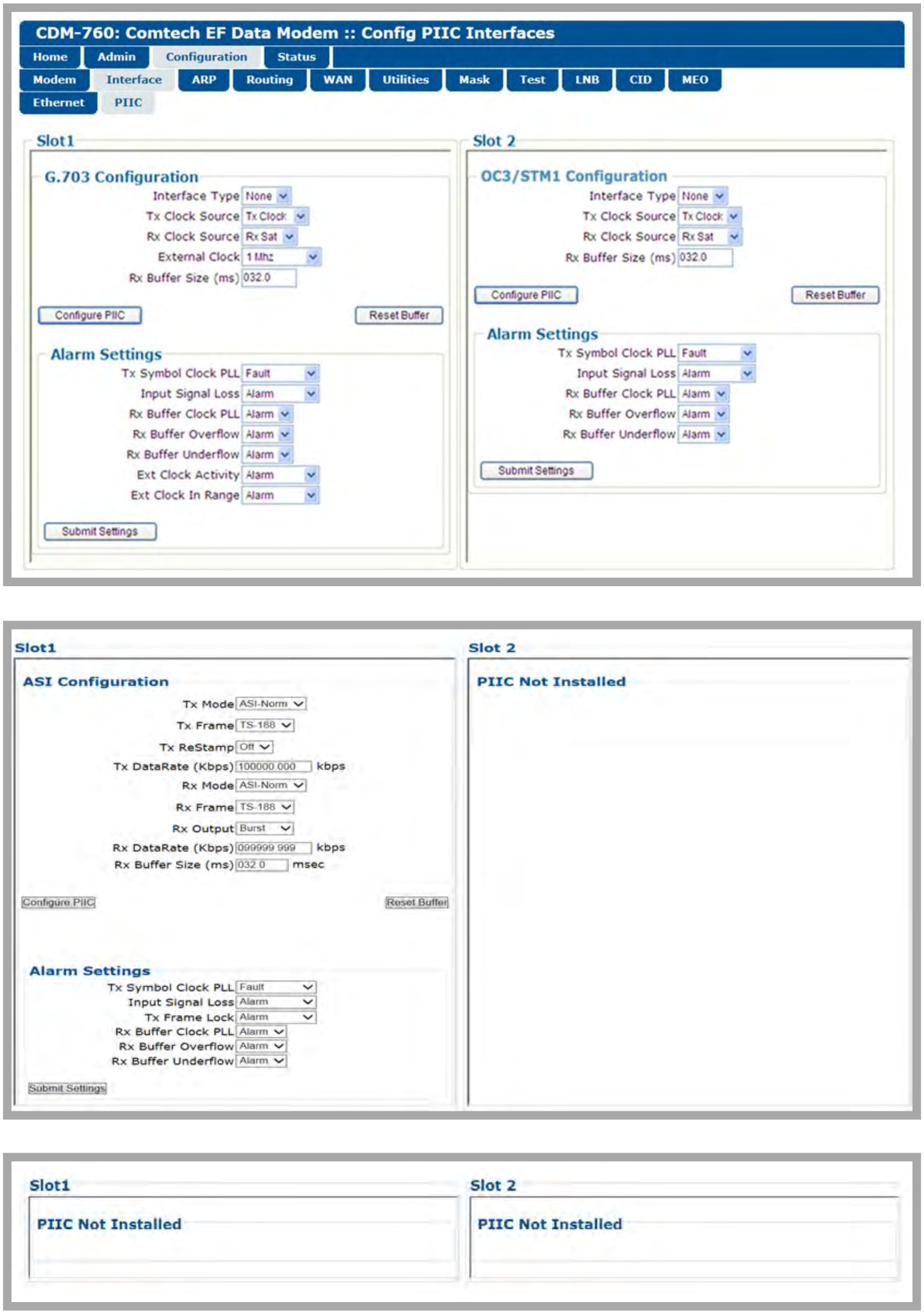
**SEE APPENDIX C. OPTIONAL PIIC (PLUG-IN INTERFACE CARD) MODULES:
Sect. C.2.1 G.703 E3/T3/STS-1 PIIC Module (CEFD P/N PL-0000795)**

This section displays whenever the G.703 E3/T3/STS-1 PIIC is installed in the applicable PIIC slot.

- Use the **Interface Type** drop-down list to select **None**, **E3**, **T3**, or **STS1**.
- Use the **Tx Clock Source** drop-down list to select **Tx Clock**, **Ext Clock**, or **Rx Sat**.
  Comtech EF Data strongly recommends that you select Tx Clock unless a high stability External Clock is present and timing of the network requires all devices to be locked to the External Clock.
- Use the **Rx Clock Source** drop-down list to select **Tx Clock**, **Ext Clock**, **Rx Sat**, or **Int Clock.**
  Comtech EF Data strongly recommends that you select Rx Sat unless a high stability External Clock is present and timing of the network requires all devices to be locked to the External Clock.
- Use the **External Clock** drop-down list to set the expected source clock rate (via the CDM-760 rear panel **J8 | EXT REF** connector) as **1 MHz**, **2 MHz**, **5 MHz**, **10 MHz**, **20 MHz**, **34.368 MHz**, **44.736 MHz**, or **51.85 MHz**.
- Enter an **Rx Buffer Size (ms)** buffer size, from 2 ms to 75 ms, in 0.5 ms steps.

Click **[Configure PIIC]** to clear the Rx Buffer.

Click **[Configure PIIC]** to save your G.703 configuration settings.



(TOP) Page Appearance w/Functional G.703, OC-3 or STM-1 PIICs Installed
(MIDDLE) Page Appearance w/Functional DVB ASI PIIC Installed (Banner and Menus not shown)
(BOTTOM) Page Appearance w/Optional High-Speed Packet Processor Installed (PIIC Operation Non-Functional, Banner and Menus not shown)

Figure 7-13. Configuration | Interface | PIIC Page

OC3/STM1 Configuration

SEE APPENDIX C. OPTIONAL PIIC (PLUG-IN INTERFACE CARD) MODULES:

- **Sect. C.2.2 OC-3 Single/Multi Mode PIIC Module Kits (CEFD P/N KT-000256/257)**
- **Sect. C.2.3 STM-1 Copper PIIC Module Kit (CEFD P/N KT-0000255)**

This section displays whenever the OC-3 Single Mode, OC-3 Multi Mode, or STM-1 Copper PIIC is installed in the applicable PIIC slot:

- Use the **Interface Type** drop-down list to select **None** or **OC3/STM1**.
- Use the **Tx Clock Source** drop-down list to select **Tx Clock** or **Rx Sat**.

  Comtech EF Data strongly recommends that you select Tx Clock unless a high stability External Clock is present and timing of the network requires all devices to be locked to the External Clock.
- Use the **Rx Clock Source** drop-down list to select **Tx Clock**, **Int Clk**, or **Rx Sat**.

  Comtech EF Data strongly recommends that you select Rx Sat unless a high stability External Clock is present and timing of the network requires all devices to be locked to the External Clock.
- Enter an **Rx Buffer Size (ms)** from 2 ms to 75 ms, in 0.5 ms steps.

Click **[Reset Buffer]** to clear the Rx Buffer.

Click **[Configure PIIC]** to save your OC-3 or STM-1 configuration settings.

ASI Configuration

SEE APPENDIX C. OPTIONAL PIIC (PLUG-IN INTERFACE CARD) MODULES:
Sect. C.2.4 DVB ASI (Asynchronous Serial Interface) PIIC Module (CEFD P/N PL-0022015)

This section displays whenever the DVB ASI PIIC is installed in the applicable PIIC slot.

- Use the **Tx Mode** drop-down list to select **Off, ASI-Norm**, or **ASI-Adv**.
- Use the **Tx Frame** drop-down list to select **None, TS-188, or TS-204**.
- Use the **Tx ReStamp** drop-down list to select **Off or On**.
- Enter the desired **Tx DataRate** (kbps) from 1000 kbps to 216,000 kbps.
- Use the **Rx Mode** drop-down list to select **Off or ASI-Norm**.
- Use the **Rx Frame** drop-down list to select **None, TS-188, or TS-204**.
- Use the **Rx Output** drop-down list to select **Stream or Burst**.
- Enter the desired R**x DataRate** (kbps) from 1000 kbps to 216,000 kbps.
- Enter an **Rx Buffer Size (ms)** from 2 ms to 75 ms, in 0.5 ms steps.

Click **[Configure PIIC]** to clear the Rx Buffer.

Click **[Configure PIIC]** to save your ASI configuration settings.

Alarm Settings

These controls are typical for all PIIC module types, except as noted.

- Use the **Tx Symbol Clock PLL** drop-down list to select **Alarm**, **Fault**, **Mask**, or **Fault (Tx On)**.
- Use the **Input Signal Loss** drop-down list to select **Alarm**, **Fault**, **Mask**, or **Fault (Tx On)**.
- Use the **Rx Buffer Clock PLL** drop-down list to select **Alarm**, **Fault**, or **Mask**.
- Use the **Rx Buffer Overflow / Underflow** drop-down list to select **Alarm**, **Fault**, or **Mask**.
- **Valid for G.703 PIICs only:** Use the **Ext Clock Activity** drop-down list to select **Alarm, Fault, Mask** or **Fault (Tx On)**. This indicates that the External Clock is selected by either the TxClock or RxClock, but no clock is present on **J8 | EXT REF**.
- **Valid for G.703 PIICs only:** Use the **Ext Clock In Range** drop-down list to select **Alarm, Fault, Mask** or **Fault (Tx On)**. This indicates that the External Clock is selected by either the TxClock or RxClock, but the clock rate on **J8 | EXT REF** does not meet the rate expected by the CDM-760.
- **Valid for ASI PIICs only:** Use the **Tx Frame Lock** drop-down list to select **Alarm, Fault, Mask** or **Fault (Tx On)**.

7.4.4.3.3 Configuration | ARP (Address Resolution Protocol)

This page is accessible only to Admin users when the optional High-Speed Packet Processor card is <u>installed and enabled</u>. See Sect. 7.4.3.1 for information about using conditional access pages.

Use this page to configure the modem's **P0 | MGMT** port ARP (Address Resolution Protocol) parameters.

ARP is a way of associating a MAC address with an IP address for all devices that are active on a broadcast domain. The modem can associate these addresses dynamically (by listening to ARP responses) or statically (by hard-coding the IP/MAC Address association).

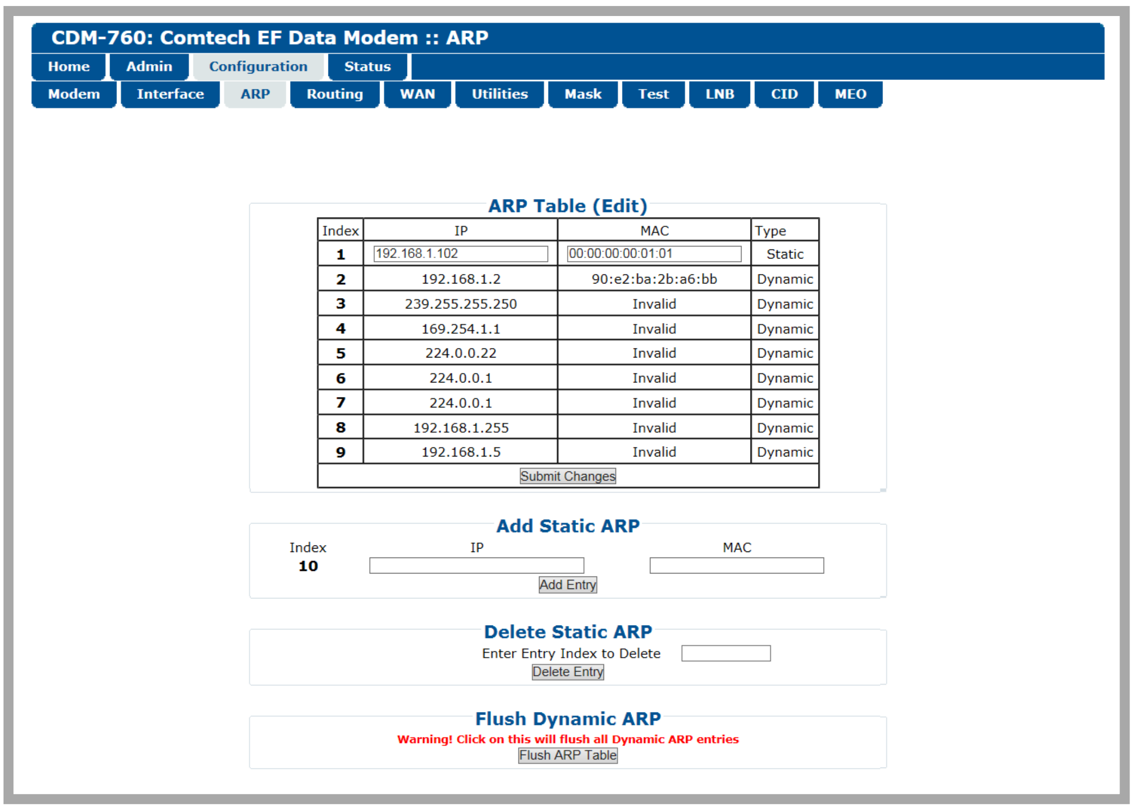


Figure 7-14. Configuration | ARP Page

ARP Table (Edit)

The ARP Table contains all known associations – it displays all current Static and Dynamic ARP entries, and allows you to directly edit the current Static ARP entries when more than one ARP entry exists. Note the following:

Column	Description
Index	This is the *read-only* internal table index number. It is automatically assigned.
IP	IP Address, in the format XXX.XXX.XXX.XXX.
MAC	MAC Address, in the format YY:YY:YY:YY:YY:YY.
Type	This *read-only* column displays the entry type as Static or Dynamic.

Click **[Submit Changes]** to save.

Add Static ARP

This section allows you to directly add a static ARP entry should you choose to hard-code an association of an IP address to a particular MAC address. Note that the index automatically increments to the next available number.

Column	Description
Index	This is the *read-only* internal table index number. It is automatically assigned.
IP	Enter a valid IP Address in the format XXX.XXX.XXX.XXX.
MAC	Enter a valid MAC-48 Address in the format YY:YY:YY:YY:YY:YY.

Click **[Add Entry]** to save.

Delete Static ARP

If a static ARP entry (created using **Add Static ARP**) is no longer required, **Enter Entry Index to Delete** and click **[Delete Entry]** to execute removal of that entry.

Flush Dynamic ARPs

You may use this function if there is a conflict on the network and/or MAC addresses are now associated with new and different IP addresses.

Click **[Flush ARP Table]** to delete all dynamically learned ARP entries.

7.4.4.3.4 Configuration | Routing Pages

1) **The Routes, DHCP, and DNS pages are accessible only to Admin users when the optional High-Speed Packet Processor card is installed and enabled. See Sect. 7.4.3.1 for information about using these conditional access pages.**
2) **At present, only Point-to-Point Routing is allowed on the CDM-760. Point-to-Multipoint Routing will be enabled on future releases.**

Click the **Routing** primary page tab, and the select the **Routes**, **DHCP**, or **DNS** tab to continue.

7.4.4.3.4.1 Configuration | Routing | Routes

Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR Sect. F.3.1.1.1 Static Route Configuration

Use this page to enter static routes into the Packet Processor to route IP traffic over the satellite or to another device on the local LAN.

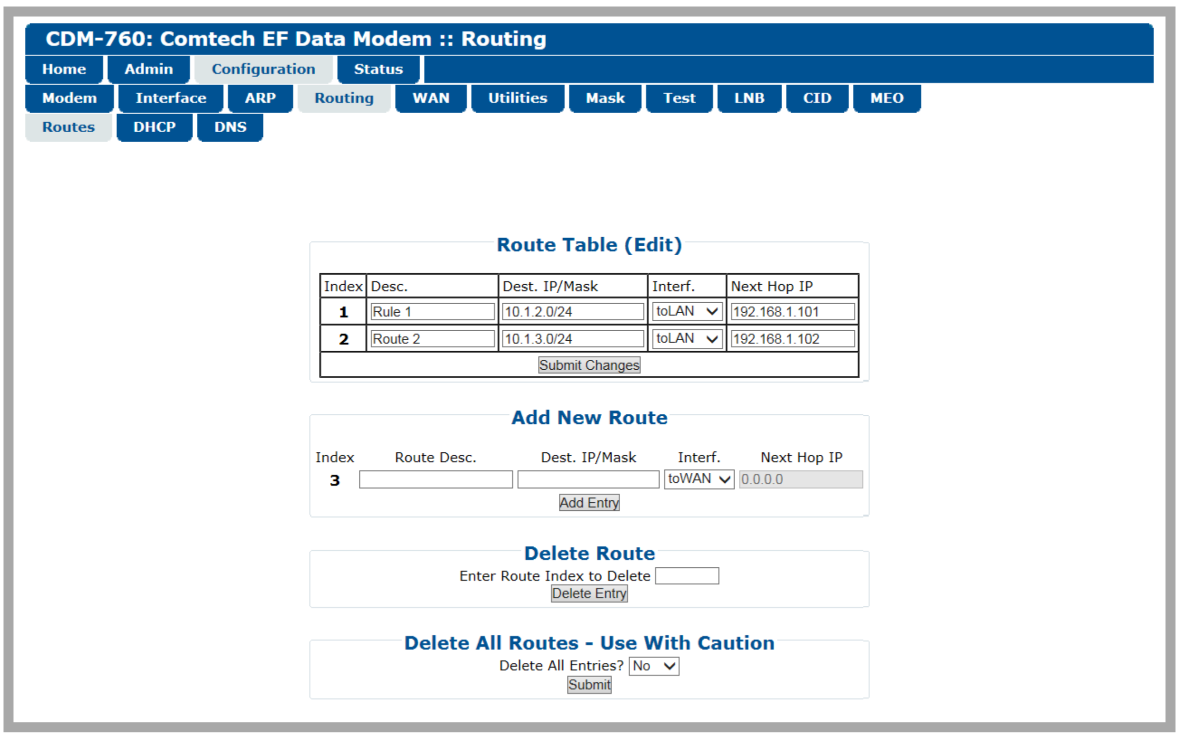


Figure 7-15. Configuration | Routing | Routes Page

Add New Route

Use the available text boxes and drop-down lists in this section to create (add) a *new* route. Note the following (from left to right):

Column	Description
Index	This is the *read-only* internal table index. It is automatically assigned.
(Route) Desc.	This label helps to maintain the network. Enter a unique label consisting of up to 20 characters in this text box.
Dest.IP/Mask	Enter a Destination IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.
Interf.	Use the drop-down list to select the Interface as toWAN or toLAN.
Next HOP IP	Enter the desired Next Hop IP Address for toLAN routes. Note that no Next Hop entry is needed for toWAN routes.

Click **[Add Entry]** to execute addition of the new route to the Route Table. Upon entry, the Route Table index automatically increments to the next available number.

Route Table (Edit)

Use the available text boxes and drop-down lists in this section to make changes to an *existing* route. See “**Add New Route**” for detailed descriptions of each routing feature.

Click **[Submit Changes]** to save.

Delete Route

Enter Route Index to Delete, and then click **[Delete Entry]** to execute removal of that route from the route table.

Delete All Routes (USE WITH CAUTION)

Use the drop-down list to select **Yes** or **No** for **Delete All Entries?** Click **[Submit]** to execute removal of **all** entries from the route table.

7.4.4.3.4.2 Configuration | Routing | DHCP

Use this page to configure the modem's **P0 | MGMT** port DHCP (Dynamic Host Configuration Protocol) Relay feature.

DHCP allows a device to be configured automatically – eliminating the need for intervention by a network administrator – and provides a server located at the hub for keeping track of devices that are connected to the network. This prevents two devices from accidentally being configured with the same IP Address.

The CDM-760 DHCP Relay feature allows you to deploy a single DHCP server at the hub that manages all of the devices throughout your remote networks. When a device on the CDM-760's network issues a DHCP request, it is relayed to the DHCP server as specified by the "DHCP Server IP Address". The DHCP response is then sent directly to the requesting device.

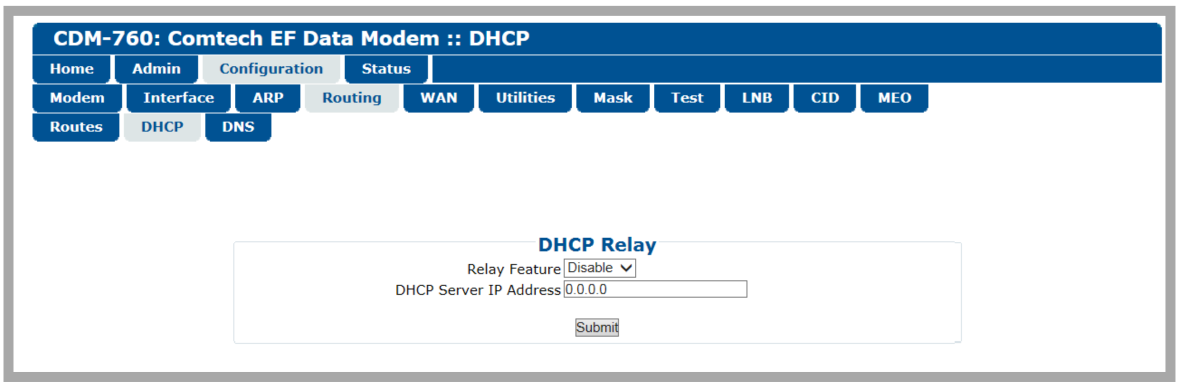


Figure 7-16. Configuration | Routing | DHCP Page

DHCP Relay

- **Relay Feature** – Use the drop-down list to **Disable** or **Enable** the DHCP Relay Feature.
- **DHCP Server IP Address** – Enter the IP Address to be used for the DHCP server at the hub in the form XXX.XXX.XXX.XXX.

Click **[Submit]** to save.

7.4.4.3.4.3 Configuration | Routing | DNS

Use this page to manage DNS (Domain Name System) caching.

DNS caching at the remote site modem makes that modem fast-accessible to recently visited web sites by storing the IP Address-to-URL map at the remote modem.

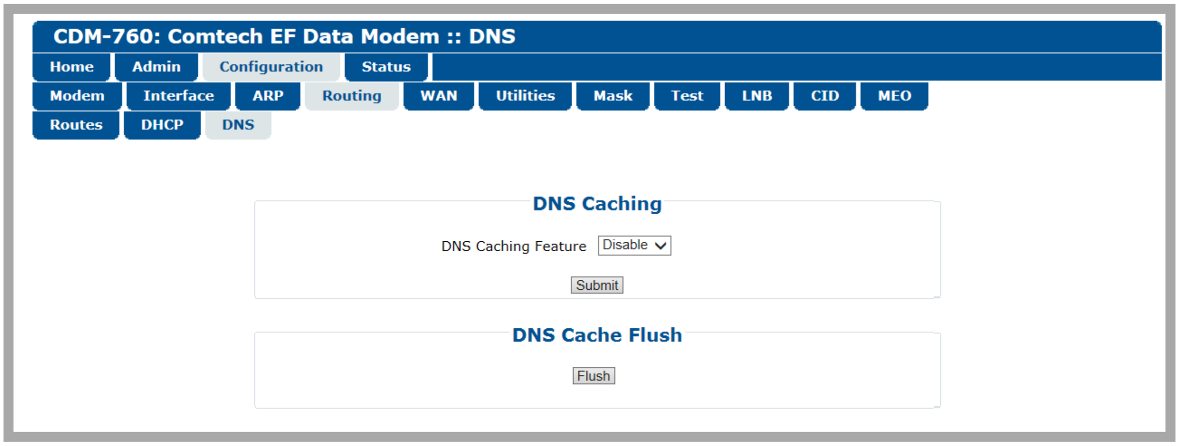


Figure 7-17. Configuration | Routing | DNS Page

DNS Caching

Use the drop-down list to set DNS as **Enabled** or **Disabled**. Click **[Submit]** to save.

DNS Cache Flush

Click **[Flush]** to clear the DNS Cache of all data.

7.4.4.3.5 Configuration | WAN Pages

1) **The nested QoS and Compression pages are accessible only to Admin users when the optional High-Speed Packet Processor card is <u>installed and enabled</u>. See Sect. 7.4.3.1 for information about using conditional access pages.**
2) **The Encryption page is non-functional in this firmware release.**

Click the **WAN** primary page tab, and then select the **QoS** or **Header Compression** tab to continue.

7.4.4.3.5.1 Configuration | WAN | QoS Page

Use the **QoS Mode** drop-down list to select **Off**, **Max/Priority**, **Min Max**, or **DiffServ**:

- When you use the QoS Mode drop-down list to select **Off**, and then click **[Submit]**, QoS is *disabled*. In place of a 'populated' page, the page appears as follows:

When the QoS is set to "Off" there is no traffic shaping or filtering. All data coming into the modem will be sent to the WAN as it is received, in the order it was received, for so long as the WAN can support the packet/frame and data rate of the incoming traffic. If there is not enough WAN capacity to support the incoming traffic, packets or frames are tail-dropped as they overflow the internal buffer.

- When you **enable** QoS with any mode *other than* **Off** and click **[Submit]**, the appearance of this page changes depending on the active QoS Mode:
  - **Max/Priority** Mode or **Min/Max** Mode (see **Figure 7-18**).
  - **DiffServ** Mode (see **Figure 7-19**).

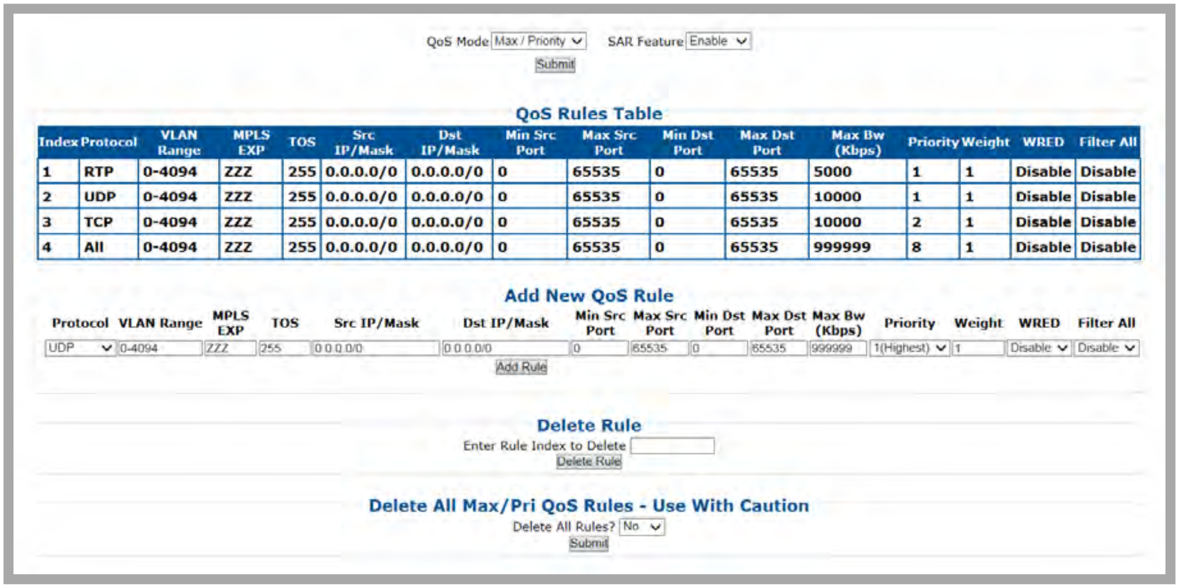
SAR Feature

This function is identical for the 'Max/Priority,' 'Min/Max,' and 'DiffServ' QoS modes.

SAR (Packet Segmentation and Reassembly) is an adaptive process; it triggers only if the packet latency exceeds the threshold value (default to 20 msec). SAR is needed, when running low-speed (<700 kbps) links, to keep latency and jitter within specifications (20 msec latency/10 msec jitter) when the lower priority queue contains large-size packets.

Use the drop-down list to **Disable** or **Enable** SAR. Click **[Submit]** to save.

7.4.4.3.5.1.1 Configuration | WAN | QoS Page – Max/Priority, Min/Max Modes



(TOP) QoS Mode = Max/Priority (Banner and Menu Bar not shown)
(BOTTOM) QoS Mode = Min/Max (Banner and Menu Bar not shown)

Figure 7-18. Configuration | WAN | QoS Page (Max/Priority, Min/Max Modes)

See Sect. 7.4.4.3.5.1 for information about the QoS Mode and SAR functions.

Add New QoS Rule

In 'Max/Priority' QoS Mode:

In 'Min/Max' QoS Mode:

Use the available text boxes and drop-down lists in this section to create a *new* QoS rule. Note the following (from left to right):

Column	Description
Protocol	Use the drop-down list to select the Protocol as UDP, TCP, ICMP, RTP, VOICE, VIDEO, RTPS, FTP, HTTP, TELNET, SMTP, SNMP, All-IP, Non-IP, or All.
VLAN Range	Enter a single VLAN ID (2012) or a range of VLAN IDs (2000-2012).
MPLS EXP	Enter an MPLS (Multi-Protocol Label Switching) experimental bit label as follows: • Enter an explicit MPLS match. For example, "101" triggers true only for an EXP bit sequence of "101". • Enter wildcard character "Z". For example, "10Z" triggers true if either "101" or "100" appears in the EXP bits of the MPLS label.
TOS	Type Of Service bits include a six-bit Differentiated Services Code Point (DSCP) and a two-bit Explicit Congestion Notification (ECN) field: • Enter an explicit Code Point match. • Enter the wildcard entry of 255 so that all values trigger true.
Src IP/Mask	Enter a Source IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.
Dst IP/Mask	Enter a Destination IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.
Min/Max Src Port	**You should specify the Min / Max Source / Destination Ports only if you are aware of the port usage of the desired protocol or application.** There are well-known ports for various protocols, but often only the 'command' messaging is transacted on these ports and the 'data' is transferred through a negotiated port.
Min/Max Dst Port	
Min BW (Kbps)	(**"Min/Max" mode only**) Assign a value to limit the flow to this minimum utilized bandwidth; otherwise, you may select the default of no bandwidth restriction.
Max BW (Kbps)	Assign a value to limit the flow to this maximum utilized bandwidth; otherwise, you may select the default of no bandwidth restriction.
Priority	(**"Max/Priority" mode only**) Use the drop-down list to assign a Priority Level from 1 to 8 for each flow: • The IP Module classifies each packet that is to be forwarded over the satellite; the packet then has a Priority assigned according to the defined QoS Rules; • Any latency critical traffic such as VoIP/RTP should always be assigned Priority 1; • Priority 1 packets are forwarded immediately; Priority 2 packets are forwarded as soon as there are no Priority 1 packets in the Queue; and so on; • Any packet that does not meet a QoS Rule is assigned to the Default Rule and is assigned a Priority of 9.

Column	Description
Weight	Enter a weight from 1 to 100. Weighting is used either to drain traffic having the same Priority Level ("Max/Priority" mode) or to drain after the minimum bandwidth is met ("Min/Max" mode). Appendix K. QUALITY OF SERVICE (QoS)
WRED	Use the drop-down list to **Disable** or **Enable** WRED (Weighted Random Early Detection).
Filter All	QoS allows flows to be 'filtered' on a per-rule basis so the Packet Processor discards traffic that you do not want to forward over a satellite link. Use the drop-down list to **Disable** or **Enable** filtering.

For either QoS Mode, click **[Add Rule]** to execute addition of the new rule to the QoS Rules Table. Upon entry, the QoS Rules Table index automatically increments to the next available number.

QoS Rules Table (*read-only*)

In 'Max/Priority' QoS Mode:

QoS Rules Table

Index	Protocol	VLAN Range	MPLS EXP	TOS	Src IP/Mask	Dst IP/Mask	Min Src Port	Max Src Port	Min Dst Port	Max Dst Port	Max Bw (Kbps)	Priority	Weight	WRED	Filter All
1	RTP	0-4094	ZZZ	255	0.0.0.0/0	0.0.0.0/0	0	65535	0	65535	5000	1	1	Disable	Disable
2	UDP	0-4094	ZZZ	255	0.0.0.0/0	0.0.0.0/0	0	65535	0	65535	10000	1	1	Disable	Disable
3	TCP	0-4094	ZZZ	255	0.0.0.0/0	0.0.0.0/0	0	65535	0	65535	10000	2	1	Disable	Disable
4	All	0-4094	ZZZ	255	0.0.0.0/0	0.0.0.0/0	0	65535	0	65535	999999	8	1	Disable	Disable

In 'Min/Max' QoS Mode:

QoS Rules Table

Index	Protocol	VLAN Range	MPLS EXP	TOS	Src IP/Mask	Dst IP/Mask	Min Src Port	Max Src Port	Min Dst Port	Max Dst Port	Min Bw (Kbps)	Max Bw (Kbps)	Weight	WRED	Filter
1	All	0-4094	ZZZ	255	0.0.0.0/0	0.0.0.0/0	0	65535	0	65535	0	999999	1	Disable	Disable

This *read-only* table displays all *existing* QoS Rules. Typical for each rule (see "**Add New QoS Rule**" for detailed descriptions for each item), from left to right:

Column	Description
Index	This is the *read-only*, automatically assigned internal table index number.
Protocol	Displays the assigned protocol for the rule.
VLAN Range	Displays the assigned VLAN ID – either a single VLAN ID (2012) or a range of VLAN IDs (2000-2012).
MPLS EXP	Displays the assigned MPLS (Multi-Protocol Label Switching) experimental bit value (explicit or wildcard).
TOS	Displays the assigned Type of Service bits.
Src IP/Mask	Displays the assigned permitted Source IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.
Dst IP/Mask	Displays the assigned permitted Destination IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.
Min Src Port	Displays the assigned minimum permitted Source Port.
Max Src Port	Displays the assigned maximum permitted Source Port.
Min Dst Port	Displays the assigned minimum permitted Destination Port.
Max Dst Port	Displays the assigned maximum permitted Destination Port.
Min BW (Kbps)	(**"Min/Max" mode only**) Displays the assigned minimum permitted Bandwidth value.

Column	Description
Max BW (Kbps)	Displays the assigned maximum permitted Bandwidth value.
Priority	(“Max/Priority” mode only) Displays the assigned established priority (1 being the highest and 8 being the lowest).
WRED	Displays the WRED (Weighted Random Early Detection) setting as Disable or Enable.
Weight	Displays the assigned weighting value, from 1 to 100.
Filter All	Displays the flow filter setting as Disable or Enable.

Delete Rule

This section is identical for both the “Max/Priority” and “Min/Max” QoS modes.

Enter Rule Index to Delete, and then click **[Delete Rule]** to execute deletion of the specified rule from the QoS Rules Table.

Delete All (Max/Pri, Min/Max) QoS Rules (USE WITH CAUTION)

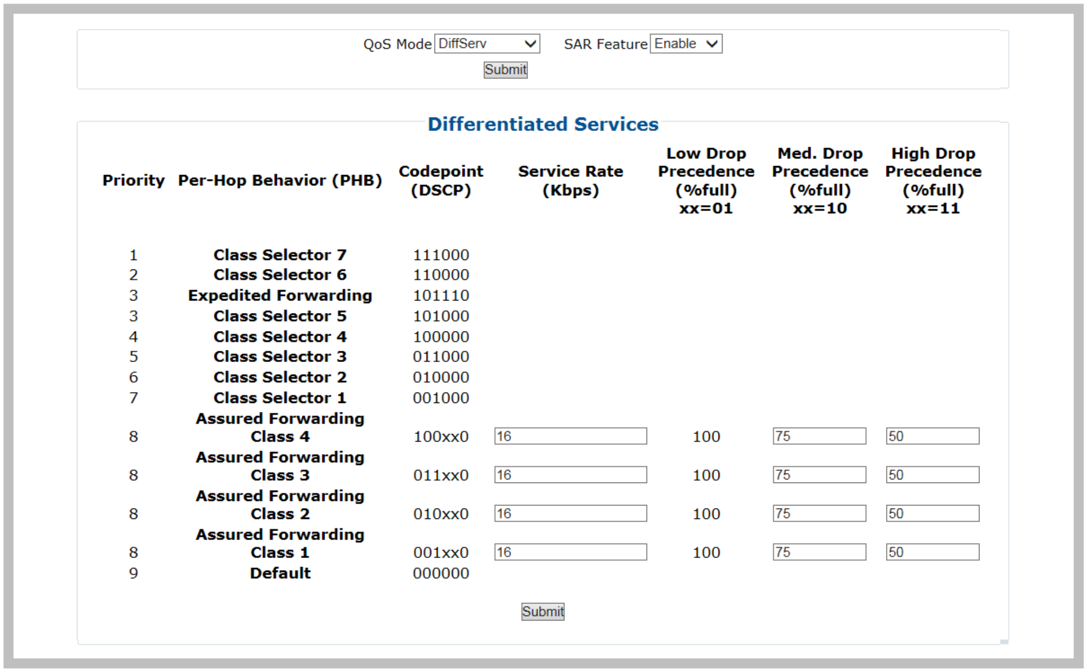
In ‘Max/Priority’ QoS Mode:

In ‘Min/Max’ QoS Mode:

For either QoS Mode*,* use the drop-down list to select **Yes**, and then click **[Submit]** to execute deletion of **all rules** from the QoS Rules Table.

7.4.4.3.5.1.2 Configuration | WAN | QoS Page – DiffServ Mode

QoS can be set to DiffServ Mode to make it fully compliant to the Differentiated Services QoS RFC (Request For Comments) standards.



QoS Mode DiffServ SAR Feature Enable
Submit

Differentiated Services

Priority	Per-Hop Behavior (PHB)	Codepoint (DSCP)	Service Rate (Kbps)	Low Drop Precedence (%full) xx=01	Med. Drop Precedence (%full) xx=10	High Drop Precedence (%full) xx=11
1	Class Selector 7	111000				
2	Class Selector 6	110000				
3	Expedited Forwarding	101110				
3	Class Selector 5	101000				
4	Class Selector 4	100000				
5	Class Selector 3	011000				
6	Class Selector 2	010000				
7	Class Selector 1	001000				
8	Assured Forwarding Class 4	100xx0	16	100	75	50
8	Assured Forwarding Class 3	011xx0	16	100	75	50
8	Assured Forwarding Class 2	010xx0	16	100	75	50
8	Assured Forwarding Class 1	001xx0	16	100	75	50
9	Default	000000				

Submit

(Banner and Menu Bar not shown)

Figure 7-19. Configuration | WAN | QoS Page (DiffServ Mode)

See Sect. 7.4.4.3.5.1 for information about the QoS Mode and SAR functions.

Differentiated Services

You have the option of configuring attributes for each queue (the acceptable ranges are shown in brackets). Note the following (from left to right):

Column	Description
Priority	IP traffic is prioritized based upon the DSCP (DiffServ Code Points) Class Selector Precedence.
Per-Hop Behavior (PHB)	This is the traffic class that determines how packets will be forwarded.
Codepoint (DSCP)	This is the Codepoint value in the Type of Service (ToS) byte of the IP header.
Service Rate (kbps)	[-0.000 / (Tx Data Rate)] The minimum bandwidth is served first among the Assured Forwarding (ASFD) classes in case of bandwidth availability, once Class Selector 7 through Class Selected 1 have been serviced.
Drop Precedences	ASFD Class 4 through 1 Code Points (b100xx0, b011xx0, b010xx0, and b001xx0) carry the drop precedence value (xx). In case of network congestion, a Weighted Random Early Detection (WRED) congestion avoidance algorithm is imposed on these queues to drop the packets randomly rather than 'tail drop.' The ASFD classes all take Priority 8 instead of their corresponding class priorities (i.e., 1 through 4) to provide "Service Rate (kbps)" among all ASFD classes.

Column	Description
Drop Precedences (cont.)	• **Low Drop Precedence (% full) [0–100]** – In case of congestion, the WRED is applied after the queue depth exceeds the configured percentage value assigned for the Drop Precedence value b001. • **Med. Drop Precedence (% full) [0–99]** – In case of congestion, the WRED is applied after the queue depth exceeds the configured percentage value assigned for the Drop Precedence value b010. • **High Drop Precedence (% full)) [0–99]** – In case of congestion, the WRED is applied after the queue depth exceeds the configured percentage value assigned for the Drop Precedence value b011. Make sure that: High Drop Precedence value < Med. Drop value < Low Drop value.

Click **[Submit]** to save.

7.4.4.3.5.2 Configuration | WAN | Header Compression

Use this page to configure optional Header and Payload Compression when this FAST feature is **activated** and the optional High-Speed Packet Processor is **installed and enabled**.

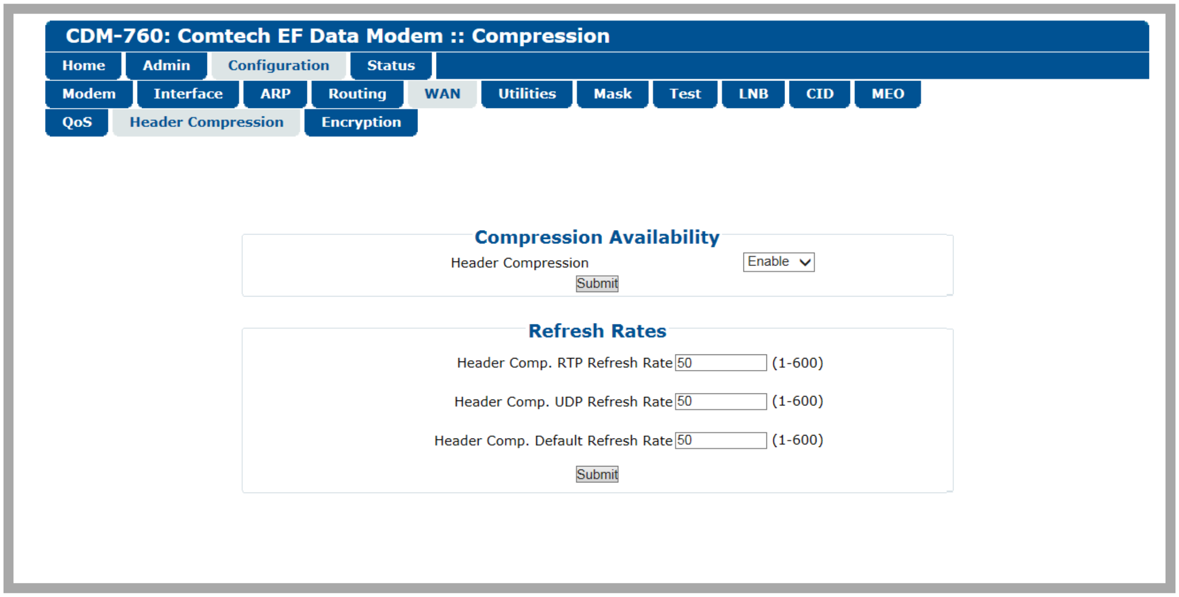


Figure 7-20. Configuration | WAN | Header Compression Page

Compression Availability

Use the **Header Compression** drop-down list to select **Enable** or **Disable**.

Click **[Submit]** to save.

Refresh Rates

Enter a refresh rate time, from **1** to **600** seconds, for each item. Note the following:

Term	Description
RTP	Real Time Protocol
UDP	User Datagram Protocol

Click **[Submit]** to save.

7.4.4.3.5.3 Configuration | WAN | Encryption (FUTURE)

Encryption is not available in this firmware release.

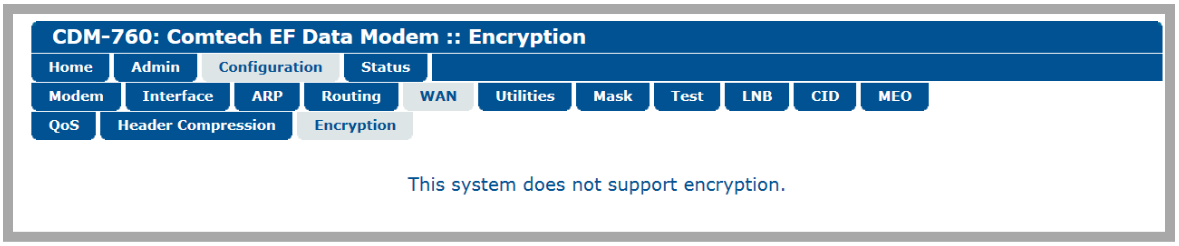


Figure 7-21. Configuration | WAN | Encryption Page (Not Available)

7.4.4.3.6 Configuration | Utilities

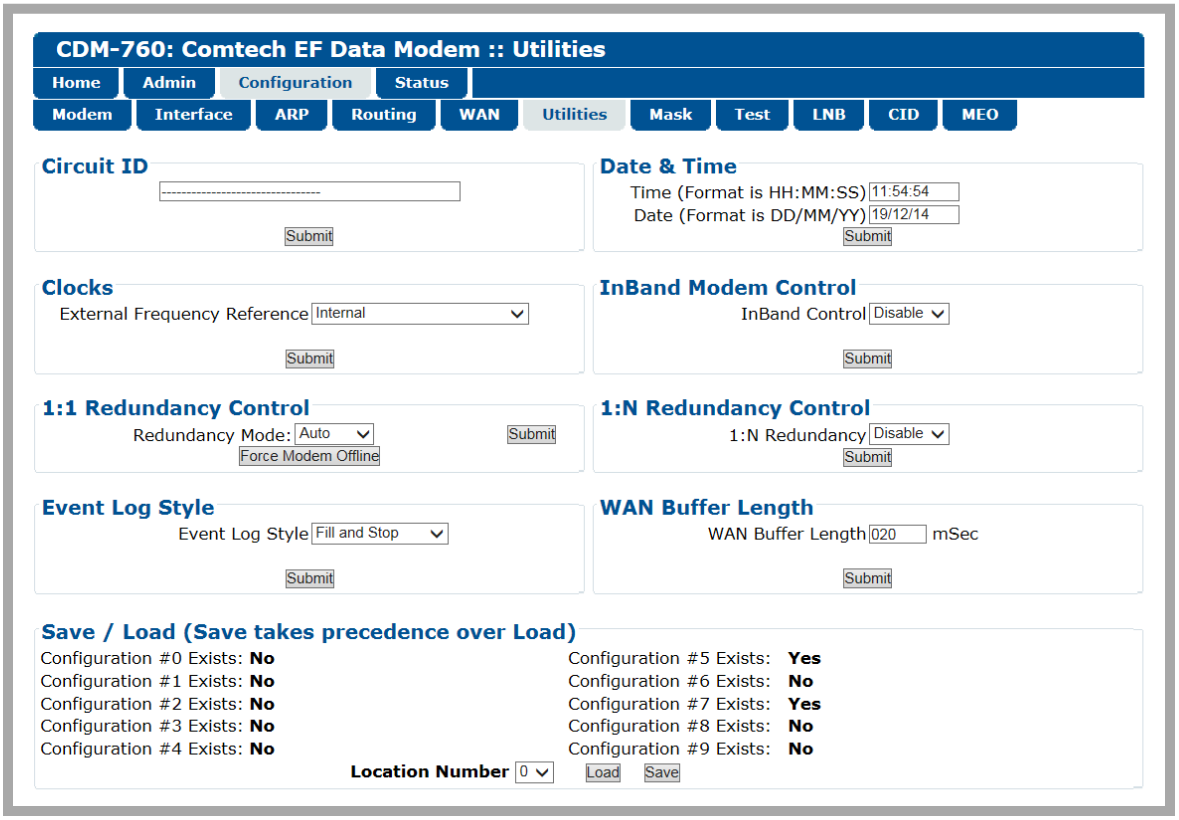


Figure 7-22. Configuration | Utilities Page

Use the available text boxes and drop-down lists to configure your settings as needed. Click **[Submit]** as applicable to save.

Unless otherwise noted – see Chapter 6. FRONT PANEL OPERATION for detailed information about the configuration parameters available on this page:

Operational Feature / Section	Chapter 6 Section Reference
Circuit ID	6.2.6.7 (Utility:) Circuit ID
Date & Time	6.2.6.1 (Utility:) Set-RTC
Clocks	6.2.2.10.1 (CONFIG: Ref) Modem Reference
InBand Modem Control	6.2.2.7.2 (CONFIG: Remote) InBand
1:1 Redundancy Control	6.2.6.5 (Utility:) 1:1
1:N Redundancy Control	6.2.6.6 (Utility:) 1:N
Event Log Style	6.2.3.2.1 (Monitor: Stored-Events) Event ### Use the drop-down list to set the Event Log Style as Fill and Stop or Fill and Rollover.
WAN Buffer Length	6.2.2.2.6 (CONFIG: Tx) WANBuff
Save / Load	6.2.5 SELECT: Store/Ld (Store/Load)

7.4.4.3.7 Configuration | Mask

Use this page to set a mask type for each system-level event.

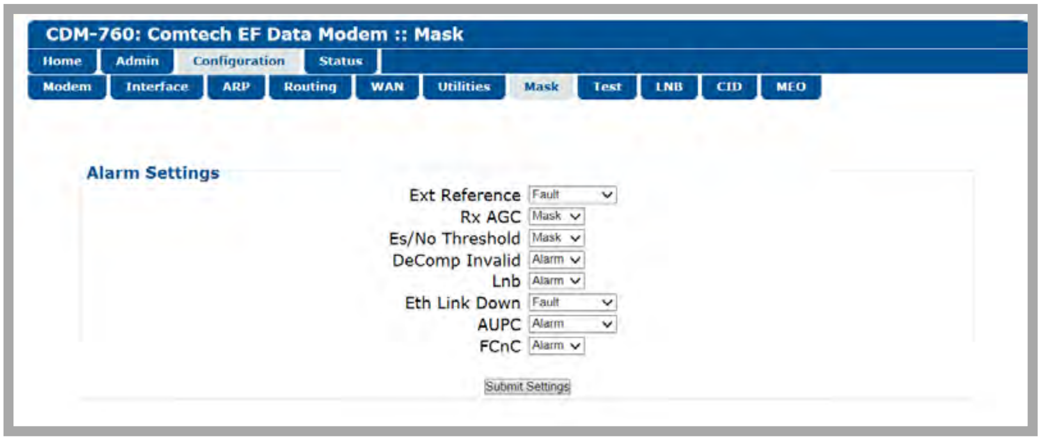


Figure 7-23. Configuration | Mask Page

Alarm Settings

Use the drop-down list for each item to select **Alarm**, **Fault**, **Mask**, or, where applicable, **Fault-Tx On**.

Modem behaviors reflect the set mask state:

Selection (Mask)	Event Description	Available Mask State			
		A	F	M	F/T
Ext Reference	Occurs when an external reference is the clock for the modem's TX, but the external reference does not meet the expected clock rate.	X	X	X	
RxAGC	Occurs when the Receive Automatic Gain Control cannot compensate for the carrier power level because the carrier has too little or too much power.	X	X	X	
Es/No Threshold	Occurs when the Receive Es/No is at or below the Receive Es/No Alarm point	X	X	X	
DeComp Invalid	Occurs when packets are received by the demodulator and its decompression setting does not match the compression setting for the far side modulator.	X	X	X	
LNB	Occurs when the high or low current limits for the Low Noise Block Down Converter have been met.	X	X	X	
Eth Link Down	Occurs when an Ethernet Interface is selected using the CONFIG: Intf menu (Chapter 6 FRONT PANEL OPERATION Sect. 6.2.2.4) as the active interface, but an Ethernet cable with Ethernet traffic has not been detected on this physical port.	X	X	X	X
AUPC	Occurs when the Tx output power has reached the Nominal + Range sum (upper limit) and the modem can no longer increase its Tx output power, but the remote reported Es/No is still lower than the Target Es/No.	X		X	X

Selection (Mask)	Event Description	Available Mask State			
		A	F	M	F/T
FCnC	Fractional Carrier-in-Carrier is common in 1:1 or 1:N redundancy systems where the primary modem is running fully operational (i.e., FAST-activated) CnC, and the backup modem(s) uses FAST-activated Fractional CnC. When Fractional CnC is enabled, the modem generates an internal fault and logs an event every 12 hours. A fault causes the normally-online modem to revert to online if all faults are cleared. This is used to prevent a Fractional CnC modem from draining all its fractional time if the normally-online full CnC modem is no longer faulted. Masking this fault prevents the Fractional CnC unit from forcing a 12-hour fault.	X	X	X	

Note the following:

Mask State	Front Panel LED 'UNIT STATUS' Color	Modem Fault State	Front Panel Visible VFD Location
Alarm	Amber	None	Monitor: Live Alarms menu
Fault	Red	Rear panel **J1 | ALARM** connector	Monitor: Stored-Events log
Mask	None	None	None: A masked event is not logged and is not seen on any front panel screen.
Fault-Tx On	Red	Rear panel **J1 | ALARM** connector	Monitor: Stored-Events log

Click **[Submit Settings]** to save.

7.4.4.3.8 Configuration | Test

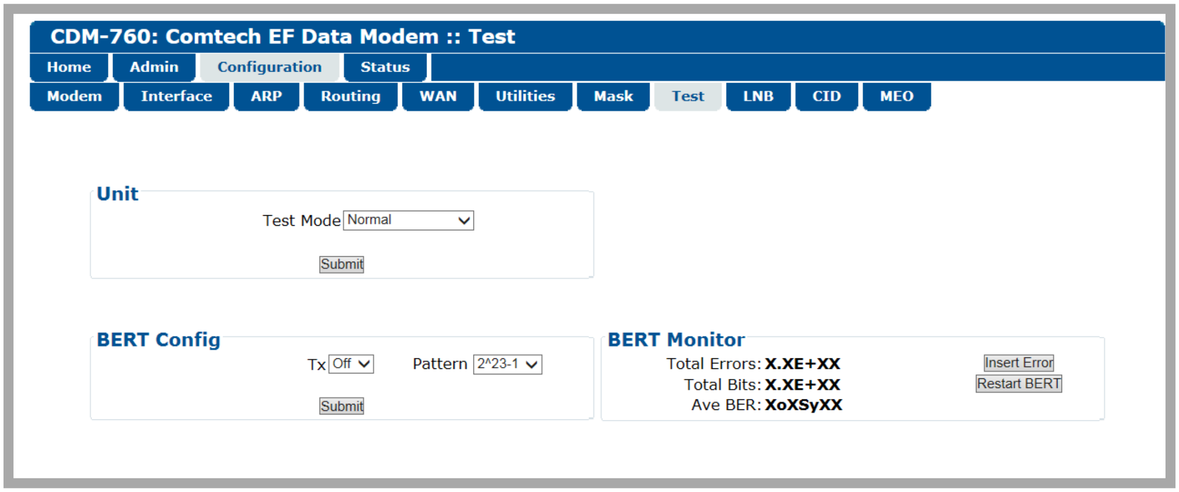


Figure 7-24. Configuration | Test Page

See Chapter 6. FRONT PANEL OPERATION for detailed information about the Bit Error Rate Test (BERT) configuration and operation parameter controls provided on this page:

Web Page Section	Chapter 6 Section Reference
Unit	6.2.4.1 (TEST:) Mode
BERT Config	6.2.4.2 (TEST:) BERT → Off/On, → Patt
BERT Monitor	6.2.4.2 (TEST:) BERT → ErrIns, → Restart

Unit

Use the drop-down list to select the desired Test Mode.

Click **[Submit**] to save.

BERT Config

Use the drop-down lists to turn the Tx BERT **On** or **Off**, and to set the desired test pattern (when **On**).

Click **[Submit]** to save.

BERT Monitor

Click **[Insert Error]** or **[Restart BERT]** to alter the ongoing BERT.

7.4.4.3.9 Configuration | LNB (Low Noise Block Down Converter)

This page is operational only when an optional LOW-NOISE BLOCK DOWN CONVERTER is installed.

Use this page to configure Low-Noise Block Down Converter parameters. Set the desired LNB configurations. Click **[Submit LNB Controls]** to save.

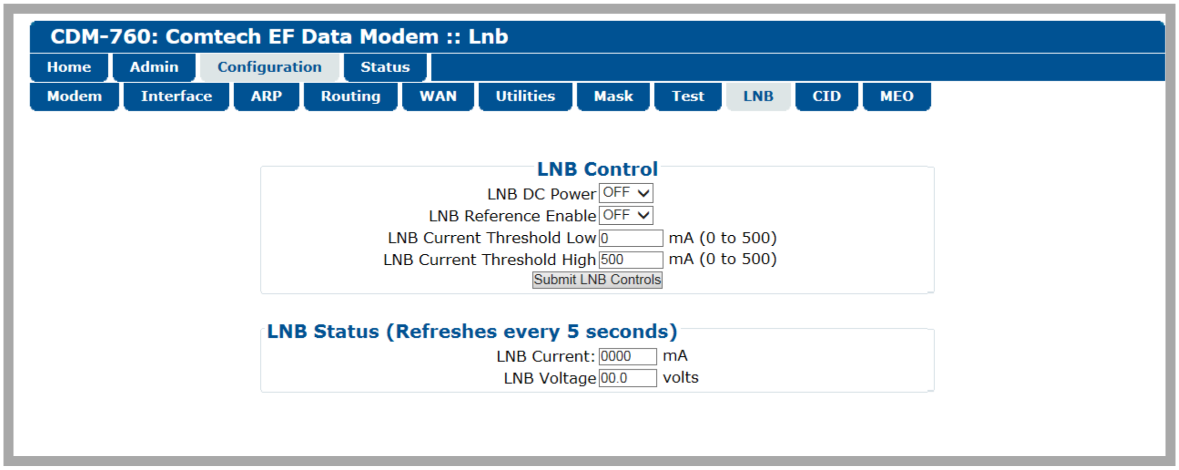


Figure 7-25. Configuration | LNB Page

LNB Control

- Use the **LNB DC Power** drop-down list to select **OFF**, **13V**, **18V**, or **24V**.
- Use the **LNB Reference Enable** drop-down list to select **ON** or **OFF**.
- Enter **LNB Current Threshold Low** and **LNB Current Threshold High** values from **0** to **500** mA.

7.4.4.3.10 Configuration: CID (Carrier ID)

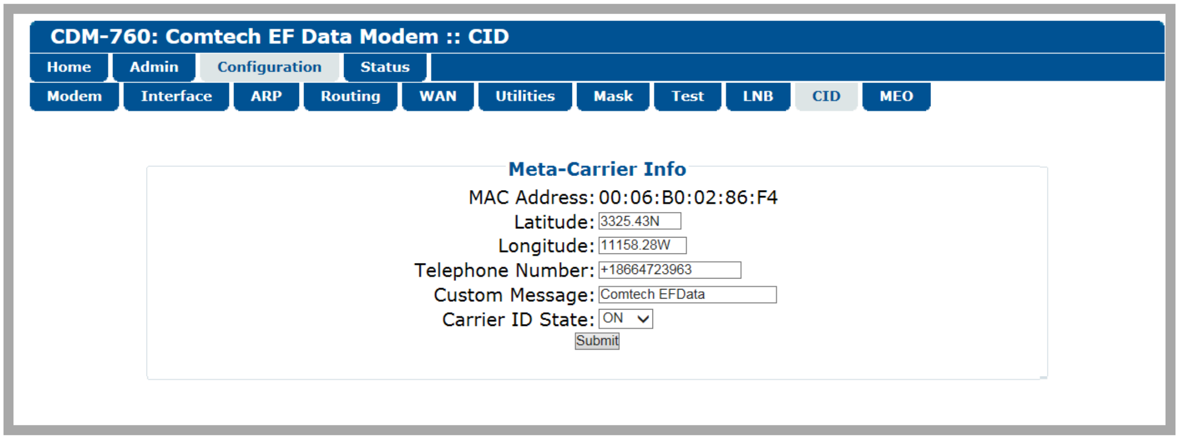


Figure 7-26. Configuration | CID Page

Configure your settings as needed. Click **[Submit]** to save.

Meta-Carrier Info

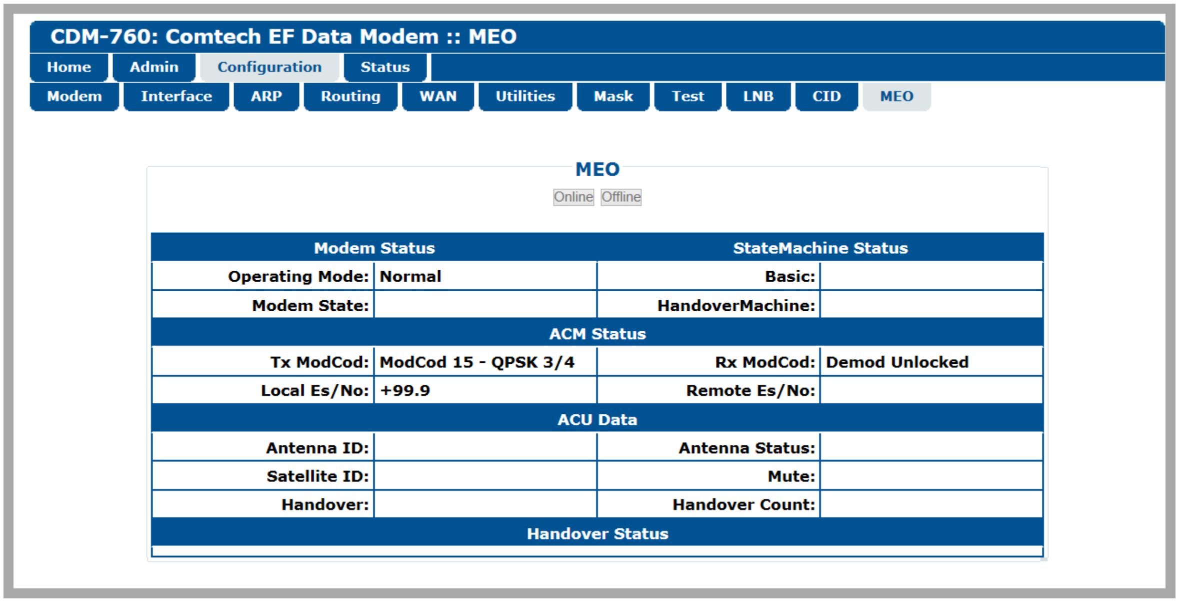
- The *read-only* **MAC Address** for the M&C card on the CDM-760 is displayed here.
- Set the modem's physical location in **Latitude** in the form DDMM.mmC, where:
  - DD = degrees (00 through 90)
  - MM = whole minutes (00 through 60)
  - mm = fractional minutes (0 through 99 (tenths or hundredths))
  - C = compass cardinal point (N = North, S = South)
- Set the modem's physical location in **Longitude** in the form DDDMM.mmC, where:
  - DDD = degrees (000 through 180)
  - MM = whole minutes (00 through 60)
  - mm = fractional minutes (0 through 99 (tenths or hundredths))
  - C = compass cardinal point (E = East, W = West)
- Enter a CID **Telephone Number** to provide a valid emergency contact number to call to resolve operational issues – e.g., in case the modulator's Tx output is causing interference on the satellite. Providing this phone number allows a satellite operator to quickly call the person(s) responsible for correcting any issues.
- Create a **Custom Message** to provide additional information that may be useful in resolving operational issues, e.g., to quickly resolve interference.
- Use the **Carrier ID State** drop-down list to select operation as **On** or **Off**. This setting enables the transmission of CID information by the modem. The default is **On**.

Click **[Submit]** to save your settings.

7.4.4.3.11 Configuration: MEO (Mid-Earth Orbit)

1) You must have a G.703 PIIC plugged into PIIC Slot #1 for any MEO Operational Modes to be accessible. If a G.703 PIIC is not installed in PIIC Slot #1, then this page is nonfunctional.

2) This page is nonfunctional when in Normal (Geostationary) operation (see Chapter 6. FRONT PANEL OPERATION Sect. 6.2.2.1.2 (CONFIG: NetSpec) Operating Mode).



Modem Status		StateMachine Status	
Operating Mode:	Normal	Basic:	
Modem State:		HandoverMachine:	
ACM Status			
Tx ModCod:	ModCod 15 - QPSK 3/4	Rx ModCod:	Demod Unlocked
Local Es/No:	+99.9	Remote Es/No:	
ACU Data			
Antenna ID:		Antenna Status:	
Satellite ID:		Mute:	
Handover:		Handover Count:	
Handover Status			

Figure 7-27. Configuration | MEO Page

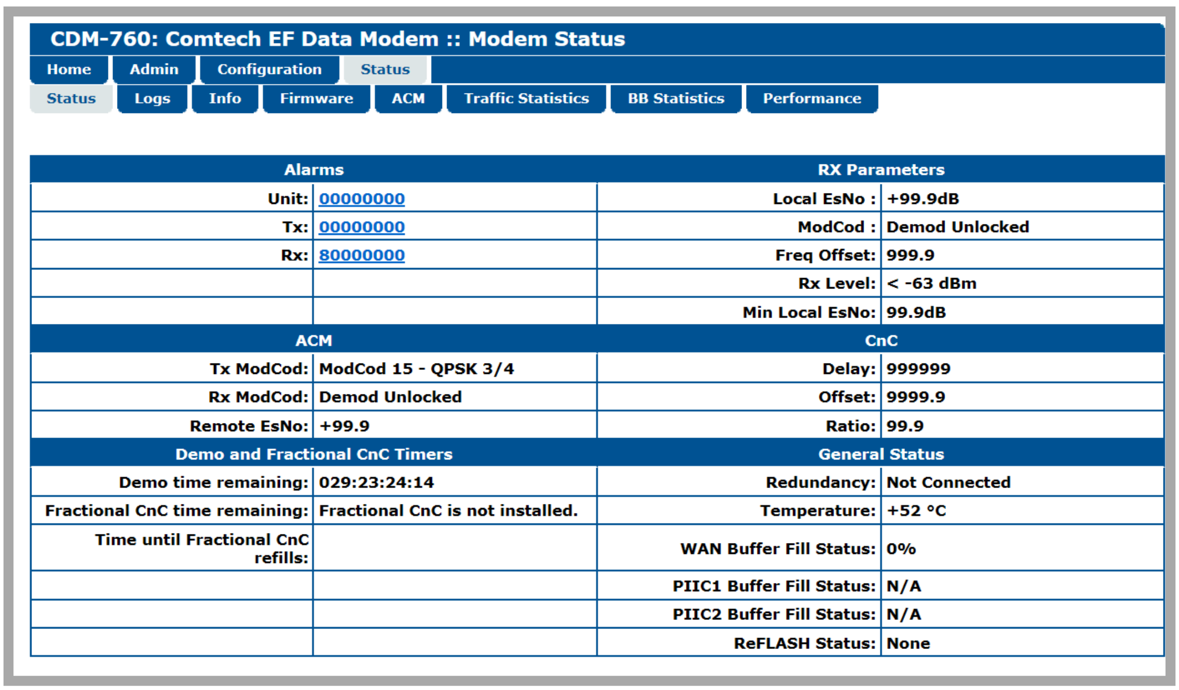
7.4.4.4 Status Pages

The **Status** pages provide you with status, event logging, and operational statistics windows. Click the **Status** navigation tab, and then select the **Status**, **Logs, Info**, **Firmware**, **ACM**, **Traffic Statistics**, **BB Statistics**, or **Performance** tab to continue.

7.4.4.4.1 Status | Status

Use this *read-only* page to review and monitor information pertaining to:

- **Alarms Status** – Click a hyperlink to view a popup window containing detailed information about the most recent logged Unit, Tx, or Rx fault/alarm.
- **Rx Parameters**
- **ACM Status**
- **CnC (Carrier-in-Carrier) information (including Fractional CnC Counters)**
- **Demo Mode and Fractional CnC Timers**
- **General Operating Status (including Redundancy connection and Unit Temperature)**



Alarms		RX Parameters	
Unit:	00000000	Local EsNo :	+99.9dB
Tx:	00000000	ModCod :	Demod Unlocked
Rx:	80000000	Freq Offset:	999.9
		Rx Level:	< -63 dBm
		Min Local EsNo:	99.9dB
ACM		**CnC**	
Tx ModCod:	ModCod 15 - QPSK 3/4	Delay:	999999
Rx ModCod:	Demod Unlocked	Offset:	9999.9
Remote EsNo:	+99.9	Ratio:	99.9
Demo and Fractional CnC Timers		**General Status**	
Demo time remaining:	029:23:24:14	Redundancy:	Not Connected
Fractional CnC time remaining:	Fractional CnC is not installed.	Temperature:	+52 °C
Time until Fractional CnC refills:		WAN Buffer Fill Status:	0%
		PIIC1 Buffer Fill Status:	N/A
		PIIC2 Buffer Fill Status:	N/A
		ReFLASH Status:	None

Figure 7-28. Status | Status Page

7.4.4.4.2 Status | Logs Pages

Click the **Logs** primary page tab, and then select the **Modem Log** or **PP Log** tab to continue.

7.4.4.4.2.1 Status | Logs | Modem Log

Use this page to view logged modem faults and alarms.

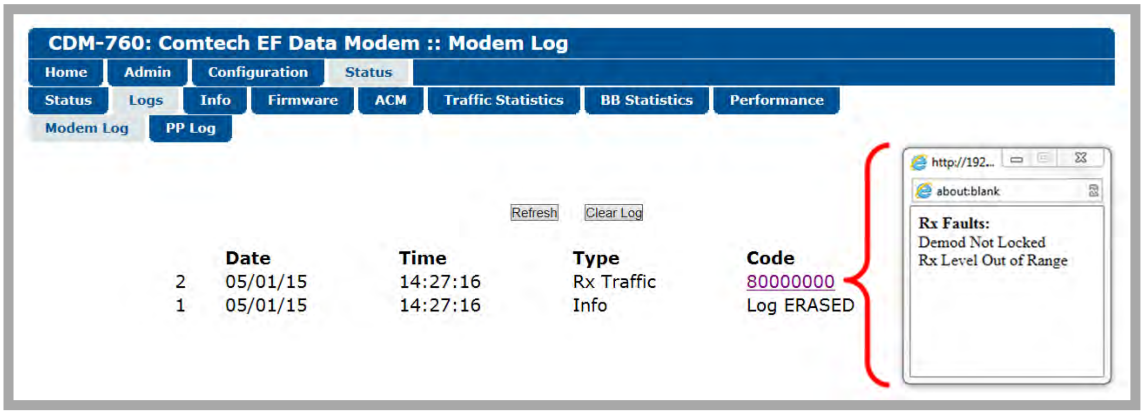


Figure 7-29. Status | Logs | Modem Log Page

- Click **[Refresh]** to update the page with the latest logged faults and alarms.
- Click **[Clear Log]** to clear the log buffer. The table then displays a single event, labeled **Log ERASED**.

This page provides a scrollable table of stored events. This table displays up to 256 events as follows:

Column	Description
(Index Number)	The event is numbered and sorted by occurrence from last to first.
Date	The event date displays here in DD/MM/YY format.
Time	The event time displays here in HH:MM:SS format.
Type	The event type displays here as Unit, Rx Traffic, Tx Traffic, or Info.
Code	This column provides a brief description for the event. When you click an available hyperlink, a popup window opens to provide detailed event information, as per the Figure 7-29 example.

7.4.4.4.2.2 Status | Logs | PP Log

This nested page is accessible only to Admin users when the optional High-Speed Packet Processor card is <u>installed and enabled</u>. See Sect. 7.4.3.1 for information about using conditional access pages.

Use this page to view logged events, faults and alarms attributed to the Packet Processor.

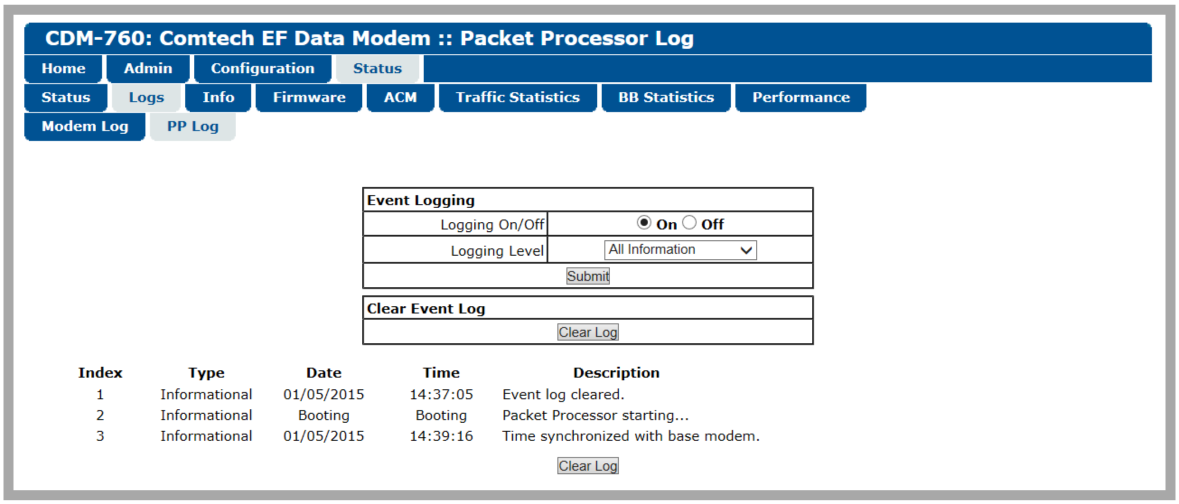


Figure 7-30. Status | Logs | PP Log Page

Event Logging

- **Logging On/Off** – Click **On** or **Off** to enable or disable event logging.
- Use the **Logging Level** drop-down list to select **Errors Only**, **Errors and Warnings**, or **All Information**.

Click **[Submit]** to execute.

Clear Event Log

Click **[Clear Log]** to clear the log buffer and remove all event entries. The table then displays a single event, labeled "**Event log cleared.**"

This page provides a scrollable table of stored events, sorted by occurrence from earliest to latest. This table displays up to 256 events as follows:

Column	Description
Index	The event is sequentially numbered.
Type	The Fault/Alarm Type displays here as Informational, Warning, or Error.
Date	The event date displays here in MM/DD/YY format.
Time	The event time displays here in HH:MM:SS format.
Description	This column provides a brief summary of the event.

7.4.4.4.3 Status | Info

Use this *read-only* page, which updates automatically every 10 seconds, to review identifying information about the modem in its current configuration, including:

- **General Information**
- **Equipment ID**
- The scrollable **Installed Options** window lists the installed hardware and activated FAST Options.
- The scrollable **Options Not Installed** window lists the available but uninstalled hardware and FAST Options.

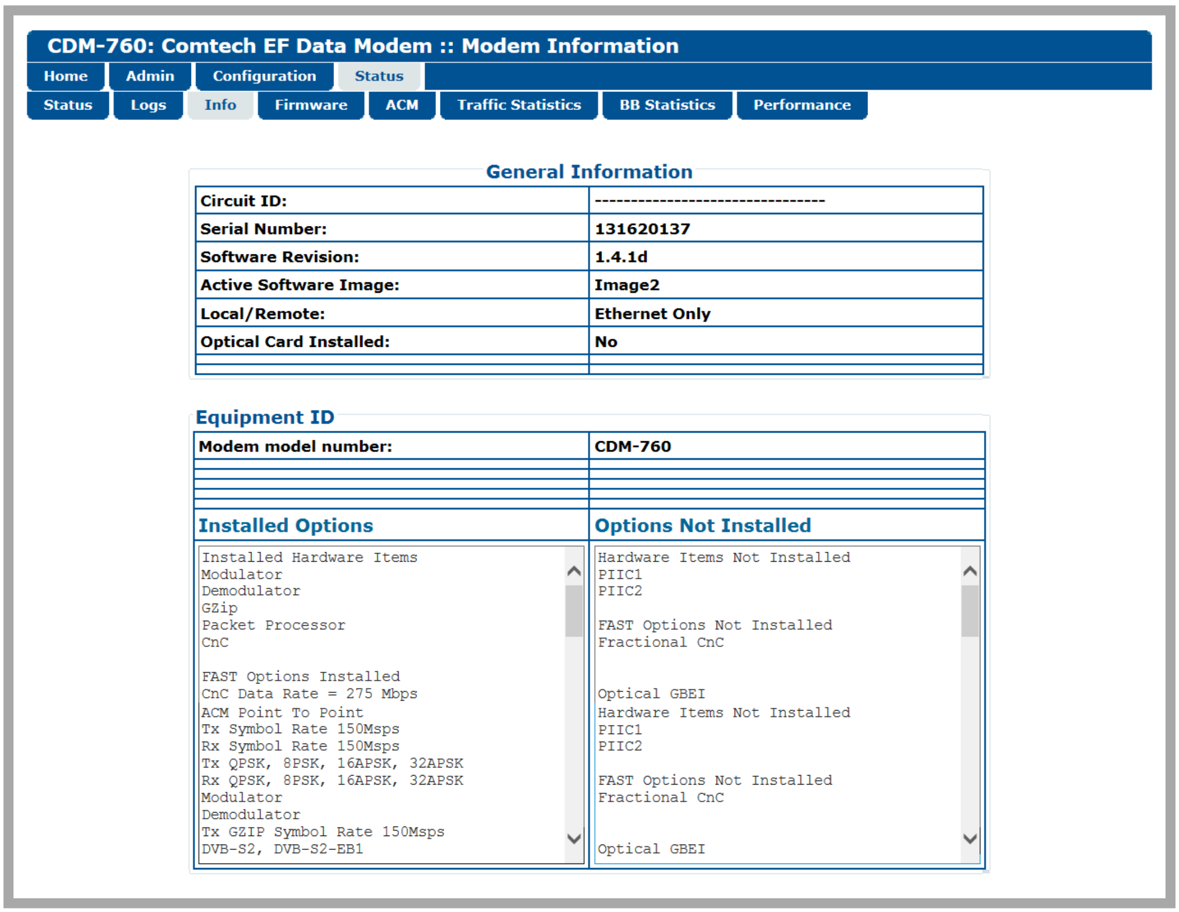


Figure 7-31. Status | Info Page

7.4.4.4.4 Status | Firmware

Use this *read-only* page to review status windows pertaining to the unit's operational firmware loads:

- The **Boot Firmware** section provides information for the currently loaded firmware boot applications.
- The **Firmware Image #1** and **Firmware Image #2** sections provide information for the boot images.

Typical for each entry, '*' indicates the Firmware Revision Letter; '**#.#.#**' is the Firmware Version Number (e.g., 1.7.3); and '**MM/DD/YY**' is the firmware build date.

CDM-760: Comtech EF Data Modem :: Modem Firmware Information

Home | Admin | Configuration | Status

Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance

Boot Firmware			
Boot	FW-0020640*	#.#.#	MM/DD/YY
AppLoader	FW-0020629*	#.#.#	MM/DD/YY
Firmware Image #1			
Bulk	FW-0020627*	#.#.#	MM/DD/YY
App	FW-0020628*	#.#.#	MM/DD/YY
Glue FPGA	FW-0020638*	#.#.#	MM/DD/YY
Terr FPGA	FW-0020639*	#.#.#	MM/DD/YY
MEO Terr FPGA	FW-0020694*	#.#.#	MM/DD/YY
PP Terr FPGA	FW-0020718*	#.#.#	MM/DD/YY
Framer FPGA	FW-0020637*	#.#.#	MM/DD/YY
MEO Framer FPGA	FW-0020693*	#.#.#	MM/DD/YY
PP Framer FPGA	FW-0020717*	#.#.#	MM/DD/YY
Mod FPGA	FW-0020529*	#.#.#	MM/DD/YY
Demod FPGA	FW-0020531*	#.#.#	MM/DD/YY
S2 Decoder FPGA	FW-0020532*	#.#.#	MM/DD/YY
EB1 Decoder FPGA	FW-0020649*	#.#.#	MM/DD/YY
EB2 Decoder FPGA	FW-0020714*	#.#.#	MM/DD/YY
Modem Intf FPGA	FW-0020530*	#.#.#	MM/DD/YY
Modem App	FW-0020641*	#.#.#	MM/DD/YY
CnC FPGA	FW-0000307*	#.#.#	MM/DD/YY
Comp FPGA	FW-0000308*	#.#.#	MM/DD/YY
Decomp FPGA	FW-0000309*	#.#.#	MM/DD/YY
G.703 FPGA	FW-0000372*	#.#.#	MM/DD/YY
OC-3 FPGA	FW-0000468*	#.#.#	MM/DD/YY
Pkt Proc	FW-0020773*	#.#.#	MM/DD/YY
Firmware Image #2			
Bulk	FW-0020627*	#.#.#	MM/DD/YY
App	FW-0020628*	#.#.#	MM/DD/YY
Glue FPGA	FW-0020638*	#.#.#	MM/DD/YY
Terr FPGA	FW-0020639*	#.#.#	MM/DD/YY
MEO Terr FPGA	FW-0020694*	#.#.#	MM/DD/YY
PP Terr FPGA	FW-0020718*	#.#.#	MM/DD/YY
Framer FPGA	FW-0020637*	#.#.#	MM/DD/YY
MEO Framer FPGA	FW-0020693*	#.#.#	MM/DD/YY
PP Framer FPGA	FW-0020717*	#.#.#	MM/DD/YY
Mod FPGA	FW-0020529*	#.#.#	MM/DD/YY
Demod FPGA	FW-0020531*	#.#.#	MM/DD/YY
S2 Decoder FPGA	FW-0020532*	#.#.#	MM/DD/YY
EB1 Decoder FPGA	FW-0020649*	#.#.#	MM/DD/YY
EB2 Decoder FPGA	FW-0020714*	#.#.#	MM/DD/YY
Modem Intf FPGA	FW-0020530*	#.#.#	MM/DD/YY
Modem App	FW-0020641*	#.#.#	MM/DD/YY
CnC FPGA	FW-0000307*	#.#.#	MM/DD/YY
Comp FPGA	FW-0000308*	#.#.#	MM/DD/YY
Decomp FPGA	FW-0000309*	#.#.#	MM/DD/YY
G.703 FPGA	FW-0000372*	#.#.#	MM/DD/YY
OC-3 FPGA	FW-0000468*	#.#.#	MM/DD/YY
Pkt Proc	FW-0020773*	#.#.#	MM/DD/YY

Figure 7-32. Status | Firmware Info Page

7.4.4.4.5 Status | ACM

Use this *read-only* page to view ACM (Adaptive Coding & Modulation) operating statistics.

CDM-760: Comtech EF Data Modem :: Modem ACM Information

Home | Admin | Configuration | Status

Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance

ACM Table			
QPSK Degradation:	0.0	8PSK Degradation:	0.0
16APSK Degradation:	0.0	32APSK Degradation:	0.0
64APSK Degradation:	0.0		
EsNo Target Margin:	1.0		
Minimum ModCod:	QPSK 1/2	Maximum ModCod:	32APSK 9/10
ModCod	**Spectral Eff**	**EsNo**	**Skip?**
QPSK 1/2	0.965327	3.30	No
QPSK 8/15	1.030227	3.70	No
QPSK 17/30	1.095126	4.10	No
QPSK 3/5	1.160026	4.50	No
QPSK 19/30	1.224926	4.80	No
QPSK 2/3	1.290788	5.30	No
QPSK 127/180	1.365543	5.80	No
QPSK 3/4	1.452076	6.30	No
QPSK 4/5	1.549426	6.90	No
QPSK 5/6	1.615288	7.40	No
8PSK 17/30	1.642246	7.90	Yes
QPSK 31/36	1.668409	7.90	No
QPSK 8/9	1.724416	8.40	Yes
8PSK 3/5	1.739569	8.10	No
QPSK 9/10	1.746049	8.60	Yes
8PSK 19/30	1.836893	8.50	No
8PSK 2/3	1.935658	8.90	No
8PSK 127/180	2.047761	9.80	No
8PSK 3/4	2.177525	10.20	No
8PSK 4/5	2.323511	11.00	No
8PSK 5/6	2.422276	11.60	Yes
16APSK 19/30	2.443246	11.20	No
8PSK 31/36	2.501937	12.30	Yes
16APSK 2/3	2.574613	11.50	No
8PSK 8/9	2.585924	13.00	Yes
8PSK 9/10	2.618365	13.30	Yes
16APSK 127/180	2.723720	12.00	No
16APSK 3/4	2.896320	12.60	No
16APSK 4/5	3.090495	13.40	No
16APSK 5/6	3.221863	14.00	No
16APSK 31/36	3.327820	14.80	Yes
32APSK 127/180	3.407407	14.50	No
16APSK 8/9	3.439530	15.20	Yes
16APSK 9/10	3.482680	15.50	Yes
32APSK 3/4	3.623332	15.10	No
32APSK 4/5	3.866247	16.00	No
32APSK 5/6	4.030589	16.80	No
32APSK 31/36	4.163143	17.40	No
32APSK 8/9	4.302894	18.20	No
32APSK 9/10	4.356875	18.50	No

Figure 7-33. Status | ACM Status Page

7.4.4.4.6 Status | Traffic Statistics Pages

Except where noted, these nested pages are accessible only to Admin users when the optional High-Speed Packet Processor card is <u>installed and enabled</u>. See Sect. 7.4.3.1 for information about using conditional access pages.

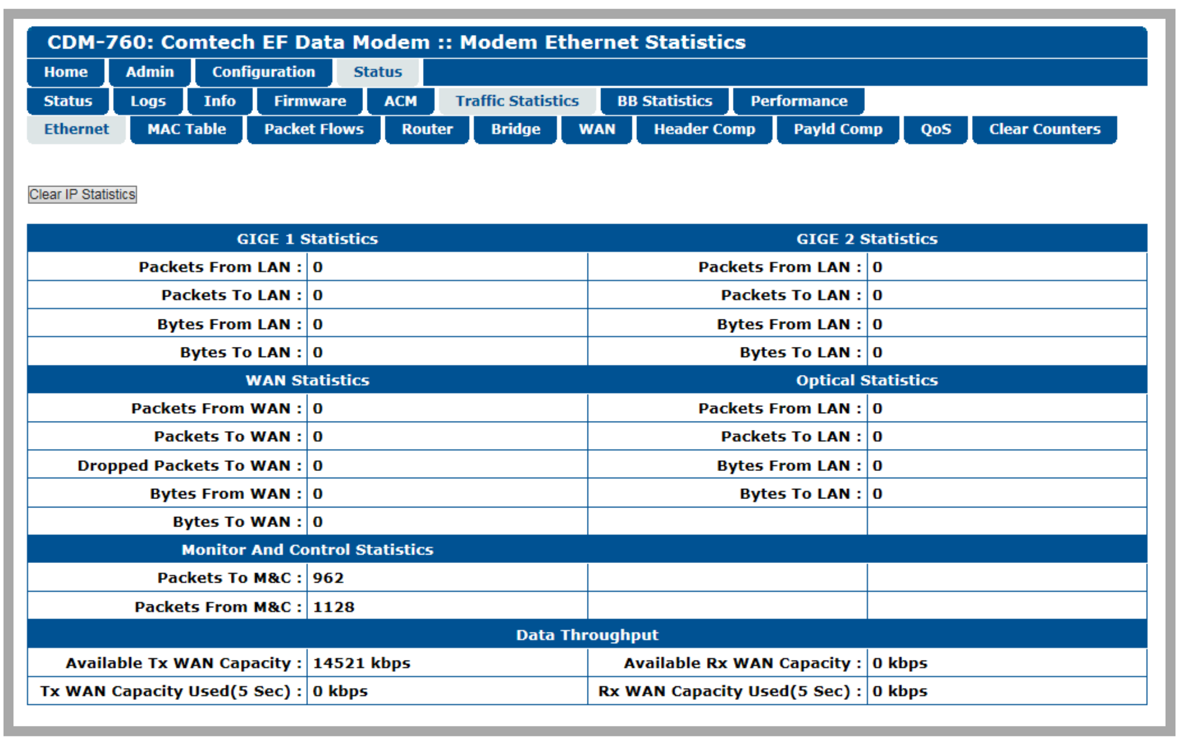
The *read-only* Traffic Statistics pages update automatically every 10 seconds. Click the **Traffic Statistics** primary page tab, and then select the **Ethernet**, **MAC Table**, **Packet Flows**, **Router**, **Bridge**, **WAN**, **Header Comp**, **Payld Comp**, **QoS**, or **Clear Counters** tab to continue.

7.4.4.4.6.1 Status | Traffic Statistics | Ethernet

This page is available with or without the presence of the optional High-Speed Packet Processor:

- When the Packet Processor is either **<u>not installed</u>** or **<u>installed but disabled</u>** (**Figure 7-34**) this page reports the traffic statistics for the **J4 |MGMT**, **J5 | DATA**, **J6 | DATA**, and **J7 | OPTICAL** Ethernet ports.

- When the Packet Processor is **<u>installed and enabled</u>** (**Figure 7-35**) this page reports the traffic statistics for the Packet Processor's **P0 | MGMT**, **P1 | DATA**, **P2 | DATA**, **P3 | DATA**, and **P4 | DATA** Ethernet ports.


CDM-760: Comtech EF Data Modem :: Modem Ethernet Statistics

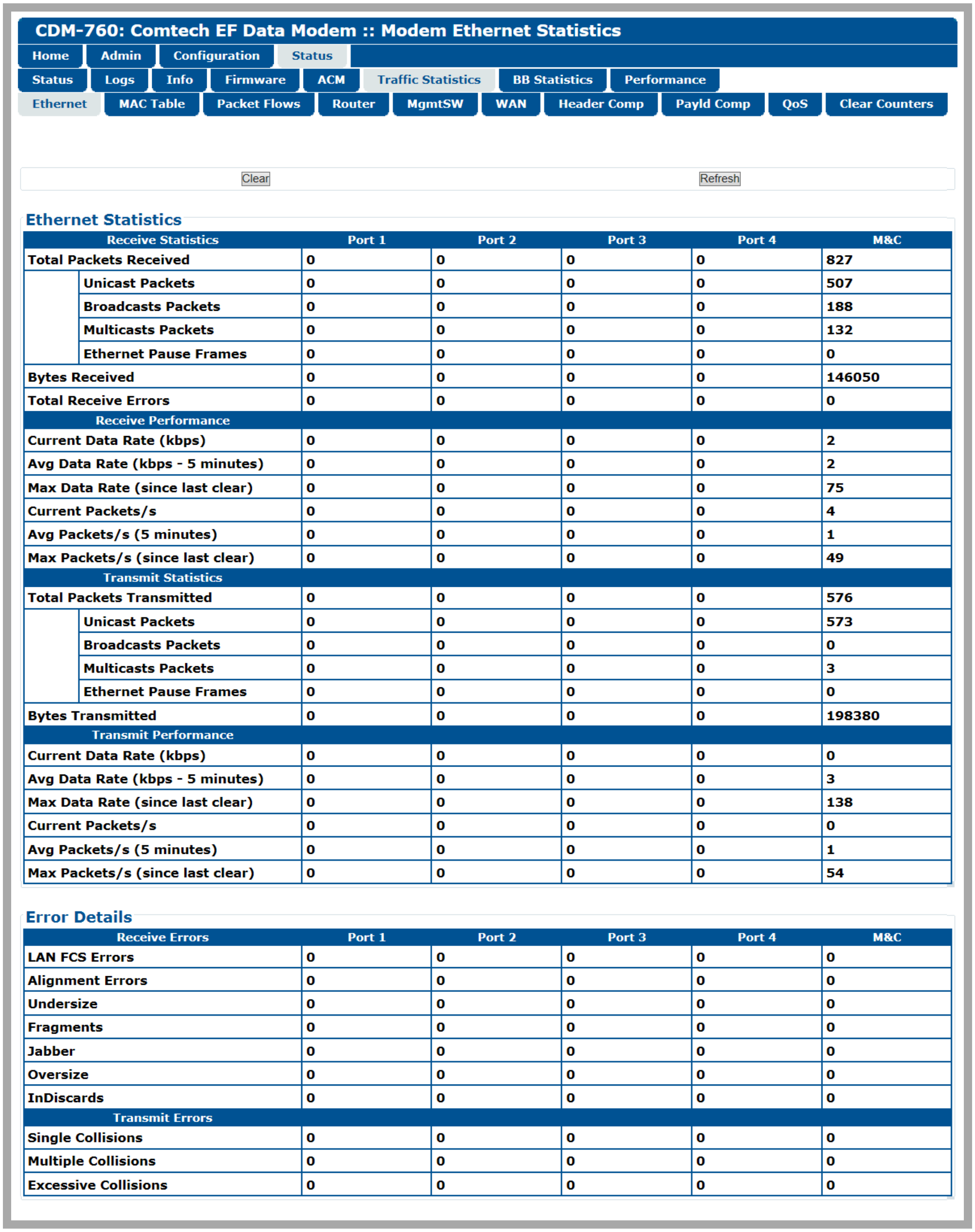
Home | Admin | Configuration | Status
Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance
Ethernet | MAC Table | Packet Flows | Router | Bridge | WAN | Header Comp | Payld Comp | QoS | Clear Counters

Clear IP Statistics

GIGE 1 Statistics		GIGE 2 Statistics	
Packets From LAN :	0	Packets From LAN :	0
Packets To LAN :	0	Packets To LAN :	0
Bytes From LAN :	0	Bytes From LAN :	0
Bytes To LAN :	0	Bytes To LAN :	0
WAN Statistics		**Optical Statistics**	
Packets From WAN :	0	Packets From LAN :	0
Packets To WAN :	0	Packets To LAN :	0
Dropped Packets To WAN :	0	Bytes From LAN :	0
Bytes From WAN :	0	Bytes To LAN :	0
Bytes To WAN :	0		
Monitor And Control Statistics			
Packets To M&C :	962		
Packets From M&C :	1128		
Data Throughput			
Available Tx WAN Capacity :	14521 kbps	Available Rx WAN Capacity :	0 kbps
Tx WAN Capacity Used(5 Sec) :	0 kbps	Rx WAN Capacity Used(5 Sec) :	0 kbps

Figure 7-34. Status | Traffic Statistics | Ethernet Page (Packet Processor DISABLED or NOT INSTALLED)

Click **[Clear IP Statistics]** to clear/reset the Ethernet statistics buffers.



Ethernet Statistics

Receive Statistics	Port 1	Port 2	Port 3	Port 4	M&C
Total Packets Received	0	0	0	0	827
Unicast Packets	0	0	0	0	507
Broadcasts Packets	0	0	0	0	188
Multicasts Packets	0	0	0	0	132
Ethernet Pause Frames	0	0	0	0	0
Bytes Received	0	0	0	0	146050
Total Receive Errors	0	0	0	0	0
Receive Performance					
Current Data Rate (kbps)	0	0	0	0	2
Avg Data Rate (kbps - 5 minutes)	0	0	0	0	2
Max Data Rate (since last clear)	0	0	0	0	75
Current Packets/s	0	0	0	0	4
Avg Packets/s (5 minutes)	0	0	0	0	1
Max Packets/s (since last clear)	0	0	0	0	49
Transmit Statistics					
Total Packets Transmitted	0	0	0	0	576
Unicast Packets	0	0	0	0	573
Broadcasts Packets	0	0	0	0	0
Multicasts Packets	0	0	0	0	3
Ethernet Pause Frames	0	0	0	0	0
Bytes Transmitted	0	0	0	0	198380
Transmit Performance					
Current Data Rate (kbps)	0	0	0	0	0
Avg Data Rate (kbps - 5 minutes)	0	0	0	0	3
Max Data Rate (since last clear)	0	0	0	0	138
Current Packets/s	0	0	0	0	0
Avg Packets/s (5 minutes)	0	0	0	0	1
Max Packets/s (since last clear)	0	0	0	0	54

Error Details

Receive Errors	Port 1	Port 2	Port 3	Port 4	M&C
LAN FCS Errors	0	0	0	0	0
Alignment Errors	0	0	0	0	0
Undersize	0	0	0	0	0
Fragments	0	0	0	0	0
Jabber	0	0	0	0	0
Oversize	0	0	0	0	0
InDiscards	0	0	0	0	0
Transmit Errors					
Single Collisions	0	0	0	0	0
Multiple Collisions	0	0	0	0	0
Excessive Collisions	0	0	0	0	0

Figure 7-35. Status | Traffic Statistics | Ethernet Page (Packet Processor Installed/Enabled)

- Click **[Clear]** to clear/reset the Ethernet statistics buffers.
- Click **[Refresh]** to update the page with the latest available statistics.

Ethernet Statistics

Receive/Transmit Statistics		
Statistics Type		Description
Total Packets Received	Unicast Packets	This is the sum for this port of all valid packets received/transmitted as either Unicast Packets, Broadcast Packets, Multicast Packets or Ethernet Pause frames.
	Broadcast Packets	
	Multicast Packets	
	Ethernet Pause Frames	
Bytes Received		This is the sum for this port total of all valid bytes received/transmitted as either Unicast Packets, Broadcast Packets, Multicast Packets or Ethernet Pause frames.
Total Receive Errors		This is the sum total for this port of all packets received/transmitted in error as either LAN FCS Errors, Alignment Errors, Undersize, Fragments, Jabber, Oversize or InDiscard.

Receive/Transmit Performance	
Statistics Type	Description
Current Data Rate (kbps)	This is the average for this port of data rate received/transmitted during the last 1 second.
Avg Data Rate (kbps – 5 minutes)	This is the average for this port of data rate received/transmitted on this port over the last 5 minutes.
Max Data Rate (since last clear)	This is the maximum received/transmitted data rate this port has seen since the last time the statistics buffer was cleared.
Current Packets/s	This is the total number of packets received/transmitted on this port during the last 1 second.
Average Packets/s (5 minutes)	This is the average number of packets received/transmitted per second on this port over the past 5 minutes.
Max Packets/s (since last clear)	This is the maximum received/transmitted packets per second this port has seen since the last time the statistics buffer was cleared.

Error Details

All packets received in error are discarded.

Receive Errors	
Statistics Type	Description
LAN FCS Error	Indicates a packet was received on his port with an invalid FCS (sometimes referred to as checksum).
Alignment Error	Indicates a packet was received on this port with an invalid FCS or was received on a non byte (8 bit) boundary.
Undersize	Indicates that a packet as seen by this port is fewer than 64 octets long (including FCS octets) but otherwise well formed.
Fragments	Indicates a portion of the packet as seen by this port was received but one or more sections of the packet are missing.
Jabber	Indicates a device on the network as seen by this port is improperly handling the Ethernet signaling.
Oversize	Indicates that a packet as seen by this port is larger than 10,240 octets long (including FCS octets) but otherwise well formed.
InDiscards	Indicates that a packet as received by this port that was forwarded incorrectly or were supposed to be handled in a special manner, but were not.

Transmit Errors	
Statistics Type	Description
Single Collision	Indicates two devices detected that the network is idle and try to send packets at exactly the same time (within one round trip delay).
Multiple Collision	Indicates small groupings of consecutive collisions have occurred indicating possible congestion on the network.
Excessive Collisions	Indicate that 16 consecutive collisions have occurred, usually a sign that the network is congested. For each excessive collision count (or after 16 consecutive collisions), a packet is dropped.

7.4.4.4.6.2 Status | Traffic Statistics | MAC Table

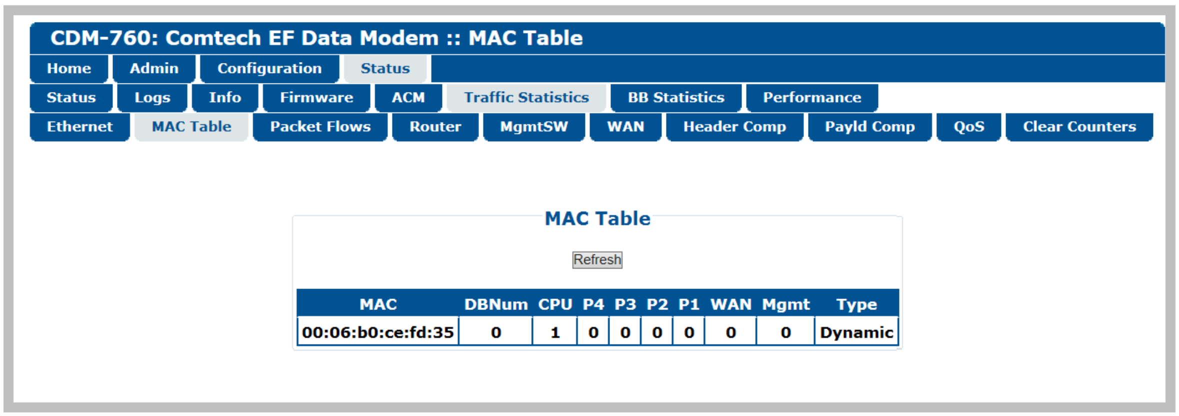


Figure 7-36. Status | Traffic Statistics | MAC Table Page

This table indicates any MAC Address that has been learned and informs on what port that address was learned. Note the following (from left to right):

Item	Description
MAC	The learned MAC Address
DBNum	Indicates what database the MAC address has been stored on.
CPU	Indicates that the MAC address has been learned by an internal process directly by the Packet Processor.
P4 P4 P2 P1 WAN Mgmt	Indicate that MAC address has been learned by these ports

MAC Table

Click **[Refresh]** to update the table with the latest learned information.

7.4.4.4.6.3 Status | Traffic Statistics | Packet Flows

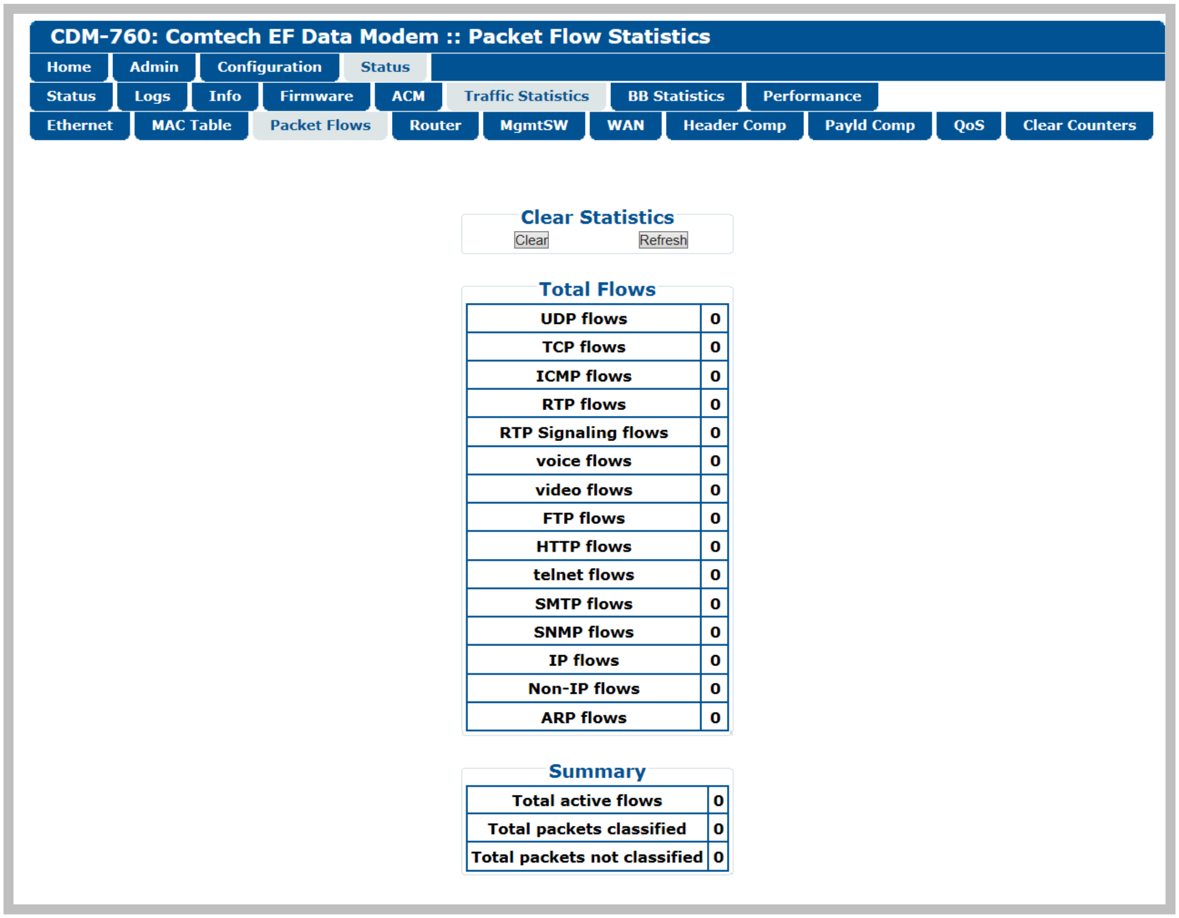


Figure 7-37. Status | Traffic Statistics | Packet Flows Page

Clear Statistics

- Click **[Clear]** to clear/reset the Packet Flows statistics buffers.
- Click **[Refresh]** to update the page with the latest available statistics.

Total Flows

This section displays the type and number of active flows the Packet Processor is currently processing.

Summary

This section displays the total number of active flows and classified packets processed by the Packet Processor to date.

Flows that cannot be classified are counted as “packets not classified.” Although “not classified” they will still transmit over WAN with the default QoS queue.

7.4.4.4.6.4 Status | Traffic Statistics | Router

Use this page to review the activity on the Packet Processor card. These items are generated per the Packet Processor stack and are used primarily for system and network debugging.

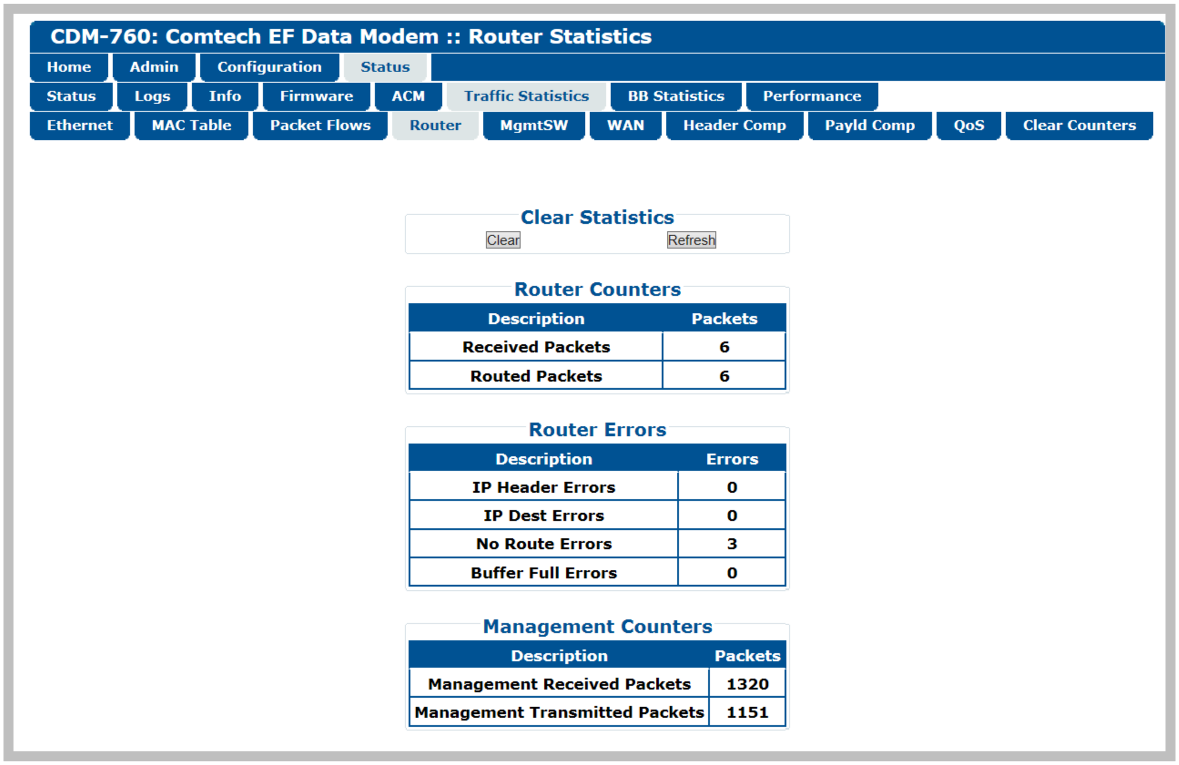


Figure 7-38. Status | Traffic Statistics | Router Page

Clear Statistics

- Click **[Clear]** to clear/reset the Router statistics buffers.
- Click **[Refresh]** to update the page with the latest available statistics.

Router Counters

Item	Description
Received Packets	Number of packets received by the Packet Processor stack for routing.
Routed Packets	Number of packets the router has found a valid route for since the statistics buffer wads last cleared. – a large mismatch generally indicates no default route. A slight mismatch means some packets are seen as un-routable This number should roughly match the number of Received Packets: • A slight mismatch means some packets are seen as unroutable. • A large mismatch generally indicates no default route.

Router Errors

Item	Description
IP Header Errors	One of the following errors occurred: • The TTL (Time To Live) errors is ‘0’ • The packet(s) received with Unicast MAC Address does not match the P0 | MGMT port MAC Address. • The IP Header checksum failed
IP Dest Errors	The number of input packets discarded because the IP Address in the IP Header's destination field was not a valid address to be received at this modem.
No Route Errors	No route was found for the Destination IP Address.
Buffer Full Errors	The number of input + output packets for which no problems were encountered, but which were discarded for lack of buffer space.

Management Counters

Item	Description
Management Received Packets	Total number of packets received by the modem’s Management IP Address since last clear.
Management Transmitted Packets	Total number of packets sent by the modem’s Management IP Address since last clear.

7.4.4.4.6.5 Status | Traffic Statistics | MgmtSW (Managed Switch)

Use this page to review the overall packet count transmitted and received by the LAN (Managed Switch DATA ports P1 through P4) and the WAN (P0 | MGMT).

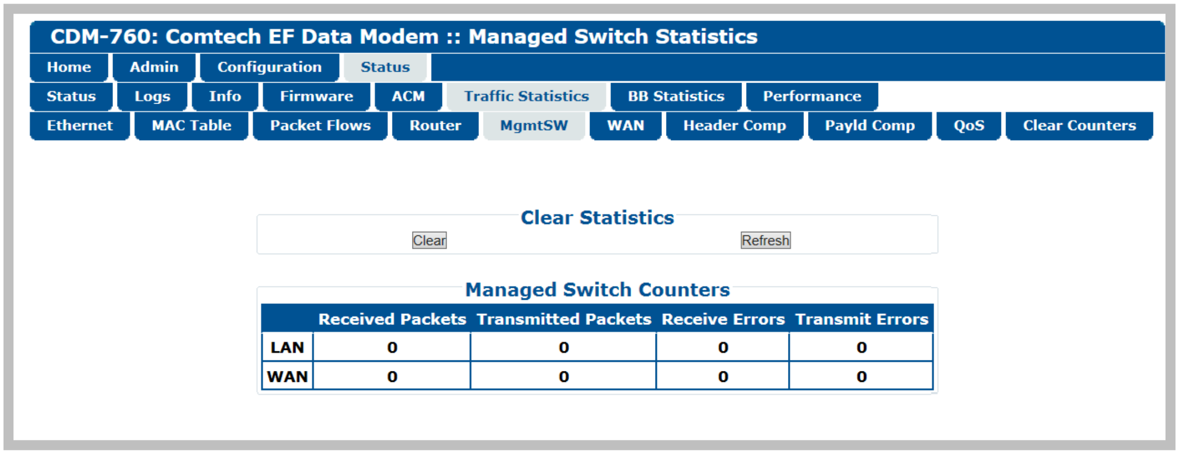


Figure 7-39. Status | Traffic Statistics | MgmtSW Page

Clear Statistics

- Click **[Clear]** to clear/reset the Managed Switch statistics buffers.
- Click **[Refresh]** to update the page with the latest available statistics.

Managed Switch Counters

Item		Description
LAN	Received Packets	Total number of packets from the LAN to ports (P1 – P4).
	Transmitted Packets	Total number of packets from ports (P1 – P4) to the LAN.
	Receive Errors	Total number of packets received on ports (P1 – P4) in error.
	Transmit Errors	Total number of packets sent on (P1 – P4) in error.
WAN	Received Packets	Total number of packets received from the WAN.
	Transmitted Packets	Total number of packets transmitted to the WAN.
	Receive Errors	Total number of packets sent over the WAN in error.
	Transmit Errors	Total number of packets sent over the WAN in error.

7.4.4.4.6.6 Status | Traffic Statistics | WAN

Use this page to review the activity on the CDM-760 between various FPGAs and the Packet Processor. These item are used primarily for debugging internal modem routing and traffic flow issues.

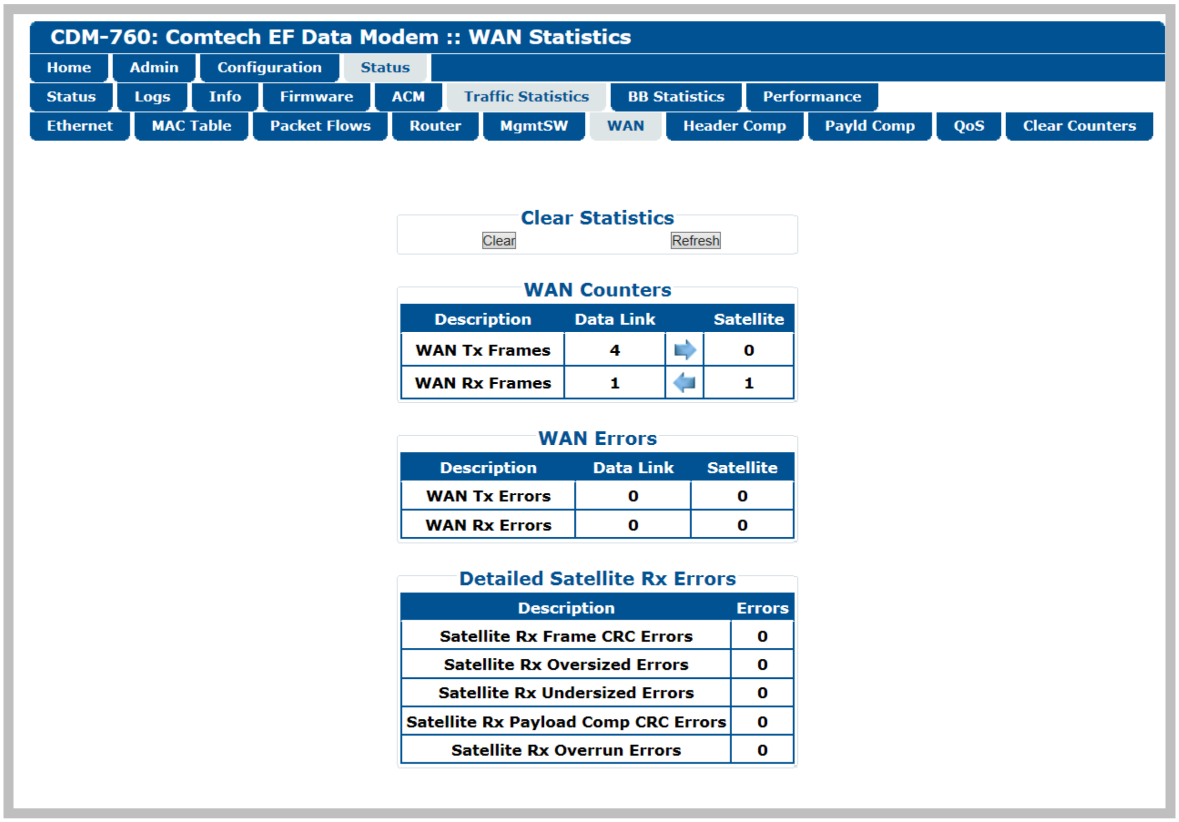


Figure 7-40. Status | Traffic Statistics | WAN Page

Clear Statistics

- Click **[Clear]** to clear/reset the WAN statistics buffers.
- Click **[Refresh]** to update the page with the latest available statistics.

WAN Counters

Item		Description
WAN Tx Frames (packets)	Data Link	Packets from Packet Processor to Packet Processor FPGA.
	Satellite	Packets from Packet Processor FPGA to framer FPGA.
WAN Tx Frames (packets)	Data Link	Packets from Packet Processor FPGA to Packet Processor.
	Satellite	Packets from framer FPGA to Packet Processor FPGA.

7.4.4.4.6.7 Status | Traffic Statistics | Header Comp (Header Compression)

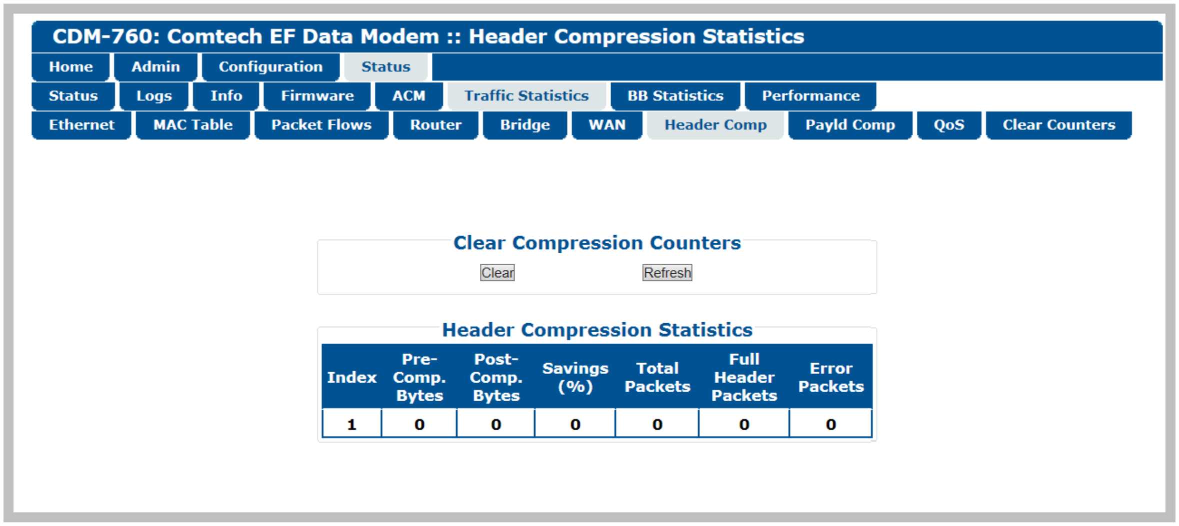


Figure 7-41. Status | Traffic Statistics | Header Comp Page

Clear Compression Counters

- Click **[Clear]** to clear/reset the Header Compression statistics buffer.
- Click **[Refresh]** to update the page with the latest available statistics.

Header Compression Statistics

Column	Description
Index	These statistics are shown on a per-QoS rule basis. This index number will match with the Index number of the QoS table as seen per the Configuration | WAN | QoS page for all data being routed. In this way you can see how each type of defined traffic is compressing on a per-rule basis.
Pre-Comp. Bytes	Total byte count of all packets since last clear that meet this QoS rule Index before header compression.
Post-Comp. Bytes	Total byte count of all packets since last clear that meet this QoS rule Index after header compression.
% Savings	Calculated as: (Pre-Comp Bytes – Post-Comp Bytes) / Pre-Comp Bytes
Total Packets	The total number of packets since last clear that meet this QoS rule Index and were sent to the header compression engine.
Full Header Packets	The number of packets since last clear in this QoS rule Index that could not be compressed. Compare this to the Total Packets for the same QoS index to see what % of packets of this type are compressible.
Error Packets	The number of packets since last clear in this QoS rule Index that compressed with an error.

7.4.4.4.6.8 Status | Traffic Statistics | Payld Comp (Payload Compression)

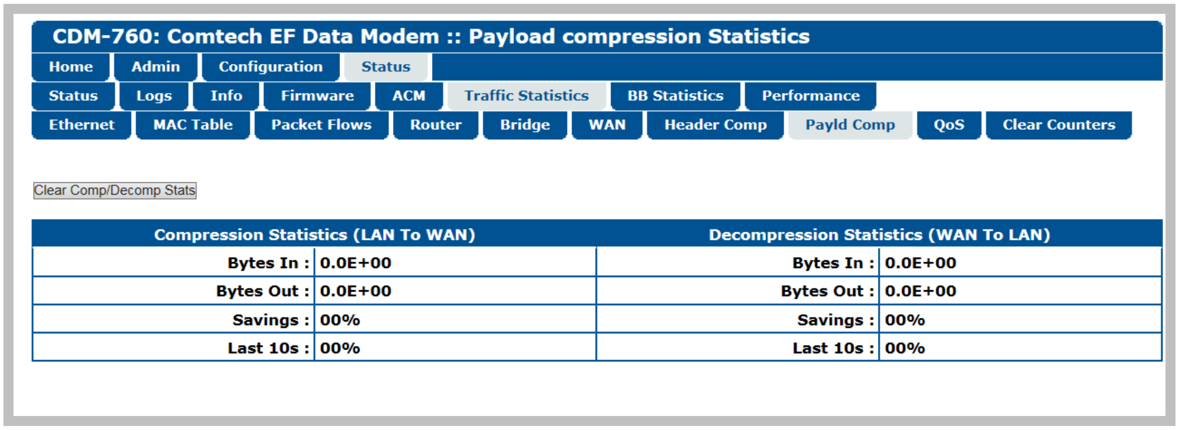


Figure 7-42. Status | Traffic Statistics | Payld Comp Page

Click **[Clear Comp/Decomp Stats]** to clear/reset the Payload Compression/Decompression statistics buffers.

7.4.4.4.6.9 Status | Traffic Statistics | QoS

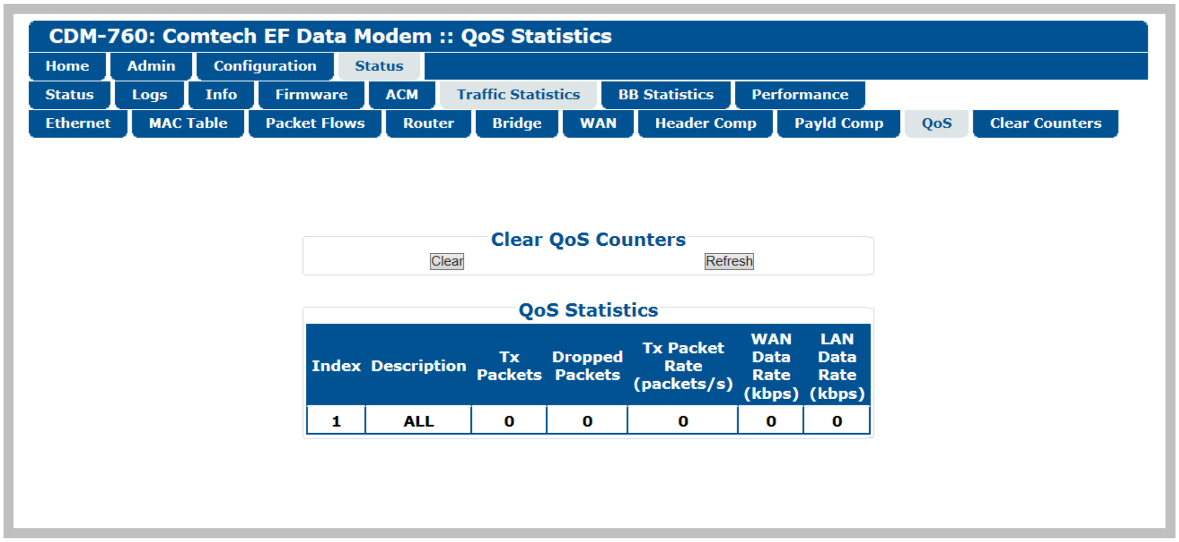


Figure 7-43. Status | Traffic Statistics | QoS Page

Clear QoS Counters

- Click **[Clear]** to clear/reset the QoS statistics buffer.
- Click **[Refresh]** to update the page with the latest available statistics.

QoS Statistics

Column	Description
Index	These statistics are shown on a per-QoS rule basis. This index number will match with the Index number of the QoS Rules Table that is provided by the Configuration | WAN | QoS page for all data being routed. In this way you can see how each type of defined traffic is being processed on a per-rule basis.
Description	This description typically matches the Protocol column field in the Configuration | WAN | QoS page QoS Table.
Tx Packets	The total number of packets since last clear that meet this QoS rule Index and were sent to the WAN.
Dropped Packets	The total number of packets since last clear that meet this QoS rule Index and were dropped or not sent to the WAN due to congestion.
Tx Packet Rate (packets/s)	The 1s average packet rate of all packets that meet this QoS rule Index and were sent to the WAN.
WAN Data Rate (kbps)	The 1s average data rate of all packets that meet this QoS rule Index and were sent to the WAN.
LAN Data Rate (kbps)	The WAN data rate seen by Ethernet. This data rate includes pre-header compression bytes.

7.4.4.4.6.10 Status | Traffic Statistics | Clear Counters

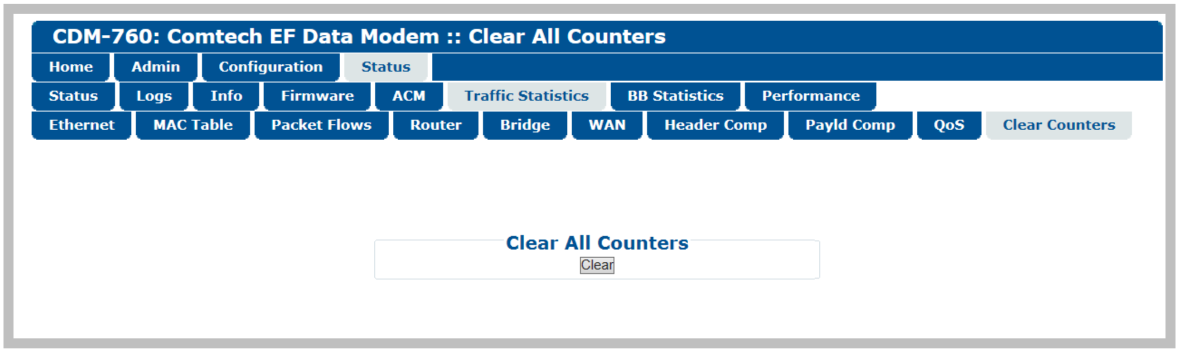


Figure 7-44. Status | Traffic Statistics | Clear Counters Page

Clear All Counters

Click **[Clear]** to clear/reset the statistics buffers for **all** Traffic Statistics pages **except** the **MAC Table** and **Payld Comp** pages.

7.4.4.4.7 Status | BB Statistics

Use this *read-only* page to view Modem Baseband operating statistics.

CDM-760: Comtech EF Data Modem :: Modem Baseband Statistics

Home | Admin | Configuration | Status

Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance

Clear Baseband Statistics

ModCod	TxFrames	RxFrames	RxError Frames
QPSK 1/2	0.0E+00	0.0E+00	0.0E+00
QPSK 8/15	0.0E+00	0.0E+00	0.0E+00
QPSK 17/30	0.0E+00	0.0E+00	0.0E+00
QPSK 3/5	0.0E+00	0.0E+00	0.0E+00
QPSK 19/30	0.0E+00	0.0E+00	0.0E+00
QPSK 2/3	0.0E+00	0.0E+00	0.0E+00
QPSK 127/180	0.0E+00	0.0E+00	0.0E+00
QPSK 3/4	4.0E+05	0.0E+00	0.0E+00
QPSK 4/5	0.0E+00	0.0E+00	0.0E+00
QPSK 5/6	0.0E+00	0.0E+00	0.0E+00
QPSK 31/36	0.0E+00	0.0E+00	0.0E+00
QPSK 8/9	0.0E+00	0.0E+00	0.0E+00
QPSK 9/10	0.0E+00	0.0E+00	0.0E+00
8PSK 17/30	0.0E+00	0.0E+00	0.0E+00
8PSK 3/5	0.0E+00	0.0E+00	0.0E+00
8PSK 19/30	0.0E+00	0.0E+00	0.0E+00
8PSK 2/3	0.0E+00	0.0E+00	0.0E+00
8PSK 127/180	0.0E+00	0.0E+00	0.0E+00
8PSK 3/4	0.0E+00	0.0E+00	0.0E+00
8PSK 4/5	0.0E+00	0.0E+00	0.0E+00
8PSK 5/6	0.0E+00	0.0E+00	0.0E+00
8PSK 31/36	0.0E+00	0.0E+00	0.0E+00
8PSK 8/9	0.0E+00	0.0E+00	0.0E+00
8PSK 9/10	0.0E+00	0.0E+00	0.0E+00
16APSK 19/30	0.0E+00	0.0E+00	0.0E+00
16APSK 2/3	0.0E+00	0.0E+00	0.0E+00
16APSK 127/180	0.0E+00	0.0E+00	0.0E+00
16APSK 3/4	0.0E+00	0.0E+00	0.0E+00
16APSK 4/5	0.0E+00	0.0E+00	0.0E+00
16APSK 5/6	0.0E+00	0.0E+00	0.0E+00
16APSK 31/36	0.0E+00	0.0E+00	0.0E+00
16APSK 8/9	0.0E+00	0.0E+00	0.0E+00
16APSK 9/10	0.0E+00	0.0E+00	0.0E+00
32APSK 127/180	0.0E+00	0.0E+00	0.0E+00
32APSK 3/4	0.0E+00	0.0E+00	0.0E+00
32APSK 4/5	0.0E+00	0.0E+00	0.0E+00
32APSK 5/6	0.0E+00	0.0E+00	0.0E+00
32APSK 31/36	0.0E+00	0.0E+00	0.0E+00
32APSK 8/9	0.0E+00	0.0E+00	0.0E+00
32APSK 9/10	0.0E+00	0.0E+00	0.0E+00
Dropped Frames			
16APSK Dropped	0.0E+00	32APSK Dropped	0.0E+00
64APSK Dropped	0.0E+00		

Figure 7-45. Status | BB Statistics Page

Click **[Clear Baseband Statistics]** to clear/reset the page statistics buffers.

7.4.4.4.8 Status | Performance Pages

Click the **Performance** primary page tab, and then select the **IQMon**, **TxGraph**, **Rx Graph**, or **CPU Usage** tab to continue.

7.4.4.4.8.1 Status | Performance | IQMon

This page provides you with a Constellation/Spectrum Analyzer feature.

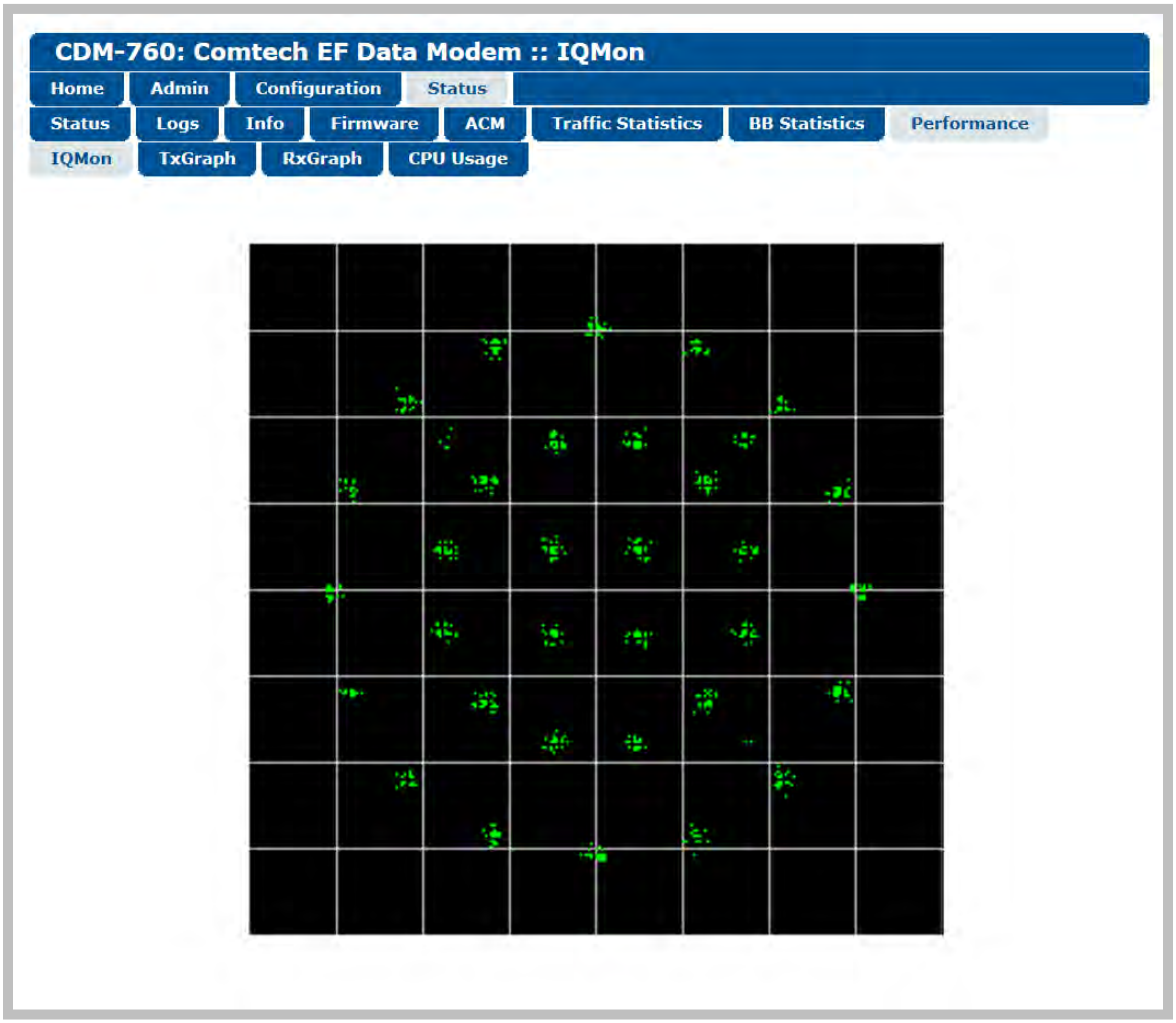


Figure 7-46. Status | Performance | IQMon Page

7.4.4.4.8.2 Status | Performance | TxGraph

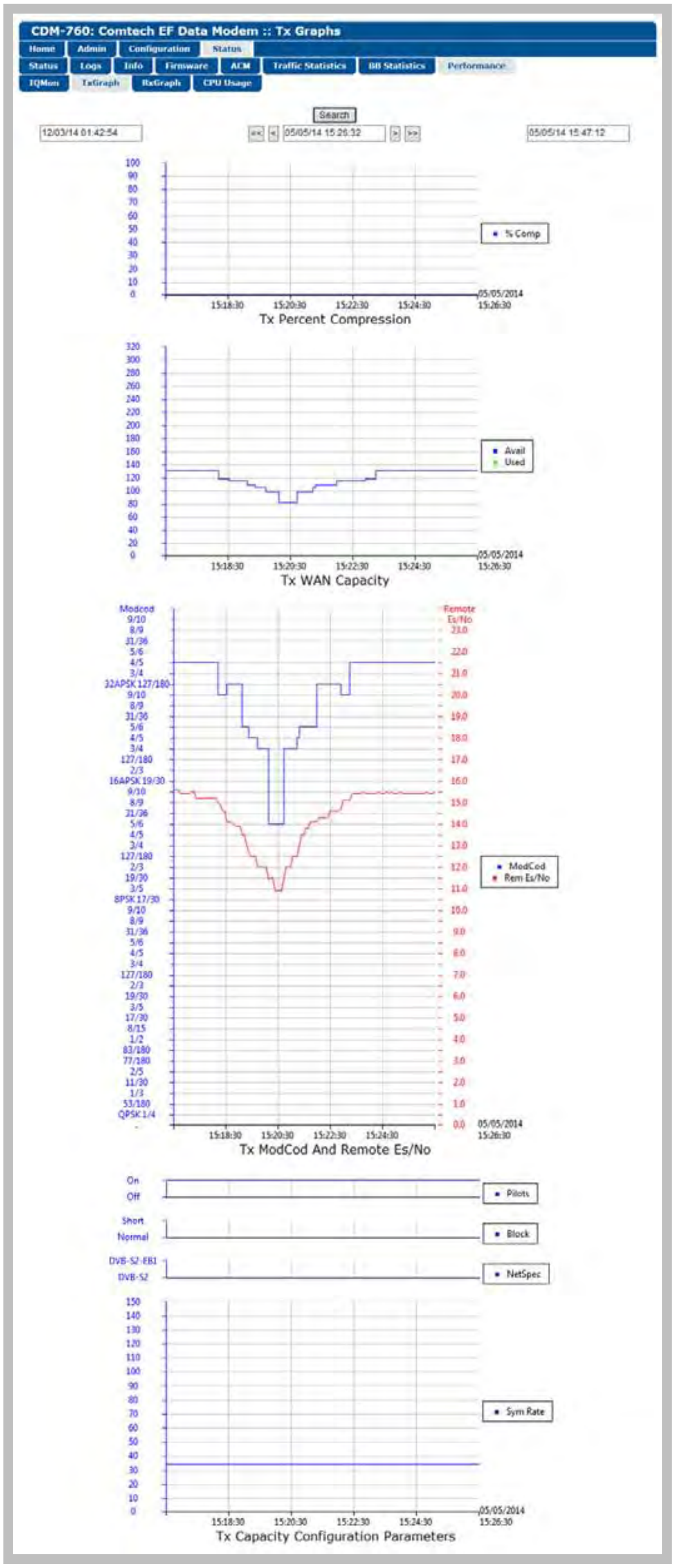


Figure 7-47. Status | Performance | TxGraph Page

When the presence of the optional K4 GZip Compression is detected, this page provides a live graphical representation of the trending characteristics that are available while using this feature.

Once you open or refresh this graph page, allow some time for the modem to compile and graph the performance statistics. If you resize the browser window, allow approximately 5 to 10 seconds for the graph set to regenerate, then re-center in the browser window.

This page provides three performance graphs and four configuration status graphs:

Tx Percent Compression Graph

The **Tx Percent Compression graph** represents the LAN to WAN compression statistic as described in **Chapter 6. FRONT PANEL OPERATION Sect. 6.2.3.6.3 (Monitor: Stats) Compression→ LanToWan or WantoLan**. Tx Percent Compression (% Comp) is calculated using the following formula:

`100 * (1-(Bytes Out/Bytes In))`

Tx WAN Capacity Graph

The **Tx WAN Capacity graph** logs the following information:

- **Avail** means "Available Capacity" or what the satellite link is capable of transmitting at any given moment. Available Capacity is calculated using the following formula:

  `(Tx Symbol Rate)(Tx Spectral Efficiency)`

  Spectral Efficiency is a function of ModCod, Pilots On or Off, and Normal or Short Block being used.

  See **Appendix B. Es/No MEASUREMENT** for detailed information about and reference tables pertaining to Spectral Efficiency.

- **Used** means "Capacity Used" or the data rate of all traffic sent over the satellite after compression (if enabled), and including any overhead the modem asserts due to encapsulation or overhead due to compression. The Capacity Used is taken directly from the "Bytes to WAN" Monitor Statistics, as averaged over the graphed time period. When compression is enabled, the capacity used may be substantially less than the terrestrial rate of the user traffic due to the effect of the compression card.

Tx ModCod and Remote Es/No Graph

The **Tx ModCod and Remote Es/No graph** is particularly useful when the modem is running is ACM mode, as it maps the remote Es/No of the far end modem synchronously along with the near side (local) Tx ModCod used. Two pieces of data are graphed in time synchronous manner:

- The left side of the graph has a vertical key of **Tx ModCod** (blue).
- The right side of the graph has a vertical key of **Remote Es/No** (red).

In this format, the graph depicts changes in ModCod that occur when the reported Remote Es/No meets the Es/No trigger points to switch up or down.

Note that the Remote Es/No is the "reported" Es/No of the far end modem as seen by the local modem. This reported Remote Es/No data can be 250ms to 400ms old as this is the amount of time it can take for this data to traverse the satellite link for processing by the local modem.

When more than one ModCod is used in the smallest interval period allowable by the graph, the most common ModCod used in that time interval is displayed.

Tx Capacity Configuration Parameters Graphs

The **Tx Capacity Configuration Parameters graphs** provides a graphical representation for some of the common configuration settings that can affect user data rate, and typically do not change:

- **Pilots On or Off**
- **Normal Block or Short Block**
- **NetSpec (Network Specification) – DVB-S2-EB2, DVB-S2-EB1, DVB-S2, or DVB-S2X.**
- **Symbol Rate**

These parameters are shown to provide you with a more complete representation of user capacity, when viewed in conjunction with the other graphs provided on this page.

7.4.4.4.8.3 Status | Performance | RxGraph

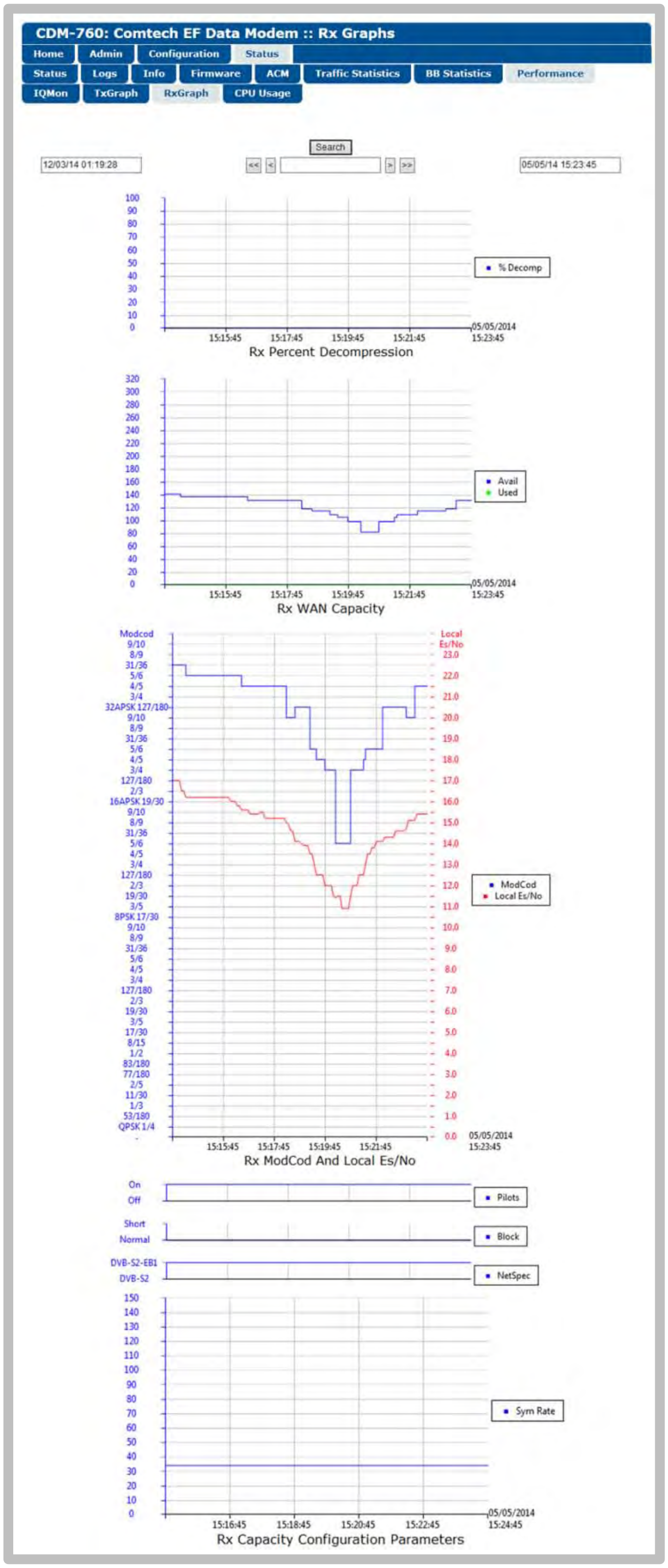


Figure 7-48. Status | Performance | RxGraph Page

When the presence of the optional K4 GZip Compression is detected, this page provides a live graphical representation of the trending characteristics that are available while using this feature.

Once you open or refresh this page, allow some time for the modem to compile and graph the performance statistics. If you resize the browser window, allow approximately 5 to 10 seconds for the graph set to regenerate, then re-center in the browser window.

This page provides three performance graphs and four configuration status graphs:

Rx Percent Decompression Graph

The **Rx Percent Decompression graph** represents the WAN to LAN decompression statistic as described in **Sect. 6.2.3.6.3 (Monitor: Stats) Compression→ LanToWan** or **WantoLan**. Rx Percent Decompression (% DeComp) is calculated using the following formula:

```
100 * (1-(Bytes Out/Bytes In))
```

Rx WAN Capacity Graph

The **Rx WAN Capacity graph** logs the following information:

- **Avail** means “Available Capacity” or what the satellite link is capable of receiving at any given moment. Available Capacity is calculated using the following formula:

  ```
  (Rx Symbol Rate)(Rx Spectral Efficiency)
  ```

  Spectral Efficiency is a function of ModCod, Pilots On or Off, and Normal or Short Block being used.

  See **Appendix B. Es/No MEASUREMENT** for detailed information about and reference tables pertaining to Spectral Efficiency.

- **Used** means “Capacity Used” or the data rate of all traffic sent over the satellite before decompression (if enabled), and including any overhead the far end modem asserts due to encapsulation or overhead due to compression. The Capacity Used is taken directly from the “Bytes from WAN” Monitor Statistics, as averaged over the graphed time period. When decompression is enabled, the capacity used may be substantially less than the terrestrial rate of the user traffic due to the effect of the compression card.

Rx ModCod and Local Es/No Graph

The **Rx ModCod and Local Es/No graph** logs two pieces of data in time synchronous manner:

- The left side of the graph has a vertical key of Rx ModCod (blue).
- The right side of the graph has a vertical key of Local Es/No (red).
- The Local Es/No is the Es/No of the local modem. When more than one ModCod is received in the smallest interval period allowable by the graph, the most common ModCod received in that time interval is displayed.

Rx Capacity Configuration Parameters Graphs

The **Rx Capacity Configuration Parameters graphs** provide a graphical representation for some of the common configuration settings that can affect user data rate, and typically do not change:

- **Pilots On or Off**
- **Normal Block or Short Block**

- **NetSpec (Network Specification) – DVB-S2-EB2, DVB-S2-EB1, DVB-S2, or DVB-S2X.**
- **Symbol Rate**

These parameters are shown to provide you with a more complete representation of user capacity, when viewed in conjunction with the other graphs provided on this page.

7.4.4.4.8.4 Status | Performance | CPU Usage

This page is accessible only to Admin users when the optional High-Speed Packet Processor card is installed and enabled. See Sect. 7.4.3.1 for information about using conditional access pages.

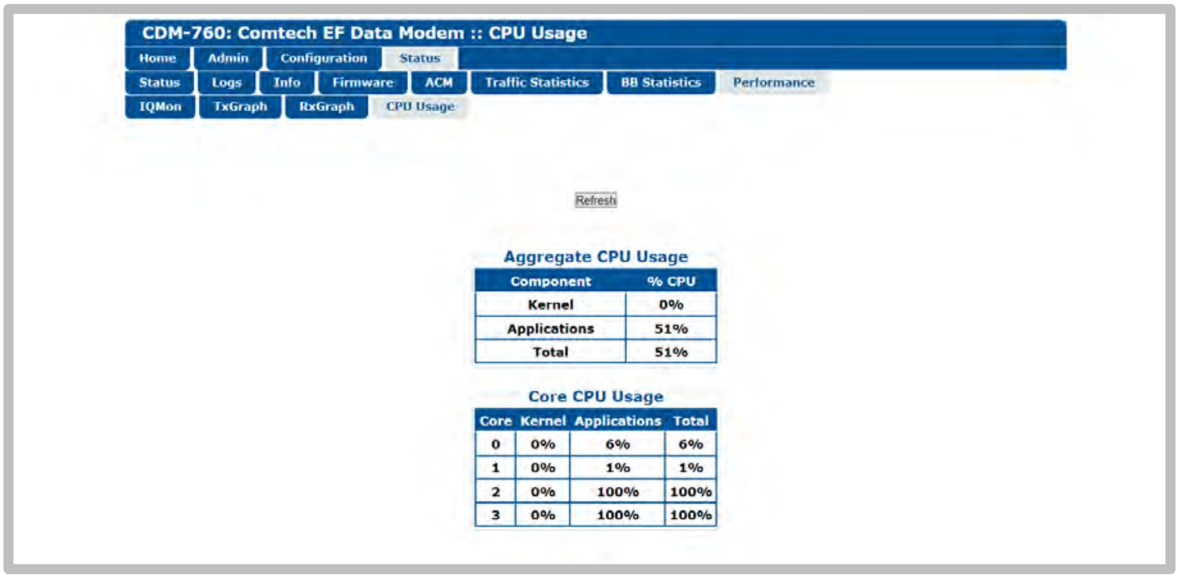


Figure 7-49. Status | Performance | CPU Usage Page

This *read-only* page displays the Packet Processor's Aggregate and Core CPU utilization as a percentage (%).

Click **[Refresh]** to clear/reset the page statistics buffers.

Notes:

Chapter 8. SERIAL INTERFACE OPERATION

8.1 Introduction

1) Use of the serial-based remote product management interface is recommended only for advanced users. All other users are strongly encouraged to use the CDM-760 front panel or CDM-760 HTTP (Web Server) Interface for monitor and control (M&C) of the CDM-760. See Chapter 6. FRONT PANEL OPERATION or Chapter 7. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT.
2) You may proceed with serial-based remote product management, assuming that:
   - The CDM-760 is operating with the latest version firmware files.
   - The CDM-760 is connected to a user-supplied, Windows-based PC, and:
     - The PC serial port is connected to the CDM-760 rear panel **J3 | REMOTE** port with a user-supplied serial cable.
     - The PC Ethernet port is connected to either the CDM-760 rear panel **J4 | MGMT** 10/100 BaseT Ethernet port or the optional High-Speed Packet Processor **P0 | MGMT** port with a user-supplied hub, switch, or direct Ethernet cable connection.
     - The PC is running a terminal emulation program (for operation of the CDM-760 Serial Interface) and a compatible web browser (for operation of the HTTP Interface).
   - The CDM-760 Management IP Address has been noted using the CDM-760 front panel (**CONFIG>IP>ADDRESSES**).

The CDM-760 Advanced High-Speed Trunking Modem serial remote product management interface is an electrical interface that is either an EIA-485 multi-drop bus (for the control of multiple devices) or an EIA-232 connection (for the control of a single device). The interface transmits data in asynchronous serial form, using ASCII characters. This data consists of control and status information, transmitted in packets of variable length in accordance with the structure and protocol explained later in this chapter.

8.2 EIA-485

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

In the other direction, on the other pair each Target has a tri-state line driver connected, and the Controller has a line-receiver connected. All the line drivers are held in high-impedance mode until one (and only one) Target transmits back to the Controller. Each Target has a unique address, and each time the Controller transmits, the address of the intended recipient Target is included in a framed 'packet' of data. All of the Targets receive the packet, but only one (the intended) will reply. The Target enables its output line driver and transmits its return data packet back to the Controller in the other direction, on the physically separate pair.

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.

8.3 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.

8.4 Remote Commands and Queries Overview

8.4.1 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 Universal Asynchronous Receiver/Transmitter (UART). The asynchronous character in the form 8-N-1 (8 data bits, no parity, 1 stop bit). The baud rate may vary from 1200 to 38400 baud.

All data is transmitted in framed packets. The Controller is in charge of the process of monitor and control, and 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 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. In this context, the Carriage Return and Line Feed characters are considered printable.

8.4.2 Packet Structure

The exchange of information is transmitted, Controller-to-Target and Target-to-Controller, in packets. Each packet contains a finite number of bytes consisting of printable ASCII characters, excluding ASCII Code 127 (DELETE).

Controller-to-Target (Issued Command or Query)						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII Code 60 (1 character)	0000 (default) (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)

Packet "issued command" example: **<0000/TMC=10[cr]**
Packet "issued query" example: **<0000/TMC?[cr]**

Target-to-Controller (Response to Command or Query)						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII Code 62 (1 character)	0000 (default) (4 characters)	/ ASCII Code 47 (1 character)	(3 characters)	=, ?, !, *, #, ~ (ASCII Codes 61, 63, 33, 42, 35, or 126) (1 character)	(n characters)	Carriage Return ASCII Code 13 (1 character)

Packet example – response received for issued query: **>0000/TMC=10[cr][lf]**

Detailed description of the packet components follow.

8.4.2.1 Start of Packet

The ‘**<**’ and ‘**>**’ characters indicate the start of an issued or received packet. They may not appear anywhere else within the body of the message.

- **Controller-to-Target:** This is the character ‘**<**’ (ASCII Code 60).
- **Target-to-Controller:** This is the character ‘**>**’ (ASCII Code 62).

8.4.2.2 Target Address

The Target Address designates the packet destination. The Controller does not have its own address. After the Controller sends a packet with the designated Target Address, the Target responds to the Controller, using this same address, to indicate the source of the packet.

- In EIA-232 applications, this value is set to **0000**.
- In EIA-485 applications, the permissible range of values is **0001** to **9999**.

8.4.2.3 Address Delimiter

This is the “forward slash” character '**/** ' (ASCII Code 47).

8.4.2.4 Instruction Code

This is a three-character alphanumeric sequence that identifies the message subject. Uppercase alphabetic characters (‘**A**’ to ‘**Z**’, ASCII Codes 65 to 90) and the numbers ‘**0**’ to ‘**9**’ *ASCII Codes 48 to 57) may be used. Wherever possible, each instruction code is named to serve as a mnemonic for its intended operation. This helps you interpret the code function, should it be shown in its raw ASCII form.

For example: TFQ stands for Transmit Frequency, **RMD** for Receive Modulation Type, etc.

8.4.2.5 Instruction Code Qualifier

This is a single character that further qualifies the preceding instruction code.

8.4.2.5.1 Controller-to-Target Instruction Code Qualifiers

The only permitted characters are ‘=’ and ‘?’.

=(ASCII Code 61)
This character is used as the Assignment Operator (AO). It establishes that the Instruction Code that precedes it is issued as a **command** to assign or configure operation. The instruction set that follows serves to assign the Target’s new parameter setting or operational value.

For example: From Controller-to-Target, <0/TFQ=0070.0000 means “set the Transmit frequency to 70 MHz.”

? (ASCII Code 63)
This character is used as the Query Operator (QO). It establishes that the Instruction Code that precedes it is issued as a **query** that returns the Target’s current configured parameter setting or operational value.

For example: From Controller-to-Target, <0/TFQ? means “what is the current value of the transmit frequency?”.

8.4.2.5.2 Target-to-Controller Instruction Code Qualifiers

The permitted characters are ‘=’, ‘?’, ‘*’ , ‘!’, ‘*’, ‘#’, and ‘~’.

=(ASCII Code 61)
This character is used in two ways:

1. If the Controller sends a query to the Target. **For example:** <0/TFQ? (meaning “what is the current value of the transmit frequency?”) – the Target responds with >0000/TFQ=xxxx.xxxx, the value for that queried parameter.
2. If the Controller sends an instruction to set a parameter to a particular value, and the value sent is valid, the Target acknowledges the message and responds with >0000/TFQ=(with no message arguments).

? (ASCII Code 63)
If the Controller issues a command to set a parameter to a particular value, and the value sent is not valid, the Target then acknowledges the message and responds with ‘?’. This indicates that there was an error in the message sent by the Controller.

For example: >0000/TFQ? (with no message arguments).

! (ASCII Code 33)
If the Controller issues a command that the Target does not recognize, the Target responds by echoing the invalid instruction code, followed by ‘!’.

For example: >0000/ABC!

*** (ASCII Code 42)**
If the Controller issues a command to set a parameter to a particular value, and the value sent is valid BUT the modem will not permit that particular parameter to be changed at present, the Target responds by echoing the valid instruction code, followed by ‘*’.

For example: >0000/TFQ* (with message arguments)

 # (ASCII Code 35)
If the Controller sends a correctly formatted command, BUT the Target is not in Remote Mode, the unit does not allow reconfiguration and responds by echoing the valid instruction code, followed by ‘#’.

For example: >0000/TFQ#

~ (ASCII Code 126)
If a message is sent via a local modem to a distant end device or ODU, the message is transmitted transparently through the local modem. In the event of the distant-end device not responding, the local modem responds by echoing the instruction code, followed by ‘~’.

For example: A response of >0001/RET~ indicates that the modem is no longer waiting for a response from the distant end device, and it is now ready for further communications.

8.4.2.6 Optional Message Arguments

Arguments are not required for all messages.

Comma ‘**,**’ (ASCII Code 44), period ‘**.**’ (ASCII Code 46), the numbers ‘**0**’ to ‘**9**’ (ASCII Codes 48 to 57), and the uppercase alphabetic characters ‘**A**’ to ‘**Z**’ (ASCII Codes 65 to 90) may be used.

8.4.2.7 End of Packet

- **Controller-to-Target:** This is the ‘Carriage Return’ ([CR]) character (ASCII Code 13).
- **Target-to-Controller:** This is the two-character sequence ‘Carriage Return’, ‘Line Feed’ ([cr][lf]) (ASCII Codes 13 and 10). Both indicate the valid termination of a packet.

8.5 Remote Commands and Queries

8.5.1 Table Indexes

NOTES:

1) **Index Columns – Where Column 'C'**=Command, and **Column 'Q'**=Query, columns marked '**X**' designate the instruction code as *Command only*, *Query only*, or *Command or Query*.
2) **In the Sect. 8.5.2 thru 8.5.X tables, the following codes are used in the 'Response to Command' column (per Sect. 8.4.2.5):**

= Message ok

\# Message ok, but unit is not in **Remote** mode.

? Received ok, but invalid arguments were found.

~ Time out of a pass-through message to a local ODU

^ Message ok, but unit is in **Ethernet** mode.

Sect. 8.5.2 Tx Parameters

CODE	C	Q	PAGE
TAR	X	X	8-13
TDR	X	X	8-12
TFM	X	X	8-11

CODE	C	Q	PAGE
TFQ	X	X	8-11
TGS	X	X	8-13

CODE	C	Q	PAGE
TMC	X	X	8-11
TPI	X	X	8-13
TPL	X	X	8-13

CODE	C	Q	PAGE
TSI	X	X	8-12
TSR	X	X	8-12
TXO	X	X	8-13

CODE	C	Q	PAGE

Sect. 8.5.3 Rx Parameters

CODE	C	Q	PAGE
EBA	X	X	8-16

CODE	C	Q	PAGE
RAR		X	8-16
RDR		X	8-15
RFM		X	8-14

CODE	C	Q	PAGE
RFQ	X	X	8-14
RGS	X	X	8-16
RMC		X	8-14

CODE	C	Q	PAGE
RPI		X	8-16
RSI		X	8-15
RSR	X	X	8-15

CODE	C	Q	PAGE

Sect. 8.5.4 IP Packet Parameters

CODE	C	Q	PAGE
CCS	X		8-17
CDS	X		8-17

CODE	C	Q	PAGE
CSA		X	8-17
DSA		X	8-17

CODE	C	Q	PAGE
EPC	X	X	8-17
ST1		X	8-18

CODE	C	Q	PAGE
WBL	X	X	8-17

CODE	C	Q	PAGE

Sect. 8.5.5 Unit Parameters

CODE	C	Q	PAGE
ADJ	X	X	8-20
ADR		X	8-19
CAE	X		8-24
CID	X	X	8-20
CNM	X	X	8-26
CSD	X	X	8-26
DAY	X	X	8-20
DMM	X	X	8-26
EDR		X	8-19

CODE	C	Q	PAGE
EFR	X	X	8-20
ELS	X	X	8-24
GFC	X	X	8-26
IEP	X		8-24
IMG		X	8-20
IPA	X	X	8-24
IPG	X	X	8-24
LC1	X	X	8-24
LC2	X	X	8-25

CODE	C	Q	PAGE
LC3	X	X	8-25
LRN	X	X	8-26
LRS	X	X	8-19
MAC		X	8-24
MDR		X	8-19
MSK	X	X	8-21
NET	X	X	8-19
NPS	X	X	8-25

CODE	C	Q	PAGE
OPM	X	X	8-19
RNE		X	8-22
SBS	X	X	8-20
SLC	X	X	8-25
SRC	X	X	8-26
SSC	X	X	8-26
SSL	X	X	8-26

CODE	C	Q	PAGE
SSN	X	X	8-26
STA	X	X	8-26
STB	X	X	8-26
STC	X	X	8-26
STV	X	X	8-26
SWC	X	X	8-26
TIM	X	X	8-20
TST	X	X	8-21

Sect. 8.5.6 ACM Parameters

CODE	C	Q	PAGE
ACM	X	X	8-27

CODE	C	Q	PAGE
ADC	X	X	8-27

CODE	C	Q	PAGE
LES		X	8-27

CODE	C	Q	PAGE
RES		X	8-27

CODE	C	Q	PAGE

Sect. 8.5.7 AUPC Parameters

CODE	C	Q	PAGE
ANP	X	X	8-28
APR	X	X	8-28
ATE	X	X	8-28

CODE	C	Q	PAGE
LCL	X	X	8-28

CODE	C	Q	PAGE
PCS	X	X	8-28

CODE	C	Q	PAGE
RCL	X	X	8-28

CODE	C	Q	PAGE

Sect. 8.5.8 PIIC Interface Parameters

CODE	C	Q	PAGE
EFI	X	X	8-29
ETS	X	X	8-30

CODE	C	Q	PAGE
PRD	X	X	8-32
PRF	X	X	8-31
PRM	X	X	8-31
PRO	X	X	8-32

CODE	C	Q	PAGE
PTD	X	X	8-32
PTF	X	X	8-31
PTM	X	X	8-31
PTR	X	X	8-32

CODE	C	Q	PAGE
RBS	X	X	8-30
RCB	X		8-31
RCK	X	X	8-29

CODE	C	Q	PAGE
TCK	X	X	8-29

Sect. 8.5.9 Bulk Configuration Strings

CODE	C	Q	PAGE
CLD	X		8-35

CODE	C	Q	PAGE
CST	X		8-35

CODE	C	Q	PAGE
MGC	X	X	8-33

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 8.5.10 ODU Parameters

CODE	C	Q	PAGE
LNC		X	8-36
LNH	X	X	8-36

CODE	C	Q	PAGE
LNL	X	X	8-36
LNR	X	X	8-36

CODE	C	Q	PAGE
LPS	X	X	8-36
LVO		X	8-36

CODE	C	Q	PAGE
BCR	X	X	8-36

CODE	C	Q	PAGE

Sect. 8.5.11 Modem Information

CODE	C	Q	PAGE
DMT		X	8-40
EID		X	8-38

CODE	C	Q	PAGE
FCC		X	8-40
FCF		X	8-40

CODE	C	Q	PAGE
FRW		X	8-37
HRV		X	8-37

CODE	C	Q	PAGE
SNO		X	8-37
SWR		X	8-37

CODE	C	Q	PAGE

Sect. 8.5.12 Modem Performance Indication

CODE	C	Q	PAGE
BKE	X		8-43
BRA		X	8-44
BRM	X		8-44
BTX	X	X	8-44

CODE	C	Q	PAGE
CDM		X	8-43
CFM		X	8-43
CRM		X	8-43
FLT		X	8-41

CODE	C	Q	PAGE
RBP	X	X	8-43
RFO		X	8-41
RPS		X	8-44
RSL		X	8-41

CODE	C	Q	PAGE
ST2		X	8-44
ST3		X	8-44
ST4		X	8-44
ST5		X	8-44

CODE	C	Q	PAGE
TBP	X	X	8-43
TMP		X	8-41

Sect. 8.5.13 Redundancy Control

CODE	C	Q	PAGE
ASW	X	X	8-45
FSW	X		8-45

CODE	C	Q	PAGE
RED		X	8-45
R11		X	8-45

CODE	C	Q	PAGE
R1N	X	X	8-45

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 8.5.14 Carrier ID

CODE	C	Q	PAGE
LAT	X	X	8-46
LNG	X	X	8-46

CODE	C	Q	PAGE
MSG	X	X	8-46
MUT	X	X	8-46

CODE	C	Q	PAGE
PHN	X	X	8-46

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 8.5.15 Dynamic Predistortion (DPD)

CODE	C	Q	PAGE
PDM	X	X	8-47

CODE	C	Q	PAGE

CODE	C	Q	PAGE

CODE	C	Q	PAGE

CODE	C	Q	PAGE

8.5.2 Tx Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Tx Frequency	TFQ =	TFQ?	9 bytes	Command or Query. Sets or returns Tx Frequency in MHz, in 100Hz steps, in the form xxxx.xxxx where: xxxx.xxxx=50 MHz to 180 MHz (70/140 MHz), or 950 MHz to 2150 MHz (L-Band) EXAMPLE: <0/TFQ=0950.9872	TFQ= TFQ? TFQ* TFQ#	TFQ=xxxx.xxxx
Tx Framing Mode	TFM =	TFM?	1 byte, 0 or 1	Command or Query. Sets or returns Tx Framing mode in the form x, where: 0=Normal Block 1=Short Block NOTE: Not all Network Specs will support both Framing Modes. EXAMPLE: <0/TFM=1 (selects Short Block mode)	TFM= TFM? TFM* TFM#	TFM=x
Tx ModCod	TMC =	TMC?	2 bytes, value of 00 to 52	Command or Query. FOR NET=0: Sets or returns Tx Modulation in the form xx, where: 00=ACM 01=reserved (QPSK 1/4) 02=reserved (QPSK 1/3) 03=reserved (QPSK 2/5) 04=QPSK 1/2 05=QPSK 3/5 06=QPSK 2/3 07=QPSK 3/4 08=QPSK 4/5 09=QPSK 5/6 10=QPSK 8/9 11=QPSK 9/10 12=8PSK 3/5 13=8PSK 2/3 14=8PSK 3/4 15=8PSK 5/6 16=8PSK 8/9 17=8PSK 9/10 18=16-APSK 2/3 19=16-APSK 3/4 20=16-APSK 4/5 21=16-APSK 5/6 22=16-APSK 8/9 23=16-APSK 9/10 24=32-APSK 3/4 25=32-APSK 4/5 26=32-APSK 5/6 27=32-APSK 8/9 28=32-APSK 9/10 FOR NET=1: Sets or returns Tx Modulation in the form xx, where: 00=ACM 01=reserved (QPSK 1/4) 02=reserved (QPSK 53/180) 03=reserved (QPSK 1/3) 04=reserved (QPSK 11/30) 05=reserved (QPSK 2/5) 06=reserved (QPSK 77/180) 07=reserved (QPSK 83/180) 08=QPSK 1/2 09=QPSK 8/15 10=QPSK 17/30 11=QPSK 3/5 12=QPSK 19/30 13=QPSK 2/3 14=QPSK 127/180 15=QPSK ¾ 16=QPSK 4/5 17=QPSK 5/6 18=QPSK 31/36 19=QPSK 8/9 20=QPSK 9/10 21=8PSK 17/30 22=8PSK 3/5 23=8PSK 19/30 24=8PSK 2/3 25=8PSK 127/180 26=8PSK 3/4 27=8PSK 4/5 28=8PSK 5/6 29=8PSK 31/36 30=8PSK 8/9 31=8PSK 9/10 32=16-ASK 19/30 33=16-APSK 2/3 34=16-APSK 128/180 35=16-APSK 3/4 36=16-APSK 4/5 37=16-APSK 5/6 38=16-APSK 31/36 39=16-APSK 8/9 40=16-APSK 9/10 41=32-APSK 127/180 42=32-APSK 3/4 43=32-APSK 4/5 44=32-APSK 5/6 45=32-APSK 31/36 46=32-APSK 8/9 47=32-APSK 9/10	TMC= TMC? TMC* TMC#	TMC=xx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Tx ModCod (cont.)				For NET=2: Sets or returns Tx Modulation in the form xx, where: 00=ACM 01=reserved (QPSK 1/4) 02=reserved (QPSK 53/180) 03=reserved (QPSK 1/3) 04=reserved (QPSK 11/30) 05=reserved (QPSK 2/5) 06=reserved (QPSK 77/180) 07=reserved (QPSK 83/180) 08=QPSK 1/2 09=QPSK 8/15 10=QPSK 17/30 11=QPSK 3/5 12=QPSK 19/30 13=QPSK 2/3 14=QPSK 127/180 15=QPSK 3/4 16=QPSK 4/5 17=QPSK 5/6 18=QPSK 31/36 19=QPSK 8/9 20=QPSK 9/10 21=8PSK 17/30 22=8PSK 3/5 23=8PSK 19/30 24=8PSK 2/3 25=8PSK 127/180 26=8PSK 3/4 27=8PSK 4/5 28=8PSK 5/6 29=8PSK 31/36 30=8PSK 8/9 31=8PSK 9/10 32=16-ASK 19/30 33=16-APSK 2/3 34=16-APSK 128/180 35=16-APSK 3/4 36=16-APSK 4/5 37=16-APSK 5/6 38=16-APSK 31/36 39=16-APSK 8/9 40=16-APSK 9/10 41=32-APSK 127/180 42=32-APSK 3/4 43=32-APSK 4/5 44=32-APSK 5/6 45=32-APSK 31/36 46=32-APSK 8/9 47=32-APSK 9/10 48=64-APSK 4/5 49=64-APSK 5/6 50=64-APSK 31/36 51=64-APSK 8/9 52=64-APSK 9/10		
Tx Symbol Rate	TSR=	TSR?	10 bytes, numeric	Command or Query. Sets or returns Tx Symbol Rate, in ksps, in the form dddddd.ddd where the range is: QPSK – From .1 to 150000 ksps 8PSK – From .1 to 120000 ksps 16-APSK – From .1 to 90000 ksps 32-APSK – From .1 to 72000 ksps 64-APSK – From .1 to 54000 ksps NOTE: If the Symbol Rate is set, then the Data Rate will be automatically calculated and updated. EXAMPLE: <0/TSR=150000.000 (150 Msps)	TSR? TSR= TSR* TSR#	TSR=xxxxxx.xxx
Tx Data Rate	TDR=	TDR?	10 bytes, numeric	Command or Query. Sets or returns Tx Data rate in kbps, in 1 bps steps, in the form xxxxxx.xxx. NOTE: If the Data Rate is set, then the Symbol Rate will be automatically calculated and updated. The symbol rate will be limit checked to assure valid ranges. EXAMPLE: <0/TDR=002047.999 (2047.999 kbps)	TDR= TDR? TDR* TDR#	TSI=x
Tx Spectrum Invert	TSI=	TSI?	1 byte, value of 0 or 1	Command or Query. Sets or returns Tx Spectrum Invert in the form x, where: 0=Normal 1=Tx Spectrum Inverted EXAMPLE: <0/TSI=0 (selects Normal)	TSI= TSI? TSI* TSI#	TDR=xxxxxx.xxx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Tx Alpha Rolloff	TAR=	TAR?	1 byte, value of 0 thru 5	Command or Query. Sets or returns Tx Alpha Rolloff in the form x, where: 0=20% 1=25% 2=35% 3=5% (only available when NET>0) 4=10% (only available when NET>0) 5=15% (only available when NET>0) EXAMPLE: <0/TAR=0 (selects a Tx Alpha Rolloff of 20%)	TAR= TAR? TAR* TAR#	TAR=x
Tx Gold Code Sequence Index	TGS=	TGS?	6 bytes	Command or Query. Sets or returns Tx Gold Code Sequence Index in the form xxxxxx, where: Gold Code Sequence Index=000000 to 262141 EXAMPLE: <0/TGS=189063	TGS= TGS? TGS* TGS#	TGS=xxxxxx
Tx Pilot	TPI=	TPI?	1 byte, value of 0 or 1	Command or Query. Sets or returns Tx Pilot in the form x, where: 0=Off 1=On NOTES: 1) CEFD recommends that you use Pilots when running any 16-APSK, 32-APSK, or 64-APSK ModCod. 2) Pilots are recommended when the symbol rate is below 5000 ksps. EXAMPLE: <0/TPI=0 (selects Pilot Off)	TPI= TPI? TPI* TPI#	TPI=x
Tx Power Level	TPL=	TPL?	5 bytes	Command or Query. Sets or returns Tx Output power level (dBm), in 0.1 dB steps, in the form sxx.x, where: s=sign (+ or -) xx.x=power level (dBm) from 0 to -25 dBm (70/140 MHz) or 0 to -40 dBm (L-Band) EXAMPLE: <0/TPL=-13.4	TPL= TPL? TPL* TPL#	TPL=sxx.x
Tx Carrier State	TXO=	TXO?	1 byte, value of 0 or 1	Command or Query. Sets or returns Tx Carrier State in the form x, where: 0=OFF due to front panel or remote control command 1=ON EXAMPLE: <0/TXO=1 (Tx Carrier ON)	TXO= TXO? TXO* TXO#	TXO=x

8.5.3 Rx Parameters

<table>
<tr><th rowspan="2">Parameter Type</th><th colspan="2">Controller-to-Target Instruction Code and Qualifier</th><th rowspan="2">Arguments for Command or Query</th><th rowspan="2" colspan="3">Description of Arguments
(Note that all arguments are ASCII numeric codes from 48 to 57)</th><th colspan="2">Target-to-Controller
(see Description of Arguments)</th></tr>
<tr><th>Command</th><th>Query</th><th>Response to Command</th><th>Response to Query</th></tr>
<tr><td>Rx Frequency</td><td>RFQ=</td><td>RFQ?</td><td>9 bytes</td><td colspan="3">Command or Query.
Sets or returns Rx Frequency ranges in MHz, in 100Hz steps, in the form xxxx.xxxx where:
xxxx.xxxx=value from 50 MHz to 180 MHz (70/140 MHz), or from 950 MHz to 2150 MHz (L-Band)
EXAMPLE: <0/RFQ=0950.9872</td><td>RFQ=
RFQ?
RFQ*
RFQ#</td><td>RFQ=xxxx.xxxx</td></tr>
<tr><td>Rx Framing Mode</td><td>N/A</td><td>RFM?</td><td>1 byte, value of 0 or 1</td><td colspan="3">Query only.
Returns Rx Framing mode in the form x, where:
0=Normal Block
1=Short Block
NOTE: Not all Network Specs will support both Framing Modes.
EXAMPLE: <0/RFM?
>0000/RFM=1 (Short Block mode)</td><td>RFM?
RFM*
RFM#</td><td>RFM=x</td></tr>
<tr><td rowspan="4">Rx ModCod</td><td rowspan="4">N/A</td><td rowspan="4">RMC?</td><td rowspan="4">2 bytes</td><td colspan="3">Command or Query.
FOR NET=0: Sets or returns Rx Demodulation in the form xx, where:</td><td rowspan="4">RMC?
RMC*
RMC#</td><td rowspan="4">RMC=xx</td></tr>
<tr><td>00=ACM
01=reserved (QPSK 1/4)
02=reserved (QPSK 1/3)
03=reserved (QPSK 2/5)
04=QPSK 1/2
05=QPSK 3/5
06=QPSK 2/3
07=QPSK 3/4
08=QPSK 4/5
09=QPSK 5/6</td><td>10=QPSK 8/9
11=QPSK 9/10
12=8PSK 3/5
13=8PSK 2/3
14=8PSK 3/4
15=8PSK 5/6
16=8PSK 8/9
17=8PSK 9/10
18=16-APSK 2/3
19=16-APSK 3/4</td><td>20=16-APSK 4/5
21=16-APSK 5/6
22=16-APSK 8/9
23=16-APSK 9/10
24=32-APSK 3/4
25=32-APSK 4/5
26=32-APSK 5/6
27=32-APSK 8/9
28=32-APSK 9/10</td></tr>
<tr><td colspan="3">FOR NET=1: Sets or returns Rx Modulation in the form xx, where:</td></tr>
<tr><td>00=ACM
01=reserved (QPSK 1/4)
02=reserved (QPSK 53/180)
03=reserved (QPSK 1/3)
04=reserved (QPSK 11/30)
05=reserved (QPSK 2/5)
06=reserved (QPSK 77/180)
07=reserved (QPSK 83/180)
08=QPSK 1/2
09=QPSK 8/15
10=QPSK 17/30
11=QPSK 3/5
12=QPSK 19/30
13=QPSK 2/3
14=QPSK 127/180
15=QPSK 3/4</td><td>16=QPSK 4/5
17=QPSK 5/6
18=QPSK 31/36
19=QPSK 8/9
20=QPSK 9/10
21=8PSK 17/30
22=8PSK 3/5
23=8PSK 19/30
24=8PSK 2/3
25=8PSK 127/180
26=8PSK 3/4
27=8PSK 4/5
28=8PSK 5/6
29=8PSK 31/36
30=8PSK 8/9
31=8PSK 9/10</td><td>32=16-ASK 19/30
33=16-APSK 2/3
34=16-APSK 128/180
35=16-APSK 3/4
36=16-APSK 4/5
37=16-APSK 5/6
38=16-APSK 31/36
39=16-APSK 8/9
40=16-APSK 9/10
41=32-APSK 127/180
42=32-APSK 3/4
43=32-APSK 4/5
44=32-APSK 5/6
45=32-APSK 31/36
46=32-APSK 8/9
47=32-APSK 9/10</td></tr>
</table>

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Rx ModCod (cont.				For NET=2: Sets or returns Rx Modulation in the form xx, where: 00=ACM 01=reserved (QPSK 1/4) 02=reserved (QPSK 53/180) 03=reserved (QPSK 1/3) 04=reserved (QPSK 11/30) 05=reserved (QPSK 2/5) 06=reserved (QPSK 77/180) 07=reserved (QPSK 83/180) 08=QPSK 1/2 09=QPSK 8/15 10=QPSK 17/30 11=QPSK 3/5 12=QPSK 19/30 13=QPSK 2/3 14=QPSK 127/180 15=QPSK 3/4 16=QPSK 4/5 17=QPSK 5/6 18=QPSK 31/36 19=QPSK 8/9 20=QPSK 9/10 21=8PSK 17/30 22=8PSK 3/5 23=8PSK 19/30 24=8PSK 2/3 25=8PSK 127/180 26=8PSK 3/4 27=8PSK 4/5 28=8PSK 5/6 29=8PSK 31/36 30=8PSK 8/9 31=8PSK 9/10 32=16-ASK 19/30 33=16-APSK 2/3 34=16-APSK 128/180 35=16-APSK 3/4 36=16-APSK 4/5 37=16-APSK 5/6 38=16-APSK 31/36 39=16-APSK 8/9 40=16-APSK 9/10 41=32-APSK 127/180 42=32-APSK 3/4 43=32-APSK 4/5 44=32-APSK 5/6 45=32-APSK 31/36 46=32-APSK 8/9 47=32-APSK 9/10 48=64-APSK 4/5 49=64-APSK 5/6 50=64-APSK 31/36 51=64-APSK 8/9 52=64-APSK 9/10 All other codes are invalid.		
Rx Symbol Rate	RSR=	RSR?	10 bytes, numeric	Command or Query. Sets or returns Rx Symbol Rate, in ksps, in the form dddddd.ddd in the range: QPSK – From .1 to 150000 ksps 8PSK – From .1 to 120000 ksps 16-APSK – From .1 to 90000 ksps 32-APSK – From .1 to 72000 ksps 64-APSK – From .1 to 54000 ksps NOTE: If the Symbol Rate is set, then the Data Rate will be automatically calculated and updated. EXAMPLE: <0/RSR=150000.000	RSR= RSR? RSR* RSR#	RSR=dddddd.ddd
Rx Data Rate	N/A	RDR?	10 bytes	Query only. Returns Rx Data Rate, in kbps, in the form xxxxxx.xxx EXAMPLE: <0/RDR? >0000/RDR=002047.999	RDR? RDR* RDR#	RDR=xxxxxx.xxx
Rx Spectrum Invert	N/A	RSI?	1 byte, value of 0 or 1	Query only. Returns Rx Spectrum Invert in the form x, where: 0=Normal 1=Rx Spectrum Inverted EXAMPLE: <0/RSI? >0000/RSI=0 (selects Normal)	RSI? RSI* RSI#	RSI=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Rx Alpha Rolloff	N/A	RAR?	1 byte, value of 0 thru 5	Query only. Returns Rx Alpha Rolloff in the form x, where: 0=20% 1=25% 2=35% 3=5% (only available when NET>0) 4=10% (only available when NET>0) 5=15% (only available when NET>0) EXAMPLE: <0/RAR? >0000/RAR=0 (reports Rx Alpha Rolloff of 20%)	RAR? RAR* RAR#	RAR=x
Rx Gold Code Sequence Index	RGS=	RGS?	6 bytes	Command or Query. Sets or returns Rx Gold Code Sequence Index in the form xxxxxx, where: xxxxxx=index number from 000000 to 262141 EXAMPLE: <0/RGS=189063	RGS= RGS? RGS* RGS#	RGS=xxxxxx
Rx Pilot	N/A	RPI?	1 byte, value of 0 or 1	Query only. Returns Rx Pilot status in the form x, where: 0=Off 1=On NOTE: This is automatically detected on demod acquisition. If the unit is not locked, the query returns 'x'.	RPI? RPI* RPI#	RPI=x
Es/No Alarm Point	EBA=	EBA?	4 bytes	Command or Query. Sets or returns Es/No alarm point, in dB, in 0.1 dB steps, in the form sxxx where: s=sign (+ or -) xxx=alarm point * 10. EXAMPLE: <0/EBA=+123 (sets alarm point to +12.3 dB)	EBA= EBA? EBA* EBA#	EBA=sxxx

8.5.4 IP Packet Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Payload Compression	EPC=	EPC?	1 byte, value of 0 thru 3	Command or Query. Enable or Disable Payload Compression and Decompression in the form x, where: 0=Disable Decompression, Disable Compression 1=Disable Decompression, Enable Compression 2=Enable Decompression, Disable Compression 3=Enable Decompression, Enable Compression EXAMPLE: <0/EPC=1 (selects decompression off and compression on)	EPC= EPC? EPC* EPC#	EPC=x
Compression Stats All	N/A	CSA?	21 bytes	Query only. Returns all compression statistics, each separated by a colon, in the form x.xE+xx:x.xE+xx:xx:xx, where: x.xE+xx=The total number of bytes into the compressor x.xE+xx=The total number of bytes out of the compressor xx=value from 00 to 99 (The percent savings or compression efficiency) xx=value from 00 to 99 (The last 10 seconds percent savings or compression efficiency) EXAMPLE: <0/CSA? RESPONSE EXAMPLE 1: >0000/CSA=2.0E+03:1.0E+03:50:50 RESPONSE EXAMPLE 2: >0000/CSA=X.XE+XX:X.XE+XX:XX:XX (If the Compression Option Card is not present, then all numeric fields display "X")	N/A	CSA= x.xE+xx:x.xE+xx :xx:xx
DeComp Stats All	N/A	DSA?	21 bytes	Query only. Returns all decompression statistics, each separated by a colon, in the form x.xE+xx:x.xE+xx:xx:xx, where: x.xE+xx=The total number of bytes into the decompressor x.xE+xx=The total number of bytes out of the decompressor xx=value from 00 to 99 The percent savings or decompression efficiency xx=value from 00 to 99 The last 10 second percent savings or decompression efficiency EXAMPLE: <0/ESA? RESPONSE EXAMPLE 1: <0/DSA=2.0E+03:1.0E+03:50:50 RESPONSE EXAMPLE 2: <0/DSA=X.XE+XX:X.XE+XX:XX:XX (if the Decompression Option Card is not present, then all numeric fields display "X")	N/A	DSA=x.xE+xx:x. xE+xx:xx:xx
Clear Compression Statistics	CCS=	N/A	None	Command only. Clear Compression Statistics. NOTE: THIS COMMAND TAKES NO ARGUMENTS. EXAMPLE: <0/CCS=	CCS= CCS? CCS* CCS#	N/A
Clear Decompression Statistics	CDS=	N/A	None	Command Only. Clear Decompression Statistics. NOTE: THIS COMMAND TAKES NO ARGUMENTS. EXAMPLE: <0/CDS=	CDS= CDS? CDS* CDS#	N/A
WAN Buffer Length	WBL=	WBL?	3 bytes	Command or Query. Sets or returns WAN Buffer Length in ms, in 20 ms steps, in the form xxx where: xxx=value from 20 to 400ms EXAMPLE: <0/WBL=100	WBL= WBL? WBL* WBL#	WBL=xxx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
IP Statistics	N/A	ST1?	143 bytes	Query only. Returns all IP Statistics, with each parameter separated by a colon, in the form x.xE+xx for each parameter is GBEI1 Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN GBEI2 Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN WAN Parameters Packets to WAN Bytes to WAN Packets from WAN Bytes from WAN M&C Parameters Packets from M&C Packets to M&C Optical Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN	N/A	ST1=x.xE+xx:x.xE+xx:xx:xx

8.5.5 Unit Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Minimum Data Rate (MultiStream Mode)	N/A	MDR?	10 bytes	Query only. **Applies to MultiStream Mode.** Returns the minimum data rate of the modem, in the form xxxxxx.xxx. In MultiStream mode, the minimum data rate calc is EDR + MDR=ADR where: MDR=(PIIC1 + PIIC2) * 1.015 for Normal Frames MDR=(PIIC1 + PIIC2) * 1.05 for Short Frames In non-MultiStream mode (Ethernet Only): MDR=ADR In non-MultiStream mode (Assume PIIC 1 G703-E3): MDR=ADR	N/A	MDR=xxxxxx.xxx
Ethernet Data Rate (MultiStream Mode)	N/A	EDR?	10 bytes	Query only. **Applies to MultiStream Mode.** Returns the Ethernet data rate of the modem in the form xxxxxx.xxx. In MultiStream mode, the Ethernet data rate calc is EDR=ADR - MDR In non-Multistream mode (Ethernet only): EDR=ADR. In non-MultiStream mode (G703-E3): EDR=00000.000 kbps	N/A	EDR=xxxxxx.xxx
Total or Aggregate Data Rate (MultiStream Mode)	N/A	ADR?	10 bytes	Query only. **Applies to MultiStream Mode.** Returns the total or aggregate data rate of the modem (which is the same as the Tx Data Rate) in the form xxxxxx.xxx. In MultiStream mode, the aggregate data rate calc is ADR=EDR+ MDR In non-Multistream mode (Ethernet only): ADR=EDR. In non-MultiStream mode (G703-E3): EDR=00000.000 kbps	N/A	ADR=xxxxxx.xxx
Local/Remote Status	LRS=	LRS?	1 byte, value of 0 thru 4	Command or Query. Sets or returns the user's Local/Remote status in the form x, where: 0=Local 1=Serial Remote (RS-232/RS-485) 2=reserved 3=Ethernet Remote 4=Ethernet plus Serial (DEFAULT) EXAMPLE: <0/LRS=0 (selects Local)	LRS= LRS? LRS* LRS#	LRS=x
Network Specification	NET=	NET?	1 byte, value of 0 thru 2	Command or Query. Sets or returns the modem's NetSpec, in the form x, where: 0=DVB-S2 1=DVB-S2-EB1 2=DVB-S2-EB2 3=DVB-S2X EXAMPLE: <0/NET=0 (selects DVB-S2)	NET= NET? NET* NET#	NET=x
Modem Operating Mode	OPM=	OPM?	1 byte, value of 0-3	Command or Query. Sets or returns the modem's Operating Mode, in the form x, where: 0=Normal 1=MEO Hub TxRx 2=MEO Remote TxRx 3=MEO RxOnly EXAMPLE: <0/OPM=0 (selects Normal)	OPM= OPM? OPM* OPM#	OPM=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Software Boot From Image	SBS=	SBS?	1 byte, value of 1 or 2	Command or Query. Sets or returns which bulk firmware image to boot from, in the form x, where: 1=Firmware is Image #1 2=Firmware is Image #2 EXAMPLE: <0/SBS=1 (selects Image 1 Firmware)	SBS= SBS? SBS* SBS#	SBS=x
Current Software Image	N/A	IMG?	1 byte, value of 1 or 2	Query only. Returns the active software image in the form x, where: 1=Bulk Image #1 currently active 2=Bulk Image #2 currently active	N/A	IMG=x
Circuit ID String	CID=	CID?	4 to 32 bytes	Command or Query. Sets or returns the user-defined Circuit ID string, selects 4 to 32 characters in length. Valid characters include: [Space] ( ) * + – . / 0 thru 9 and A thru Z	CID= CID? CID* CID#	CID=x
Date	DAY=	DAY?	6 bytes	Command or Query. Sets or returns a date in the form ddmmyy (European format), where dd=day of the month (01- 31) mm=month (01-12) yy=year (00-99) EXAMPLE: <0/DAY=240457 (April 24, 2057)	DAY= DAY? DAY* DAY#	DAY=ddmmyy
Time	TIM=	TIM?	6 bytes	Command or Query. Sets or returns the time from midnight in the form hhmmss, where: hh=hours (00-23) mm=minutes (00-59) ss=seconds (00-59) EXAMPLE: <0/TIM=231259 (23 hours:12 minutes:59 seconds)	TIM= TIM? TIM* TIM#	TIM=hhmmss
External Frequency Reference	EFR=	EFR?	1 byte, value of 0 thru 5	Command or Query. Sets or returns the External Frequency Reference in the form x, where: 0=Internal 10MHz (DEFAULT) 1=External 1 MHz 2=External 2 MHz 3=External 5 MHz 4=External 10 MHz 5=Internal 10MHz plus output (this means that the Reference is available on the “J8 | EXT REF” rear panel connector (connector LED indicates when ON). EXAMPLE: <0/EFR=1 (selects External 1MHz)	EFR= EFR? EFR* EFR#	EFR=x
Adjustment for Internal 10MHz High- stability Reference	ADJ=	ADJ?	4 bytes	Command or Query. Sets or returns fine adjustment of the Internal 10MHz Reference on the High-Stability Frequency Reference module in the form sddd, where: s=sign (+ or –) ddd=value from 000 to 999.	ADJ= ADJ? ADJ* ADJ#	ADJ=sddd

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Unit Test Mode	TST=	TST?	1 byte, value of 0 thru 8	Command or Query. Sets or returns Unit Test Mode in the form x, where: 0=Normal Mode (no test) 1=Tx CW 2=Reserved 3=Single Side Band 4=IQ PN Sequence 5=RF Loopback (auto configures Rx to match Tx) 6=IF Loopback EXAMPLE: <0/TST=5 (RF Loopback)	TST= TST? TST* TST#	TST=x
Unit Alarm Mask	MSK=	MSK?	36 bytes	Command or Query. Sets or returns unit alarm masks in the form abcdefgxxxxxxxxxhijklmxxxxnopqrsxxxx, where: Unit Alarm mask conditions, in form abcdefg, where: a=Rx AGC Alarm*** b=Es/No Alarm*** c=Ethernet Link Alarm d=LNB e=Reference alarm f=AUPC Alarm**** g=Rx decompression mismatch alarm*** z=FCnC Alarm*** xxxxxxxxx (8 spares) PIIC1 Alarm mask conditions, in form hijklm, where: h=Rx Buf PLL Alarm*** i=Rx Buf OverFlow Alarm*** j=Rx Buf UnderFlow Alarm*** k=Ext Clk Act Alarm l=Ext Clk In Range Alarm m=Input signal loss Alarm n=Tx Symbol Clock PLL Alarm o=Tx Frame Lock Alarmxx (2 spares) PIIC2 Alarm mask conditions, in form nopqrs, where: p=Rx Buf PLL Alarm*** q=Rx Buf OverFlow Alarm*** r=Rx Buf UnderFlow Alarm*** s=Ext Clk Act Alarm t=Ext Clk In Range Alarm u=input signal loss Alarm v=Tx Symbol Clock PLL Alarm w=Tx Frame Lock Alarm xx (2 spares)	MSK= MSK? MSK* MSK#	MSK= abcdefgzxxxxxx xx hijklmnoxx pqrstuvwxx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Unit Alarm Mask (cont.)				For PIIC1 And PIIC2 U=Uninstalled X=Installed/Spare Value of each mask: *** indicates a three-state mask where 0=Unmasked Alarm (will not cause a redundant switch) 1=Unmasked Fault (default, causes redundant switch) 2=Masked (Ignore alarm or fault) **** indicates a 3 state mask where 0=Unmasked Alarm (will not cause a redundant switch) 1=Masked (Ignore alarm or fault) 2=Unmasked Fault Tx On (causes redundant switch but leaves Transmit output power on) All other masks are four-state masks where 0=Unmasked Alarm (will not cause a redundant switch) 1=Unmasked Fault (default, causes redundant switch) 2=Masked (Ignore alarm or fault) 3=Unmasked Fault Tx On (causes redundant switch but leaves Transmit output power on) NOTE: Masks for alarms that are not applicable to various interface types (such as external clocks for OC3) are reserved as placeholders and will not have any effect on operation. EXAMPLE: <0/MSK? <0000/MSK=11001010000000000000000000000000		
Retrieve next five unread Stored Events	N/A	RNE?	110 bytes	Query only. Returns the oldest five 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, where Sub-body=Axxxxxxxxddmmyyhhmmss: A is the fault type where: 1=Unit 2=Rx Traffic 3=Tx Traffic 4=Info xxxxxxxx is the Fault Code number, as in FLT? or Info Code, which may be: 00000000=Power Off 00000001=Power On 00000002=Log Cleared 00000003=Global Config Change 00000004=Redundancy Config Change 00000005=Fractional CnC On 00000006=Demo Mode is On 00000007=Watch Dog Reset 00000008=RFD Reset 00000009=FRB Reset 0000000A=NVRAM Reset	N/A	RNE=[CR]Axxxxxxxxddmmyyhhmmss[CR]Axxxxxxxxddmmyyhhmmss[CR]Axxxxxxxxddmmyyhhmmss[CR]Axxxxxxxxddmmyyhhmmss[CR]Axxxxxxxxddmmyyhhmmss

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Retrieve next five unread Stored Events (cont.)				ddmmyy=date stamp. hhmmss=time stamp. NOTE: If there are less than five events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNE*.		
Clear All Stored Events	CAE=	N/A	None	Command only. Forces the software to clear the events log. THIS COMMAND TAKES NO ARGUMENTS.	CAE= CAE? CAE* CAE#	N/A
Initialize the Stored Events Pointer	IEP=	N/A	None	Command only. Resets internal pointer to allow RNE? queries to start at the beginning of the stored events log. THIS COMMAND TAKES NO ARGUMENTS.	IEP= IEP? IEP#	N/A
Event Log Style	ELS=	ELS?	1 byte, value of 0 or 1	Command or Query Sets or returns the EventLog Style in the form x, where: 0=Fill and Stop (DEFAULT) 1=Fill and Roll-over EXAMPLE: <0/ELS=0 (sets EventLog to Fill and Stop)	ELS= ELS? ELS* ELS#	ELS=x
Management IP Address	IPA=	IPA?	18 bytes	Command or Query. Sets or returns the IP Address and network prefix for the 10/100 Base-T Ethernet management port, in the form aaa.bbb.ccc.ddd.yy, where: aaa=000-223 bbb=000-255 ccc=000-255 ddd=000-255 yy=network prefix (value from 8 to 31) EXAMPLE: <0/IPA=010.006.030.001.24	IPA= IPA? IPA* IPA#	IPA=xxx.xxx.xxx.xxx.yy
Management Default IP Gateway	IPG=	IPG?	15 bytes	Command or Query. Sets or returns the IP Gateway Address for the Ethernet management port in the form aaa.bbb.ccc.ddd where: aaa=000-223 bbb=000-255 ccc=000-255 ddd=001-255 EXAMPLE: <0/IPG=010.006.030.001	IPG= IPG? IPG* IPG#	IPG=xxx.xxx.xxx.xxx
Management MAC Address	N/A	MAC?	12 bytes, hexadecimal	Query only. Returns the unique MAC Address for the modem in the form aabbccddeeff. EXAMPLE: <0/MAC? <0000/MAC=0006B00001C2	N/A	MAC=aabbccddeeff

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
GE1 Link Configuration	LC1=	LC1?	1 byte, value of 0 thru 6	Command or Query. Sets or returns the GE1 Interface mode in the form x, where: 0=Auto Negotiate (default) 1=1000Mbps Full Duplex 2=100Mbps Full Duplex 3=100Mbps Half Duplex 4=10Mbps Full Duplex 5=10Mbps Half Duplex 6=Off	LC1= LC1? LC1* LC1#	LC1=x
GE2 Link Configuration	LC2=	LC2?	1 byte, value of 0 thru 6	Command or Query. Sets or returns the GE2 Interface mode in the form x, where: 0=Auto Negotiate (default) 1=1000Mbps Full Duplex 2=100Mbps Full Duplex 3=100Mbps Half Duplex 4=10Mbps Full Duplex 5=10Mbps Half Duplex 6=Off	LC2= LC2? LC2* LC2#	LC2=x
Negotiated Port Status	N/A	NPS?	2 bytes	Query only Returns GE1/GE2 port status in the form ab, where: a=GE1 status b=GE2 status defines as follows: 0=Not Resolved or No Link 1=10 Mbps Half-Duplex 2=10 Mbps Full-Duplex 3=100 Mbps Half-Duplex 4=100 Mbps Full-Duplex 5=1000 Mbps Full-Duplex EXAMPLE: <0/NPS? <0000/NPS=55 (1000 Mbps both ports)	N/A	NPS=ab
Gig Optical Ethernet Interface	LC3=	LC3?	1 byte, value of 0 or 1	Command or Query. Sets or returns the GigE Optical Ethernet Interface mode in the form x, where: 0=Off 1=On NOTE: Option must be purchased and SFP module installed!	LC3= LC3? LC3* LC3#	LC3=x
Inband Communi-cations	SLC=	SLC?	1 byte, value of 0 or 1	Command or Query. Sets or returns isolation (opening) or connection of the SERDES link between the management Ethernet port and the data Ethernet ports, in the form x, where: 0=InBand Disabled 1=InBand Enabled	SLC= SLC? SLC* SLC#	SLC=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
GBEI Flow Control	GFC=	GFC?	1 byte, value of 0 or 1	Command or Query. Enables or disables flow control in the form x, where: 0=Disable GBEI Flow Control 1=Enable GBEI Flow Control **NOTE:** Applies to all ports.	GFC= GFC* GFC#	GFC=x
GBEI MAC Learning	LRN=	LRN?	1 byte, value of 0 or 1	Command or Query. Enables or disables MAC address learning in the form x, where: 0=Disable MAC learning 1=Enable MAC learning **NOTE:** Applies to all ports.	LRN= LRN?	LRN=x
SNMP Read Community	SRC=	SRC?	1 to 20 bytes, characters, no spaces	Command or Query. Sets or returns SNMP read community string. **NOTE:** Empty string is not allowed **EXAMPLE:** <0/SRC=public	SRC= SRC!	SRC=x
SNMP Write Community	SWC=	SWC?	1 to 20 bytes, characters, no spaces	Command or Query. Sets or returns SNMP write community string. **NOTE:** Empty string is not allowed. **EXAMPLE:** <0/SWC=private	SWC= SWC!	SWC=x
SNMP Trap Community	STC=	STC?	1 to 20 bytes, characters, no spaces	Command or Query. Sets or returns SNMP traps community string. **NOTE:** Empty string is not allowed **EXAMPLE:** <0/STC=Comtech	STC= STC!	STC=x
SNMP Trap Destination IP Address 1	STA=	STA?	15 bytes	Command or Query. Sets or returns the IP address of the first SNMP Trap destination IP Address 1 where traps will be sent, in the form xxx.xxx.xxx.xxx. **EXAMPLE:** <0/STA=010.006.030.001 (if not configured, returns 000.000.000.000)	STA= STA!	STA=xxx.xxx.xxx.xxx
SNMP Trap Destination IP Address 2	STB=	STB?	15 bytes	Command or Query. Sets or returns the IP address of the SNMP Trap destination IP Address 2 where traps will be sent, in the form xxx.xxx.xxx.xxx. **EXAMPLE:** <0/STB=010.006.030.001 (if not configured, returns 000.000.000.000)	STB= STB!	STB=xxx.xxx.xxx.xxx
SNMP System Contact	SSC=	SSC?	0 to 255 bytes, characters,	Command or Query. Sets or returns SNMP System Contact string. **EXAMPLE:** <0/SSC=Joe Net Admin (if not configured, returns empty string: <0/SSC=)	SSC= SSC!	SSC=x
SNMP Unit Name	SSN=	SSN?	16 bytes, characters,	Command or Query. Sets or returns SNMP System Name string. **EXAMPLE:** <0/SSN=Remote1 (if not configured, returns empty string: <0/SSC=)	SSN= SSN!	SSN=x
SNMP System Location	SSL=	SSL?	0 to 255 bytes	Command or Query. Sets or returns SNMP System Location string. **EXAMPLE:** <1/SSL=Upstairs back right (if not configured, returns empty string: <0/SSL=)	SSL= SSL!	SSL=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
SNMP Trap Version	STV=	STV?	1 byte, value of 1 or 2	Command or Query. Sets or returns SNMP Trap Version that will be used to send traps in the form x, where: 1=SNMP Trap Version 1 2=SNMP Trap Version 2 EXAMPLE: <0/STV=1	STV= STV!	STV=x
DoubleTalk® Carrier-in-Carrier® (CnC) Mode	CNM=	CNM?	1 byte, value of 0 or 1	Command or Query. Enables or Disables CnC in the form x, where: 0=Off 1=On NOTES: 1) CnC may be enabled only if the optional plug-in hardware CnC card has been installed AND a CnC FAST option is unlocked. 2) The range of permitted data rates is controlled by a FAST feature code. (Read EID to decode the installed options for the modem.)	CNM= CNM? CNM* CNM#	CNM=x
CnC Min/Max Search Delay	CSD=	CSD?	6 bytes	Command or Query. (CnC parameter) Sets or returns CnC min/max delay value, in ms, in the form xxxyyy where: xxx=minimum delay yyy=maximum delay NOTE: Maximum allowable value is 300ms. EXAMPLE: <0/CSD=010300 (sets delay range from 10 ms min to 300 ms max value)	CSD= CSD? CSD* CSD#	CSD=xxxyyy
Demo Mode	DMM=	DMM?	1 byte, value of 0 or 1	Command or Query. Enables or Disables Demo Mode in the form x, where: 0=Disable Demo Mode 1=Enable Demo Mode EXAMPLE: <0/DMM=0 (disables Demo Mode)	DMM= DMM? DMM* DMM#	DMM=x

8.5.6 ACM Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
ACM Operating Parameters	ACM=	ACM?	7 bytes	Command or Query. Sets or returns ACM operating parameters in the form mmMMATT, where: mm=Minimum ModCod, range is 1 to 28 (NET=0) or 1 to 47 (NET=1) MM=Maximum ModCod, range is 1 to 28 A=Defines action on remote demod unlock (0=go to minimum Tx ModCod, 1=maintain Tx ModCod) TT=Target EsNo Margin, from 0 to 45 that is ten times the EsNo in dB (from 0.0dB to 4.5dB). EXAMPLE: <0/ACM=0121010 (sets min ModCod=1, max ModCod=21, Go to minimum Tx ModCod when remote demod unlocks, sets Target Es/No at 1.0dB.)	ACM= ACM? ACM* ACM#	ACM=mmMMATT
ACM Degradation Configuration	ADC=	ADC?	10 bytes	Command or Query. Sets or returns ACM configuration parameters in the form qqeesstt, where: qq=QPSK degradation in dB from 0.0 to 9.9 ee=8PSK degradation in dB from 0.0 to 9.9 ss=16-APSK degradation in dB from 0.0 to 9.9 tt=32-APSK degradation in dB from 0.0 to 9.9 uu=64-APSK degradation in dB from 0.0 to 9.9 EXAMPLE: <0/ADC=0305071720 (sets QPSK degradation to 0.3 dB, 8PSK degradation to 0.5 dB, 16-APSK degradation to 0.7 dB, 32-APSK degradation to 1.7 dB, and 64-APSK to 2.0 dB)	ADC= ADC? ADC* ACC#	ADC=qqeessttuu
Remote Signal to Noise Ratio	N/A	RES?	5 bytes	Query only. Returns the value of the remote demod Es/No, in dB, in 0.1 dB steps, in the form sxx.x. EXAMPLE: <0/RES? <0/RES=+12.4 (Es/No=12.4 dB) NOTE: Responds with +99.9 when demod is unlocked or >23.5 if Es/No value is out of range.	N/A	RES=sxx.x
Local Signal to Noise Ratio	N/A	LES?	5 bytes	Query only. Returns the value of Local Es/No, in dB, in 0.1 dB steps, in the form sxx.x. EXAMPLE: <0/LES? >0000/LES=+12.3 (Es/No=12.3 dB) NOTE: Responds with +99.9 when demod is unlocked or >23.5 if Es/No value is out of range.	N/A	LES=sxx.x

8.5.7 AUPC Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Power Control State (AUPC)	PCS=	PCS?	1 byte, value of 0 or 1	Command or Query. Sets or returns Power Control State in the form x, where: 0=Manual 1=AUPC (Automatic Power Control) EXAMPLE: <0/PCS=1 (enables AUPC)	PCS= PCS? PCS* PCS#	PCS=x
AUPC Target Es/No	ATE=	ATE?	4 bytes	Command or Query. Sets or returns the Target Es/No in the form xx.x, where: xx.x=from 00.0 dB to 23.5 dB. EXAMPLE: <0/ATE=12.5 (sets Target Es/No to 12.5 dB)	ATE= ATE? ATE* ATE#	ATE=xx.x
AUPC Nominal Power Value	ANP=	ANP?	5 bytes	Command or Query. Sets or returns the Nominal Power Value in the form sxx.x, where: s=sign (+ or -) xx.x=Value in the range from -40.0 dBm to 0.0 dBm (L-Band) or -25.0 dBm to 0.0 dBm (70/140 MHz). EXAMPLE: <0/ANP=-12.5 (sets Nominal Value to -12.5 dBm)	ANP= ANP? ANP* ANP#	ANP=sxx.x
AUPC Power Range	APR=	APR?	4 bytes	Command or Query. Sets or returns the Power Range in the form xx.x, where xx.x=Value in the range from 0.0 dBm to 40.0 dBm (L-Band) or 0.0 dBm to 25.0 dBm (70/140 MHz). EXAMPLE: <0/APR=25.0 (sets Power Range to 25.0 dBm)	APR= APR? APR* APR#	APR=xx.x
AUPC Remote Carrier Loss Action	RCL=	RCL?	1 byte, value of 0 or 1	Command or Query. Sets or returns Remote Carrier Loss Action in the form x, where: 0=Goto Nominal Power Value 1=Goto Max Power Value (Nominal Value + Range) EXAMPLE: <0/APR=25.0 (sets Power Range to 25.0 dBm)	RCL= RCL? RCL* RCL#	RCL=x
AUPC Local Carrier Loss Action	LCL=	LCL?	1 byte, value of 0 or 1	Command or Query. Sets or returns Local Carrier Loss Action in the form x, where: 0=Goto Nominal Power Value 1=Goto Max Power Value (Nominal Value + Range) EXAMPLE: <0/LCL=0 (sets Nominal Power)	LCL= LCL? LCL* LCL#	LCL=x

8.5.8 PIIC Interface Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Rx Interface Clock source	RCK=	RCK?s	2 bytes	Command or Query. Sets or returns Rx Clock Source (for Data Rate accuracy) in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Rx Clock Source, where: 0=Tx Clock 1=External Clock (not valid for OC3 interface) 2=Rx Sat 3=Internal Clock NOTE: In MultiStream Mode, RCK is forced to internal clock. EXAMPLE: <0/RCK=12 (Slot 1, Rx Sat Clock is selected)	RCK= RCK? RCK * RCK #	RCK=x
Tx Interface Clock source	TCK=	TCK?s	2 bytes	Command or Query. Sets or returns Tx Clock Source (for Data Rate accuracy), where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Rx Clock Source, where: 0=Tx Clock 1=External Clock (not valid for OC3 interface) 2=Rx Sat EXAMPLE: <0/TCK=10 (Slot 1, Tx Clock is selected)	TCK= TCK? TCK * TCK #	TCK=x
Interface Reference Clock	EFI=	EFI?s	2 bytes	Command or Query. (G.703 interface only) Sets or returns External Clock (Interface) in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=EXT CLK (Data Rate Accuracy), where: 0=1 MHz 1=2 MHz 2=5 MHz 3=10 MHz 4=20 MHz 5=34.368 MHz 6=44.736 MHz 7=51.840 MHz NOTE: For selections 5-7, the PIIC must be set to the corresponding interface type – i.e., 5 is valid when PIIC is in E3 mode, 6 is valid when PIIC is in T3 mode, and 7 is valid when PIIC is in STS1 mode. EXAMPLE: <0/EFI=14 (Selects 10MHz on Slot 1)	EFI= EFI? EFI * EFI #	EFI=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
PIIC Mode Select	ETS=	ETS?s	2 bytes	Command or Query. Sets or returns the PIIC interface card mode in the form sm, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Mode, where: For G.703 PIIC module: 0=NONE 1=E3 2=T3 3=STS1 NOTE: G703 PIIC settings other than none will also set the selected G.703 data rate. The unit will adjust the symbol rate based on the modulation type, code rate, framing, and pilots to keep the selected data rate For OC3 PIIC module: 0=NONE 1=OC3/STM-1 NOTE: OC3 PIIC settings other than NONE will also set the modem data rate to 155.52 Mbps. The unit will adjust the symbol rate based on the modulation type, code rate, framing, and pilots to keep the selected data rate. NOTE: Commands are valid only with the appropriate PIIC interface as indicated above. In addition, the following is true for various cards. EXAMPLE: <0/ETS=11 (sets G.703 PIIC module in Slot 1 to E3 mode; sets OC3 PIIC module in Slot 1 to OC3/STM-1 mode) MultiStream and Single Stream Modes: To enable MultiStream Mode: 1. Disable all PIIC Interfaces. 2. Enable one or more Gigabit Ethernet Interfaces. 3. Set the SR, ModCod, etc. to meet your requirements. 4. Enable PIIC 1 or PIIC 2 or both interfaces. To enable PIIC1 or PIIC2 in synchronous interface mode: 1. Disable all PIIC Interfaces. 2. Disable all Gigabit Ethernet Interfaces. 3. Enable PIIC1 or PIIC2. NOTE: GBEI 1, GBEI 2 and Optical Ethernet must all be disabled before a PIIC can operate in a synchronous mode.	ETS= ETS? ETS * ETS #	ETS=m
PIIC Rx Buffer Size	RBS=	RBS?s	6 bytes	Command or Query. Sets or returns Rx Buffer Size (in ms), in the form sxxx.x where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 xxx.x=Rx Buffer Size, in 0.5 ms steps, from 2.0 to 75.0 ms EXAMPLE: <0/RBS=1032.5 (selects 32.5 ms for Slot 1)	RBS= RBS? RBS* RBS#	RBS=xxx.x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Re Center Buffer	RCB=	N/A	1 byte	Command only. Force the software to recenter the receive buffer. s=Interface Slot, where: 1=Slot 1 2=Slot 2 EXAMPLE: <0/RCB=2 (re-centers the buffer on the Slot 2 interface card)	RCB= RCB? RCB# RCB*	N/A
PIIC Rx ASI Mode	PRM=	PRM?s	1 byte	Command or Query. (ASI PIIC only) Sets or returns Rx ASI Mode in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Mode, where: 0=Off 1=ASI-Normal	PRM= PRM? PRM# PRM*	PRM=x
PIIC Tx ASI Mode	PTM=	PTM?s	1 byte	Command or Query. (ASI PIIC only) Sets or returns Tx ASI Mode in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Mode, where: 0=Off 1=ASI-Normal 2=ASI- Advanced	PTM= PTM? PTM# PTM*	PTM=x
PIIC Rx ASI Framing	PRF=	PRF?s	1 byte	Command or Query. (ASI PIIC only) Sets or returns Rx ASI Framing in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Framing, where: 0=None 1=TS-188 2=TS-204	PRF= PRF? PRF# PRF*	PRF=x
PIIC Tx ASI Framing	PTF=	PTF?s	1 byte	Command or Query. (ASI PIIC only) Sets or returns Tx ASI Framing in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Framing, where: 0=None 1=TS-188 2=TS-204	PTF= PTF? PTF# PTF*	PTF=x

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
PIIC Rx ASI Data Rate	PRD=	PRD?s	10 bytes, numeric	Command or Query. **(ASI PIIC only)** Sets or returns Rx ASI Data Rate, in kbps, in the form dddddd.ddd: EXAMPLE: <0/PRD=1210000.000 (sets Slot 1 PIIC Rx ASI Data Rate to 210Mbps)	PRD= PRD? PRD * PRD #	PRD=dddddd.ddd
PIIC Tx ASI Data Rate	PTD=	PTD?s	10 bytes, numeric	Command or Query. **(ASI PIIC only)** Sets or returns Tx ASI Data Rate, in kbps, in the form dddddd.ddd: EXAMPLE: <0/PTD=1210000.000 (sets Slot 1 PIIC Tx ASI Data Rate to 210Mbps)	PTD= PTD? PTD * PTD #	PTD=dddddd.ddd
PIIC Rx ASI Output Format	PRO=	PRO?s	1 byte	Command or Query. **(ASI PIIC only)** Sets or returns Rx ASI Output Data Format in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=Format, where: 0=Normal Stream 1=Burst Output	PRO= PRO? PRO# PRO*	PRO=x
PIIC Tx ASI Restamping	PTR=	PTR?s	1 byte	Command or Query. **(ASI PIIC only)** Sets or returns Tx ASI PCR Restamping in the form sx, where: s=Interface Slot, where: 1=Slot 1 2=Slot 2 x=PCR Restamping control, where: 0=Disable 1=Enable	PTR= PTR? PTR# PTR*	PTR=x

8.5.9 Bulk Configuration Strings

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Global Configuration	MGC=	MGC?	245 bytes, numerical entries, fixed values and delimiters	Command or Query. Sets or returns Global Configuration of CDM-760, in the form shown in the 'Response to Query' column, where: FFFF.FFFF=Tx Frequency same as TFQ SSSSSS.SSS=TX Symbol Rate same as TSR MM=Tx ModCod same as TMC B=Tx Framing Mode same as TFM V=Tx Spectrum Inversion same as TSI A=Tx Alpha Rolloff same as TAR GGGGGG=Tx Gold Code same as TGS T=Tx Pilot same as TPI L=Tx Pilot Location same as TLP sPP.P=Tx Power Level same as TPL X=Tx Carrier State same as TXO ffff.ffff=Rx Frequency same as RFQ ssssss.sss=Rx Symbol Rate same as RSR mm=Rx ModCod same as RMC b=Rx Framing Mode same as RFM v=Rx Spectrum Inversion same as RSI a=Rx Alpha Rolloff same as RAR gggggg=Rx Gold Code same as RGS ee.e=Es/No Alarm Point same as EBA bbb=WAN Buffer Length same as WBL r=External Reference Frequency Selection same as EFR c=Enable Payload Compression same as EPC d=Learning and Aging same as LRN f=Flow Control same as GFC 1=GigE Port 1 Control same as LC1 2=GigE Port 2 Control same as LC2 i=in band signaling control same as SLC r=LNB Reference Enable same as LNR p=LNB DC Power Supply Control same as LPS 3=Opt Eth Port Control same as LC3 n=Network Specification (NetSpec) same as NET w=CnC mode same as CNM BBBCCC=CnC/DPD search delays same as CSD CCC=LNB High Current Limit Value same as LNH a=Local Carrier Loss Action same as LCL b=Operating Mode same as OPM DDddEee=ACM Operating Parameters same as ACM HHhhJJjj=ACM Degradation Configuration same as first 8 bytes of ADC lll=LNB Low Current Limit Value same as LNL xx=ACM Degradation Configuration same as last 2 bytes of ADC	MGC= MGC? MGC* MGC#	MGC=FFFF.FF FFSSSSSS.SS SMMBVAGGG GGGTLsPP.PXf fff.ffffssssss.sss mmbvaggggge e.ebbbrcdf12irp 3nwBBBCCCC CCabDDddEee HHhhJJjjlllxxTe eeeeeeeeeeeee eeeeeeeeeeeee eeeeeeeeecddd deeeeeuuu.uuu. uuu.uuu.uuvvv.v vv.vvv.vvvGHffff f111111111111 1111111122222 2222222222222 22

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Global Configuration (cont.)				T=Unit Test Mode — same as TST eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee=Unit Alarm Mask — same as MSK c=Power Control State — same as PCS dddd=AUPC Target Es/No — same as ATE eeeee=AUPC Nominal Power Value — same as ANP uuu.uuu.uuu.uuu.uu=IP address — same as IPA vvv.vvv.vvv.vvv=IP gateway address — same as IPG G=Tx/Rx BERT State — same as BTX H=Tx/Rx BERT Pattern — same as TBP fffff=AUPC Power Range — same as APR 11111111111111111111=PIIC Card 1 Configuration — Notes 1-3 22222222222222222222=PIIC Card 2 Configuration — Notes 1-3 *END OF MGC COMMAND/QUERY STRING* NOTES: 1) There are several possible types of PIIC interfaces available. The first bit of each 20 bit field determines the PIIC interface type. 0 means no interface detected, non zero means an interface type was detected. 2) If no interface is present, then the following bits will be returned: 0UUUUUUUUUUUUUUUUUUU 3) If an interface is detected but the interface type is set to NONE, then the following bits will be returned: 20xxxxxxxxxxxxxxxxxx, where: 2 means G.703 interface detected 0 means NONE selected so it is disabled. Description Of PIIC Interface Types: ABCDEFGHIJKLMNOPssss A=type of interface detected 0=No interface detected 1=Reserved 2=G.703 interface detected 3=OC3 interface detected 4=ASI interface detected B=PIIC Mode — same as ETS (G703 and OC3 only) C=Tx Intf Clock Source — same as TCK (G703 and OC3 only D=Rx Intf Clock Source — same as RCK (G703 and OC3 only) E=Intf Reference Clock — same as EFI (G703 only) FGHIJ=Rx Buffer Size — same as RBS K=Tx ASI Mode — same as PTM (ASI only) L=Tx ASI Framing — same as PTF (ASI only) M=Tx ASI Restamping — same as PTR (ASI only) N=Rx ASI Mode — same as PRM (ASI only) O=Rx ASI Framing — same as PRF (ASI only) P=Rx ASI Output Format — same as PRO (ASI only) ssss=spares		

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Configuration Save	CST=	N/A	1 byte, value of 0 thru 9	Command only. Stores the current modem configuration in Configuration Memory location defined by the one-byte argument (0 to 9). EXAMPLE: <0/CST=4 (stores the current configuration in location 4)	CST= CST? CST* CST#	N/A
Configuration Load	CLD=	N/A	1 byte, value of 0 thru 9	Command only. Retrieves a previously stored modem configuration from Configuration Memory location defined by the one-byte argument (0 to 9). EXAMPLE: <0/CLD=4 (loads modem configuration from location 4 to be the active configuration)	CLD= CLD? CLD* CLD#	N/A

8.5.10 ODU Parameters

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
LNB 10MHz Reference Enable	LNR=	LNR?	1 byte, value of 0 or 1	Command or Query. Enables or disables LNB 10MHz Reference Enable in the form x, where: 0=Disable LNB Reference 1=Enable LNB Reference	LNR= LNR? LNR* LNR#	LNR=x
LNB DC Power Control	LPS=	LPS?	1 byte, value of 0 thru 3	Command or Query. Sets or returns LNB DC Power Supply Control in the form x, where: 0=OFF 1=13V LNB Voltage 2=18V LNB Voltage 3=24V LNB Voltage	LPS= LPS? LPS* LPS#	LPS=x
LNB Low Current Limit	LNL=	LNL?	3 bytes	Command or Query. Sets or returns Low Current Limit in the form xxx, where: xxx=value from 0 to 500 mA.	LNL= LNL? LNL* LNL#	LNL=xxx
LNB High Current Limit	LNH=	LNH?	3 bytes	Command or Query. Sets or returns High Current Limit in the form xxx, where: xxx=value from 0 to 500 mA.	LNH= LNH? LNH* LNH#	LNH=xxx
LNB Current	N/A	LNC?	4 bytes	Query only. Returns the LNB Current Limit in the form xxxx, where: xxxx=value in mA. EXAMPLE: <0/LNC? >0000/LNC=0500	LNC#	LNC=xxxx
LNB Voltage	N/A	LVO?	4 bytes	Query only. Returns the LNB Voltage in the form xx.x, where: xx.x=value in volts. EXAMPLE: <0/LNC? >0000/LVO=12.0	LVO#	LVO=xx.x
BUC 10MHz Reference Enable	BCR=	BCR?	1 byte, value of 0 or 1	Command or Query. Enables or disables BUC 10MHz Reference Enable in the form x, where: 0=Disable BUC Reference 1=Enable BUC Reference	BCR= BCR? BCR* BCR#	BCR=x

8.5.11 Modem Information

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Hardware Revision	N/A	HRV?	4 bytes	Query only. Return hardware revision level of both main circuit cards in the form xx.yy where: xx=the main (bottom) card yy=the top (modem) card.	HRV#	HRV=xx.yy
Software Revision	N/A	SWR?	62 bytes	Query only. Returns the value of the internal software revisions installed in the unit, see example below. EXAMPLE: <0/SWR? >0000/SWR=Boot:01.01.01 AppLoader:01.01.01 Bulk1:01.01.01 Bulk2:01.01.01	SWR#	SWR=Boot:xx.xx.xx AppLoader:xx.xx.xx Bulk1:xx.xx.xx Bulk2:xx.xx.xx
Firmware information	N/A	FRW?1 FRW?2 FRW?B	434 or 74 bytes	Query only. Returns firmware information for image 1 or 2 or the boot loader in the form xxxxxx, where: EXAMPLE 1: <0/FRW?1 >0000/FRW=1:FW-0020628- 1.1.1 03/22/13<CR> FW-0020628- 1.1.1 03/22/13<CR> FW-0020638- 1.1.1 10/24/12<CR> FW-0020639- 1.1.1 02/28/13<CR> FW-0020638- 1.1.1 01/28/13<CR> FW-0020529- 1.1.1 01/09/13<CR> FW-0020531- 1.1.1 01/21/13<CR> FW-0020532- 1.1.1 12/18/12<CR> FW-0020649- 1.1.1 12/17/12<CR> FW-0020530- 1.1.1 01/09/13<CR> FW-0020641- 1.1.1 03/20/13<CR> FW-0020307C 1.1.4 08/26/11<CR> FW-0020308B 1.3.2 02/19/13<CR> FW-0020309B 1.3.2 01/31/13<CR> FW-0020372D 1.2.3 02/14/13<CR> FW-0020468C 1.1.4 02/26/13<CR> EXAMPLE 2: <0/FRW?B >0000/FRW=B:Boot: FW-0020640- 1.1.1 02/13/13<CR> App Loader: FW-0020629- 1.1.1 02/08/13<CR>	FRW? FRW#	FRW=
Serial Number	N/A	SNO?	9 bytes	Query only. Returns the modem 9 digit serial number. EXAMPLE: <0/SNO? >0000/SNO=176500143	SNO#	SNO=xxxxxxxxx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Equipment ID	N/A	EID?	29 bytes	Query only Returns the equipment ID and installed options in the form AAAABCDEFGHIJKLMNOPQUSTUVWXYZ , where: AAAA=0760 , the modem model number Installed hardware: B=Modulator 0=not present, 1=present C=Demodulator 0=not present, 1=present D=Gzip 0=not present, 1=present E=Packet Processor 0=not present, 1=present F=CnC/DPD, 0=not present, 1=present G=PIIC1[1] H=PIIC2[1] I=Optical Present 0=not present, 1=present J=Reserved [1]PIIC cards will be reported as: 0=not present 1= ASI 2=G.703 3=OC3 4=reserved Software FAST options: K=CnC Data Rate 0=None/Off 1=5 Mbps 2=10 Mbps 3=15 Mbps 4=20 Mbps 5=25 Mbps 6=30 Mbps 7=40 Mbps 8=52 Mbps 9=75 Mbps A=100 Mbps B=125 Mbps C=160 Mbps D=225 Mbps E=275 Mbps L=Fractional CnC 0=Not Installed 1=Installed	EID#	EID=AAAABCD EFGHIJKLMNO PQUSTUVWXY Z

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Equipment ID (cont.)				M=ACM 0=None 1=ACM Point to Point N=Tx Symbol Rate[2] O=Rx Symbol Rate[2] [2]0=None 1=5 Msps 2=18 Msps 3=36 Msps 4=54 Msps 5=72 Msps 6=110 Msps 7=150 Msps P=Tx Modulation[3] Q=Rx Modulation[3] [3]0=None 1=QPSK+8PSK 2=QPSK+8PSK+16-APSK 3=QPSK+8PSK+16-APSK+32-APSK 4=QPSK+8PSK+16-APSK+32-APSK+64-APSK R=Modulator 0=not installed, 1=installed S=Demodulator 0=not installed, 1=installed T=DPD (Dynamic Predistortion) 0=not installed, 1=installed U=Reserved (set to 0) V=Optical 0=not installed, 1=installed W=GZIP Tx Symbol Rate 0=None 1=5 Msps 2=18 Msps 3=36 Msps 4=54 Msps 5=72 Msps 6=110 Msps 7=150 Msps X=Reserved (set to 0) Y=Network Specification 0=None 1=DVB-S2 2=DVB-S2 + DVB-S2-EB1 + DVB-S2X 3=DVB-S2 + DVB-S2-EB1 + DVB-S2-EB2 + DVB-S2X Z=Spare (reserved and indicated with an X) EXAMPLE: >0000/EID=xxxx indicates all software options and FAST codes		

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
CnC Fractional Time Remaining	N/A	FCC?	11 bytes	Query only. Returns the fractional CnC time remaining in the current 365 day period in the form DD:HH:MM:SS, where: DD=The number of days HH=The number of hours MM=The number of minutes SS=The number of seconds NOTE: This timer is only active when fractional CnC is purchased and CnC is enabled and running. When the timer hits zero, CnC will be disabled until the current 365 day period expires. When the current 365 day period expires, the fractional timer will automatically reset to 90 days.	N/A	FCC=DD:HH:MM:SS
Time remaining in 365 day period	N/A	FCF?	11 bytes	Query only. Returns the time remaining in the current 365 day period, in the form DD:HH:MM:SS, where: DD=The number of days HH=The number of hours MM=The number of minutes SS=The number seconds NOTE: When the timer hits zero, it will automatically reset to and begin counting down again.	N/A	FCF=DD:HH:MM:SS
Demo Time remaining	N/A	DMT?	11 bytes	Query only. Returns the Demo time remaining in the form DD:HH:MM:SS, where: DD=The number of days HH=The number of hours MM=The number of minutes SS=The number seconds IMPORTANT NOTE! The Demo Mode timer cannot be reset. This timer is active only when Demo Mode is enabled. When the timer hits zero, Demo Mode is permanently disabled.	N/A	DMT=DD:HH:MM:SS

8.5.12 Modem Performance Indication

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Rx Signal Level	N/A	RSL?	5 bytes	Query only. Returns value of Rx signal level, in dBm, in the form xxxxx, where: xxxxx=value from -20 to -90 dBm. If >-20dBm, returns RSL=GT-20 (GT='greater than') If <-90 dBm, returns RSL=LT-90 (LT='less than') If <-20 and >-90 returns RSL=EQ-XX (EQ='equal to') EXAMPLE: <0/RSL=EQ-45 (indicating -45 dBm)	N/A	RSL=xxxxx
Rx Frequency Offset	N/A	RFO?	6 bytes	Query only. Returns value of measured frequency offset of the carrier being demodulated, in the form sxxx.x, where: s=sign (+ or -) xxx.x=value from 0 to 200 kHz, in 100 Hz steps. Returns 999999 if the demodulator is unlocked. EXAMPLE: <0/RFO=+002.3 (selects + 2.3 kHz)	N/A	RFO=sxxx.x
Temperature	N/A	TMP?	3 bytes	Query only. Returns the highest of 4 temperature sensors. Value of the internal temperature sensor, in the form xxx, where: xxx=degrees C EXAMPLE: <0/TMP=+26	N/A	TMP=xxxs
Faults and Status	N/A	FLT?	9 bytes	Query only. Returns the current *highest-priority* fault and status codes for the Unit (hardware), TX Traffic, RX Traffic, and ODUs in the form aaaaaaaabbbbbbbbccccccccdexx, where: aaaaaaaa=Unit status: 00000000=No faults 80000000=Main Board Power Supply 3.3V 40000000=Main Board Power Supply 1.5V 20000000=Main Board Power Supply 1.2V 10000000=Main Board Power Supply 1.8V 08000000=Main Board Power Supply 1.9V 04000000=Main Board Power Supply 2.5V 02000000=Main Board Power Supply 1.25V 01000000=Modem Board Power Supply 5.8V 00800000=Modem Board Power Supply 3.8V 00400000=Modem Board Power Supply 2.8V 00200000=Modem Board Power Supply 3.3V 00100000=Modem Board Power Supply 1.5V 00080000=Modem Board Power Supply 1.2V 00040000=Tx Power Cal 00020000=FPGA Load Fail 00010000=Reference Unlocked 00008000=Temperature Exceeded 00004000=Unit Fault	N/A	FLT=aaaaaaaa bbbbbbbbcccccc cccdexx

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Faults and Status (cont.)				00002000=PIIC1 External Clock Activity 00001000=PIIC1 External Clock In Range 00000800=PIIC2 External Clock Activity 00000400=PIIC2 External Clock In Range 00000200=Log File Fault NOTE: External clocks are not valid with OC3 or ASI interface bbbbbbbb=Tx status: 00000000=No Faults 80000000=Input Data 40000000=Tx PLL 20000000=PIIC1 Symbol Clock PLL 10000000=PIIC2 Symbol Clock PLL 08000000=PIIC1 Input Signal Loss 04000000=PIIC2 Input Signal Loss 02000000=Ethernet Buffer Clear cccccccc=Rx status: 00000000=No Fault 80000000=Demodulator unlocked 40000000=AGC Signal Level 20000000=CnC Lock 10000000=Output Data 08000000=Es/No 04000000=PLL 02000000=PIIC1 Buffer Overflow 01000000=PIIC1 Buffer Underflow 00800000=PIIC1 Buffer PLL 00400000=PIIC2 Buffer Overflow 00200000=PIIC2 Buffer Underflow 00100000=PIIC2 Buffer PLL 00080000=DeComp Inv 00040000=LNB Current 00020000=LNB Voltage 00008000=DPD Lock d=Change in modem fault status since last poll 0=unchanged 1=changed e=Change in modem configuration since last poll 0=unchanged 1=changed xx=spares		

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
CnC Ratio Monitor	N/A	CRM?	4 bytes	Query only. When CnC is enabled and the modem is locked, it monitors the ratio between the interferer and the desired power. Ratio is returned, in dB, in the form xxxx. EXAMPLE: <0/CRM? RESPONSE EXAMPLE 1: >0000/CRM=+02 (interferer > desired) (format:=sdd) RESPONSE EXAMPLE 2: >0000/CRM=LT11 (less than –11 dB) RESPONSE EXAMPLE 3: >0000/CRM=GT11 (greater than +11 dB) RESPONSE EXAMPLE 4: >0000/CRM=99.9 (not locked or CnC not enabled)	N/A	CRM=xxxx
CnC Delay Monitor	N/A	CDM?	6 bytes	Query only. When CnC is enabled and the modem is locked, it monitors the delay, in microseconds (µs), of the interferer. Delay is returned in the form xxxxxx. EXAMPLE: <0/CDM? RESPONSE EXAMPLE 1: >0000/CDM=229500 (returns 229,500 µs or 229.5 ms) RESPONSE EXAMPLE 2: >0000/CDM=999999 (not locked or CnC not enabled)	N/A	CDM=xxxxxx
CnC Freq Offset Monitor	N/A	CFM?	6 bytes	Query only. When CnC is enabled, an estimated frequency offset, in kHz, will be calculated between desired and interferer, Frequency offset is returned in the form xxxx.x. EXAMPLE: <0/CFM? RESPONSE EXAMPLE 1: >0000/CFM=+001.0 (1 kHz) RESPONSE EXAMPLE 2: >0000/CFM=9999.9 (not locked or CnC not enabled)	N/A	CFM=xxxx.x
Rx BERT Pattern	RBP=	RBP?	1 byte, value of 0 thru 6	Command or Query. Sets or returns the PN loopback pattern type in the form x, where: 0=2^23-1 (DEFAULT) 1=Reserved 2=Reserved 3=Reserved 4=Reserved 5=2047 6=2^15-1 EXAMPLE: <0/RBP=0 (default 2^23-1)	RBP= RBP? RBP* RBP#	RBP=
Tx BERT Pattern	TBP=	TBP?	1 byte, value of 0 thru 6	Command or Query. Initialises the PN loopback functionality and sets the pattern type in the form x, where: 0=2^23-1 1=Reserved 2=Reserved 3=Reserved 4=Reserved 5=2047 6=2^15-1 EXAMPLE: <0/TBP=0 (default 2^23-1)	TBP= TBP? TBP* TBP#	TBP=
BERT Error Insert	BKE=	N/A	None	Command only. Inserts a single error. THIS COMMAND TAKES NO ARGUMENTS.	BKE= BKE? BKE#	N/A

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
BERT Clear BER Counters	BRM=	N/A	None	Command only Clears the BER counters. THIS COMMAND TAKES NO ARGUMENTS.	BRM= BRM? BRM* BRM#	N/A
BERT Results All: Total Bit Errors, Total Number Of Bits and average BER	N/A	BRA?	23 or 15 bytes	Query only. Returns 3 values, with each parameter is separated by a colon, in the form x.xEx:y.yEy:z.zEz where: x.xEx=total number of bit errors yEy=total number of bits z.zEz=value of the average BER or “No Sync” if no demod lock. EXAMPLE 1: <0/BRA? RESPONSE EXAMPLE 1: >0000/BRA=1.0E+03:2.2E+06:1.0E+03 (No Demod Lock) RESPONSE EXAMPLE 2: >0000/BRA=1.0E+03:2.2E+06 (No Sync)	N/A	BRA=x.xEx:y.yEy:z.zEz
Tx BERT State	BTX=	BTX?	1 byte, value of 0 or 1	Command or Query. Sets or returns Tx BERT state in the form x, where: 0=off 1=on EXAMPLE: <0/BTX=1 (BERT On)	BTX= BTX? BTX* BTX#	BTX=x
BERT Pattern Sync	N/A	RPS?	1 byte, value of 1 or 2	Query only. Returns the BER Test Pattern Sync Status in the form x, where: 1=pattern sync 2=no pattern sync	N/A	RPS=x
Tx Baseband Frames per ModCod	N/A	ST2?		Query only. Return format for each Tx ModCod entry, separated by a colon, in the form x.xE+xx for each entry. There are 28 total entries when NET=0; 47 total entries when NET=1; and 52 total entries when NET=2.	N/A	ST2=
Rx Baseband Frames per ModCod	N/A	ST3?		Query only. Return format for each Rx ModCod entry, separated by a colon, in the form x.xE+xx for each entry. There are 28 total entries when NET= 0; 47 total entries when NET=1; and 52 total entries when NET=2.	N/A	ST3=
Rx Baseband Frames received with errors per ModCod	N/A	ST4?		Query only. Return format for each Rx ModCod entry, separated by a colon, in the form x.xE+xx for each entry. There are 28 total entries when NET=0; 47 total entries when NET=1; and 52 total entries when NET=2.	N/A	ST4=
Rx Baseband Frames discarded	N/A	ST5?		Query only. Returns the Rx baseband frames received without errors, but discarded due to the required feature code not having been purchased. Returns two entries separated by a colon: First entry=16 APSK frames discarded Second=32 APSK frames discarded.	N/A	ST5=

8.5.13 Redundancy Control

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
1:1 Operational Mode	ASW	ASW?	1 byte, value of 0 or 1	Command or Query. Sets or returns 1:1 operational mode in the form x, where: 0=Unit is in Manual mode 1=Unit is in Auto mode. NOTE: In Manual Mode, all fault relays are forced to the non-faulted condition. This allows an online unit to be configured without undesired switchover to a backup unit (Changing Rx frequency would normally cause the online unit to unlock and a switchover to the backup modem would occur).	ASW= ASW? ASW * ASW #	ASW=x
1:1 Force Unit Offline	FSW=	FSW?	0 bytes	Command only. This command takes no arguments. In a 1:1 switch environment, this command forces an online unit offline. If the unit is offline, then no action is taken. NOTES: 1) The 1:1 redundancy system must be installed! 2) Both online and offline units must be in Manual Mode for this command to function. 3) If the 1:1 redundancy system is not installed, then the command will return FSW? 4) If the unit is offline, then the command will return FSW? EXAMPLE: <0/FSW=	FSW= FSW?	FSW=
1:1 Redundancy Unit online or offline	N/A	RED?	0 bytes	Query only. Return 1:1 online/offline status in the form x, where: 0=Unit is offline 1=Unit is online EXAMPLE: <0/RED? >0000/RED=1 (indicates the unit is online)	N/A	RED=x
1:N Redundancy Enable	R1N=	R1N?	1 byte, value of 0 or 1	Command or Query. Sets or returns 1:N operational mode in the form x, where: 0=Unit is not enabled for 1:N switch operation. 1=Unit is enabled for 1:N switch operation. EXAMPLE: <0/R1N=1 (indicates the unit is enabled for 1:N)	R1N= R1N? R1N * R1N #	R1N=x
1:1 Redundancy Switch Available	N/A	R11?	1 byte, value of 0 or 1	Query only. Returns 1:1 switch status in the form x, where: 0=Unit is not connected to a 1:1 switch 1=Unit is connected to a 1:1 switch EXAMPLE: <0/R11? >0000/R11=0 (indicates the unit is not connected to a 1:1 switch)	N/A	R11=x

8.5.14 Carrier ID

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Carrier ID Mute	MUT=	MUT?	1 byte, value of 0 or 1	Command or Query. Sets or returns mute mode in the form x, where: 0=Carrier ID is On. 1=Carrier ID is Off (Muted). EXAMPLE: <0/MUT=0 (Turns Carrier ID On)	MUT= MUT? MUT* MUT#	MUT=x
Carrier ID Latitude	LAT=	LAT?	8 bytes	Command or Query. Sets or returns Latitude in the form mmss.ssh, where: mm=Latitude in Minutes ss.ss=Latitude in decimal Seconds h=Hemisphere (N or S). EXAMPLE: <0/LAT=3325.43N	LAT= LAT? LAT* LAT#	LAT=mmss.ssh
Carrier ID Longitude	LNG=	LNG?	9 bytes	Command or Query. Sets or returns Longitude in the form mmmss.ssh, where: mmm=Longitude in Minutes ss.ss=Longitude in decimal Seconds h=Hemisphere (E or W). EXAMPLE: <0/LAT=11158.28W	LNG= LNG? LNG* LNG#	LNG=mmmss.ssh
Carrier ID Phone Number	PHN=	PHN?	Variable 1 to 18 bytes	Command or Query. Sets or returns a variable length string denoting Phone Number String can consist of any of the characters "+0123456789x " (not including ") '+' and ' ' (Space) are ignored/deleted when sending and 'x' denotes extension. EXAMPLE: <0/PHN=+18664723963 x123	PHN= PHN? PHN * PHN #	PHN=x
Carrier ID Custom Message	MSG	MSG?	Variable 1 to 24 bytes	Command or Query. Sets or returns a variable length string with a Custom Message String can consist of any printable character. EXAMPLE: <0/MSG=Comtech EFData	MSG= MSG? MSG* MSG #	MSG=x

8.5.15 Dynamic Predistortion (DPD)

Parameter Type	Controller-to-Target Instruction Code and Qualifier		Arguments for Command or Query	Description of Arguments (Note that all arguments are ASCII numeric codes from 48 to 57)	Target-to-Controller (see Description of Arguments)	
	Command	Query			Response to Command	Response to Query
Dynamic Predistortion (DPD) Mode	PDM=	PDM?	1 byte, value of 0 or 1	Command or Query. Sets DPD mode in the form x, where: 0=Off 1=Local 2= Remote NOTES: 1) DPD may be enabled only if the optional plug-in hardware CnC card has been installed AND a DPD FAST option is unlocked. 2) CnC mode must be OFF, and the Tx symbol rate set within the allowable range. See DPD spec for minimum Tx symbol rate. 3) Maximum Tx symbol rate is determined by constellation type and DPD Mode setting, and/or installed FAST options. (Read EID to decode the installed options for the modem.)	PDM= PDM? PDM* PDM#	PDM=x

Notes:

Appendix A. OBSOLETE FIRMWARE FTP UPDATE PROCEDURES

A.1 Overview

The firmware FTP update procedures for CDM-760 FW Ver. 1.3.1 or earlier users differ from the procedures used under current operations (FW Ver. 1.4.1 or later). You must use this appendix for the firmware update procedure that is specific to any CDM-760 running any firmware version earlier than FW Ver. 1.4.1.

Before proceeding, you should familiarize yourself with the introduction and initial preparation steps that are typical for any firmware update process. Make sure that you first read Sects. 4.1 through 4.3 in Chapter 4. UPDATING FIRMWARE before attempting to update your obsolete firmware.

If your modem is running an obsolete firmware version, these restrictions apply as to how you may proceed with the firmware update process:

FW UPDATE PATH	FW UPDATE PROCESS USES…	NEXT FW GATEWAY YOU MUST UPDATE TO BEFORE LATER FW CAN BE UPDATED
1.1.1	FTP CLIENT (Filezilla)	1.2.1
From 1.2.1 to 1.3.1	FTP PUT .TAR	1.3.1
From 1.3.1 to CURRENT	FTP PUT .ZIP **–OR–** UPLOAD USING THE CDM-760 HTTP (WEB SERVBER) INTERFACE ADMIN | UPGRADE PAGE	CURRENT

A.2 FW Vers. 1.3.1 / 1.2.1 Ethernet FTP Upload Procedure

A.2.1 Prerequisites

Before proceeding with the CDM-760 FW Vers. 1.2.1 / 1.3.1 Ethernet FTP Upload Procedure, this section assumes that:

- **Your CDM-760 is connected to a user-supplied, Windows-based PC running the latest version of Java, and:**
  - **The PC Ethernet port is connected to the CDM-760 rear panel J4 | MGMT RJ-45 M&C port with a user-supplied hub, switch, or direct Ethernet cable connection. Note that the optional High-Speed Packet Processor, and its RJ-45 M&C and data connections, is not available to FW Vers. 1.3.1 and earlier users.**
  - **The PC is running a compatible Web browser (for operation of the CDM-760 HTTP Interface).**
  - **The PC serial port is connected to the CDM-760 rear panel J3 | REMOTE serial port with a standard user serial cable.**
  - **The PC is running a terminal emulation program (for operation of the CDM-760 Serial Remote Control Interface).**
- **You have noted the CDM-760 Ethernet Management IP Address using either the CDM-760 Front Panel or the Serial Remote Control Interface. You may also use the CDM-760 HTTP Interface Admin | Access page to review and reconfigure this IP Address as needed.**
- **You have downloaded (or otherwise received from Comtech EF Data) the desired firmware update(s), and you have extracted the firmware files into an accessible temporary folder (e.g., C:\CDM760) on the User PC.**
- **You have configured your modem remote control for "Ethernet" or "Ser+Ethernet" – confirm by viewing the SELECT: Configuration → Remote screen:**

```
Remote Control:Ser+Ethernet
        Inband:Disable               (⬍)
```

- **Typical for all tasks that follow – type the command without quotes, and then press Enter to execute.**

A.2.2 Use Windows Command-Line to Perform the FW Ver. 1.3.1 or 1.2.1 Ethernet FTP Upload Procedure

This section assumes that:

- **You have a working User PC-to-modem operational setup;**
- **You have created a temporary file folder on your PC for extraction and placement of the firmware update files. See Sect. 4.2 in Chapter 4. UPDATING FIRMWARE for complete instructions on completing these tasks.**
- **You have extracted the Version 1.3.1 or 1.2.1 firmware files into an accessible temporary folder (e.g., C:\CDM760) that you created earlier on the User PC – see Sect. 4.3 in Chapter 4. UPDATING FIRMWARE for completing these tasks.**

The CDM-760 HTTP Interface 'Admin | Upgrade' page was under development in the FW Ver. 1.3.1 and 1.2.1 releases, and may not be used to update the modem firmware images. Use Windows Command-line as instructed in this section.

Do these steps:

1. Use Command-line to send a "**PING"** command to confirm proper communication between the User PC and the CDM-760:
   - Type **"ping xxx.xxx.xxx.xxx"** at the Command-line prompt (where '**xxx.xxx.xxx.xxx**' is the CDM-760 Ethernet Management IP Address). The response should confirm whether the PC is properly connected to and communicating with the modem.

2. Make note of the *active* firmware image that the CDM-760 is running at present:
   - From the CDM-760 Front Panel, use the arrow keys to view the **SELECT: Utility → Firmware** screen. The top line of this screen displays the running active image as "**ActiveImage:1**" or "**ActiveImage:2**".
     The FTP upload procedure will overwrite the *standby* image.

3. Use Command-line to transfer (FTP) the files from the User PC to the CDM-760:
   - Make sure you are active in the proper working folder (directory) created earlier – if not, type "**cd CDM760**".
   - Type "**ftp xxx.xxx.xxx.xxx**" (where '**xxx.xxx.xxx.xxx**' is the CDM-760 Ethernet Management IP Address).
   - If Command-line prompts you for a user name, one is not required. Press **Enter** to continue.
   - The Command-line prompt changes to "**ftp>**". Type "**put F0020627.tar F0020627.tar**" at the prompt (without quotes) to begin the file transfer.

     The naming and file format for Firmware Vers. 1.3.1 and 1.2.1 differs from the naming and file format for Firmware Ver. 1.1.1! See Sect. A.3 for instructions on updating CDM-760 modems running FW Ver. 1.1.1.

     The file transfer process takes about 10 minutes – **do not power off the PC or modem during this time**. As the upgrade process continues, the modem front panel displays:

```
Programming ModemApp
XXX% Complete
```

```
Loading FPGA XX of XX
XXX% Complete
```

   - Once the file transfers, Command-line displays the upload result, similar to:

```
200 Port command okay
150 Opening data connection for STOR (192.168.1.1,-9944)
226 File received OK – XXXXXXX bytes in XX.XXX sec
001 Flash programming Successful!!
ftp: XXXXXXX bytes sent in XX.XXSeconds XXX.XXXKbytes/sec.
```

   - Type "**bye**" to terminate the FTP session, and then close the Command-line window.

4. Use one of these methods to verify that the PC-to-Modem FTP file transfer was successful:

- **Use the CDM-760 Front Panel** – After reboot, confirm that the Modem Firmware Version that displays on the CDM-760 Front Panel VFD top-level screen matches the firmware version just loaded. You may also review the **SELECT: Utility → Firmware → Info → Image#1** and **Image#2** screens for detailed firmware information.
- **Use the CDM-760 HTTP Interface** – Review the firmware version on the **Home** page, or the Image 1 and Image 2 folder contents on the **Status | Firmware** page:


(Note that the appearance of the CDM-760 HTTP Interface **Status | Firmware** FW Ver. 1.3.1 / 1.2.1 page differs from the appearance of the FW Ver. 1.4.1 page. The FW Ver. 1.2.1 page is shown here.)

- **Use the Serial Remote Control Interface** – Execute one of the following queries:
  - Condensed – **<0/SWR?** (*displays firmware versions*)
  - Detailed – **<0/FRW?1** (for Image 1) or **<0/FRW?2** (for Image 2) (*displays complete firmware load information*)

A.2.3 Select the Updated Firmware for Modem Operation

Do these steps:

1. Make note of the current Active Image on the **SELECT: Utility → Firmware** screen:

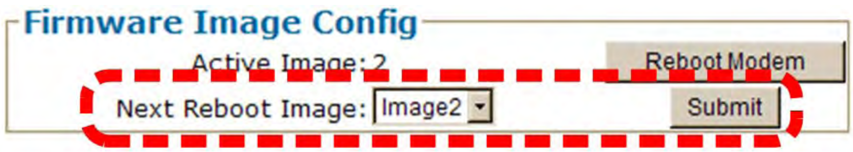
```
Firmware Images: ActiveImage: 2
     Info    Select                  (◄ ►)
```

Then, on the bottom line, use the ◄► arrow keys to select **Select**. Press **ENTER** to continue:

```
Current Active Image is #2
 Next reboot, will use Image: #1    (♦)
```

In order for the Image that was just updated to be 'active' the next time you reboot the modem, you must select that firmware image to be the Current Active Image. Use the ▲ ▼ arrow keys to select **1** or **2**. (In this example, Image #1 was updated and is therefore the required choice.)

Alternately, on the CDM-760 HTTP Interface **Configuration | Utilities** page, use the Next Reboot Image drop-down list in the *Firmware Image Config* section to select **Image1** or **Image2**, and then click [**Submit**]:



Once you press **ENTER** on the front panel or click **[Submit]** from the CDM-760 HTTP Interface, the modem verifies the checksums of all the files that are being updated:

```
Calculating checksums on selected Image.
               Please wait
```

This process takes several minutes. **Do not turn off the modem during this time.** When the process is complete, this message displays:

```
     Selected Image has been written.
   Reboot Modem or <ENTER> to Continue.
```

A.2.4 Reboot the Modem

Reboot the CDM-760 using one of the following methods:

- *For a hard reboot* – Use the rear panel ON/OFF switch (or otherwise disconnect the modem power source), and then reconnect the modem power.
- *For a soft reboot* – From the Firmware Image Config section of the CDM-760 HTTP Interface 'Configuration | Utilities' page, click [Reboot Modem]:

Note that, if booting into a new image *and* the Top Card Application has been changed, an additional step occurs as the CDM-760 downloads to a different flash memory. This additional upload takes approximately two minutes.

Once the modem reboots, the Web browser prompts you to re-enter the User Name and Password in order to resume use of the CDM-760 HTTP Interface.

The CDM-760 is now operating with its upgraded firmware. The firmware update process is now complete.

A.3 FW Ver. 1.1.1 Ethernet FTP Upload Procedure

Although there are many available FTP client utilities, this procedure requires that you use an Open-Source (freeware) FTP client called FileZilla. COMTECH EF DATA DOES NOT PROVIDE THIS UTILITY PROGRAM.

A.3.1 Prerequisites

Before proceeding with the CDM-760 FW Ver. 1.1.1 FileZilla-based FTP utility application installation / configuration and the Ethernet FTP Upload Procedure, this section assumes that:

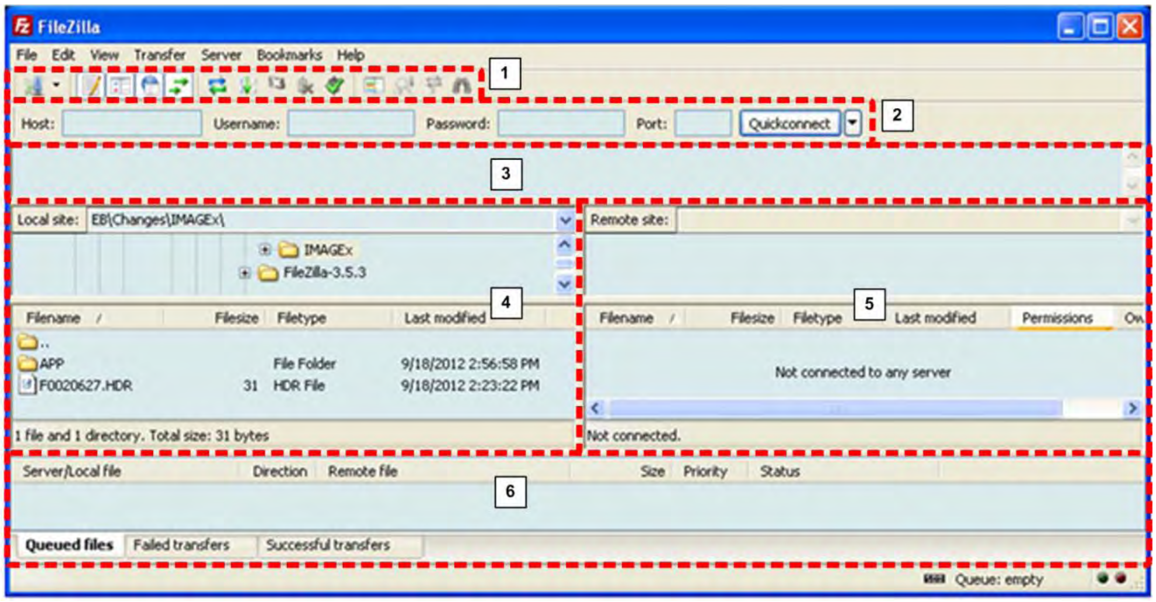
- **Your CDM-760 is connected to a user-supplied, Windows-based PC running the latest version of Java, and:**
  - **The PC Ethernet port is connected to the CDM-760 rear panel J4 | MGMT RJ-45 M&C port with a user-supplied hub, switch, or direct Ethernet cable connection. Note that the optional High-Speed Packet Processor (and its RJ-45 M&C and data connections) is not available to FW Ver. 1.1.1 users.**
  - **The PC is running a compatible Web browser (e.g., Internet Explorer 8 or later) for operation of the CDM-760 HTTP Interface.**
  - **The PC serial port is connected to the CDM-760 rear panel J3 | REMOTE serial port with a standard user serial cable.**
  - **The PC is running a terminal emulation program (for operation of the CDM-760 Serial Remote Control Interface).**
- **You have noted the CDM-760 Ethernet Management IP Address using either the CDM-760 Front Panel or the Serial Remote Control Interface. You may also use the CDM-760 HTTP Interface Admin | Access page to review and reconfigure this IP Address as needed.**
- **You have downloaded (or otherwise received from Comtech EF Data) the desired firmware update(s), and you have extracted the firmware files into an accessible temporary folder (e.g., C:\CDM760) on the User PC.**
- **You have configured your modem remote control for “Ethernet” or “Ser+Ethernet” – confirm by viewing the SELECT: Configuration → Remote screen:**

```
Remote Control:Ser+Ethernet
       Inband:Disable              (♦)
```

A.3.2 Install and Configure the FileZilla FTP Utility on the User PC

You can download FileZilla from http://filezilla-project.org/download.php. For detailed information on using installing and using FTP clients such as FileZilla, refer to your specific utility program Help documentation.

Figure A-1 shows the operating features of the FileZilla FTP Utility. The screen shots featured in this appendix depict use of FileZilla Version 3.5.3, but any later version will suffice.



Feature	Description
1	Toolbar
2	Quick connect bar
3	Message Log

Feature	Description
4	Local pane
5	Remote pane
6	Transfer queue pane

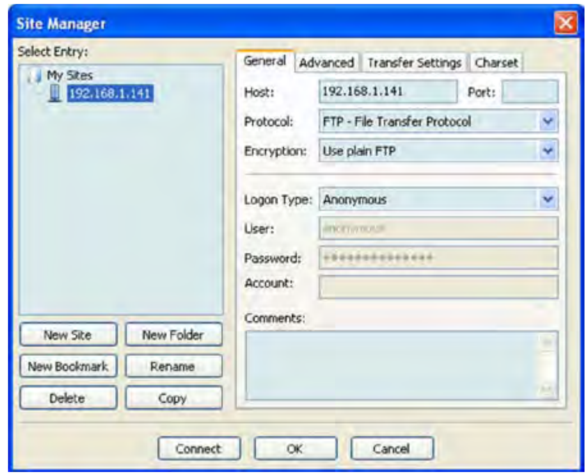
Figure A-1. Filezilla FTP Utility Features (Version 3.5.3 shown)

Once you install FileZilla on the User PC, you must then configure it to match the CDM-760's FTP server before attempting the firmware FTP update procedure.

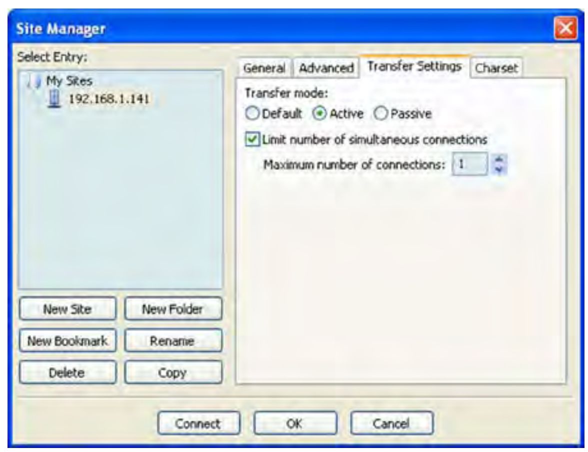
Do these steps:

1. Open FileZilla. The FileZilla FTP Utility, similar to this example, appears (see **Figure A-1** to identify the FileZilla FTP Utility features):

2. Select **File → Site Manager...** or click the **Site Manager** icon (the first icon at the far left on the Toolbar). The "**Site Manager**" dialogue box appears:



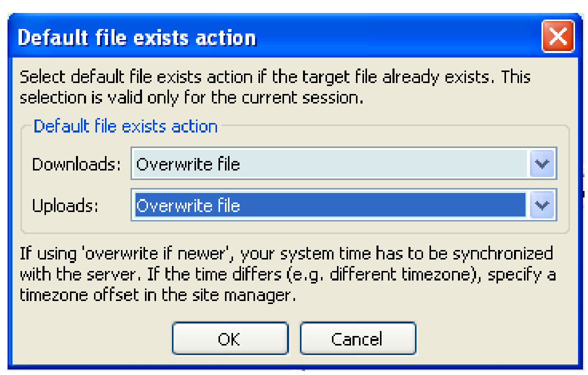
3. Click **[New Site]** (located below the ***Select Entry:*** window) and enter a name (e.g., this example uses the assigned CDM-760 Ethernet Management IP Address).
4. Select the "**General**" tab to display the dialog box and fill out the fields:
   - For "**Host:**" enter a name (e.g., the CDM-760 Ethernet Management IP Address).
   - For "**Protocol:**" make sure the drop-down list is set to "**FTP – File Transfer Protocol**".
   - For "**Encryption**:" make sure the drop-down list is set to "**Use plain FTP**".
   - For "**Logon Type:**" make sure the drop-down list is set to "**Anonymous**".
5. Select the "**Transfer Settings**" tab to display the dialog box:
   - For "**Transfer Mode:**" click the "**Active**" option button.
   - Put a checkmark in the "**Limit number of simultaneous connections**" checkbox, and then make sure the "**Maximum number of connections:**" drop-down list is set to "**1**" (the CDM-760 supports only one FTP connection at a time).



   Click **[OK]** to save the settings. The dialog box will close and you will return to the main window.
6. From the main window, select **Transfer → Default file exists action...** The "**Default file exists action**" dialog box appears:

   Make sure that both the "**Downloads:**" and "**Uploads:**" drop-down lists are set to "**Overwrite file**".

   Click **[OK]** to save the settings. The dialog box will close and you will return to the main window.



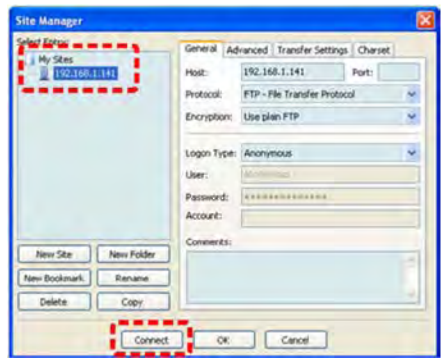
A.3.3 Performing the FileZilla-based FTP Update Procedure

Do these steps:

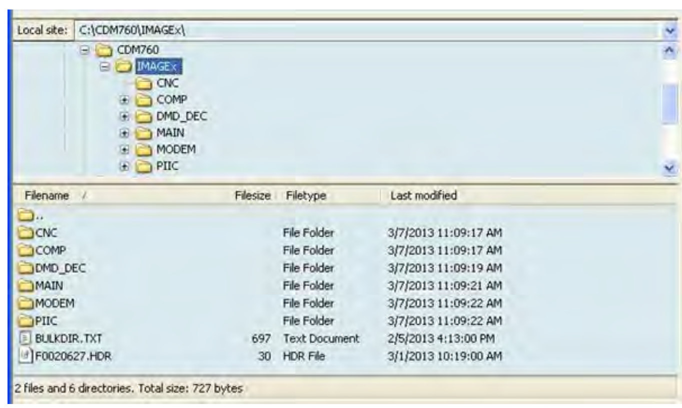
1. Confirm that the firmware update file was properly downloaded and extracted to your working folder. The contents of the C:\CDM760 folder should look like this:

(The “IMAGEx” folder contains the firmware update files.)

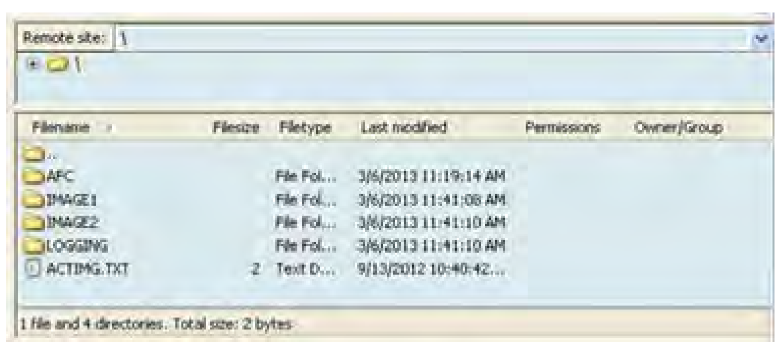
2. Select **File → Site Manager...** or click the **Site Manager** icon. Select the site created earlier, and then click **[Connect]**.



The “**Local site:**” pane (on the left-hand side, representing the User PC working folder) should look like this:



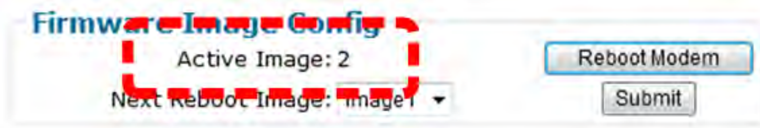
The “**Remote site:**” pane (on the right-hand side, representing the CDM-760) should look like this:



3. **On the CDM-760 Front Panel** – Go to the **SELECT: Utility → Firmware** screen and make note of the displayed ActiveImage:

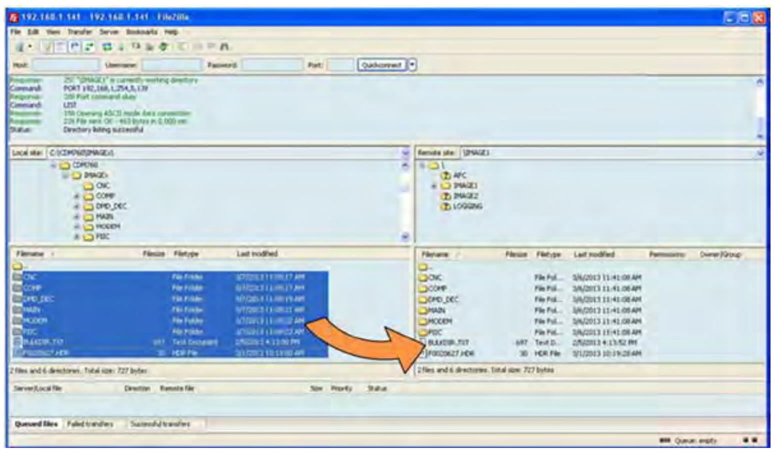
```
Firmware Images: ActiveImage: 2
Info    Select                (◀▶)
```

Alternately, from the *Firmware Image Config* section on the CDM-760 HTTP Interface **Configuration | Utilities** page, note the current Active Image:



If the screen displays "**1**" then the modem is currently running out of **IMAGE1** and you must update **IMAGE2**. If the screen displays "**2**" then you must update **IMAGE1**.

4. **From the FileZilla "Remote site:" pane** – Once you determine which image to update, double click on the "**IMAGE1**" or "**IMAGE2**" folder. (Because ActiveImage = **2** in this example, select the "**IMAGE1**" folder.)
5. **From the FileZilla "Local site:" pane** – Click on the "**C:\CDM760\IMAGEx**" folder. The folder contents will display in the bottom section of the pane.
6. Highlight the "**C:\CDM760\IMAGEx**" folder contents in the bottom section of the "**Local site:**" pane. Then, drag and drop the contents into the bottom section of the "**Remote site:**" pane:



7. The CDM-760 begins the firmware re-flash process. As files transfer from the User PC to the modem, the list of files and their transfer progress displays in the transfer queue pane (at the bottom of the screen). It takes approximately 15 minutes for all files to transfer. **Do not turn off the User PC or modem during this process.**
8. **On the CDM-760 Front Panel** – Make note of the current Active Image on the **SELECT: Utility → Firmware** screen:

```
Firmware Images: ActiveImage: 2
Info    Select               (◀ ▶)
```

Then, on the bottom line, use the ◀▶ arrow keys to select Select. Press **ENTER** to continue:

```
 Current Active Image is #2
 Next reboot, will use Image: #1  (↕)
```

In order for the Image that was just updated to be 'active' the next time you reboot the modem, you must select that firmware image to be the Current Active Image. Use the ▲ ▼ arrow keys to select **1** or **2**. (In this example, Image #1 was updated and is therefore the required choice.)

Alternately, on the CDM-760 HTTP Interface **Configuration | Utilities** page, use the Next Reboot Image drop-down list in the *Firmware Image Config* section to select **Image1** or **Image2**, and then click [**Submit**]:

Once you press **ENTER** on the front panel or click **[Submit]** from the CDM-760 HTTP Interface, the modem verifies the checksums of all the files that are being updated:

Calculating checksums on selected Image.
Please wait

This process takes several minutes. **Do not turn off the modem during this time.** When the process is complete, this message displays:

Selected Image has been written.
Reboot Modem or <ENTER> to Continue.

9. Reboot the CDM-760 using one of these methods:
- *For a hard reboot* – Use the rear panel ON/OFF switch (or otherwise disconnect the modem power source), and then reconnect the modem power.
- *For a soft reboot* – From the Firmware Image Config section of the CDM-760 HTTP Interface **Configuration | Utilities** page, click **[Reboot Modem]**:

Note that, if booting into a new image *and* the Top Card Application has been changed, an additional step occurs as the CDM-760 downloads to a different flash memory. This additional upload takes approximately two minutes. Once the modem reboots, you will be prompted to re-enter the User Name and Password in order to resume use of the CDM-760 HTTP Interface.

10. Use one of these methods to verify that the PC-to-Modem FTP file transfer was successful:
- **From the CDM-760 Front Panel** – Confirm that, upon reboot, the modem Firmware Version that displays on the CDM-760 Front Panel VFD top-level screen matches the firmware version just loaded. You may also review the **SELECT: Utility → Firmware → Info → Image#1** and **Image#2** screens for detailed firmware information.
- **From the CDM-760 HTTP Interface** – Review the firmware version on the **Home** page, or the Image 1 and Image 2 folder contents on the **Status | Firmware** page:

(Note that the appearance of the CDM-760 HTTP Interface Status | Firmware FW Ver. 1.1.1 page differs from the appearance of the FW Ver. 1.4.1 page. The FW Ver. 1.1.1 page is shown here.)

- **Using the Serial Remote Control Interface** – Execute one of these remote control queries:
  - Condensed – **<0/SWR?** (*displays firmware versions*)
  - Detailed – **<0/FRW?1** (for Image 1) or **<0/FRW?2** (for Image 2) (*displays complete firmware load information*)

11. To update the other firmware image, repeat Steps 3 through 10.

The CDM-760 is now operating with its upgraded firmware. The firmware update process is now complete.,

Appendix B. Es/No MEASUREMENT

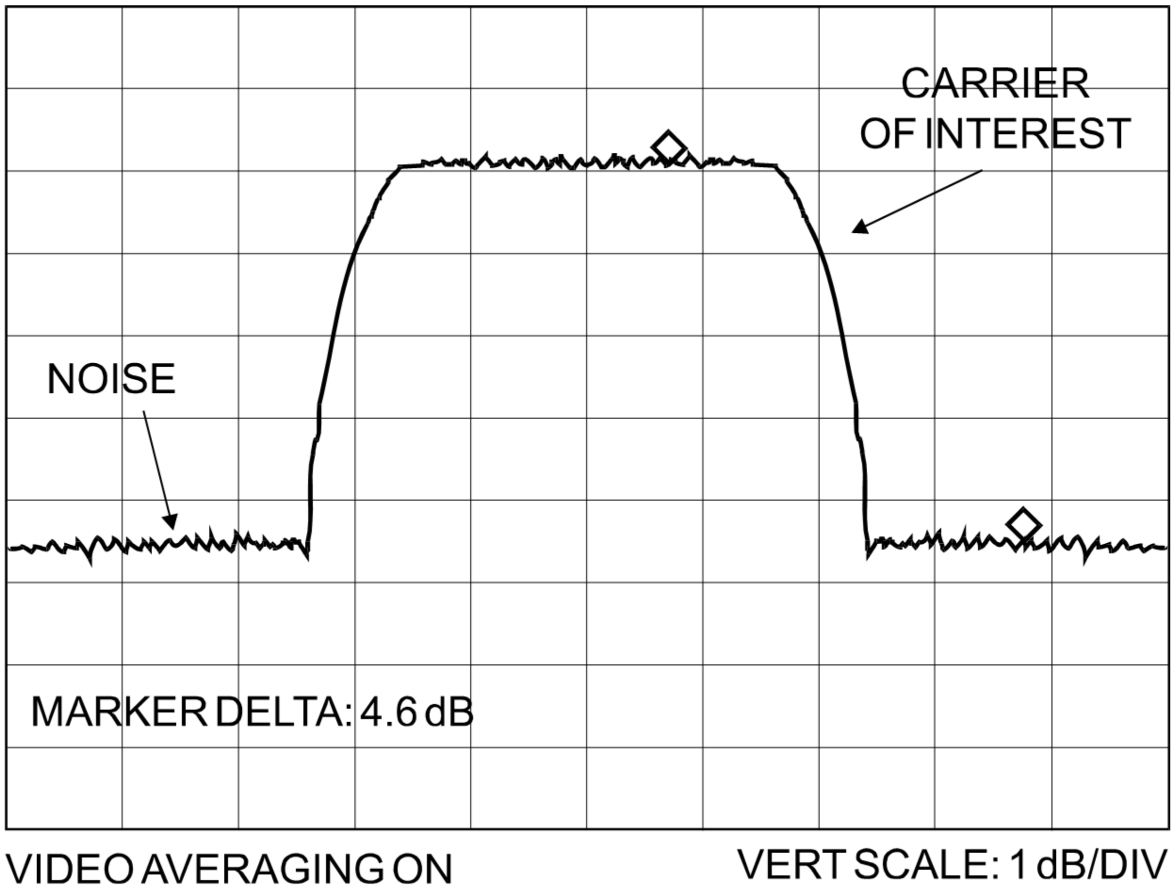
Although the CDM-760 Advanced High-Speed Trunking Modem calculates and displays the value of receive Es/No on the front panel of the unit, it is sometimes useful to measure the value using a spectrum analyzer, if one is available.

The idea is to accurately measure the value of (Co+No)/No (Carrier density + Noise density/Noise density). This is accomplished by tuning the center frequency of the Spectrum analyzer to the signal of interest, and measuring the difference between the peak spectral density of the signal (the flat part of the spectrum shown) and the noise density. To make this measurement:

- Use a vertical scale of 1 or 2 dB/division.
- Set the Resolution Bandwidth of the Spectrum Analyzer to < 20% of the symbol rate.
- Use video filtering and/or video averaging to reduce the variance in the displayed trace to a low enough level that the difference can be measured to within 0.2dB.
- Place a marker on the flat part of the signal of interest, then use the MARKER DELTA function to put a second marker on the noise to the side of the carrier. This value is (Co+No)/No, in dB.
- Use this value of (Co+No)/No in the table on the following page to determine the Eb/No. You will need to know the operating mode to read from the appropriate column.
- If the (Co+No)/No value measured does not correspond to an exact table entry, interpolate using the two nearest values.

Note that the accuracy of this method degrades significantly at low values of (Co+No)/No (approximately less than 6 dB).

Example: In the diagram that follows, the (Co+No)/No measured is 4.6 dB. If Rate 1/2 QPSK is used, this corresponds to an Es/No of approximately 2.8 dB (DVB-S2).



The relationship used to derive the table values (the only simple way for DVB-S2) is as follows:

$$Es/No = C/N = 10\log_{10}(10^{((Co + No)/ 10)} -1)$$

where:

Es/No and **(Co+No)/No** are expressed in dB.

Table B-1. DVBS2, Normal Block, Pilot ON, QEF (PER 10^{-7}) AWGN Linear Channel

MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits / Hz)	QEF Eb/No	QEF Es/No
QPSK	1/4	0.1	150	0.05	72	0.48	0.9	-2.3
	1/3	0.1	150	0.06	96	0.64	0.8	-1.1
	2/5	0.1	150	0.08	115.5	0.77	0.9	-0.2
	1/2	0.1	150	0.10	144.80	0.97	1.4	1.2
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
	3/4	0.1	150	0.15	217.80	1.45	2.6	4.2
	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	2/3	0.1	120	0.19	232.30	1.94	3.9	6.8
	3/4	0.1	120	0.22	261.40	2.18	4.7	8.1
	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.20	2.62	7.0	11.2
16APSK	2/3	0.1	90	0.26	231.80	2.58	5.2	9.3
	3/4	0.1	90	0.29	260.60	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4	11.3
	5/6	0.1	90	0.32	290.00	3.22	6.8	11.9
	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	9/10	0.1	90	0.35	313.50	3.48	8.0	13.4
32APSK	3/4	0.1	72	0.36	260.90	3.62	7.5	13.1
	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
	5/6	0.1	72	0.40	290.20	4.03	8.6	14.7
	8/9	0.1	72	0.43	309.80	4.30	9.8	16.1
	9/10	0.1	72	0.44	313.70	4.36	10.0	16.4

Table B-2. DVB-S2-EB2/EB-1, Normal Block, Pilot ON, QEF (PER 10^{-7}) AWGN Linear Channel

MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits/Hz)	QEF Eb/No (* = EB2)	QEF Es/No (* = EB2)
QPSK	1/4	0.1	150	0.05	72.00	0.48	0.9	-2.3
	53/180	0.1	150	0.06	85.50	0.57	1/0.9*	-1.4/-1.5*
	1/3	0.1	150	0.06	96.00	0.64	0.8	-1.1
	11/30	0.1	150	0.07	106.50	0.71	1.0	-0.5
	2/5	0.1	150	0.08	115.50	0.77	0.9	-0.2
	77/180	0.1	150	0.08	123.00	0.82	1.2	0.3
	83/180	0.1	150	0.09	133.50	0.89	1.3	0.8
	1/2	0.1	150	0.10	145.50	0.97	1.3	1.2
	8/15	0.1	150	0.10	154.50	1.03	1.6	1.7
	17/30	0.1	150	0.11	165.00	1.10	1.7	2.1
	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	19/30	0.1	150	0.12	183.00	1.22	1.9	2.8
	2/3	0.1	150	0.13	193.50	1.29	2.2	3.3
	127/180	0.1	150	0.14	205.50	1.37	2.4	3.8
	3/4	0.1	150	0.15	217.50	1.45	2.6	4.2
	4/5	0.1	150	0.16	232.50	1.55	3.0	4.9
	5/6	0.1	150	0.16	243.00	1.62	3.3	5.4
	31/36	0.1	150	0.17	250.50	1.67	3.7	5.9
	8/9	0.1	150	0.17	258.00	1.72	4.0	6.4
	9/10	0.1	150	0.18	262.50	1.75	4.2	6.6
8PSK	17/30	0.1	120	0.16	196.80	1.64	3.8	5.9
	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	19/30	0.1	120	0.18	220.80	1.84	3.9	6.5
	2/3	0.1	120	0.19	232.80	1.94	3.9	6.8
	127/180	0.1	120	0.21	246.00	2.05	4.7/4.5*	7.8/7.6*
	3/4	0.1	120	0.22	261.60	2.18	4.7	8.1
	4/5	0.1	120	0.23	278.40	2.32	5.3	9.0
	5/6	0.1	120	0.24	290.40	2.42	5.8	9.6
	31/36	0.1	120	0.25	300.00	2.50	6.3	10.3
	8/9	0.1	120	0.26	310.80	2.59	6.9	11.0
	9/10	0.1	120	0.26	314.40	2.62	7.0	11.2
16APSK	19/30	0.1	90	0.24	219.60	2.44	5.3/5*	9.2/8.9*
	2/3	0.1	90	0.26	231.30	2.57	5.2/5.1*	9.3/9.2*
	127/180	0.1	90	0.27	244.80	2.72	5.7/5.5*	10/9.8*
	3/4	0.1	90	0.29	261.00	2.90	5.9	10.5
	4/5	0.1	90	0.31	278.10	3.09	6.4/6.3*	11.3/11.2*
	5/6	0.1	90	0.32	289.80	3.22	6.8/6.7*	11.9/11.8*
	31/36	0.1	90	0.33	299.70	3.33	7.6/7.2*	12.8/12.4*
	8/9	0.1	90	0.34	309.60	3.44	7.8/7.6*	13.2/13*
	9/10	0.1	90	0.35	313.20	3.48	8/7.9*	13.4/13.3*
32APSK	127/180	0.1	72	0.34	245.52	3.41	7.2/7*	12.5/12.3*
	3/4	0.1	72	0.36	260.64	3.62	7.5/7.3*	13.1/12.9*
	4/5	0.1	72	0.39	278.64	3.87	8.1/8*	14/13.9*
	5/6	0.1	72	0.40	290.16	4.03	8.6/8.4*	14.7/14.5*
	31/36	0.1	72	0.42	299.52	4.16	9.2/8.9*	15.4/15.1*
	8/9	0.1	72	0.43	309.60	4.30	9.8/9.4*	16.1/15.7*
	9/10	0.1	72	0.44	313.92	4.36	10/9.8*	16.4/16.2*
64APSK*	4/5	0.1	54	0.46	250.02	4.63	NA/10.4*	NA/17.1*
	5/6	0.1	54	0.48	260.28	4.82	NA/11.1*	NA/17.9*
	31/36	0.1	54	0.50	268.92	4.98	NA/11.5*	NA/18.5*
	8/9	0.1	54	0.52	278.10	5.15	NA/12.3*	NA/19.4*
	9/10	0.1	54	0.52	281.88	5.22	NA/12.7*	NA/19.9*

Table B-3. DVB-S2X (in addition to DVB-S2 MODCODs), Normal Block, Pilot ON, QEF (FER=1E-5) AWGN Linear Channel

MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits / Hz)	QEF Eb/No (* = EB2)	QEF Es/No (* = EB2)
QPSK	13/45	0.1	150	0.06	83.14	0.55	0.8	-1.8
	9/20	0.1	150	0.09	130.20	0.87	1.0	0.4
	11/20	0.1	150	0.11	159.40	1.06	1.4	1.7
8PSK	5/9-L	0.1	120	0.16	193.18	1.61	2.9	5.0
	26/45-L	0.1	120	0.17	200.96	1.67	3.2	5.4
	23/36	0.1	120	0.19	222.37	1.85	3.8	6.5
	25/36	0.1	120	0.20	241.84	2.02	4.3	7.3
	13/18	0.1	120	0.21	251.57	2.10	4.5	7.7
16APSK	1/2-L	0.1	90	0.19	173.29	1.93	3.5	6.3
	8/15-L	0.1	90	0.21	184.94	2.05	3.7	6.8
	5/9-L	0.1	90	0.21	192.71	2.14	3.8	7.1
	26/45	0.1	90	0.22	200.47	2.23	4.4	7.9
	3/5	0.1	90	0.23	208.24	2.31	4.7	8.3
	3/5-L	0.1	90	0.23	208.24	2.31	4.1	7.7
	28/45	0.1	90	0.24	216.01	2.40	4.7	8.5
	23/36	0.1	90	0.25	221.83	2.46	4.7	8.6
	2/3-L	0.1	90	0.26	231.54	2.57	4.5	8.6
	25/36	0.1	90	0.27	241.25	2.68	5.3	9.6
	13/18	0.1	90	0.28	250.96	2.79	5.5	10.0
	7/9	0.1	90	0.30	270.38	3.00	6.1	10.9
	77/90	0.1	90	0.33	297.56	3.31	7.1	12.3
32APSK	2/3-L	0.1	72	0.32	231.73	3.22	6.5	11.6
	32/45	0.1	72	0.34	247.28	3.43	6.8	12.2
	11/15	0.1	72	0.35	255.05	3.54	7.1	12.6
	7/9	0.1	72	0.38	270.60	3.76	7.8	13.5
64APSK	32/45-L	0.1	54	0.41	222.01	4.11	8.4	14.5
	11/15	0.1	54	0.42	228.99	4.24	9.0	15.3
	7/9	0.1	54	0.45	242.95	4.50	9.5	16.0
	4/5	0.1	54	0.46	249.93	4.63	9.7	16.4
	5/6	0.1	54	0.48	260.39	4.82	10.3	17.1

Notes:

Appendix C. OPTIONAL PIIC (PLUG-IN INTERFACE CARD) MODULES

C.1 Overview

The CDM-760 Advanced High-Speed Satellite Modem rear panel features two slots that accommodate optional PIIC (Plug-in Interface Card) data modules. These modules plug into either or both of the Interface Option slots located on the rear panel of the CDM-760 chassis (**Figure C-2**).

By convention, a modem is **D**ata **C**ommunications **E**quipment (DCE) where Tx data enters the data interface and Rx data exits. Via the chassis' PIIC module connections, the CDM-760 provides physical and electrical connection between the external terrestrial device and the internal circuitry of the modulator or demodulator.

While the CDM-760's available optional PIIC modules are usually ordered with the modem, they are easily field-installed. The available PIIC modules, and reference to their pertinent section in this appendix, are as follows:

CEFD Kit / Assembly	Description	For Details See Appendix C Sect.
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module	C.2.1
KT-0000256	SFP OC-3 Single Mode PIIC Module	C.2.2
KT-0000257	SFP OC-3 Multi Mode PIIC Module	C.2.3
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module	
PL-0022015	DVB ASI Asynchronous Serial Interface PIIC Module	C.2.4

Additional PIIC module data options (e.g., HSSI) will become available upon request.

Any PIIC module supported by the CDM-760 can be used in any slot. In Single Stream Mode, a single PIIC module is active and no other interfaces are active. In MultiStream Mode, one or both PIIC modules are active AND at least one Gigabit Ethernet interface is active. The CDM-760 acts as a multiplexor/demultiplexor in MultiStream Mode.

C.1.1 PIIC Conditional Availability

Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR

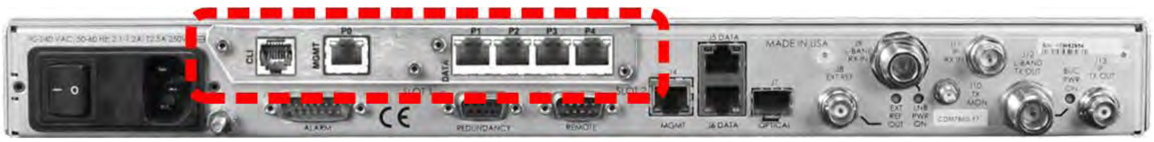


Figure C-1. Optional High-Speed Packet Processor (No PIICs Allowed)

A CDM-760 that is equipped with the High-Speed Packet Processor (**Figure C-1**) <u>cannot</u> accommodate operation of PIIC synchronous traffic data modules (G.703 T3, E3, STM-1, OC-3, etc.).

When the CDM-760 is factory-equipped with the optional High-Speed Packet Processor card (it is also available as a field upgrade using CEFD Kit KT-0020958), the card installs into the modem rear panel chassis physical space otherwise occupied by the PIICs. The PIICs therefore cannot be co-installed.

C.1.2 Typical PIIC Module Installation

Figure C-2. Typical PIIC Module Installation

Do these steps to install the optional PIIC module(s) (Figure C-2):

Step	Task
1	Remove the PIIC slot blank panel(s) by loosening the captive thumbscrews.
2	Install the PIIC module(s) into position using the chassis' internal card guides. Slide the module straight back into the chassis until the module is firmly plugged into the mating receptacle(s).
3	Secure the captive thumbscrews of the module(s).

C.2 Optional PIIC Modules

C.2.1 G.703 E3/T3/STS-1 PIIC Module (CEFD P/N PL-0000795)

Figure C-3. G.703 E3/T3/STS-1 PIIC Module

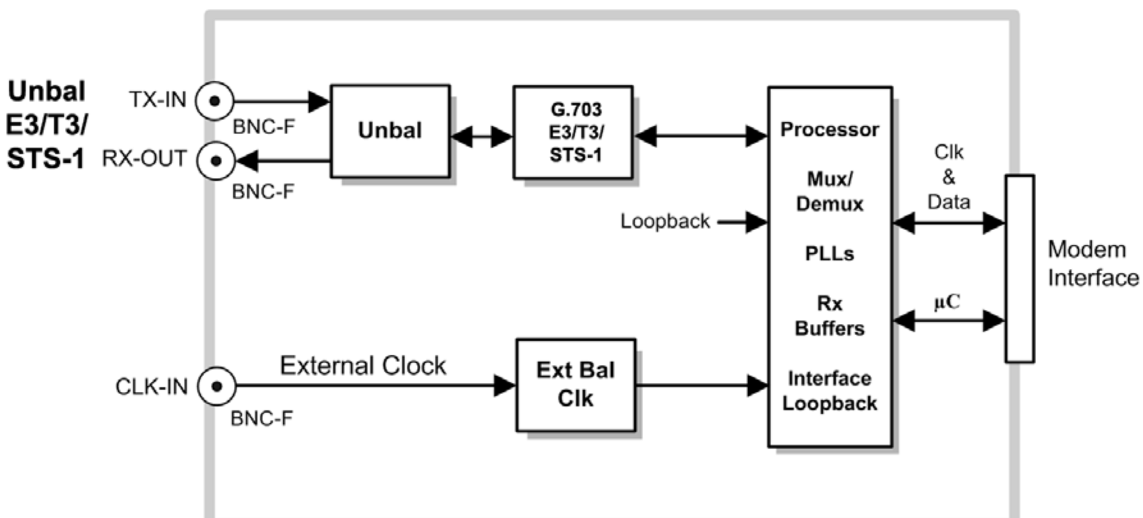


Figure C-4. G.703 E3/T3/STS-1 PIIC Module Block Diagram

Name	Connector Type	Description	Direction (I/O)
TX-IN	BNC	Data In	I
RX-OUT	BNC	Data Out	O
CLK-IN	BNC	External Clock Input	I

Figure C-5. G.703 E3/T3/STS-1 PIIC Module Panel Connectors

C.2.1.1 G.703 E3/T3/STS-1 PIIC Module – Specifications

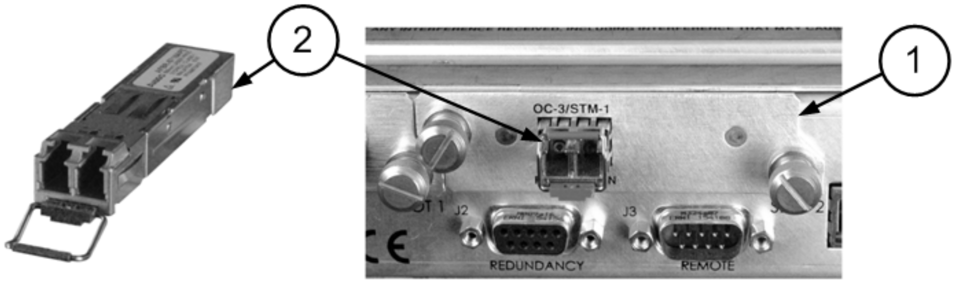
C.2.1.1.1 General Specifications

Item	Description
Interfaces	1 - Tx G.703 port, E3, T3, STS-1 Input 1 - Rx G.703 port, E3, T3, STS-1 Output 1 – External Clock Input
External Clock Input	
Connector Type	BNC female
Impedance	75 Ω ± 5%
Input Amplitude	0.5 to 5.0 V peak to peak
Input Frequency	1, 2, 5, 10, 20, 34.368 (E3), 44.736 (T3), and 51.840 (STS-1) MHz
Signal Characteristics	Sine wave or square with duty cycle of 50 ± 10%
Maximum Buffer Size	75 ms max for Doppler, 20 Mbit for ISSY
Clock Options	Tx Clock = Tx, Rx (satellite) , or External Rx Clock = Tx, Rx (satellite), Internal, or External
Acquisition Range	Programmed Tx rate +/- 100 ppm
Test	Baseband Loopback (at interface) Interface Loopback (through interface card) 2047 test pattern generator
Hot Swap Capability	Yes

C.2.1.1.2 Interface Specifications

Interface	Description
G.703 Unbalanced:	Channel supports G.703 E3, T3, and STS-1.
Connector Type	BNC female
Signals Supported	ITU-T-G.703 SD, RD
Data Rate	(E3) 34.368, (T3) 44.736 Mbps, (STS-1) 51.84 Mbps
Tx and Rx Data Rates	Tx and Rx data rates are programmed the same
Line Coding	HDB3 (for E3), B3ZS (for DS3), AMI (Common)
Pulse Mask	ITU-T-G.703
Jitter	Telcordia GR-499-CORE For T3 and STS-1, G.823 for E3
Impedance	75 Ω Per ITU-T-G.703
Alarms	Loss of signal, All 1's

C.2.2 OC-3 Single/Multi Mode PIIC Module Kits (CEFD P/N KT-0000256/257)



KT-000256/257 OC-3 Single Mode or Multi Mode PIIC Module Kits				
Item	Quantity		CEFD Part Number	Description
	KT-0000256	KT-0000257		
1	1	1	PL-0001067	PIIC Module
2	1	–	IC-0000687	SFP OC-3 Single Mode Optical Transceiver Module
	–	1	IC-0000690	SFP OC-3 Multi Mode Optical Transceiver Module

Figure C-6. OC-3 Single Mode or Multi Mode PIIC Module Kit (CEFD P/N KT-000025X)

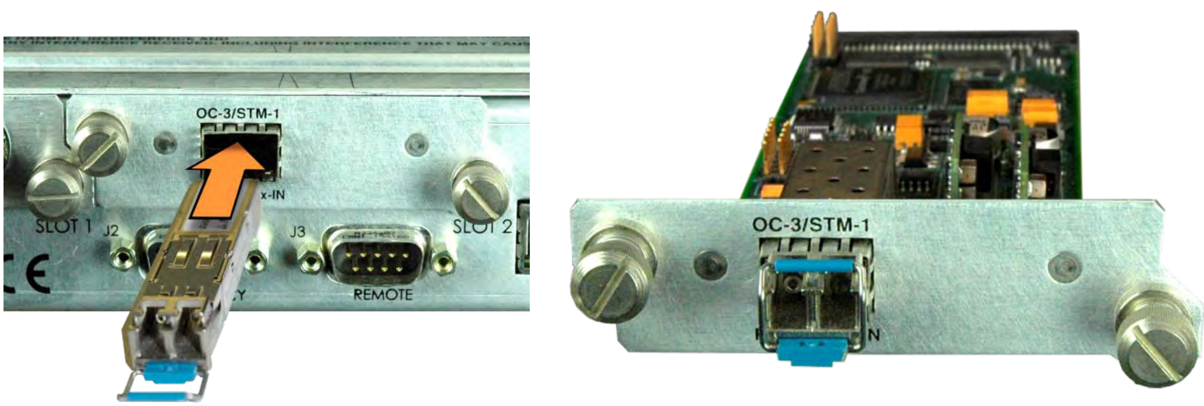


Figure C-7. OC-3 Single Mode or Multi Mode PIIC Module – SFP Installation

Use the OC-3 Single or Multi Mode PIIC module in either of the CDM-760 rear panel interface option slots. The PIIC module features an SFP (Small Form Factor Pluggable) docking cage that accepts either the Comtech EF Data OC-3 Single Mode or Multi Mode SFP transceiver module (**Figure C-9**).

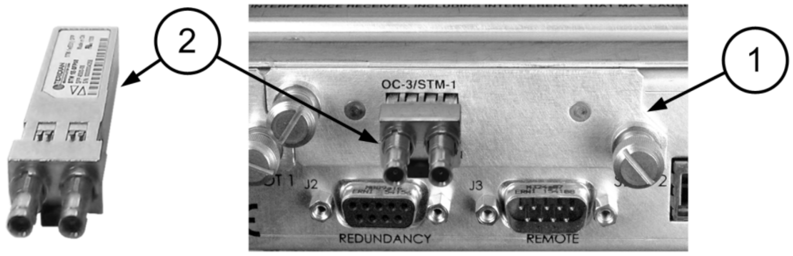
User-supplied standard modules (SFP Multi-Source Agreement (MSA) SFF-8074i and SFF-8472 Rev. 9.3) may be used, but Comtech EF Data does not guarantee interoperability.

See **Figure C-2** for installation of a PIIC module into an available PIIC interface slot.

C.2.2.1 OC-3 Single/Multi Mode PIIC Module – Summary of Specifications

Item	Description
Interfaces	• OC-3 Single Mode (CEFD Kit **KT-0000256)** • OC-3 Multi Mode (CEFD Kit **KT-0000257)**
Data Rate	155.52 Mbps ±20 ppm
Framing and Signaling	SONET OC-3 SDH STM-1
Direction	Full Duplex, allowing Tx/Rx only operation
Connectors	Duplex LC
Fiber	• Single Mode: 1300 nm, spectral width 7.7 nm rms • Multi Mode: 1300 nm, 62.5/125 µm, spectral width 63 nm rms
Typical Distance	• Single Mode: Up to 15 Km • Multi Mode: Up to 500 m
Output Power	• Single Mode: -12 dBm Typical • Multi Mode: -14 dBm Typical
Input Power	• Single Mode: -31 dBm to -8 dBm • Multi Mode: -35 dBm to -30 dBm
Jitter	G.825
Diagnostics	• Baseband Loopback (at interface) • Interface Loopback (through interface module)
Rx Buffer	0.5 to 75 ms in 0.1 ms steps

C.2.3 STM-1 Copper PIIC Module Kit (CEFD P/N KT-0000255)



KT-000255 STM-1 Copper PIIC Module Kit			
ITEM	**QTY**	**CEFD P/N**	**DESCRIPTION**
1	1	PL-0001067	PIIC Module
2	1	IC-0000686	SFP STM-1 155 Mbps Copper Transceiver Module
3	1	CA-0000967	Cable Assembly **(NOT SHOWN)**

Figure C-8. STM-1 Copper PIIC Module Kit (CEFD P/N KT-0000255)

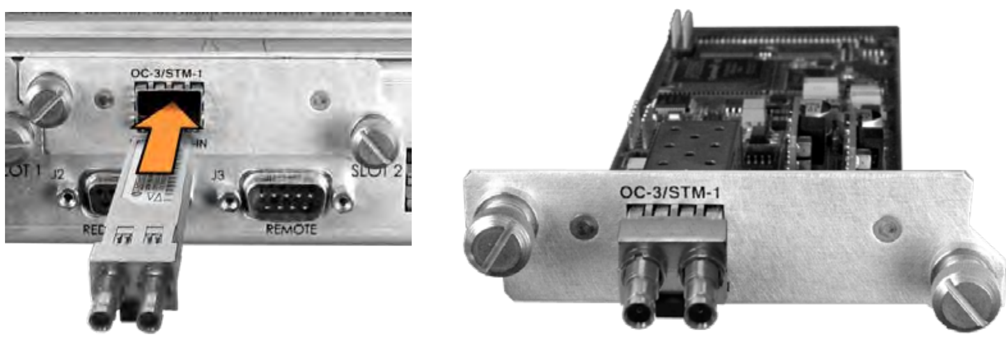


Figure C-9. STM-1 Copper PIIC Module – SFP Installation

Use the STM-1 Copper PIIC module in either of the CDM-760 rear panel interface option slots. The PIIC module features an SFP (Small Form Factor Pluggable) docking cage that accepts the Comtech EF Data SFP STM-1 transceiver module (**Figure C-7**).

User-supplied standard modules (SFP Multi-Source Agreement (MSA) SFF-8074i and SFF-8472 Rev. 9.3) may be used, but Comtech EF Data does not guarantee interoperability.

See **Figure C-2** for installation of a PIIC module into an available PIIC interface slot.

C.2.3.1 STM-1 Copper PIIC Module – Summary of Specifications

Item	Description
Data Rate	155.52 Mbps ±20 ppm
Framing and Signaling	G.703/GR-253, CMI
Jitter	G.825
Direction	Full duplex, allowing Tx/Rx only operation
Connectors	BNC-F, 75Ω
Output Level	1 Vpp Typical
Input Level	0.5 Vpp to 1.1 Vpp
Diagnostics	• Baseband Loopback (at interface) • Interface Loopback (through interface module)
Rx Buffer	0.5 to 75 ms in 0.1 ms steps

C.2.4 DVB ASI (Asynchronous Serial Interface) PIIC Module (CEFD P/N PL-0022015)

Figure C-10. G.703 E3/T3/STS-1 PIIC Module

Name	Connector Type	Description	Direction (I/O)
ASI-IN	BNC	Data In	I
ASI-OUT	BNC	Data Out	O

Figure C-7. DVB ASI (Asynchronous Serial Interface) PIIC Module Panel Connectors

C.2.4.1 DVB ASI (Asynchronous Serial Interface) PIIC Module – Summary of Specifications

Item	Description
Data Rate	1 - 216 Mbps
Framing and Signaling	DVB-ASI, 188 and 204 Byte Framing
Jitter	EN 50083-9
Direction	Full duplex, allowing Tx/Rx only operation
Connectors	BNC-F, 75Ω
Output Level	800mVpp +/-10%
Input Level	200mVpp – 880mVpp
Diagnostics	• Baseband Loopback (at interface) • Interface Loopback (through interface module)
Rx Buffer	0.5 to 75 ms in 0.1 ms steps

Appendix D. ETHERNET NETWORK CONFIGURATION

D.1 Overview

For operations requiring Ethernet-based terrestrial data handling, it is important to stress the importance of avoiding Ethernet looping connection problems – with or without use of the CDM-760 Advanced High-Speed Trunking Modem in redundancy. These issues are specifically addressed with a CDM-760 redundancy configuration that uses Comtech EF Data's CRS-170A (L-Band) or CRS-180 (70/140 MHz) 1:1 Redundancy Switches, or a CRS-500 M:N Redundancy System in 1:N redundancy.

Use this appendix to review the differing methods for Ethernet-based data handling with the CDM-760.

D.2 Ethernet Routers and Switches

Routers and switches allow connection of one or more computers or networked devices to other computers or network devices. Each has two or more connectors, called physical ports, in which cables connect to other network devices.

An **Ethernet switch** examines the traffic that comes across it, and learns where particular MAC addresses are. An Ethernet switch maintains what is known as a **C**ontent **A**ddressable **M**emory (**CAM**) table, listing the MAC addresses for each switch port. The Ethernet switch uses the CAM table to determine where to forward Ethernet frames. By default, Ethernet switches will update the CAM table automatically; for example, if an Ethernet switch sees traffic from 'Machine A' coming in on 'Port 2', it now knows that 'Machine A' is connected to that port, and that traffic destined for 'Machine A' needs to only be sent to that port and not any of the others.

An **Ethernet router** determines where to forward IP traffic based upon the destination IP address and the Route table entries in the router. An Ethernet router can be programmed to understand and route the data it is directed to handle; for example, broadband routers include the ability to "hide" computers behind a type of firewall, which involves slightly modifying the packets of network traffic as they traverse the device. All routers include some kind of user interface for configuring how the router will treat traffic: larger routers include the equivalent of a full-blown programming language to describe how they should operate, as well as the ability to communicate with other routers to describe or determine the best way to direct network traffic from 'Point A' to 'Point B'.

D.3 Ethernet Configuration Examples

This section explains the problems with **Ethernet Networking Loops**, and how to properly design applications architecture for handling **Standard traffic** and **Split-path traffic.** *Standard traffic* is defined as Rx and Tx Ethernet traffic using the same port on the same router or switch, whereas *split-path traffic* is Rx and Tx Ethernet traffic using different ports of the same router or switch.

D.3.1 Ethernet Network Overview

When placing modems in a network, there are a number of issues that must be addressed – first and foremost on the list of concerns is whether implementation of the switches in the network will cause a **Networking Loop**. This is problematic because a Networking Loop will cause a **Broadcast Storm**, which shuts down the network and causes harm to devices in that network.

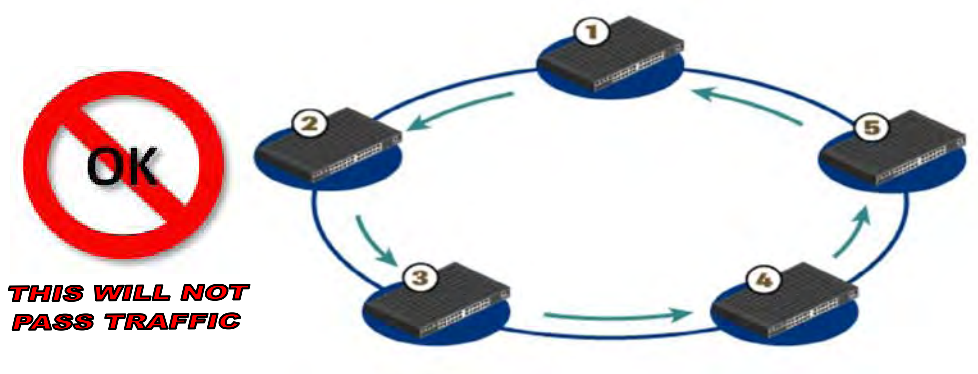


Figure D-1. Networking Loop with Switches

Figure D-1 illustrates a Networking Loop with switches. The problem with this configuration is that **'Switch 1'** will send out an ARP request looking for a particular MAC, then each subsequent switch passes along that request until **'Switch 1'** receives it again. At this point, two things could happen:

1. The switch could continue to forward all requests out all ports, creating more and more traffic on the network until there is no bandwidth available and the switch either reboots or locks up.
2. The switch could sense that the ARP request came back to the switch on a different port. The switch could then stop forwarding traffic out the proper port.

Other factors will affect the network: e.g., if the switch is running Spanning Tree Protocol, VLANs, etc.

D.4 CDM-760 Ethernet Overview

D.4.1 Ethernet Interfaces

InBand Modem Control allows remote Ethernet access via the Gigabit Ethernet data interfaces. There are two operational modes for data flow while using the CDM-760. The selection of InBand "Enable" or "Disable" will yield two different Ethernet circuit paths.

- **InBand Disabled – Figure D-2** shows the internal Ethernet architecture for the CDM-760 when InBand is "Disabled".

  Typically, the management port is configured so that management traffic is physically separated from the data traffic ports. Setting InBand as "Disabled" facilitates this configuration.

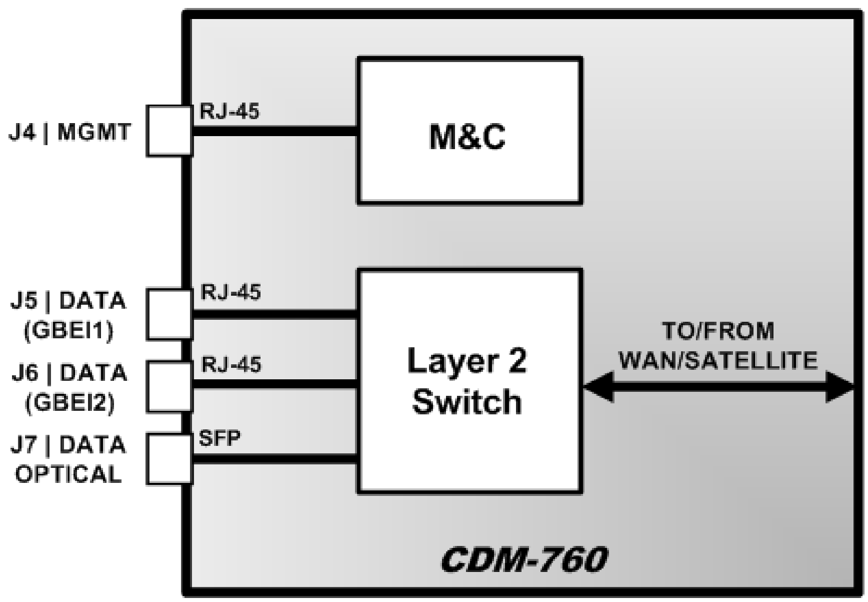


Figure D-2. CDM-760 Architecture – InBand "Disabled"

In this setting the only way to communicate with the M&C via an Ethernet connection is through the base unit **J4 | MGMT** GigE RJ-45 connection. In this configuration, it is common to see remote M&C and data travel together over the satellite link separated by VLAN, where a VLAN-aware switch will separate the traffic into user traffic and management traffic as seen in **Figure D-3**.

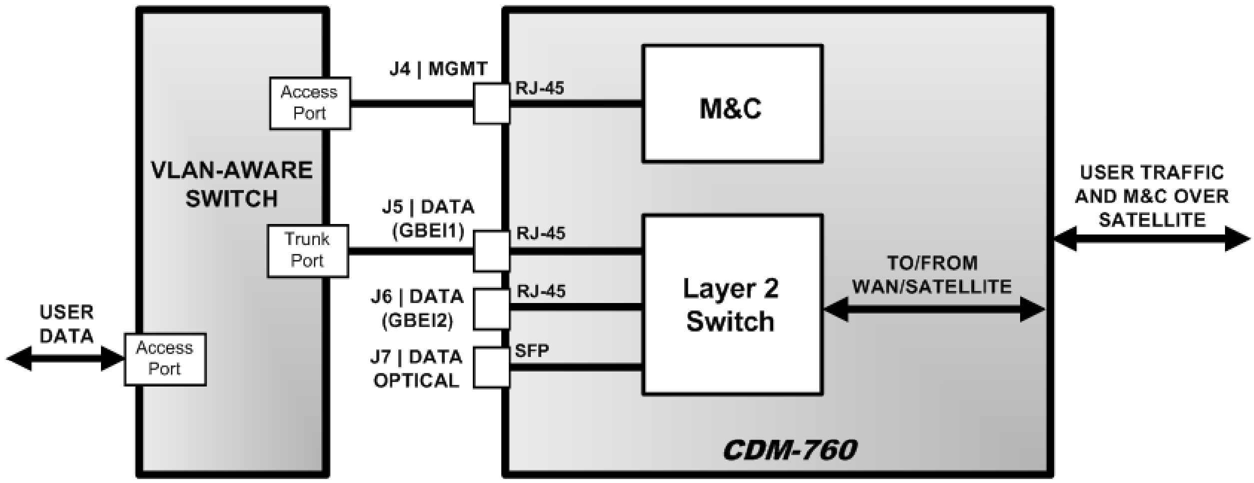


Figure D-3. CDM-760 Switching – InBand "Disabled"

- **InBand Enabled – Figure D-4** shows the internal Ethernet architecture for the CDM-760 when InBand is "Enabled". In other circumstances it may be advantageous to allow the M&C traffic and User Data traffic to co-exist in order to monitor and control a remote site without the need for an external switch. Setting InBand as "Enabled" facilitates this configuration.

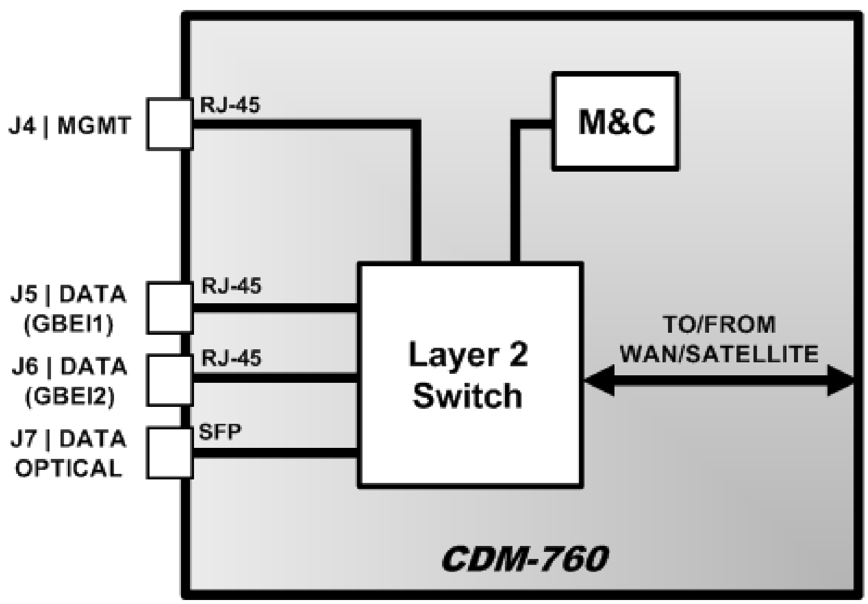


Figure D-4. CDM-760 Architecture – InBand "Enabled"

With this configuration, you must take care not to create an Ethernet loop (**Figure D-5**). Ethernet loops happen when an Ethernet frame can get to the same switch or modem on more than one port. See **Sect. D.3.1** for more information.

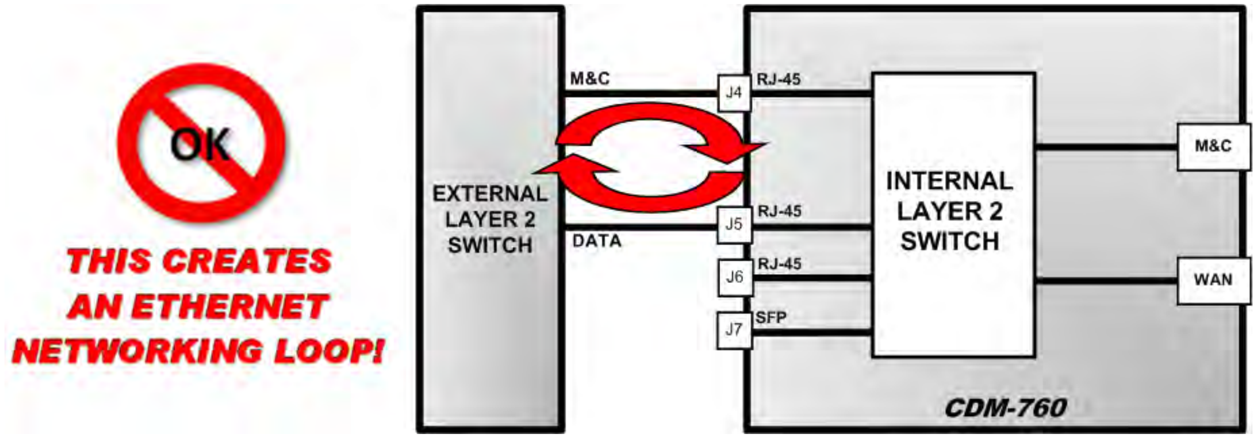


Figure D-5. Improper Use of External Switch with CDM-760 – InBand "Enabled"

D.4.2 Ethernet Overhead

After Ethernet packets are sent from the internal switch to the modem WAN interface, Generic Stream Encapsulation (GSE) is used and overhead is <1%.

Notes:

Appendix E. ETHERNET STATISTICS AND STATUS REPORTING

E.1 Overview

Information is available from the CDM-760 Advanced High-Speed Trunking Modem to report ongoing and time-varying quantities, along with some operational status items. Of particular interest in this section are those related to the Ethernet data traffic associated with normal operation and metrics – i.e., items that are attributed new meaning in special modes like Adaptive Coding and Modulation (ACM) or DoubleTalk Carrier-in-Carrier (CnC). All of the metrics (counts, configuration, ratios, etc.) are referred to collectively as *statistics*. (For the purpose of this application, the intent of using the word ‘statistics’ here is to gather naturally associated items.)

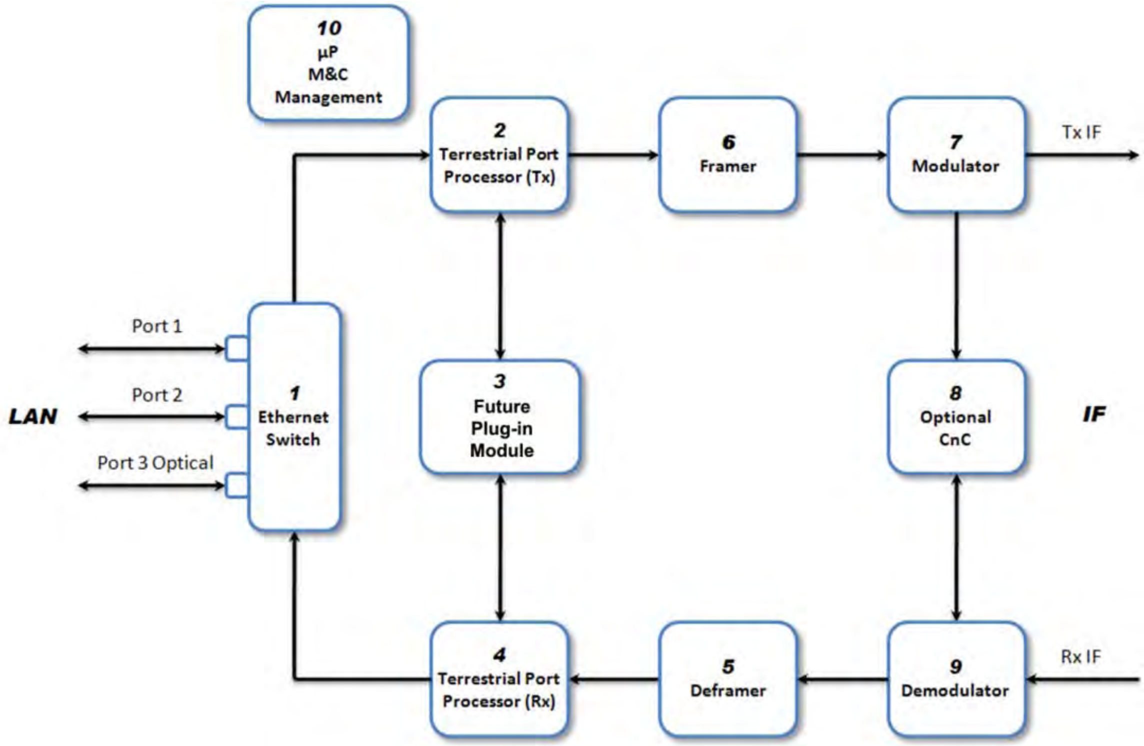
This appendix excludes much of the information provided elsewhere in this manual (e.g., Es/No, RSL, etc.) in order to focus strictly on the topic of Ethernet data traffic.

E.2 Data Flow Diagram

Figure E-1 provides a simplified way to visualize the CDM-760 and its data traffic handling capabilities. While this diagram includes a few of the normal modulator and demodulator features, its primary purpose is to emphasize the blocks involved in data flow.

Note the following:

- The names of the blocks/regions correspond to generic functions within the modem.
- The blocks in this diagram are numbered to indicate valid traffic flow between blocks.
- Data flow only occurs as indicated by the lines in the diagram. For example, data flow from Blocks **1** to **2** is *valid*, while data flow between Blocks **2** and **8** is *not*.
- The arrows in the diagram indicate the direction of data flow; while data flow between Blocks **1** and **2** is *valid*, data flow between Blocks **2** and **1** *does not occur*. Arrows on *both ends* of a link show where data flow is *bidirectional*.



Name	Function
LAN Region	This unmarked region of the diagram refers to the LAN – the source / destination for data traffic. The information of interest is tailored to Ethernet interfaces, so most of the statistics do not apply to the G.703 interface.
Block 1 – Ethernet Switch	The LAN's access to the modem is at the Ethernet switch. There are two RJ-45 10/100/1000BaseT ports (Port 1 – J5 | DATA / GBEI1, and Port 2 – J6 | DATA / GBEI2) and one optional optical Gigabit Ethernet (SFP module) port (Port 3 – J7 | OPTICAL) available at the rear of the modem.
Block 2 – Terrestrial Port Processor (Tx)	Data from the LAN destined to the satellite flows into this block.
Block 3 – Expansion Slot	This is reserved for future plug-in modules.
Block 4 – Terrestrial Port Processor (Rx)	This is the counterpart to the Tx processor. It forms Ethernet packets and forwards them to the Ethernet Switch.
Block 5 – Deframer	The data from the satellite frames is recovered.
Block 6 – Framer	Data processing to assemble data into frames for the modulator is performed in this block.
Block 7 – Modulator	Frames are mapped into the appropriate FECFrame and mapped into the selected ModCod for transmission to the satellite.
Block 8 – CnC	Signals to and from the satellite are processed here to cancel the locally transmitted carrier and receive the carrier from the distant end.
Block 9 – Demodulator	Carriers received from the satellite are processed here to recover data frames.
Block 10 – µP / M&C / Management	The microcontroller (µP) is involved in collection and calculation of statistics.
IF Region	This unmarked region of the diagram refers to data to or from the satellite link.

Figure E-1. CDM-760 Data Flow Diagram

E.3 Statistics Items

The tabulated content presented in the sections that follow may or may not be operational at this time.

E.3.1 Ethernet Data Statistics

Item	Fig. G-1 Block Flow		Comments
	From	To	
GBEI1 Mode	1 4	2 1	Normal, test, PHY Up, PHY Down, OFF
GBEI2 Mode	1 4	2 1	Normal, test, PHY Up, PHY Down, OFF
GBEI3 (Optical) Mode	1 4	2 1	Normal, test, PHY Up, PHY Down, OFF
Total packets destined to WAN	1	2	Aggregate of all accepted packets less M&C packets
Total bytes destined to WAN	1	2	Aggregate of all accepted bytes less M&C bytes
Packets from LAN to PORT 1 (J5 | DATA / GEBI1)	LAN	1	Packets accepted to Port 1 (J5 | DATA / GBEI1) and inclusive of M&C
Packets from LAN to PORT 2 (J6 | DATA / GBEI2)	LAN	1	Packets accepted to Port 2 (J6 | DATA / GBEI2) and inclusive of M&C
Packets from LAN to optical PORT 3 (J7 | OPTICAL)	LAN	1	Packets accepted to Port 3 (J7 | OPTICAL optional port) and inclusive of M&C
Packets from M&C	10	1	Number of packets sent from the M&C to either LAN or WAN side
Packets from LAN that were dropped due to buffer full in Switch Chip	1	2	Number of VALID acceptable packets that were thrown away due to buffer full
Packets from WAN to PORT 11 (J5 | DATA / GEBI1)	2	1	Breakout of packets from WAN to Port 1 (J5 | DATA / GBEI1) and inclusive of M&C packets
Packets from WAN to PORT 2 (J6 | DATA / GBEI2)	1	LAN	Breakout of packets from WAN to Port 2 (J6 | DATA / GBEI2) and inclusive of M&C packets
Packets from WAN to PORT 3 (J7 | OPTICAL)	–	–	Breakout of packets from WAN to Port 3 (J7 | OPTICAL optional port) and inclusive of M&C packets
Packets to M&C	1	10	Number of packets sent to the M&C from either LAN or WAN side
Total packets destined to LAN	4	1	Aggregate of all LAN packets (less M&C packets)
Total bytes destined to LAN	4	1	Aggregate of all LAN bytes (less M&C bytes)
Counter Reset	10	–	Resets all above counters

E.3.2 Framing and Baseband Statistics

Item	Fig. G-1 Block Flow		Comments
	From	To	
BB Tx Frame Count by Mod Cod	6	7	Excludes PL Dummy frames
BB Rx Frame Count by Mod Cod	9	5	Excludes PL Dummy frames
BB Rx Frames received in error By Mod Cod	9	5	Excludes PL Dummy Frames (CRC or LDPC or BCH errors or any uncorrectable error)
BB Rx Frames received count for 16APSK	9	5	While 16APSK option not active
BB Rx Frames received count for 32APSK	9	5	While 32APSK option not active
Counter Reset	9	5	Resets all above counters

E.3.3 Status Items

Status items are not strictly part of the Statistics but are important items used for monitoring for current conditions.

E.3.4 BER Testing

Item	Comments
ModCod Selection	Allows selection of ModCod for test.
PN Sequence Test On/Off	Enable / Disable Test.
BER Test Result	Test results – continuous. PN data is generated in the Framer (Fig. G-1 Block 6) and recovered in the Deframer (Fig. G-1 Block 5).

E.3.5 ACM Modulator Status

Item	Comments
Current Tx ModCod	Currently active Tx ModCod.
Remote Es/No Reading	Es/No from distant end.

E.3.6 ACM Demodulator Status

Item	Comments
Rx ModCod	Currently active Rx ModCod.
Local Es/No Reading	Es/No of local demodulator.

E.3.7 CnC Status

Item	Comments
CnC PSD Ratio	Power Spectral Density (PSD) ratio at local end. PSD = Interferer - Distant, density (dB).
CnC Ratio (Power)	Power Ratio at local end. CnC Ratio = Interferer - Distant, power (dB).
CnC frequency offset	ΔF between Interferer and Distant carriers.
CnC Delay	Round trip delay of Tx carrier in ms (measured in Fig. G-1 Block 8).

Appendix F. OPTIONAL HIGH-SPEED PACKET PROCESSOR

F.1 High-Speed Packet Processor – Introduction

The High-Speed Packet Processor is an optional feature for the CDM-760 Advanced High-Speed Trunking Modem. In addition to providing Layer 2 and Layer 3 functionality, it incorporates a number of key features for Wide Area Network (WAN) bandwidth optimization. This includes Header Compression, Quality of Service (QoS), and Static Routing.

The CDM-760 chassis features two rear panel slots that accommodate optional PIIC (Plug-in Interface Card) synchronous traffic data modules. In place of PIICs, the CDM-760 can instead accommodate the High-Speed Packet Processor option (**Figure F-1**). This option can be ordered at time of initial purchase; the modem is shipped with the Packet Processor installed into the chassis PCBs, with a rear chassis faceplate that is installed with #4-40 hex jack screws. It is also available as a field upgrade kit (CEFD P/N KT-0020958).

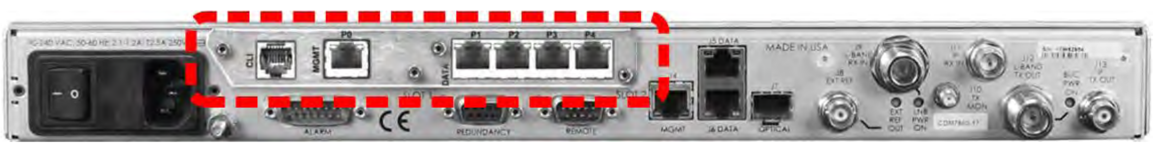


Figure F-1. CDM-760 w/Optional High-Speed Packet Processor

F.1.1 High-Speed Packet Processor – Operational Requirements

F.1.1.1 Major Assemblies

High-Speed Packet Processor Option / Upgrade Kit KT-0020958		
CEFD Part Number	**QTY**	**Description**
PL-0021603	1	High-Speed Packet Processor PCB Assembly
FP-0021300	1	Cover, Chassis
HW/SEM440X1/4PH	4	Screw, #4-40 x 1/4 LG Pan Head
HW/JS440M03	4	Screw, #4-40 x 5/16 LG Hex Jack

F.1.1.2 Limitations and Interoperability/Compatibility Considerations

1) **At present, use of the optional High-Speed Packet Processor with the CDM-760 Advanced High-Speed Trunking Modem requires Firmware Version 1.4.1 or higher to accommodate Packet Processor functionality.**
2) **A CDM-760 that is equipped with the Packet Processor option is not interoperable for IP/Ethernet Traffic with a CDM-760 that is not equipped with this option.**
3) **A CDM-760 that is equipped with the Packet Processor option is not available for operation of PIIC synchronous traffic data modules (G.703 T3, E3, STM-1, OC-3, etc.). The Packet Processor occupies the same physical chassis space within the modem as these synchronous data interfaces and therefore cannot be co-installed.**

F.1.2 High-Speed Packet Processor Field Upgrade

F.1.2.1 Field Upgrade Overview

This section describes the field upgrade procedure you need to follow to retrofit your in-service CDM-760 Advanced High-Speed Trunking Modem with the High-Speed Packet Processor option.

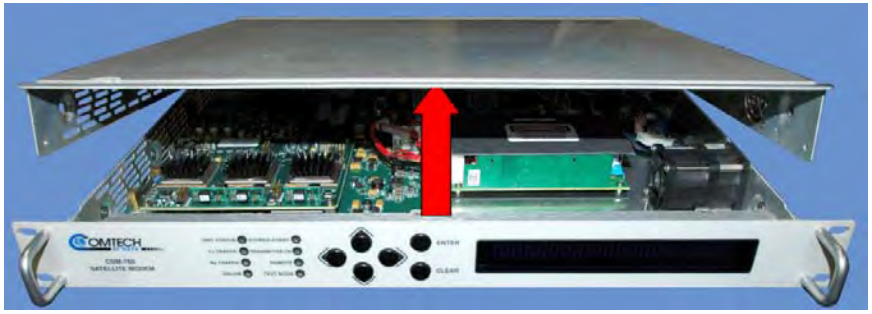
F.1.2.2 Requirements for Field Upgrade

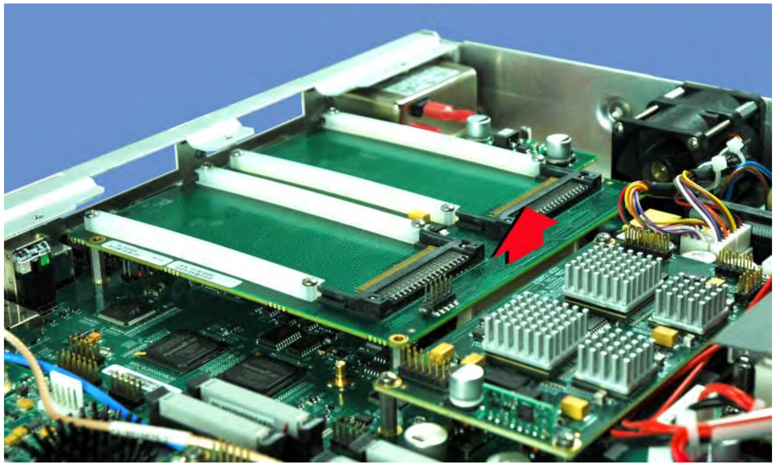
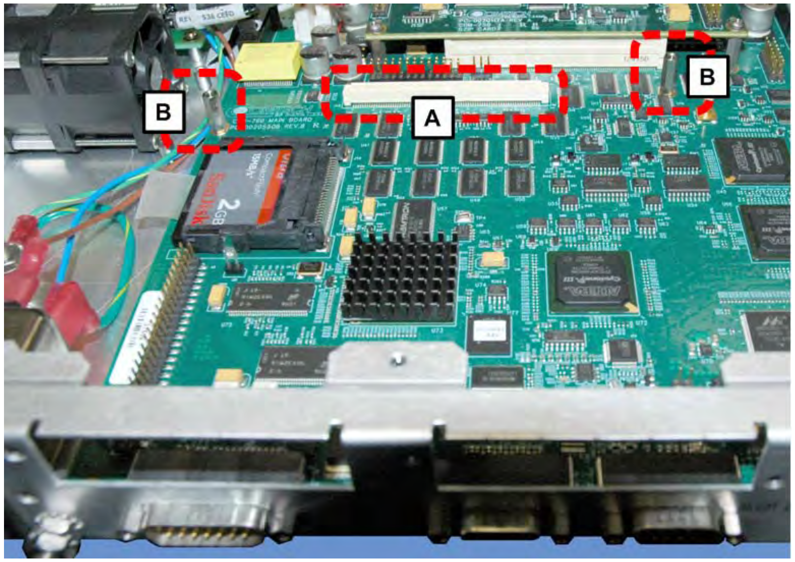
- CDM-760 Advanced High-Speed Trunking Modem
- Medium Phillips™ Screwdriver
- CEFD P/N KT-0020958 High-Speed Packet Processor Option Kit, containing:

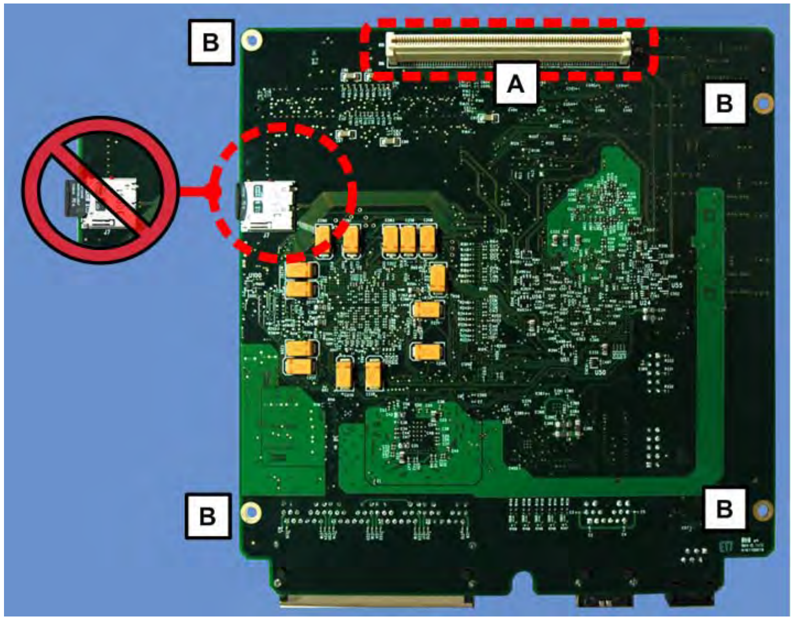
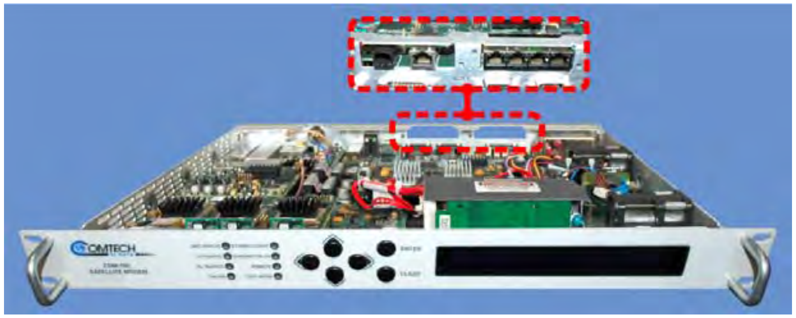
CEFD Part Number	QTY	Description
PL-0021603	1	High-Speed Packet Processor PCB Assembly
FP-0021300	1	Cover, Chassis
HW/SEM440X1/4PH	4	Screw, #4-40 x 1/4 LG Pan Head
HW/JS440M03	4	Screw, #4-40 x 5/16 LG Hex Jack

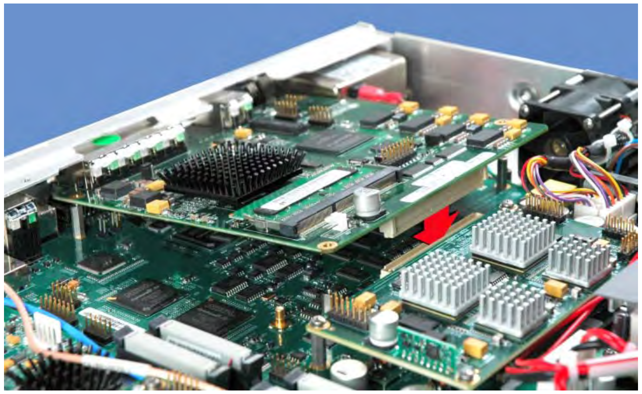
F.1.2.3 Field Upgrade Procedure

Do these steps:

Step	Task	
1	Turn off the CDM-760 and disconnect the modem's power cord from its power source. Use the screwdriver to remove the chassis cover top and side fasteners. Remove the cover from the CDM-760 chassis. **IMPORTANT:** Be sure to retain the cover's top and side fasteners for re-assembly of the cover to the chassis once the upgrade is complete.	
2	Remove and set aside both PIIC slot faceplates from the modem rear panel. They are no longer needed after this upgrade.	

Step	Task	
3	Remove the PIIC motherboard card from the modem assembly: **A.** Use the screwdriver to remove the screws securing the PIIC motherboard card to the mating mounting bosses. They may be set aside or reused for securing the Packet Processor card to these same bosses. **B.** Carefully unplug the PIIC motherboard card from its mated connector – take care not to damage any components top-mounted to the card or chassis PCBs. Remove the card from the chassis and set it aside. It is no longer needed after this upgrade.	
4	This figure shows the upgrade location within the chassis, as viewed from the rear panel. The modem's chassis connector interface **[A]** and two of the four card mounting bosses **[B]** can be seen here.	

Step	Task	
4 (cont.)	**IMPORTANT:** The bottom of the High-Speed Packet Processor card is shown here. This card incorporates an SDD memory card socket. Take care not to disengage the SDD card from its socket at any time during the upgrade process. Accidental disengagement of the SDD during the upgrade process will result in failure of High-Speed Packet Processor operation upon bootup of the modem. The Packet Processor card's bottom-mounted connector **[A]** and all four mounting holes **[B]** can also be seen here.	
5	Install the Packet Processor card: **A.** Tilt the Packet Processor card in a slight downward angle, to pass the RJ-45 and RJ-11 ports through the chassis rear panel PIIC cutouts.	

Step	Task	
5 (cont.)	**B.** Plug the card firmly into the modem connector – take care not to damage any chassis-mounted components. Similarly, be sure not to damage the bottom of the card on the chassis' mounting bosses while plugging the card receptacle into its mating connector. **C.** Placement is complete once the card receptacle is fully engaged within its mating connector, and the mounting holes at the front and rear of the card are centered with the mounting boss threaded holes.	
6	Use the screwdriver and provided fasteners (4X 4-40 x 1/4 LG pan head screws) to secure the Packet Processor to the mounting bosses.	

<table>
<tr><th>Step</th><th colspan="2">Task</th></tr>
<tr><td>7</td><td>Use the screwdriver and existing fasteners to reinstall the top cover onto the CDM-760 chassis.

IMPORTANT: You must reinstall the cover after installing the High-Speed Packet Processor Card Option Kit. It is critical that you operate the modem with the cover in place to facilitate chassis internal cooling and to prevent overheating of the Packet Processor card.

Plug the modem’s power cord back into its power source.</td><td></td></tr>
<tr><td>8</td><td>Use the provided fasteners (4X 4-40 x 5/16 LG hex jack screws) to secure the Packet Processor faceplate to the chassis rear panel.</td><td></td></tr>
<tr><td>9</td><td colspan="2">Make all necessary traffic and M&C cable connections to the Packet Processor.

IMPORTANT: To prepare for Packet Processor operation, be sure to move your Ethernet monitor and control (M&C) cable from the rear panel J4 | MGMT port to the Packet Processor P0 | MGMT port. The Packet Processor P1 through P4 Ethernet ports also replace use of the rear panel J5 | DATA and J6 | DATA Ethernet ports.</td></tr>
<tr><td>10</td><td>Reconnect the power source to the modem and turn the modem ON.

Both the optional DC and standard AC power interfaces are shown here.</td><td> </td></tr>
<tr><td>11</td><td>Once the modem boots up, you must use the CDM-760 front panel to enable Packet Processor operation and resume use of the modem. See Sect. D.2.2 in this appendix for further information.</td><td>
</td></tr>
</table>

BLANK PAGE

F.2 CDM-760 High-Speed Packet Processor Configuration and Operation

F.2.1 CDM-760 Operational Overview

After installation of the optional High-Speed Packet Processor, either in the factory or on site, the CDM-760 provides several means for configuring Packet Processor operation:

- Local Control via the CDM-760 Front Panel keypad and VFD (used only for enabling or disabling the Packet Processor).
- Remote Control with a user-supplied PC via the:
  - CDM-760 HTTP (Web Server) Interface using a compatible Web browser.
  - Ethernet-based Simple Network Management Protocol (SNMP) using a Network Management System (NMS) and Management Information Base (MIB) File Browser.

USE OF THE ETHERNET-BASED SNMP INTERFACE IS RECOMMENDED ONLY FOR ADVANCED USERS. ONCE YOU ENABLE PACKET PROCESSOR OPERATION FROM USING THE CDM-760 FRONT PANEL, YOU SHOULD USE THE HTTP (WEB SERVER) INTERFACE AS THE PRIMARY MEANS FOR MONITOR AND CONTROL (M&C) OF THE CDM-760.

F.2.2 Use the CDM-760 Front Panel to Enable Packet Processor Operation

See Chapter 6. FRONT PANEL OPERATION for in-depth information about the function and operation of the CDM-760 front panel, when used for Packet Processor operation.

Feature	Description	Function	Chapter 6 Sect.
1	**LED Indicators**	The LEDs indicate, in a summary fashion, the status of the modem.	**6.1.1**
2	**Keypad**	The keypad comprises six individual keyswitches. The keys have a positive 'click' action that provides tactile feedback. Enter data via the keypad. Data, prompts, and messages are displayed on the VFD.	**6.1.2**
3	**Vacuum Fluorescent Display (VFD)**	The VFD is an active display showing two lines of 24 characters each. It produces a blue light with adjustable brightness. Nested menus display all available options and prompt you to carry out a required action.	**6.1.3**

Figure F-2. CDM-760 Front Panel Features

With the Packet Processor installed, you must first **enable** Packet Processor operation using the CDM-760 Front Panel. **Do these steps:**

1) Before proceeding, make sure that your rear panel Ethernet traffic and M&C cabling connections have been made for Packet Processor operation.

2) Typical for all front panel screens, the flashing solid block indicates the cursor position.

1. Use the nested Configuration | Interface menu to enable Packet Processor operation:

a) From the front panel main (**SELECT:**) menu, use the ◄ ► arrow keys to select the **Configuration** menu branch. Press **ENTER** to proceed:

```
SELECT: Configuration  Monitor  Test
      Store/Ld  Utility  ODU  FAST  (◄ ►)
```

b) From the **CONFIG:** screen, use the ◄ ► arrow keys to select the **Intf** (Interface) menu. Press **ENTER** to proceed:

```
CONFIG: NetSpec  Tx  Rx Intf  CnC Comp
        Remote  IP  Mask Ref  MEO  (◄ ►)
```

c) On the **bottom** line of the **Interface** screen, use the ◄ ►arrow keys to navigate to the **Packet Processor** column. Press **ENTER** to proceed:

```
GBEI1    GBEI2    Optical   PacketProcessor
Off      Off      NONE      Disabled
```

d) Use the ▲▼arrow keys to select Packet Processor operation as **Enabled**. Press **ENTER** to proceed.

```
Packet Processor:Enabled
                                       (⬍)
```

The modem will boot of the High-Speed Packet Processor card:

```
      Packet Processor card booting…
               Please wait
```

Conversely, if the Packet Processor is **Enabled** and you set the Packet Processor interface as **Disabled**:

```
      Packet Processor card booting…
               Please wait
```

Make sure that your rear panel Ethernet traffic and M&C cabling and connections have been made for non-Packet Processor operation.

2. Once you enable the Packet Processor operation and reboot the modem, you should use the CDM-760 HTTP Interface for Packet Processor-related modem operations.

F.2.3 CDM-760 Configuration – HTTP (Web Server) Interface

See Chapter 7. ETHERNET INTERFACE OPERATION for in-depth information about the function and operation of the CDM-760 HTTP Interface.

YOU MAY PROCEED WITH ETHERNET-BASED REMOTE PRODUCT MANAGEMENT (WEB SERVER OR SNMP) UNDER THE ASSUMPTIONS THAT:

- **The CDM-760 is operating with the latest version firmware files.**
- **The CDM-760 is connected to a user-supplied, Windows-based PC, and:**
  - o **The PC Ethernet port is connected to the High-Speed Packet Processor P0 | MGMT RJ-45 10/100/1000 BaseT Ethernet port with a user-supplied hub, switch, or direct Ethernet cable connection.**
  - o **The User PC is running a compatible web browser (for operation of the HTTP Interface).**
- **The CDM-760 Management IP Address has been noted using the CDM-760 Serial Interface or CDM-760 Front Panel.**

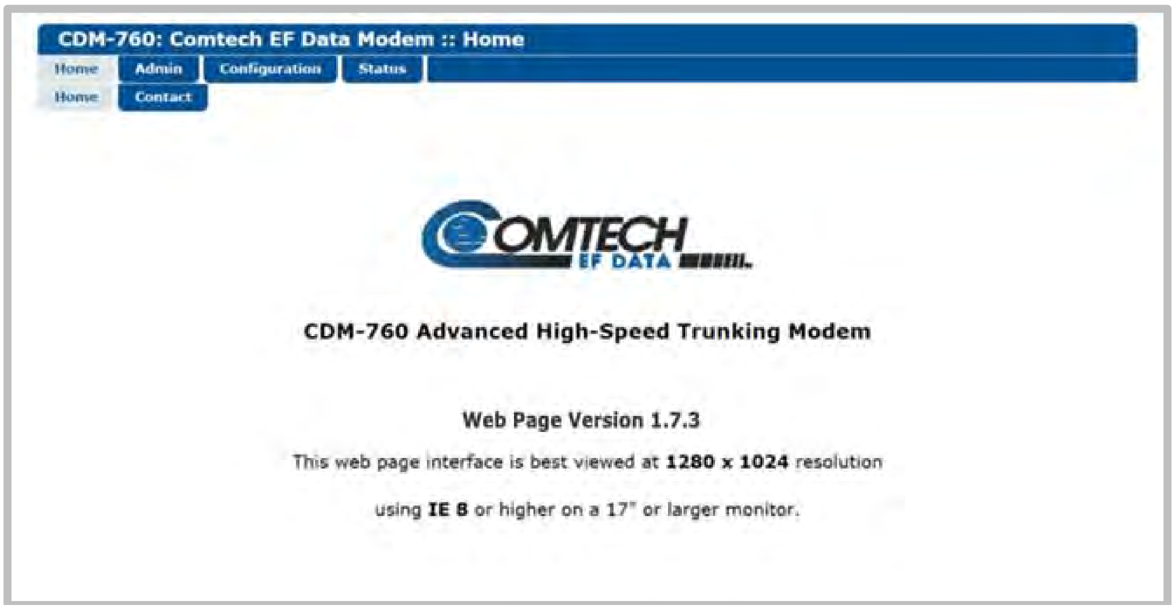


Figure F-3. CDM-760 HTTP (Web Server) Interface Example (Home Page Shown)

F.2.3.1 Conditional Access to High-Speed Packet Processor Pages

Carefully review the information in this section.

A large number of pages in the HTTP Interface address operation of the CDM-760 once it is equipped with the optional High-Speed Packet Processor card. These pages are accessible only when this card is **installed and enabled**.

The HTTP Interface menu tree diagram (**Figure F-4**) indicates with an asterisk (*) those primary and nested Packet Processor pages having such conditional access and operation. Modem operations not specific to Packet Processor operation appear dimmed in this diagram.

See Chapter 7. ETHERNET INTERFACE OPERATION for in-depth information about the function and operation of the CDM-760 HTTP Interface as used for Packet Processor operations.

Access to these pages is further restricted to "Admin" (Administrative) users **only**. If a user with "*Read/Write*" or "*Read-only*" user access privileges attempts to select any Packet Processor-specific page, the error message **"You do not have security privilege to access this area"** displays in the browser window. Access to that page is prohibited.

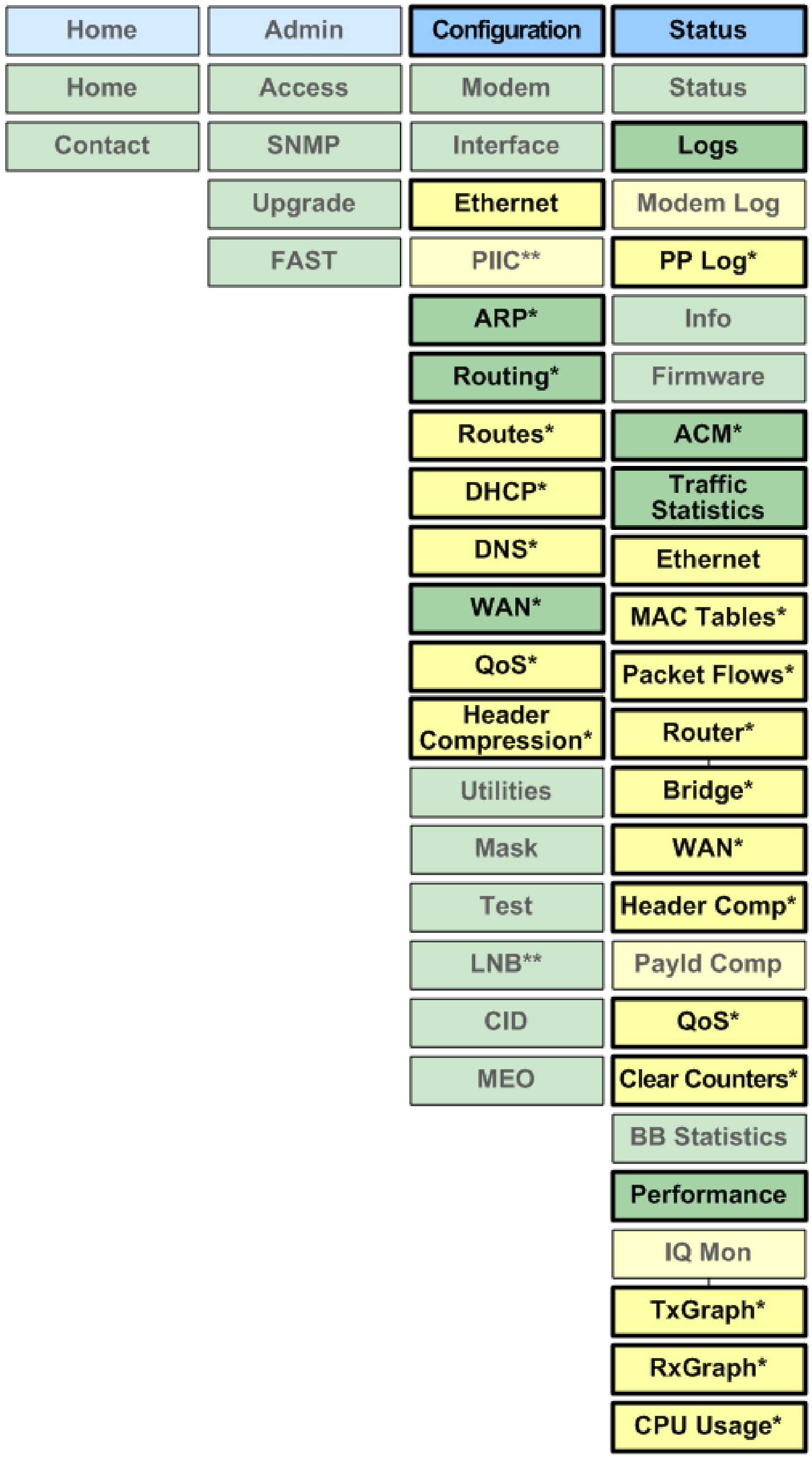
This menu tree depicts the CDM-760 HTTP Interface as it appears with all FAST Features activated, and the optional High-Speed Packet Processor **installed and active**.

If the Administrator logs in and attempts to access any Packet Processor-specific page when the Packet Processor card is **not installed**, the following message displays:

Click **[Back to previous page]** to resume use of the interface.

If the Administrator logs in and attempts to access any Packet Processor-specific page when the Packet Processor card is **installed** but card operation is **disabled**, the following message displays:

Click **[Back to previous page]** to continue any other available operations, or go to the CDM-760 Front Panel **CONFIG > INTF** screen to set **PacketProcessor** operation as **Enabled** (the modem will automatically reboot).



(“*” indicates that the Packet Processor is required to access the page)

Figure F-4. CDM-760 HTTP Interface Menu Tree – High-Speed Packet Processor Pages (FW Ver. 1.7.3)

F.3 High-Speed Packet Processor Features

The High-Speed Packet Processor enables efficient IP networking and transport over satellite either in Router Mode (**P0 | MGMT** port only) or Managed Switch Mode (**P1 | DATA** through **P4 | DATA** ports). The combination of QoS and Header Compression ensures the highest quality of service with minimal jitter and latency for real-time traffic as well as priority treatment of mission critical applications. When combined with the hardware based payload compression card, the CDM-760 offers the maximum bandwidth efficiency.

F.3.1 Modes of Operation

See Chapter 7. ETHERNET INTERFACE OPERATION for in-depth information about the function and operation of the CDM-760 HTTP Interface as used for Packet Processor operations.

At present, Router Point-to-Point Mode and Bridge Point-to-Point Mode are the only modes of operation allowed by the CDM-760.

F.3.1.1 Static Route Configuration

A CDM-760 equipped with the High-Speed Packet Processor operates in “Router Point-to-Point” mode to support Point-to-Point network topologies. The Packet Processor’s **P0 | MGMT** M&C port operates in a routed mode; the **P1** through **P4** data ports operate in “Bridge Point-to-Point” mode – these user data interfaces are never routed.

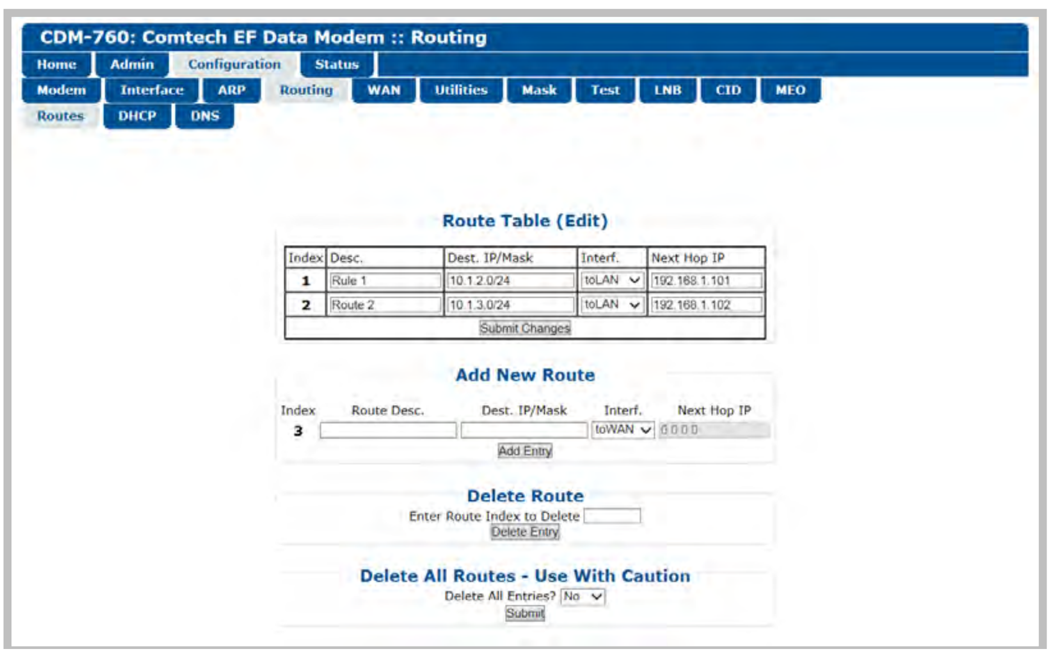


Figure F-5. Configuration | Routing | Routes Page

The CDM-760 HTTP Interface **Configuration | Routing | Routes** page (**Figure F-5**) provides the ability to configure and manage static routes – you can edit existing routes, or add new routes. You may also delete some or all routes if needed.

Whether you are editing existing routes or adding new routes, it is important to follow the guidelines and examples that follow.

It is important to enter a valid Destination IP Address and Mask. This Network Address (sometimes referred to as a Subnet ID) and Mask must be associated with each other.

For example: If you have a two (2) host subnet with IP Addresses 192.168.1.25 – 192.168.1.26, your mask must be /30 or (255.255.255.252) and your Network Address must be 192.168.1.24.

More common Network Addresses are:

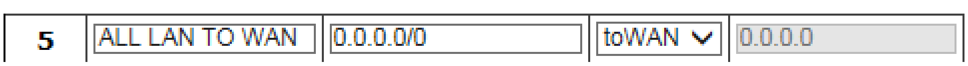
- XXX.XXX.XXX.0/24
- XXX.XXX.0.0/16

There are subnet calculators available online that can assist with subnet divisions, IDs, and Broadcast Addresses. An example of these available utilities can be found online at http://www.subnet-calculator,com.

Once you have specified the Destination IP Address and Mask, you must use the **Interf.** drop-down list to select if the route is intended for the **WAN** or the **LAN**:

- Select **toWAN** to direct the modem to receive packets via the P0 | MGMT LAN port, and, if the packet satisfies the route, to transmit the packets out of the modem over the satellite.
- Select **toLAN** to direct the modem to forward the packet from the WAN (satellite) to the LAN connection (i.e., the P0 | MGMT port); you must enter the IP Address of the next hop router the packets should be forwarded to. No route entries are required for packets that have a final destination on the same subnet as the P0 | MGMT subnet.

In some cases, when the modem is acting as the remote/edge router, all of the user IP Addresses are on the same subnet as the modem's P0 | MGMT port. In this case, you only need to configure the router to send all packets seen by the modem over the satellite with a single entry:



If you enter an invalid subnet and mask for the route, the entry will be denied. Also, if you are entering a route toLAN you must enter a valid IP Address that is on the modem's P0 / MGMT subnet or your entry will be denied.

Figure F-6 illustrates a basic point-to-point link with one CDM-760 located at the HUB Site, and another CDM-760 located at the REMOTE Site. The Hub Site features internal servers and an Internet connection; the Remote Site has four users.

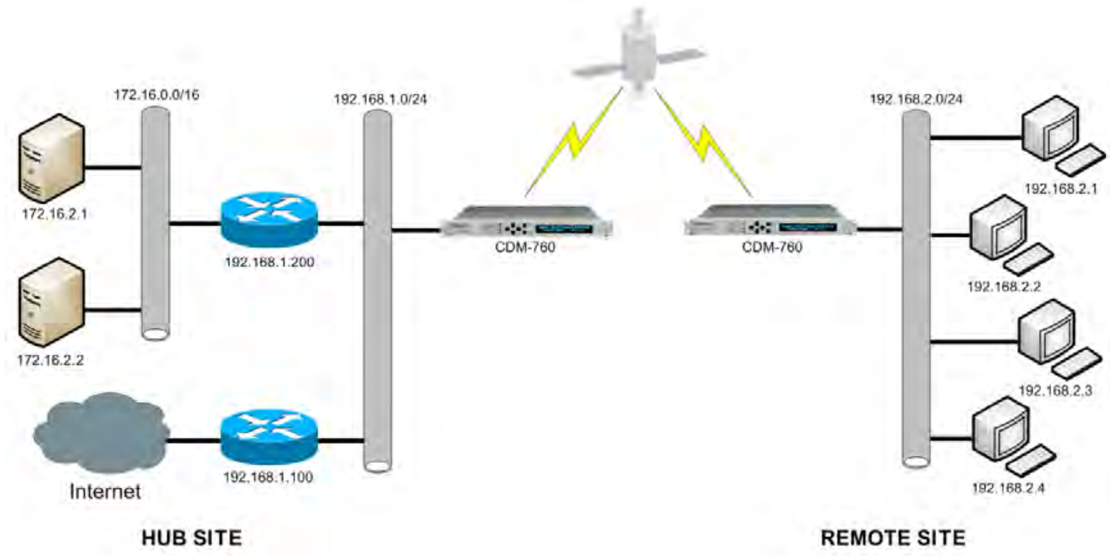


Figure F-6. Point-to-Point Network Example

The Route Table, as viewed on the CDM-760 HTTP Interface **Configuration | Routing | Routes** page for the Hub Site modem, should appear as follows:

Route Table (Edit)

Index	Desc.	Dest. IP/Mask	Interf.	Next Hop IP
1	To Remote	192.168.2.0/24	toWAN	0.0.0.0
2	Servers	172.16.0.0/16	toLAN	192.168.1.200
3	Internet / Default Rt	0.0.0.0/0	toLAN	192.168.1.100

Submit Changes

The Route Table, as viewed on the CDM-760 HTTP Interface **Configuration | Routing | Routes** page for the Remote Site modem, should appear as follows:

Route Table (Edit)

Index	Desc.	Dest. IP/Mask	Interf.	Next Hop IP
1	Non LAN traffic to H	0.0.0.0/0	toWAN	0.0.0.0

Submit Changes

In cases where a packet may satisfy more than one route entry, the route with the most specific entry will be chosen. The longer the bit mask, the more specific the route is. For example:

Route Table (Edit)

Index	Desc.	Dest. IP/Mask	Interf.	Next Hop IP
1	Least Specific	192.168.2.0/24	toLAN	192.168.1.101
2	Middle	192.168.2.0/27	toLAN	192.168.1.102
3	Most Specific	192.168.2.0/30	toLAN	192.168.1.103

Submit Changes

In this example, if a packet comes in from the WAN with a Destination IP Address of 192.168.2.1, it will be routed using to 192.168.1.103 using Route Index #3. Route 3 is the most specific route that the packet satisfies and has the largest mask (/30). If a packet comes in from the WAN with a Destination IP Address of 192.168.2.5, it will be routed to 192.168.1.102 using Route Index #2, as it does not satisfy the more specific Index #3 but does satisfy Route Indexes #1 and #2, with #2 being more specific.

F.3.2 Quality of Service (QoS)

Appendix K. QUALITY OF SERVICE (QoS)

Quality of Service (QoS) ensures the highest quality of service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications, and maximum bandwidth efficiency.

The High-Speed Packet Processor offers a number of QoS configurations. The supported modes of QoS are:

- **Max/Priority** – This QoS mode provides multi-level traffic prioritization with the ability to limit maximum traffic per priority class. Drain is based on strict priority, so highest priority traffic will drain before a lower priority drains, either until it is empty or until it meets its maximum data rate (Max DR). Similar to Max/Priority mode, **Max/Priority with Weighting** provides multi-level traffic prioritization with the ability to limit maximum traffic per priority class. It enables multiple rules with the same priority, where the drain can be biased rather than Round-Robin. The configurable weight is a user-specified parameter ranging from 1 to 100; Scheduler will drain more data from a Weight=8 queue than a Weight=7 queue under the same priority, until the Max is met.
- **Min/Max** – This mode provides a Committed Information Rate (CIR) to each user-defined class of traffic with the ability to allow a higher burstable rate depending on availability. Once the minimums are met, all Max rates are drained in a Round-Robin manner. Similar to Min/Max mode, **Min/Max with Weighting p**rovides a Committed Information Rate (CIR) to each user-defined class of traffic with the ability to allow a higher burstable rate depending on availability. However, once the Minimums are met, the drain with weighting uses a user-specified parameter in a range from 1 to 100; Scheduler will drain more data from a Weight=8 queue than a Weight=7 queue until the Max is met.
- **DiffServ** – This industry-standard method of providing QoS enables seamless co-existence in networks that implement Differentiated Services. When using rule-based QoS, you can configure up to 32 different rules based on:
  - **TOS**
  - **Protocol**
  - **MPLS_EXP bits**
  - **VLAN**
  - **Source Port (range)**
  - **Destinaton Port (range)**
  - **Source IP Address/Mask**
  - **Destination IP Address/Mask**

F.3.3 Header Compression

The High-Speed Packet Processor incorporates industry-leading header compression for Ethernet Layer 2 or Layer 3 IP traffic. Header compression can reduce the 40-byte IP/UDP/RTP header to as little as 1 byte; for TCP/IP, the 40-byte header is reduced to as little as 3 bytes.

For applications such as Voice-over-IP (VoIP), header compression can provide bandwidth savings exceeding 60%. **For example**, the 8 kbps G.729 voice codec requires 24 kbps of IP bandwidth once encapsulated into an IP/UDP/RTP datagram. With header compression, the same voice call needs about 8.5 kbps – a saving of almost 65%.

In addition, bandwidth requirements for typical Web/HTTP traffic can be reduced by 10% or more with TCP/IP header compression.

F.3.4 FAST Options

No FAST options are associated with the High-Speed Packet Processor. Once installed and enabled, the Packet Processor is already configured for full operation of Routing, QoS, and Header Compression at the full rate of the modem.

Notes:

Appendix G. ADAPTIVE CODING AND MODULATION (ACM) OPTION

G.1 Overview

Adaptive Coding and Modulation (ACM) is a technique that allows for automatic change in modulation and FEC Code Rate in response to changing link conditions. ACM may be used in packet-based satellite links (as when using the CDM-760 with Ethernet Interface) to boost system throughput. The basic goal of ACM is to capture historically unused satellite system link margin and convert this margin into additional data throughput.

An ACM system is set up using a constant physical layer symbol rate – and therefore occupied bandwidth – and power, but with a varying assortment of modulation and coding combinations called *ModCods*. The ModCods are selected to span a range of Es/No (Energy per Symbol to Noise density ratio) so that if a system detects a change in link margin – e.g., fading – it can use a different ModCod to preserve the link, albeit at a different user throughput rate. Therefore, in an ACM system, as Es/No increases or decreases, so does the user data rate.

ACM operation is a FAST-enabled option in the CDM-760. When enabled with ACM, the CDM-760 offers significant operational enhancements:

- ACM turns fade margin into increased link capacity – gains of 100% or more are possible, compared to traditional Constant Coding and Modulation (CCM). This is accomplished by automatically adapting the modulation type and FEC code rate to give highest possible throughput.
- ACM maximizes throughput regardless of link conditions (noise, clear sky, rain fade, inclined orbit, antenna pointing error, or other impairments). Initial setup is easy and requires no further user intervention.
- With a CCM system, severe rain fading can cause the total loss of the link – the result being zero throughput. ACM can keep the link active during heavy fades with lower throughput, and can yield much higher system availability.
- As Comtech EF Data's DoubleTalk Carrier-in-Carrier (CnC) operates in conjunction with ACM in the CDM-760, the benefits of CnC and ACM are available simultaneously.

G.2 Background

The CDM-760 system was originally based on DVB-S2 standards. New network specifications such as DVB-S2-EB1 have been released by Comtech EF Data since the initial release of the CDM-760. The DVB-S2 network specification in the CDM-760 offers 24 MODCODs that work over a guaranteed Es/No range of 1.2dB to 16.5dB. By comparison, Comtech EF Data's DVB-S2-EB1 Network Specification offers a suite of 40 MODCODs over this same Es/No range – nearly twice the number of MODCOD selections for enhanced ACM performance

DVB standards also defined much of the system for both ACM and a related feature named InBand Signaling. The CDM-760 supports duplex ACM operation between a pair of modems in a point-to-point link (point-to-multipoint ACM operation is not currently supported). In ACM mode, the symbol rate remains constant, and the modulation and coding (ModCod in DVB-S2 terms) changes to preserve the data integrity. Most links are designed with enough Es/No margin to provide error free performance under faded conditions when there is higher attenuation in the uplink or downlink path to/from the satellite.

Depending on the geographical region and link budget criteria, faded conditions can occur less than 1% of the time. In such as case the operating Es/No of the link is higher than needed for more than 99% of the year. ACM takes advantage of this link margin by increasing the ModCod during unfaded conditions allowing the link to operate at a higher data rates during these periods. A simplified example illustrates the point. **Table G-1** shows the several ModCods, the Spectral Efficiency (SE), and Es/No for the CDM-760 assuming Normal FEC Frame (64,800 bits).

Table G-1. ACM Example for Standard FECFrame (64,800 bits)

ModCod #	ModCod	Spectral Efficiency Pilots ON	Guaranteed Es/No (dB)	Data Rate (Mbps) at 20 Msps
04	QPSK 1/2	0.9653	1.4	19.31
05	QPSK 3/5	1.1600	3.7	23.20
06	QPSK 2/3	1.2908	3.4	25.82
07	QPSK 3/4	1.4521	4.6	29.04
08	QPSK 4/5	1.5494	5.1	30.99
09	QPSK 5/6	1.6153	5.6	32.31
10	QPSK 8/9	1.7244	6.7	34.49
11	QPSK 9/10	1.7460	6.8	34.49

For example: If a link is designed to operate at an Es/No of 3.7dB during a 3.0dB fade, the 3.0dB fade is commonly referred to as link margin. When fade conditions are not present, the link margin is directly converted into a higher link Es/No: 3.7dB + 3.0dB margin = new Es/No of 6.7dB. This non-faded Es/No of 6.7dB allows for a much higher ModCod to be used, offering a higher Spectral Efficiency. The corresponding Spectral Efficiencies in this example range from 1.1600 to 1.7244.

The Data Rate and Symbol Rate are related by the Spectral Efficiency as follows:

DR (Data Rate) = SR (Symbol Rate) x SE (Spectral Efficiency)

For a 20 Msps link, this corresponds to the data rates listed in **Table G-1. Table G-2** compares the ACM link with its CCM counterpart. In ACM mode, the link operates most of the time with clear sky conditions at 34.49 Mbps and drops back to 23.20 Mbps only when the link is faded. In CCM mode the link must remain in its worst case condition at 23.20 Mbps.

Table G-2. ModCod Comparison: ACM vs. CCM

Condition	Es/No (dB)	ACM ModCod	ACM Data Rate	CCM ModCod	CCM Data Rate
Clear Sky	6.7	QPSK 8/9	34.49	QPSK 3/5	23.20
Faded	3.7	QPSK 3/5	23.20	QPSK 3/5	23.20

There are a few important factors to consider for ACM operation:

- The digital communication system must tolerate a change in data rate. This excludes synchronous interfaces such as G.703 T3/E3 interfaces, which operate at a fixed data rates (44.768 / 34.368 Mbps).
- Ethernet is a suitable data stream because the packet nature of this interface accommodates changing data rates.
- The bit rate is not allowed to change arbitrarily. Link conditions determine the operational ModCod, as measured by the far side demod Es/No reading. The ModCod chosen must always operate at or above the minimum threshold for reliable communications for any given ModCod.
- There are generally two types of scenarios where ACM operation is run:
  - ***Minimum Guaranteed DR:*** A link budget is run using worst case fade conditions and a fixed availability (ex. 99.8%). The ModCod selected in this link budget is considered to be the lowest acceptable ModCod that meets the DR and availability of the link budget. 99.8% of the year the data rate of the link will be at or greater than this minimum data rate. For most of the year the DR will exceed the minimum guaranteed figure, 0.2% of the year the link will be down or at a DR that does not meet the minimum guaranteed figure.
  - ***Relaxed Availability:*** A link availability below typical thresholds (ex: 97%) is used to calculate a worst case fade condition at a desired data rate. It is understood that although the availability is less than desirable, for the majority of the year the DR will exceed the customer contracted DR and justify the lower throughput for a larger percentage of the year. This is essentially a tradeoff between minimum DR contracted and effective DR averaged over the course of a year.

G.2.1 ACM Operational Link Example

Most links are designed to deliver a level of link availability based on worst case conditions. Since worst case conditions occur only a very small part of the time, the link has margin above the minimum during the majority of the time. ACM shatters this limitation and operates at higher data rates when conditions are good.

For example: Consider a link with a 25 Mbps service level agreement (SLA) between Nigeria and Germany that requires 99.8% availability. Once designed, the link will provide this level of SLA for all but 17.5 hours of the year. **Figure G-1** plots the amount of downlink fade margin versus availability for this link.

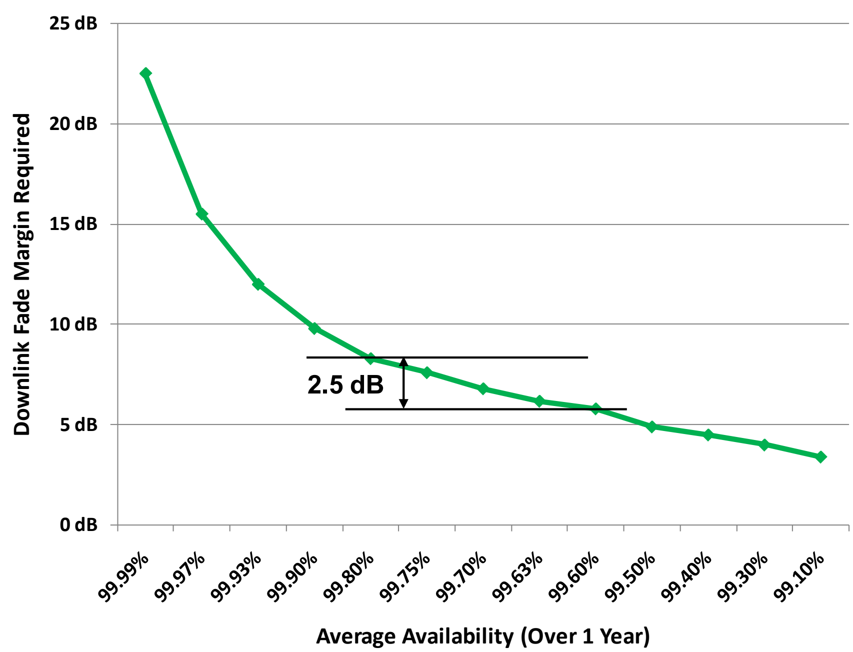


Figure G-1. Downlink Margin vs. Average Link Availability

At 99.8% availability there are over 364 days when the downlink margin is higher than the minimum to support 25 Mbps. So the question arises: What additional throughput will ACM provide?

An answer is shown in **Figure G-2**, where user throughput is plotted versus time. Initially, the link is unfaded and operates at 64 Mbps. The modem takes advantage of the margin and ACM operation provides a higher than contracted level of throughput. Later, a 2.2dB fade occurs and the ModCod is adjusted to preserve data integrity, causing an adjustment of the data rate to 51 Mbps, which is substantially above the SLA of 25 Mbps. Still later, the link recovers to 64 Mbps, followed by a deep fade of 6.9dB that throttles throughput down to 31 Mbps. **Table G-3** summarizes the capacity.

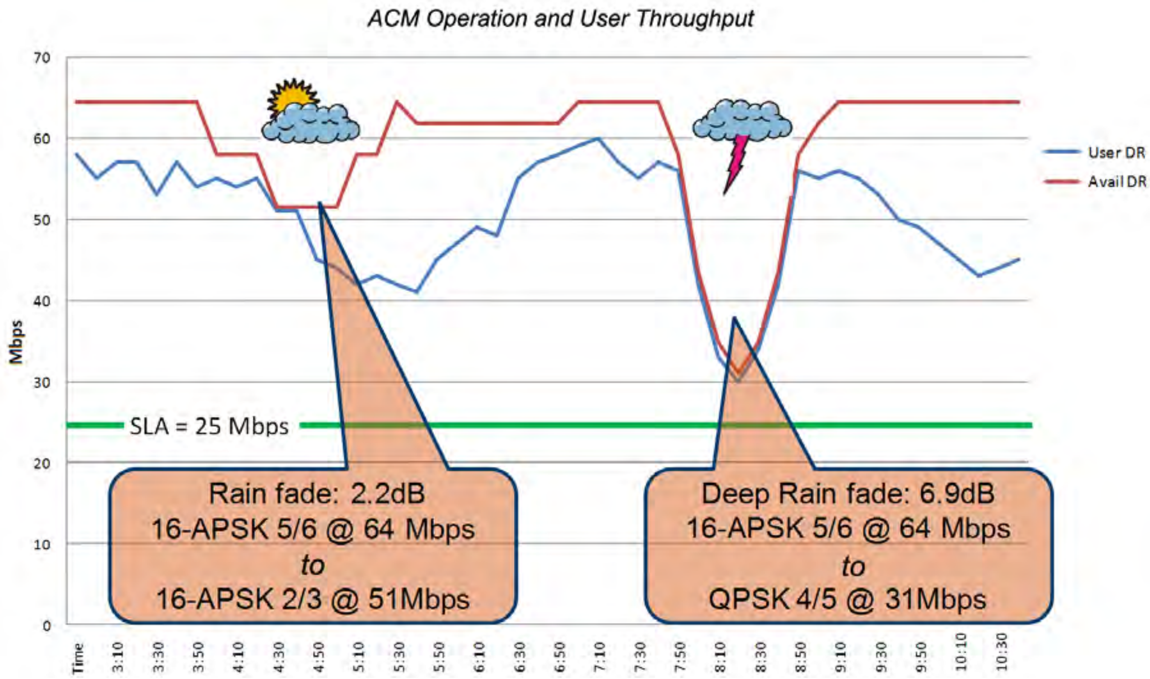


Figure G-2. User Throughput vs. Time and Fades

Table G-3. Turning Margin into Additional Capacity

Parameter	SLA	Clear	2.2dB Fade	6.9dB Fade
Data Rate	25 Mbps	64 Mbps	51 Mbps	31 Mbps
ModCod	QPSK 3/5	16-APSK 5/6	16-APSK 2/3	QPSK 4/5

G.3 ACM System Description

A generic example of ACM-over-Satellite is shown in **Figure G-3.** There are a number of essential requirements to enable this scheme:

- A near side modulator and FEC encoder that can instantaneously, when commanded, change either modulation type, FEC encoder rate or both. This needs to be accomplished without the corruption of data anywhere in the path. The ModCod must remain fixed throughout an entire frame and may change to any other ModCod on the next frame.
- The near side modulator is required to send the value of ModCod at the start of each frame to inform the far side demodulator/decoder how to configure for the correct ModCod.
- A far side demodulator/decoder must be capable of demodulating and decoding the signal transmitted by the near side modulator without any prior knowledge of when a change has taken place, based purely on the value of ModCod seen at the start of each Frame. Again, this needs to be accomplished without the corruption of data anywhere in the path.
- The far side receiver needs to derive an estimate of the link quality, the received Es/No, and then communicate this estimate, via a return channel, back to the near side modulator.
- The near side modulator needs to process the link quality metric from the far side demodulator and, based upon a pre-determined algorithm, adapt the data rate and change the ModCod sent to the far side receiver. This closes the loop and maximizes the data rate for the current link conditions.

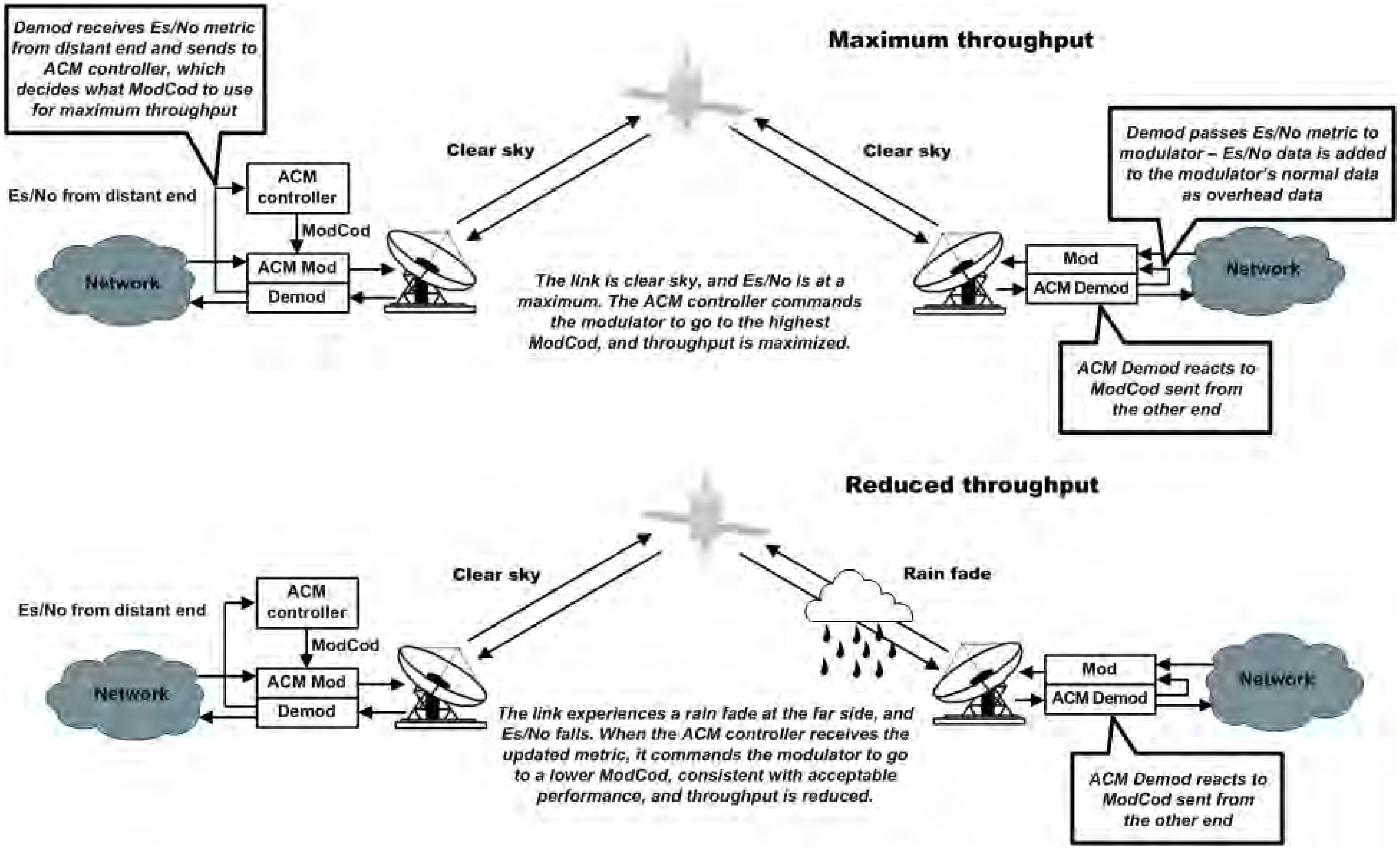


Figure G-3. ACM-over-Satellite – Generic Example

BLANK PAGE

G.4 CDM-760 ACM Scheme

The description of ACM operation in this section serves as the prelude to configuring the CDM-760 for ACM operation. The key items discussed are:

- Target Es/No Margin
- Distortion – allowing for degradation by modulation type
- Pilots – ON/OFF
- Standard and Short Frames
- Monotonic operation
- ModCod selection

G.4.1 Target Es/No Margin

The Target Es/No Margin adds a fixed amount of margin to all of the modem's specified Es/No values. Links normally include margin to meet performance criteria. When ACM is enabled, a method is needed to add margin to the guaranteed Es/No specification so the modem will switch to the next ModCod in a way that maintains a level of performance, generally near the QEF point (PER ≈ 10-7); the Target Es/No Margin provides this. This Es/No margin is added to the published guaranteed Es/No specification per ModCod for ACM operation – the value of Target Es/No ranges from 0 to 4.5 dB.

For example: An Es/No Margin of 1.0dB would mean that the minimum Es/No required to run at ModCod (5) QPSK 3/5 would be the guaranteed Es/No (2.7 dB) plus the Target Margin (1.0 dB) = 3.7 dB.

The Target Es/No Margin can and should also be used as a way to dial in a maximum fade slope. ACM messages sent from the far side demod to the near side modulator contain the Es/No estimate that the demod was seeing at that particular time; the ACM message is sent four (4) times per second. In the worst case scenario, due to the distance traveled over satellite and the symbol rate of the link, there can be 300-400ms of path delay AND a 250ms (1/4 second) messaging gap from the last time the Es/No is measured by the far side demod to the time the near side modulator can act on this measurement. If the maximum slope of a fade (e.g., rain fade) is 1.0 dB/second it would desirable to minimally set the Target Es/No to a figure that would be greater than the maximum possible fade. To help choose the Es/No Margin, **Figure G-4** depicts a graph of ACM messaging delay (including satellite delay).

For example: A 10 Msps link is run and has a maximum rain fade of 1 dB/second. At 10 Msps there will be a single hop latency of 300ms and an additional maximum ACM message gap of 250ms. So, if a 1.0dB rain fade began just after an ACM message was sent it would be **`300 + 250 = 550ms`** before an updated ACM message with the reduced Es/No is received and acted upon by the near side modulator. The near side modulator would then process the request (20ms), change its ModCod, and the signal would be sent back to the far end demodulator landing at the far side in another 300ms. In this example, the maximum time it takes from when the fade begins to receipt of the new ModCod is **`300 + 250 + 20 + 300 = 870ms`**. At a maximum fade of 1dB/second and with 850ms of total round trip time to act on an ACM message, the minimum ACM margin you would require would be **`1dB/second * 870ms = 0.87 dB`**."

The default Target Es/No Margin is 1.0 dB.

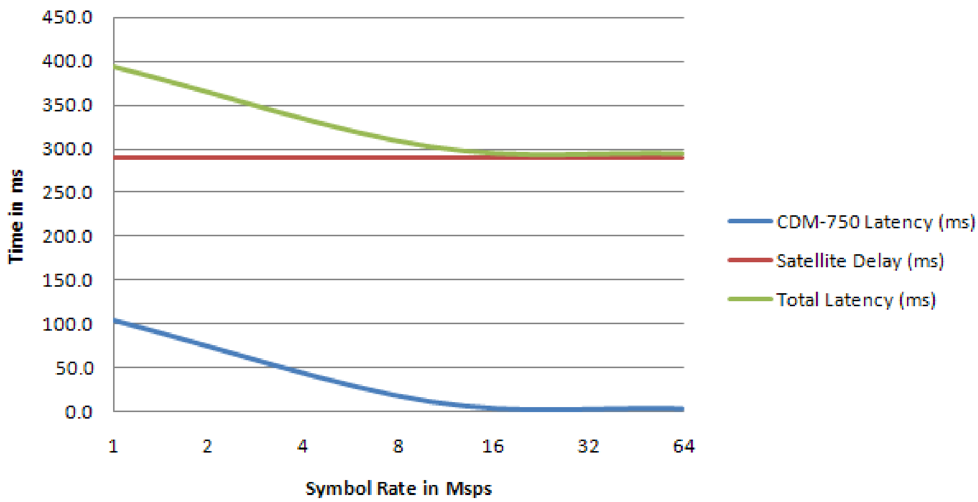


Figure G-4. Single Hop Latency

G.4.2 Distortion Adaptation / Modulation Type Impairment

Distortion is a very serious impairment, particularly for ModCods using 16APSK and 32APSK. These higher order modulations rely on amplitude modulation (AM) and phase modulation (PM) compared to 'phase only' modulations such as QPSK/8PSK. The amplitude modulation gives rise to AM/AM and AM/PM distortion when operating near the satellite amplifier compression limit. To compensate, you may enter additional impairments by modulation type; this allows correct parameter adjustment in cases of additional degradation when a transponder is operated close to saturation.

This distortion also penalizes higher-order ModCods (16APSK and 32APSK) much more than QPSK/8PSK. The default for all degradation values is 0.0dB – when operating in the linear portion of the ground amplifier and satellite amplifier segment, degradation should be minimal and can be left at 0.0dB for most applications.

The additional impairment allows programming of an offset for each DVB-S2 constellation type, which will ideally match the estimated satellite link distortion. These impairments apply to the forward (transmit) link. The factors are added to CDM-760 specified Es/No for a given constellation. **Table G-4** describes the impairment entry.

Table G-4. Modulation Type Impairment

Additional Impairment	Variable Name	dB (Factory Default Shown) Adjustable 0.0 to 9.9 dB
QPSK Degradation	QPSK_DEG	0.0
8PSK Degradation	8PSK_DEG	0.0
16APSK Degradation	16APSK_DEG	0.0
32APSK Degradation	32APSK_DEG	0.0

Note: Impairment Setting – QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK

G.4.3 Pilots

DVB-S2 originally introduced Pilots as a means to combat phase noise. An additional concern arose because the very powerful Low Density Parity-Check Forward Error Correction (LDPC FEC) reduced the conventional operating point of a demodulator much closer to the noise floor than was done historically, increasing the risk of cycle slips.

There are several ModCods where DVB-S2 advised using Pilots to avoid cycle slips:

- 8PSK 3/5 and 2/3
- 16APSK 3/4
- 32APSK 3/5

The use of Pilots was also recommended by DVB-S2 for ACM operation to guarantee continuous receiver synchronization. Here, the DVB advises that there are ModCod cases that are simply more reliable with Pilots *on*, even in the case of reasonable phase noise.

For the purpose of data integrity and maximum ModCod selection, ***the CDM-760 modem always enables Pilots*** **ON** ***for all ModCods whenever ACM mode is selected***.

G.4.4 Long and Short Frames

It is possible to process a mix of Normal and short frames, although is not believed to be very valuable for high speed point to point trunking applications. In addition, 9/10 ModCod is not allowed for short frames, and it is not selectable in short frame mode. The CDM-760 can be configured for either Normal or short frames, and does not support mixing frame types. When operating in ACM mode, ALWAYS use Normal frames at both ends of the link.

G.4.5 Monotonic vs. Non-monotonic Operation

Non-monotonic ModCods are “pruned” from ACM operation. The advantage afforded such ModCods, in terms of spectral efficiency, is diminished by the availability of an equivalent or higher spectrally efficient ModCod at an Es/No that is equal to or less than the current ModCod.

G.4.6 ModCod Selection

Table G-5, **Table G-6**, and **Table G-7** show the guaranteed Es/No at QEF for each ModCod in the DVB-S2, DVB-S2-EB1, and DVB-S2X Network Specifications, along with spectral efficiency and ModCod “pruning”. The ModCod elements that are shaded in these tables are pruned from ACM operation because they are not monotonic. **Figure G-5** and **Figure G-6** show considerable overlap of ModCod combinations for both the DVB-S2 and DVB-S2-EB1 Network Specifications.

The pruning and overlap depicted in these tables and figures infer omission of some ModCods; therefore, without dropping some of these ModCods, there is a non-monotonic change of Bits/Hz with changing Es/No. As this would result in an unstable system, re-sorting the DVB-S2 or DVB-S2-EB1 tables resolves this.

For example: When moving from QPSK 5/6 to the next best ModCod choice, when the Es/No is increasing, the modem would be better suited to switch to 8PSK 3/5, which requires only 5.8dB Es/No and provides 1.74 bits/Hz. You have intentionally pruned QPSK 8/9 and QPSK 9/10, which have Es/No requirements of 6.4 and 6.8dB – higher than 8PSK 3/5, yet providing less spectral efficiency than 8PSK 3/5.

Table G-5. DVB-S2 Symbol Rate and Data Rate by ModCod in ACM Mode

(Normal Block, Pilot ON, QEF (~PER 10^{-7})

MOD	ModCod #	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbsp)	Spectral Efficiency (Bits / Hz)	QEF Eb/No	QEF Es/No
QPSK	**04**	1/2	0.1	150	0.10	144.80	0.97	1.4	1.2
	05	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	06	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
	07	¾	0.1	150	0.15	217.80	1.45	2.6	4.2
	08	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
	09	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
	10	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	11	9/10	0.1	150	0.17	261.40	1.75	4.2	6.6
8PSK	**12**	3/5	0.1	120	0.17	208./80	1.74	3.4	5.8
	13	2/3	0.1	120	0.19	232.30	1.94	3.9	6.8
	14	¾	0.1	120	0.22	261.40	2.18	4.7	8.1
	15	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
	16	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
	17	9/10	0.1	120	0.26	314.20	2.62	7.0	11.2
16APSK	**18**	2/3	0.1	90	0.26	231.80	2.58	5.2	9.3
	19	3/4	0.1	90	0.29	260.60	2.90	5.9	10.5
	20	4/5	0.1	90	0.31	278.10	3.09	6.4	11.3
	21	5/6	0.1	90	0.32	290.00	3.22	6.8	11.9
	22	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	23	9/10	0.1	90	0.35	313.50	3.48	8.0	13.4
3APSK	**24**	3/4	0.1	72	0.36	260.90	3.62	7.5	13.1
	25	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
	26	5/6	0.1	72	0.40	290.20	4.03	8.6	14.7
	27	8/9	0.1	72	0.43	309.80	4.30	9.8	16.1
	28	9/10	0.1	72	0.44	313.70	4.36	10.0	16.4

Table G-6. DVB-S2-EB1 Symbol Rate and Data Rate by ModCod in ACM Mode

(Normal Block, Pilot ON, QEF (~PER 10^{-7})

MOD	ModCod #	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbsp)	Spectral Efficiency (Bits / Hz)	QEF Eb/No	QEF Es/No
QPSK	**08**	1/2	0.1	150	0.10	144.75	0.97	1.4	1.2
	09	8/15	0.1	150	0.10	154.50	1.03	1.5	1.6
	10	17/30	0.1	150	0.11	164.25	1.10	1.6	2.0
	11	3/5	0.1	150	0.12	174.00	1.16	1.9	2.5
	12	19/30	0.1	150	0.12	183.75	1.23	1.8	2.7
	13	2/3	0.1	150	0.13	196.65	1.29	2.2	3.3
	14	127/180	0.1	150	0.14	204.90	1.37	2.3	3.7
	15	3/4	0.1	150	0.15	217.80	1.45	2.7	4.3
	16	4/5	0.1	150	0.15	232.35	1.55	3.0	4.9
	17	5/6	0.1	150	0.16	242025	1.62	3.3	5.4
	18	31/30	0.1	150	0.17	250.20	1.67	3.6	5.9
	19	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	20	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	**21**	17/30	0.1	120	0.16	197.04	1.64	3.3	5.5
	22	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	23	19/30	0.1	120	0.18	220.44	1.84	3.8	6.4
	24	2/3	0.1	120	0.19	232.32	1.94	4.0	6.9
	25	127/180	0.1	120	0.20	245076	2.05	4.7	7.8
	26	3/4	0.1	120	0.22	261.36	2.18	4.7	8.1
	27	4/5	0.1	120	0.23	278.88	2.32	5.3	9.0
	28	5/6	0.1	120	0.24	290.64	2.42	5.7	9.6
	29	31/36	0.1	120	0.25	300.24	2.50	6.3	10.3
	30	8/9	0.1	120	0.26	310.32	2.59	6.9	11.0
	31	9/10	0.1	120	0.26	314.16	2.62	7.0	11.2
16APSK	**32**	19/30	0.1	90	0.24	219.87	2.44	5.1	9.0
	33	2/3	0.1	90	0.26	231.75	2.58	5.3	9.4
	34	127/180	0.1	90	0.27	245.16	2.72	5.8	10.2
	35	3/4	0.1	90	0.29	260.64	2.90	6.0	10.6
	36	4/5	0.1	90	0.31	278.10	3.09	6.5	11.4
	37	5/6	0.1	90	0.32	289.98	3.22	6.9	12.0
	38	31/36	0.1	90	0.33	299.52	3.33	7.5	12.7
	39	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	40	9/10	0.1	90	0.35	313.47	3.48	8.1	13.5
32APSK	**41**	127/180	0.1	72	0.34	245.30	3.41	7.5	12.8
	42	3/4	0.1	72	0.36	260.86	3.62	7.5	13.1
	43	4/5	0.1	72	0.39	278.35	3.87	8.2	14.1
	44	5/6	0.1	72	0.40	290.23	4.03	8.6	14.7
	45	31/36	0.1	72	0.42	299.74	4.16	9.2	15.4
	46	8/9	0.1	72	0.43	309.82	4.30	9.9	16.2
	47	9/10	0.1	72	0.44	313.70	4.36	10.1	16.5

Table G-7. DVB-S2X Symbol Rate and Data Rate by ModCod in ACM Mode

(Normal Block, Pilot ON, QEF (~PER 10^{-7})

MOD	ModCod #	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits / Hz)	QEF Eb/No	QEF Es/No
QPSK	6	1/2	0.1	150	0.10	144.80	0.97	1.4	1.2
	7	11/20	0.1	150	0.11	159.40	1.06	1.4	1.7
	8	3/5	0.1	150	0.12	174.00	1.16	1.8	2.4
	9	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
	10	3/4	0.1	150	0.15	217.80	1.45	2.6	4.2
	11	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
	12	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
	13	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
	14	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	15	5/9-L	0.1	120	0.16	193.18	1.61	2.9	5.0
	16	26/45-L	0.1	120	0.17	200.96	1.67	3.2	5.4
	17	3/5	0.1	120	0.17	208.80	1.74	3.4	5.8
	18	23/36	0.1	120	0.19	222.37	1.85	3.8	6.5
	19	2/3	0.1	120	0.19	232.30	1.94	3.9	6.8
	20	25/36	0.1	120	0.20	241.84	2.02	4.3	7.3
	21	13/18	0.1	120	0.21	251.57	2.10	4.5	7.7
	22	3/4	0.1	120	0.22	261.40	2.18	4.7	8.1
	23	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
	24	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
	25	9/10	0.1	120	0.26	314.20	2.62	7.0	11.2
16APSK	26	1/2-L	0.1	90	0.19	173.29	1.93	3.5	6.3
	27	8/15-L	0.1	90	0.21	184.94	2.05	3.7	6.8
	28	5/9-L	0.1	90	0.21	192.71	2.14	3.8	7.1
	29	26/45	0.1	90	0.22	200.47	2.23	4.4	7.9
	30	3/5	0.1	90	0.23	208.24	2.31	4.7	8.3
	31	3/5-L	0.1	90	0.23	208.24	2.31	4.1	7.7
	32	28/45	0.1	90	0.24	216.01	2.40	4.7	8.5
	33	23/36	0.1	90	0.25	221.83	2.46	4.7	8.6
	34	2/3-L	0.1	90	0.26	231.54	2.57	4.5	8.6
	35	2/3	0.1	90	0.26	231.80	2.58	5.2	9.3
	36	25/36	0.1	90	0.27	241.25	2.68	5.3	9.6
	37	13/18	0.1	90	0.28	250.96	2.79	5.5	10.0
	38	3/4	0.1	90	0.29	260.60	2.90	5.9	10.5
	39	7/9	0.1	90	0.30	270.38	3.00	6.1	10.9
	40	4/5	0.1	90	0.31	278.10	3.09	6.4	11.3
	41	5/6	0.1	90	0.32	290.00	3.22	6.8	11.9
	42	77/90	0.1	90	0.33	297.56	3.31	7.1	12.3
	43	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
	44	9/10	0.1	90	0.35	313.50	3.48	8.0	13.4
32APSK	45	2/3-L	0.1	72	0.32	231.73	3.22	6.5	11.6
	46	32/45	0.1	72	0.34	247.28	3.43	6.8	12.2
	47	11/15	0.1	72	0.35	255.05	3.54	7.1	12.6
	48	3/4	0.1	72	0.36	260.90	3.62	7.5	13.1
	49	7/9	0.1	72	0.38	270.60	3.76	7.8	13.5
	50	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
	51	5/6	0.1	72	0.40	290.20	4.03	8.6	14.7
	52	8/9	0.1	72	0.43	309.80	4.30	9.8	16.1
	53	9/10	0.1	72	0.44	313.70	4.36	10.0	16.4
64APSK	54	32/45-L	0.1	54	0.41	222.01	4.11	8.4	14.5
	55	11/15	0.1	54	0.42	228.99	4.24	9.0	15.3
	56	7/9	0.1	54	0.45	242.95	4.50	9.5	16.0
	57	4/5	0.1	54	0.46	249.93	4.63	9.7	16.4
	58	5/6	0.1	54	0.48	260.39	4.82	10.3	17.1

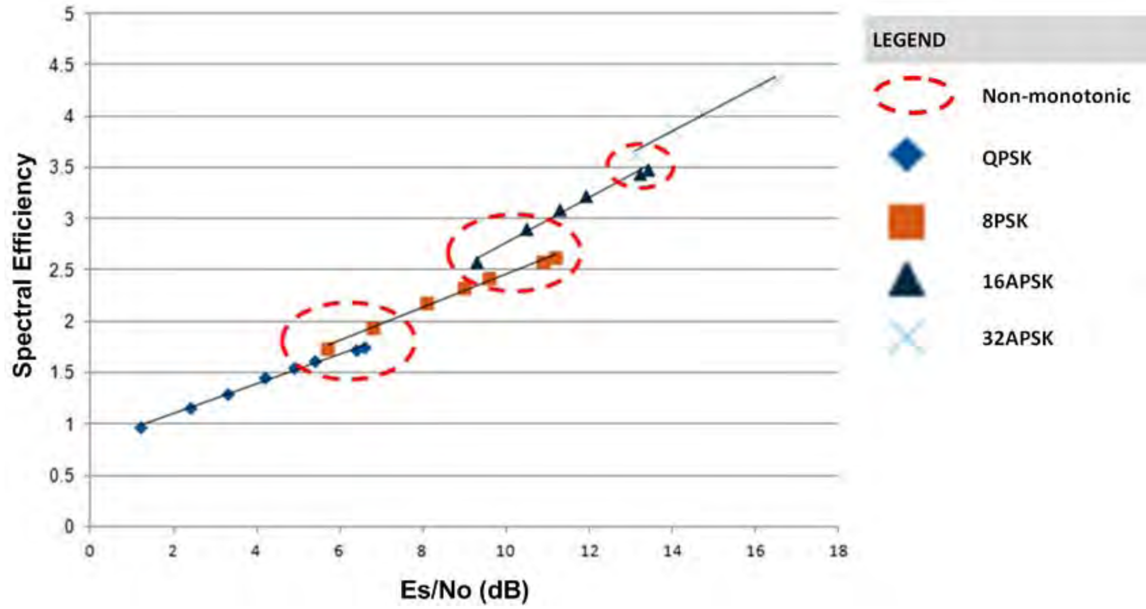


Figure G-5. DVB-S2 Spectral Efficiency vs. Es/No (Pilot On, 64K Block Size)

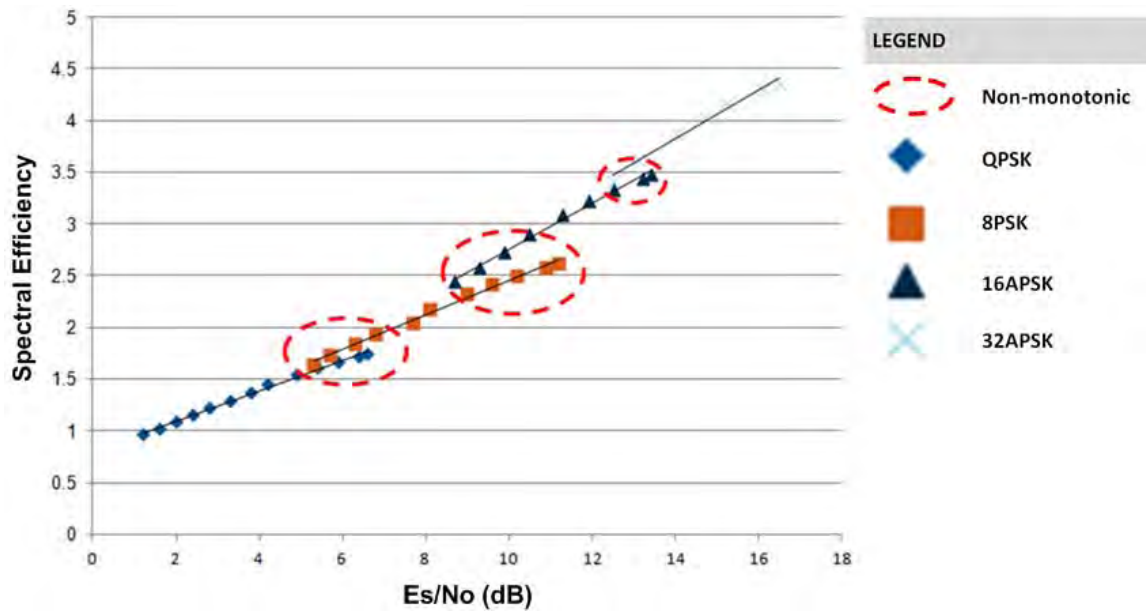


Figure G-6. DVB-S2-EB1 Spectral Efficiency vs. Es/No (Pilot On, 64K Block Size)

Also, a practical system needs some hysteresis to avoid dithering and to provide for an orderly transition to adjacent ModCods. The minimum distance between adjacent ModCods must be at least the amount of hysteresis – the figure used for hysteresis is fixed in the CDM-760 at 0.5 dB. The actual Es/No values used are based on the guaranteed Es/No values *plus* Target Es/No Margin *plus* modulation type impairment, *not* the DVB-S2 ideal Es/No figures.

Taking into account the ModCod spacing, hysteresis, Target Es/No Margin, modulation type impairment and monotonic behavior suggests a practical way to select the Es/No thresholds for switching ModCods, and a way to prune ModCods from the list. During parameter configuration, the modem selects the usable ModCods.

Figure G-7 presents a practical set of ModCods based on ModCod selection. This example uses the DVB-S2 Network Specification. The pruned or inactive ModCods are shown along the baseline of the plot. The transition to the next higher ModCod is the Es/No (spec) + Es/No Target Margin (user selected) + hysteresis (0.5 dB) + modulation impairment (user selected), while a step down is the Es/No (spec) + Es/No Target Margin + modulation impairment. In the example, the Target Es/No Margin and Modulation Impairment are zero.

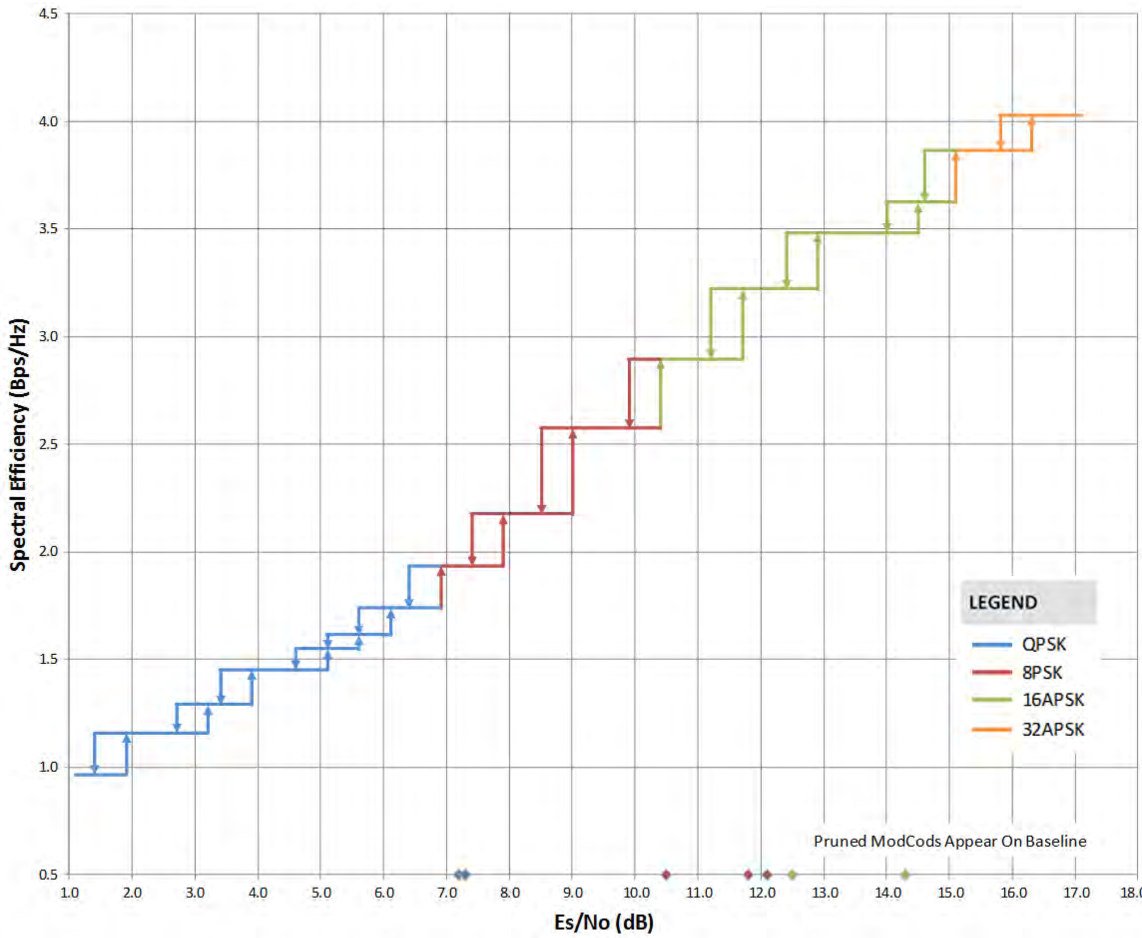


Figure G-7. Spectral Efficiency vs. Modem Es/No @ QEF (Pruned ModCods)

G.4.7 ACM Congestion Control

When the ACM controller switches from a lower to a higher ModCod, the bandwidth of the WAN link is instantaneously increased. This is not a problem, as the link will adapt to push more packets/second through the link. Conversely, when the ACM controller switches from a higher to a lower ModCod, the bandwidth of the WAN link is instantaneously reduced.

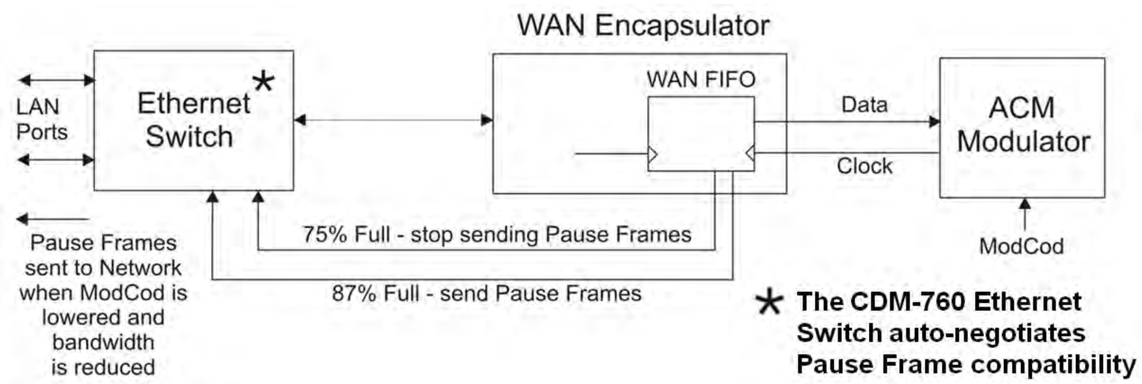


Figure G-8. CDM-760 – ACM Congestion Control

As shown in **Figure G-8**, in order to mitigate packet loss when bandwidth is reduced, the CDM-760 incorporates a WAN buffer. When this WAN buffer cannot accommodate the amount of Ethernet traffic due to the WAN bandwidth, the CDM-760 can be configured to initiate a method for congestion control. The means to do this is by enabling **Flow Control**.

When Flow Control is **Enabled**, the WAN buffer produces two control signals that enable and disable the sending of Ethernet ***Pause Frames*** – Ethernet frames designed to implement flow control at the MAC layer. A switch supporting 802.3x can send a Pause Frame (with Pause time set to 0xFFFF) to force the link partner to stop sending data. Devices use the Auto-Negotiation protocol to discover the Pause Frame capabilities of the device at the other end of the link.

In **Figure G-8**, it can be seen that when the WAN buffer reaches a fill state of 87%, it signals the Ethernet Switch to send Pause frames back to the LAN to inhibit the sending of further data. The Pause Frames continue to be sent until the FIFO fill state has been reduced to 75%. At this point, normal operation in resumed by sending a Pause Frame with Pause time set to 0x0000.

This mechanism has been shown to be very effective at mitigating packet loss when the Ethernet traffic exceeds the WAN capacity.

G.4.8 Notes and Recommendations

- CDM-760 ACM operation is designed for point-to-point operation only. Future point to multi-point operation will be introduced in a later release of the product. ACM operation and purchased option are required on all modems running the link (two in non-redundant mode and four in 1:1 redundant mode).
- ACM constitutes a closed-loop control system similar in concept to Automatic Uplink Power Control (AUPC). It should be remembered that, like all control systems, the speed at which the system can react is governed by a number of factors, including: the time taken to estimate Es/No to the required accuracy at the far side demodulator; the transport delay over the satellite; and the processing of messages and associated action taken at the near side modulator.
- The ACM controller algorithm that resides in the CDM-760 does not have to switch through ModCods sequentially – it can change, if needed, directly from ModCod4 to ModCod28 (or vice versa).
- While ACM can do remarkable things, the fundamentals still apply. The demodulator will not run at a 16APSK ModCod if the Es/No instantaneously drops to 0dB – the demodulator will lose lock and the system will recover by switching to ModCod4 (if so configured). ***The recommended setting for Minimum ModCod is 4. Comtech EF Data also recommends that you set the Unlock Action to 'Go to minimum ModCod' – this will give the most robust link availability.***
- Running the ACM link with the Target Es/No Margin set to 0dB will give the best utilization of link power but, in conditions of fast fading, may cause demod unlock events or highly degraded BER just prior to the switch to a lower ModCod. In order to mitigate this, use a increase the target Es/No Margin if the fading events are particularly severe and/or frequent.
- The value of Max ModCod may be limited by other FAST codes installed in the CDM-760. **For example,** suppose the 15 Msps FAST option is installed, and the symbol rate is set to 15 Msps; the theoretical maximum data rate would be 52.2 Mbps at ModCod 23. However, if CnC is being used with a 40 Mbps FAST limit, the ACM Max ModCod will be limited to ModCod 18, or 38.6 Mbps. If, for a given symbol rate, it is not possible to set Max ModCod to the desired value, you should therefore check to determine what other FAST codes may be limiting Max ModCod.
- Es/No is the preferred metric for driving the adaptation – this is the value displayed on the monitor screens. If you want to convert this to Eb/No then remember that the relationship is simply **Eb/No = Es/No – 10log(Spectral Efficiency)**.
- To achieve minimum latency, set the WAN buffer to the smallest practical value. The default setting is 20ms, and Comtech EF Data recommends keeping it at this level.
- ACM is 100% compatible with DoubleTalk Carrier-in-Carrier (CnC) and Dynamic Predistortion (DPD).
- ACM maximizes throughput not only when Es/No varies due to atmospheric conditions, but it also mitigates the effects of other impairments such as antenna pointing error, excessive phase noise, and certain types of interference. However, rapidly fluctuating impairments, such as scintillation at low antenna look-angles at C-band, will generally not be improved by ACM or will require abnormally large Target Es/No Margin.
- ACM modes are ***not*** compatible with CCM modes, due to differences in frame preambles.

G.5 CDM-760 ACM Configuration and Operation

G.5.1 CDM-760 Operational Overview

ACM operation is a FAST option that must first be ordered, and then activated in the CDM-760 High Speed Trunking Modem. If this option is not enabled in the modem, contact your Comtech EF Data Sales Representative to upgrade the modem to support the desired level of ACM operation.

Table G-5 and **Table G-6**, provided in **Sect. G.4.6**, list the minimum and maximum modem symbol rates and associated data rate capacity when in ACM mode.

With ACM operation enabled, Tx and Rx Symbol Rates can be set to any rate desired up to the maximum purchased symbol rate in 1 sps steps.

CAUTION: When considering ACM operation, note that the symbol rate of the carrier chosen can limit higher order modulation schemes from running.

For example: Although you can configure the modem to run ACM operation at 100 Msps, with this size carrier, 16APSK and 32APSK will never be attained as the symbol rate limitation for these modulation types is 90Msps and 72Msps accordingly. For most geostationary, non HTS (High Throughput Satellites) systems, even the largest transponders can only accommodate a carrier that is 72Msps or less, so this is typically not an issue.

Actual user data rate throughput will be at least 99% of the maximum satellite data rate capacity when running in GSE Ethernet encapsulated mode. ACM mode is suggested to run only in Normal (64,800 bit) frames with pilots ON.

You can configure, monitor and control ACM operations in the following ways:

- Local Control via the CDM-760 Front Panel keypad and VFD.
- Remote Control with a user-supplied PC via the:
  - CDM-760 HTTP (Web Server) Interface using a compatible Web browser.
  - Ethernet-based Simple Network Management Protocol (SNMP) using a Network Management System (NMS) and Management Information Base (MIB) File Browser.
  - Serial Interface.

USE OF THE ETHERNET-BASED SNMP AND SERIAL-BASED REMOTE CONTROL INTERFACES ARE RECOMMENDED ONLY FOR ADVANCED USERS. COMTECH EF DATA STRONGLY ENCOURAGES USE OF THE CDM-760 FRONT PANEL OR HTTP (WEB SERVER) INTERFACE FOR MONITOR AND CONTROL (M&C) OF THE CDM-760.

G.5.2 ACM Operation Using the CDM-760 Front Panel

See Chapter 6. FRONT PANEL OPERATION for in-depth information about CDM-760 front panel operations.

Figure G-9. CDM-760 Front Panel View

Figure G-9 shows the CDM-760 front panel operational features:

1. **LED Indicators –** These eight LEDs show the summary status of key modem operations.

2. **Keypad –** Use the keypad to **ENTER** data. The keypad has six individual keys. The keys have a positive ‘click’ action that gives tactile feedback.

3. **Vacuum Fluorescent Display (VFD)** – The VFD shows data, menus, prompts, and messages. The VFD is an active display with adjustable brightness. It shows two lines of 40 characters each. Nested menus show options and prompts that guide you in carrying out required actions.

G.5.2.1 Configure ACM Operation

Do these steps to configure the CDM-760 for ACM operation:

Step	Task
1	Make sure the Gigabit Ethernet interface is selected and enabled. See **Sect. 6.2.2.4.2 (CONFIG: INTF) GEBIx.** **The GBEI1 (J5 | DATA) and GBEI2 (J6 | DATA) Gigabit Ethernet ports are functional when the PIIC slots card is installed, or when the optional High-Speed Packet Processor card is <u>INSTALLED BUT DISABLED</u>. These base unit ports are non-functional when the optional High-Speed Packet Processor is <u>INSTALLED AND ENABLED</u>. You must use the CDM-760 HTTP (Web Server) Interface to configure Packet Processor P0 | M&C and P1 through P4 | DATA port operation (see Sect. G.X.X).**
2	Select the Tx and Rx modulation types. See **Sects. 6.2.2.2.1 (CONFIG: Tx) Mod** and **6.2.2.3.1 (CONFIG: Rx) Mod.**
3	Program the Tx and Rx symbol rates. See **Sects. 6.2.2.2.2 (CONFIG: Tx) Data→Tx Symbol Rate** and **6.2.2.3.2 (CONFIG: Rx) Data→Rx Symbol Rate**
4	Enter the operating Tx Power **(Sect. 6.2.2.2.4 (CONFIG: Tx) Power)**, Tx **frequency (Sect. 6.2.2.2.3 (CONFIG: Tx) Freq)**, and Rx frequency **(Sect. 6.2.2.3.3 (CONFIG: Rx) Freq).**
5	Before engaging ACM, conduct a test to verify both modems are interoperable.

Step	Task
6	Configure ACM **(see Sect. 6.2.2.2.5 (CONFIG: Tx) ACM):** A. *Min/Max-ModCod:* Enter the lowest and highest ModCods desired for system operation (default is ModCod-4 QPSK ½ rate is the lowest and ModCod-28 32-APSK 9/10 is the highest). B. Unlock Action: This decides the action taken if the demodulator at the distant end loses lock. Select “Min” (recommended) or “Maintain.” If the distant end demodulator unlocks the modulator will either go to the minimum ModCod allowable as sent in step (a) or maintain the last known ModCod before the distant end was lost. C. Es/No Target Margin: This allows the addition of margin to overcome the degradation that accompanies real links. The Es/No Target Margin is added the specified Es/No for all ModCods to allow the link to maintain error rates. The range is 0 to 4.5dB (the default value is 0.0 dB). D. Modulation Impairment: The amount of degradation for each modulation type is selected (0dB is the default). This selection recognizes that impairments rise as modulation order increases. It provides some help combating compression: **QPSK:** 0.2 dB **16APSK:** 0.4 dB **8PSK:** 0.3 dB **32APSK:** 0.6 dB **Note:** The impairment for QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK
7	Once you complete Steps 1 through 6, the modem then determines the optimal set of ModCods and prunes non-optimal ModCods.

G.5.2.2 Monitor ACM Performance and Operation

Use the **MONITOR: ACM** front panel menu to view the current Tx and Rx ModCod, as well as the Local and Remote Es/No.

```
Tx Modcod=8PSK   8/9      RemEsNo:+20.0 db
Rx Modcod=8PSK   8/9      LocEsNo:+19.9 db
```

This ***read-only*** screen provides the active ACM Mode information:

Parameter	Description
Tx Modcod	Displays the Tx ModCod.
RemEsNo	Displays the EsNo reported by the remote modem.
Rx Modcod	Displays the Rx ModCod.
LocEsNo	Displays the EsNo of the local unit.

The Es/No display values between –3.0dB and +23.0 dB, with a resolution of 0.1 dB. If either the local or remote demodulator is unlocked, the Es/No will display ‘**No Sync**’.

Note that you may often see that the RX ModCod is “00”. This is normal when there is no real data being received. DVB-S2 states that when no data is available, the modulator should insert a Dummy PLFRAME. These Dummy PLFRAMEs are used to keep the demod locked, but contain no user data and have a ModCod value of “00”.
If you wish to see the exact detail of the ModCod (data rate, modulation, code rate), view these parameters using the **INFO: TX** or **INFO: RX** screens. Furthermore, if using the **CONFIG: TX** or

CONFIG: RX menus, both the symbol rate and data rate are displayed. All of these screens update dynamically – if a ModCod changes, the parameters are refreshed on these displays.

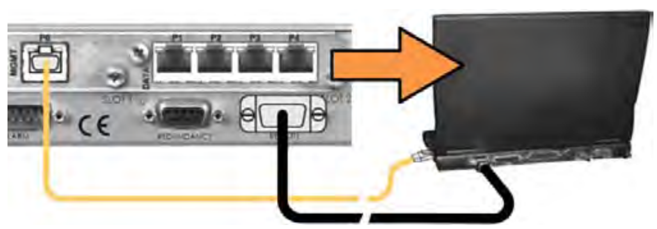
G.5.3 ACM Operation Using the CDM-760 HTTP (Web Server) Interface

See Chapter 7. ETHERNET INTERFACE OPERATION for in-depth explanations of the function and operation of the CDM-760 HTTP (Web Server) Interface.

Ethernet-based remote operation of the CDM-760 is available when you connect a Windows-based PC to one of two rear panel RJ-45 BaseT Ethernet ports:

- When the PIIC slots card is installed, or when the optional High-Speed Packet Processor card is **INSTALLED BUT DISABLED**, use an Ethernet hub, switch, or direct cable connection to connect the CDM-760 rear panel **J4 | MGMT** 10/100/1000 Fast Ethernet port to an Ethernet port on the User PC.

- **Alternately**, when the optional High-Speed Packet Processor is **installed and enabled**, use an Ethernet hub, switch, or direct cable connection to connect the Packet Processor's **P0 | MGMT** 10/100/1000 BaseT Ethernet port to an Ethernet port on the User PC.



YOU MAY PROCEED WITH ETHERNET REMOTE INTERFACE OPERATION (WEB SERVER OR SNMP) UNDER THE ASSUMPTIONS THAT:

- **The CDM-760 is operating with the latest version firmware files.**
- **The CDM-760 is fully connected to the user-supplied, Windows-based PC.**
- **You have identified the CDM-760's Management IP Address using the CDM-760 Front Panel or via the CDM-760 Serial Remote Control Interface. (Note that you are unable to change the Modem IP Address with the HTTP Interface.)**

G.5.3.1 Access the CDM-760 HTTP Interface

Type the CDM-760's Management IP Address into the **Address** area of the user-supplied web browser. Once you enter a valid **User Name** and **Password**, the HTTP Interface **Home** page displays (**Figure G-10**). Note that the (Firmware) **Version** shown in this example is subject to change.

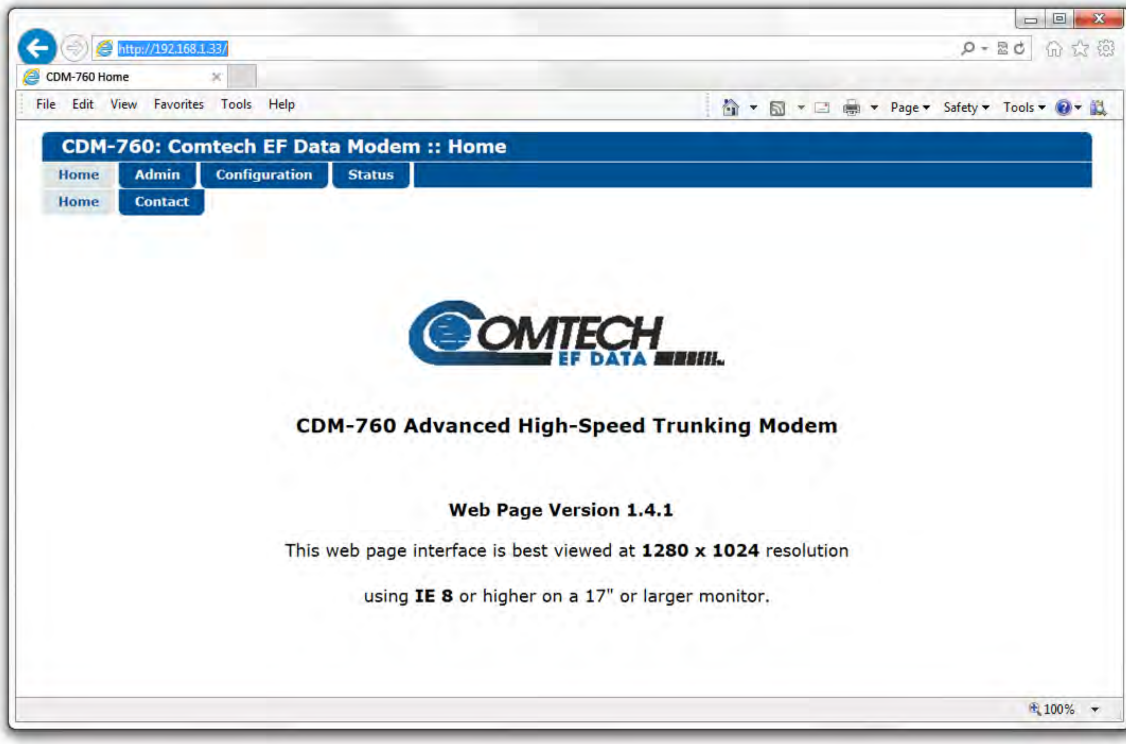


Figure G-10. CDM-760 HTTP Interface Home Page

G.5.3.2 HTTP Interface – ACM Pages

The sections that follow provide summaries of the interface pages that provide you with monitoring and control of ACM operations (Chapter 7 information reference is shown in parentheses):

- **Configuration | Modem (see Sect. 7.4.4.3.1)**
- **Configuration | Test (see Sect 7.4.4.3.8)**
- **Status | Status (see Sect. 7.4.4.4.1)**
- **Status | ACM (see Sect. 7.4.4.4.5)**
- **Status | Performance | IQMon (Sect. 7.4.4.4.8.1)**
- **Status | Performance | TxGraph (Sect. 7.4.4.4.8.2)**
- **Status | Performance | RxGraph (Sect. 7.4.4.4.8.23)**

G.5.3.2.1 Configure ACM Operation

To configure ACM operation, use the **Configuration | Modem** page to carry out the tasks explained in **Sect. C.5.1**.

If you edit any field, or change any item selected from a drop-down, make sure to click the ACM page section's [Submit] action button before you leave the Configuration | Modem page. If you go to another page without first clicking the action button, your changes are not saved.

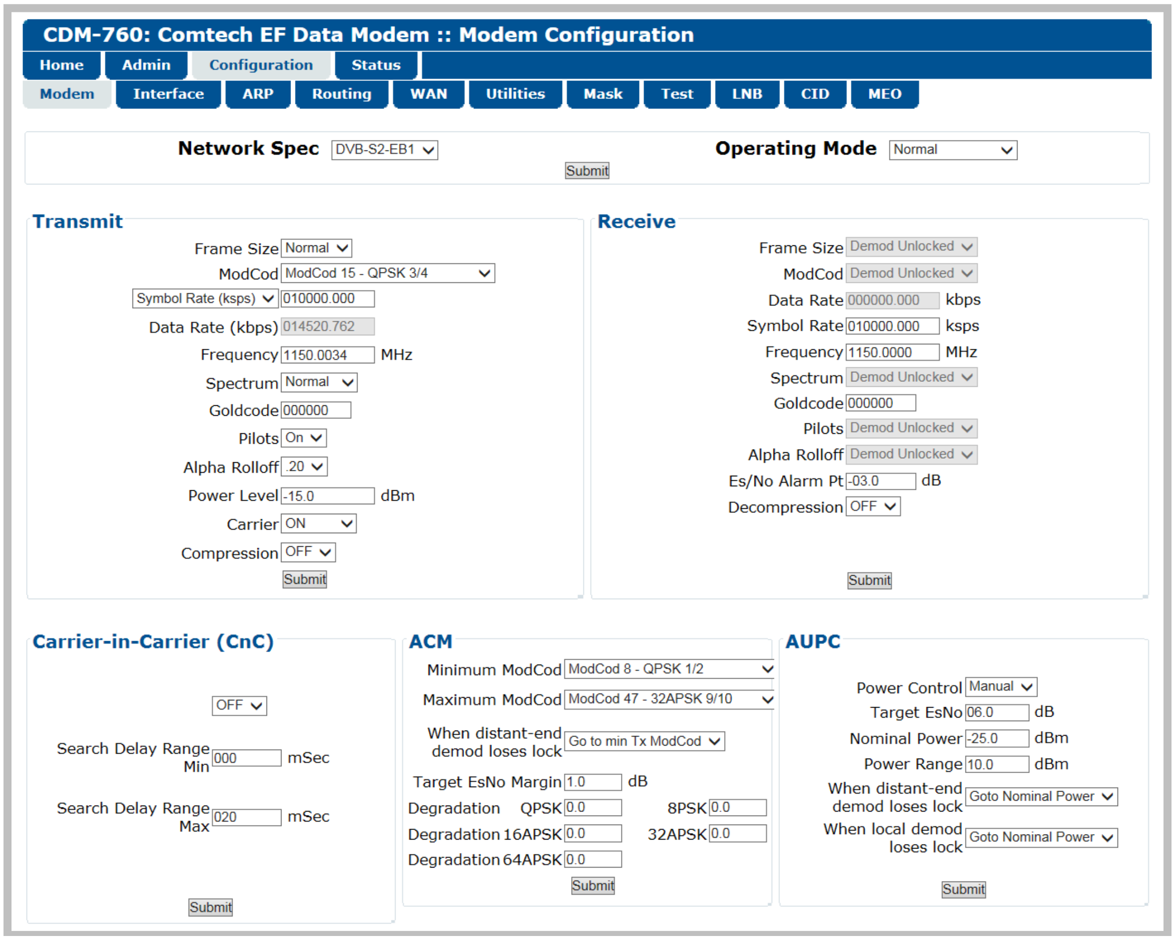


Figure G-11. Configuration | Modem Page

G.5.3.2.2 Monitor ACM Performance and Statistics

The CDM-760 HTTP Interface provides several tools for you to monitor ACM operation. Use the *read-only* **Status | ACM** (**Figure G-12**) and **Status | Status** (**Figure G-13**) pages to view ACM operating statistics.

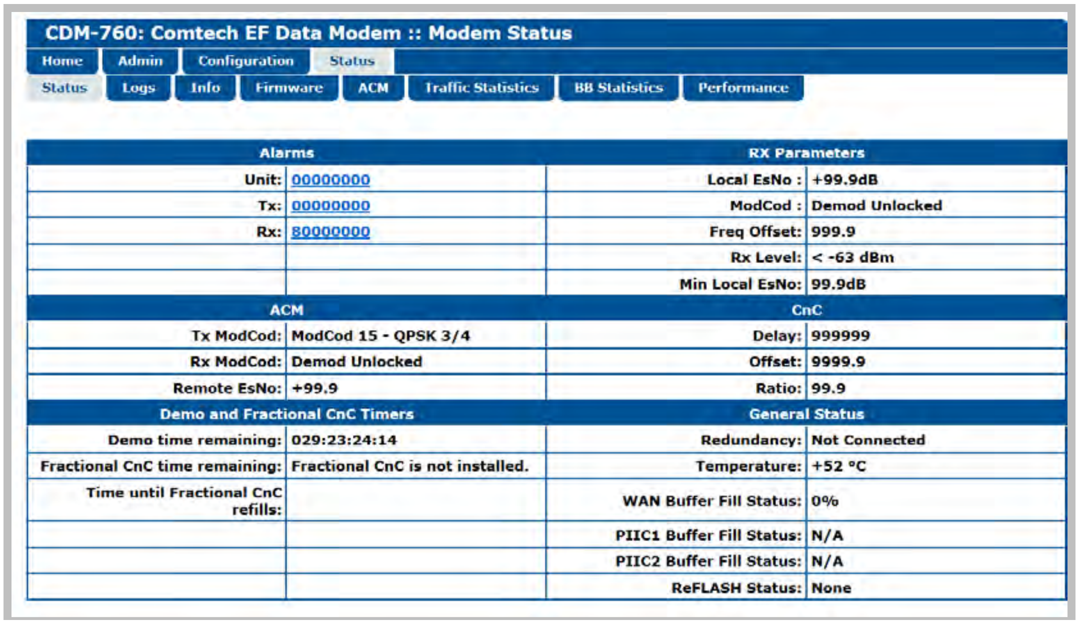
CDM-760: Comtech EF Data Modem :: Modem ACM Information

Home | Admin | Configuration | Status

Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance

ACM Table			
QPSK Degradation:	0.0	8PSK Degradation:	0.0
16APSK Degradation:	0.0	32APSK Degradation:	0.0
64APSK Degradation:	0.0		
EsNo Target Margin:	1.0		
Minimum ModCod:	QPSK 1/2	Maximum ModCod:	32APSK 9/10
ModCod	**Spectral Eff**	**EsNo**	**Skip?**
QPSK 1/2	0.965327	3.30	No
QPSK 8/15	1.030227	3.70	No
QPSK 17/30	1.095126	4.10	No
QPSK 3/5	1.160026	4.50	No
QPSK 19/30	1.224926	4.80	No
QPSK 2/3	1.290788	5.30	No
QPSK 127/180	1.365543	5.80	No
QPSK 3/4	1.452076	6.30	No
QPSK 4/5	1.549426	6.90	No
QPSK 5/6	1.615288	7.40	No
8PSK 17/30	1.642246	7.90	Yes
QPSK 31/36	1.668409	7.90	No
QPSK 8/9	1.724416	8.40	Yes
8PSK 3/5	1.739569	8.10	No
QPSK 9/10	1.746049	8.60	Yes
8PSK 19/30	1.836893	8.50	No
8PSK 2/3	1.935658	8.90	No
8PSK 127/180	2.047761	9.80	No
8PSK 3/4	2.177525	10.20	No
8PSK 4/5	2.323511	11.00	No
8PSK 5/6	2.422276	11.60	Yes
16APSK 19/30	2.443246	11.20	No
8PSK 31/36	2.501937	12.30	Yes
16APSK 2/3	2.574613	11.50	No
8PSK 8/9	2.585924	13.00	Yes
8PSK 9/10	2.618365	13.30	Yes
16APSK 127/180	2.723720	12.00	No
16APSK 3/4	2.896320	12.60	No
16APSK 4/5	3.090495	13.40	No
16APSK 5/6	3.221863	14.00	No
16APSK 31/36	3.327820	14.80	Yes
32APSK 127/180	3.407407	14.50	No
16APSK 8/9	3.439530	15.20	Yes
16APSK 9/10	3.482680	15.50	Yes
32APSK 3/4	3.623332	15.10	No
32APSK 4/5	3.866247	16.00	No
32APSK 5/6	4.030589	16.80	No
32APSK 31/36	4.163143	17.40	No
32APSK 8/9	4.302894	18.20	No
32APSK 9/10	4.356875	18.50	No

Figure G-12. Status | ACM Page



CDM-760: Comtech EF Data Modem :: Modem Status

Home | Admin | Configuration | Status

Status | Logs | Info | Firmware | ACM | Traffic Statistics | BB Statistics | Performance

Alarms		RX Parameters	
Unit:	00000000	Local EsNo :	+99.9dB
Tx:	00000000	ModCod :	Demod Unlocked
Rx:	80000000	Freq Offset:	999.9
		Rx Level:	< -63 dBm
		Min Local EsNo:	99.9dB
ACM		**CnC**	
Tx ModCod:	ModCod 15 - QPSK 3/4	Delay:	999999
Rx ModCod:	Demod Unlocked	Offset:	9999.9
Remote EsNo:	+99.9	Ratio:	99.9
Demo and Fractional CnC Timers		**General Status**	
Demo time remaining:	029:23:24:14	Redundancy:	Not Connected
Fractional CnC time remaining:	Fractional CnC is not installed.	Temperature:	+52 °C
Time until Fractional CnC refills:		WAN Buffer Fill Status:	0%
		PIIC1 Buffer Fill Status:	N/A
		PIIC2 Buffer Fill Status:	N/A
		ReFLASH Status:	None

Figure G-13. Status | Status Page

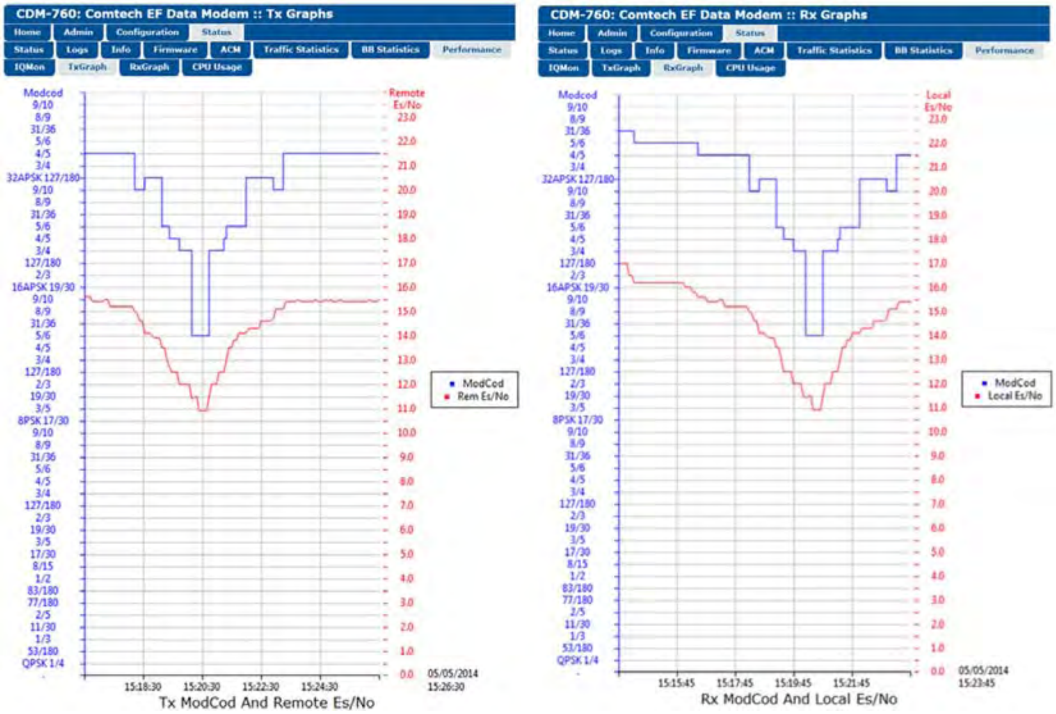


Figure G-14. Status | Performance | TxGraph and RxGraph Pages Graphing

The **Tx ModCod and Remote Es/No** graph on the *read-only* **Status | Performance | TxGraph** page (**Figure G-14, left**) is particularly useful when the modem is running is ACM mode, as it maps the remote Es/No of the far end modem synchronously along with the near side (local) Tx ModCod used. Two pieces of data are graphed in time synchronous manner:

- The left side of the graph has a vertical key of Tx ModCod (blue).
- The right side of the graph has a vertical key of Remote Es/No (red).

Similarly, The **Rx ModCod and Local Es/No** graph on the *read-only* **Status | Performance | RxGraph** page (**Figure G-14, right**) logs two pieces of data in time synchronous manner:

- The left side of the graph has a vertical key of Rx ModCod (blue).
- The right side of the graph has a vertical key of Local Es/No (red).

The Local Es/No is the Es/No of the local modem. When more than one ModCod is received in the smallest interval period allowable by the graph, the most common ModCod received in that time interval is displayed.

In this format, the graph depicts changes in ModCod that occur when the reported Remote Es/No meets the Es/No trigger points to switch up or down.

Note that the Remote Es/No is the "reported" Es/No of the far end modem as seen by the local modem. This reported Remote Es/No data can be 250ms to 400ms old as this is the amount of time it can take for this data to traverse the satellite link for processing by the local modem.

Via Internal BERT Tester: When using the Ethernet IP interface, it is not an easy matter to verify BER performance. A way to verify that the ACM link is meeting performance is by using the internal BERT tester provided on the **Configuration | Test** page (**Figure G-15**). Not only will the internal BERT verify BER performance, it is also tolerant of the change in bit rate that accompanies a change in ModCod. The BERT can be used to confirm that there are no sync losses or bursts of bit errors when a ModCod changes.

See Chapter 6. FRONT PANEL OPERATION for information about the Test Mode configuration parameters available on this page:

Web Page Section	Chapter 6 Section Reference
Unit	6.2.4.1 (TEST:) Mode
BERT Config	6.2.4.2 (TEST:) BERT → Off/On, → Patt
BERT Monitor	6.2.4.2 (TEST:) BERT → ErrIns, → Restart

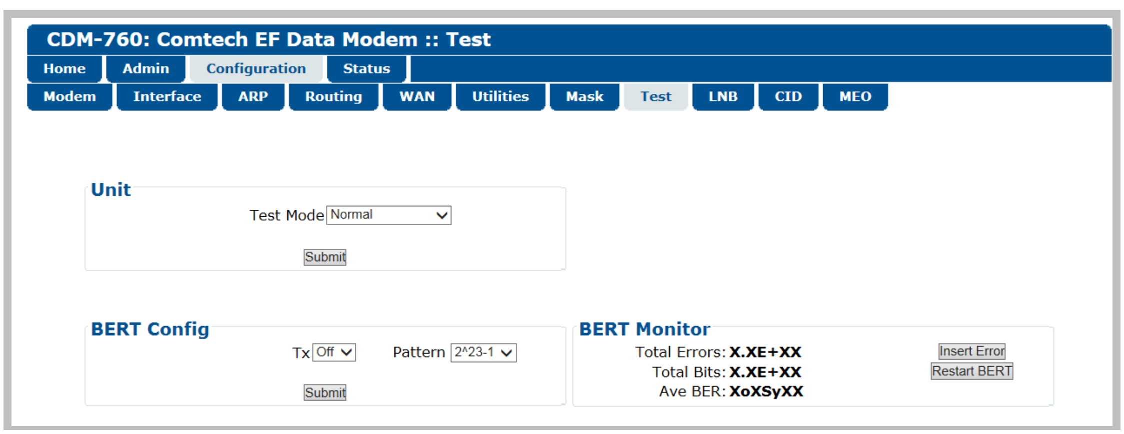


Figure G-15. Configuration | Test Page

The **Status | Performance | IQMon** page (**Figure G-16**) provides you with a Constellation / Spectrum Analyzer feature. If you have access to a bench oscilloscope in X-Y mode, Pins #3 and #11 on the CDM-760 rear panel **J1 | ALARMS** connector provide analog voltages to monitor the constellation. The advantage here is that ModCod changes may be viewed instantaneously.

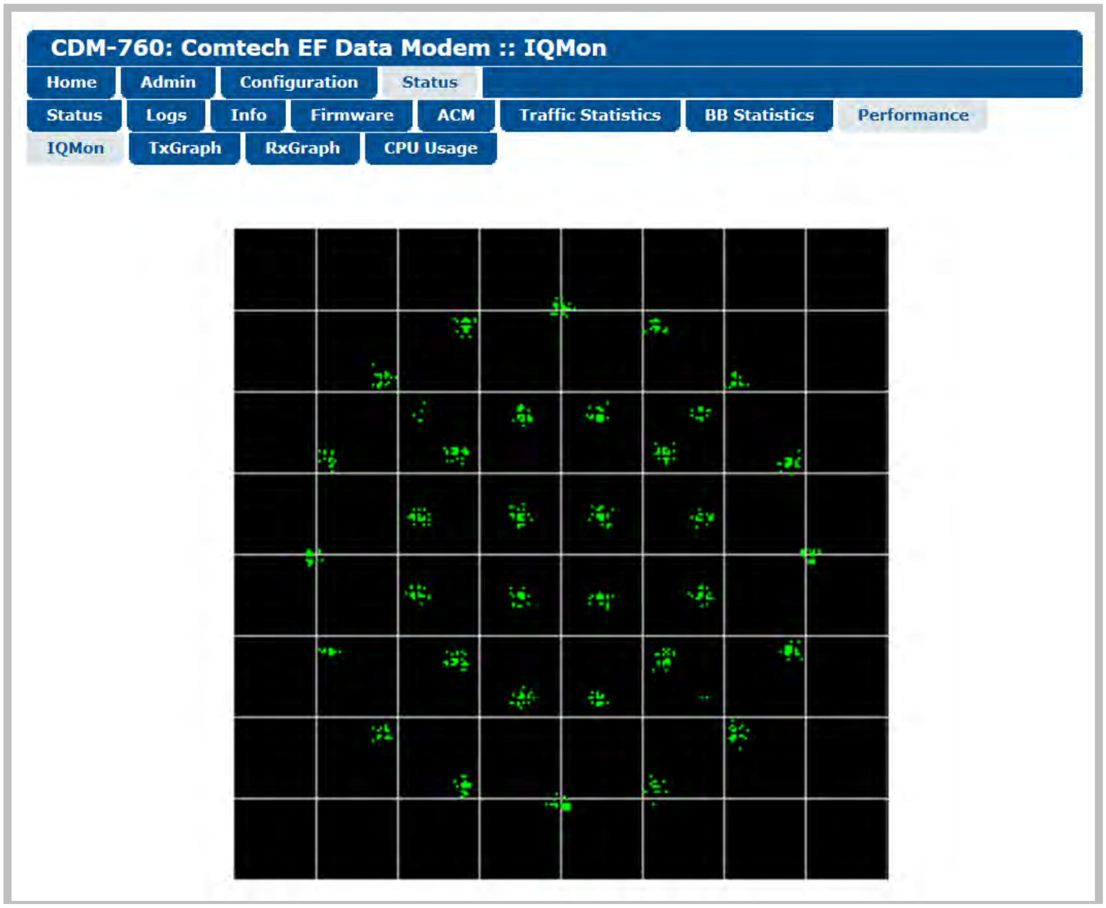


Figure G-16. Status | Performance | IQMon Page

G.5.4 ACM Operation Using the CDM-760 Serial Remote Control Interface

G.5.4.1 CDM-760 Typical Serial Remote Control Overview

See Chapter 8. SERIAL INTERFACE OPERATION for an in-depth explanation of the use of remote commands and queries over the CDM-760 Serial Remote Control Interface.

The CDM-760's serial remote interface is an electrical interface that is either an EIA-485 multi-drop bus (for the control of multiple devices) or an EIA-232 connection (for the control of a single device). The interface uses ASCII characters in asynchronous serial form to transmit data between the Controller (e.g., a User PC) and Target (e.g., the modem and ODU). This data consists of control and status information, transmitted in packets of variable length in accordance with the structure and protocol explained in detail in Chapter 8.

The Controller is in charge of the process of monitor and control, and 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.

The exchange of information is transmitted, Controller-to-Target and Target-to-Controller, in '**packets**'. Each packet contains a finite number of bytes consisting of printable ASCII characters, excluding ASCII code 127 (DELETE).

In this context, the Carriage Return and Line Feed characters are considered printable. With one exception, all messages from Controller-to-Target require a response – 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.

Controller-to-Target (Issued Command or Query)						
Start of Packet	**Target Address**	**Address Delimiter**	**Instruction Code**	**Code Qualifier**	**Optional Arguments**	**End of Packet**
< ASCII Code 60 (1 character)	0000 (default) (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)

Packet "issued command" example: **<0000/TMC = 10[cr]**
Packet "issued query" example: **<0000/TMC?[cr]**

Target-to-Controller (Response to Command or Query)						
Start of Packet	**Target Address**	**Address Delimiter**	**Instruction Code**	**Code Qualifier**	**Optional Arguments**	**End of Packet**
> ASCII Code 62 (1 character)	0000 (default) (4 characters)	/ ASCII Code 47 (1 character)	(3 characters)	= , ?, !, *, #, ~ (ASCII Codes 61, 63, 33, 42, 35, or 126) (1 character)	(n characters)	Carriage Return ASCII Code 13 (1 character)

Packet example – response received for issued query: **>0000/TMC = 10[cr][lf]**

G.5.4.2 ACM Configuration and Operation Using Serial Remote Control Commands/Queries

The operands available through the CDM-760 Serial Interface are identified in the following table – details on using these remote commands and queries are explicitly defined in **Chapter 8.**

Operand	Description
ACM	Sets or reports ACM operating parameters.
ADC	Sets or reports ACM degradation-on-configuration parameters.
RES	Reports the value of the remote demod Es/No, in dB.
LES	Reports the value of the local Es/No, in dB.
TMC	Sets or reports Tx modulation (TMC=00 is ACM mode)
RMC	Sets or reports Rx demodulation (RMC=00 is ACM mode)
MGC	Reports the global modem configuration, including ACM Operating Parameters and ACM Degradation Configuration
EID	Reports the equipment ID and installed options, including ACM

G.6 ACM Summary of Specifications

ACM Operational Mode	Functional in DVB-S2, DVB-S2-EB1/EB2, and DVB-S2X network specification modes
Symbol Rate Range	1 to 150 Msps
Interface	10/100/100BaseT Ethernet, with auto-sensing 10/100/1000 and auto-crossover detection or optional Optical Gigabit Ethernet interface
Remote Es/No reporting	Automatically reported from remote modem
Max span of data rate	0.1 to 314 Mbps (entire range of modem capability)
Switch point (decreasing Es/No)	Corresponds to Es/No (plus impairments) at QEF (~PER = 10^{-7})
Switch point hysteresis	Configurable via microprocessor switches only
Max fading rate	Configurable Target Es/No margin from 0.0 to 4.5 dB
Max ModCod update rate	Updates to the MODCOD can happen up to 4 times per second (no restriction on distance between MODCODs)
Configurable parameters	Minimum and Maximum ModCod
	Remote Demodulator Unlock options: • Maintain current ModCod • Go to minimum ModCod
	Es/No Target Margin: 0.0 to 4.5 dB0 in 0.1dB steps
	Modulation Type Impairment selection: • Impairment for QPSK, 8PSK, 16APSK and 32APSK: 0 to 9.9dB in 0.1dB steps • Impairment for QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK
Monitored parameters	Tx and Rx ModCods
	Local and Remote Es/No: (-3.0dB to +22.0dB, 0.1dB resolution)
	Configuration and monitor menus displaying data rate, modulation and code rate update dynamically with ModCod
Regulatory Compliance	CE Mark, FCC Part 15 Subpart B, RoHS-compliant

Notes:

Appendix H. CARRIER ID (DVB-CID METACARRIER®)

H.1 Overview

Radio Frequency Interference (RFI) is the largest single issue that impacts Quality of Service for satellite operators. CID (Carrier Identification) is a means to combat radio frequency interference.

The CDM-760 Advanced High-Speed Trunking Modem incorporates a patent-pending CID technique that uses MetaCarrier® spread spectrum technology to embed a unique carrier identification sequence for the transmitted carrier.

Since the initial release of this technology in the CDM-760, the European Telecommunications Standards Institute (ETSI) has adopted a modified version of Comtech's original scheme, which is defined in **ETSI TS 103 129 – Digital Video Broadcasting (DVB) Framing Structure, Channel Coding and Modulation of a Carrier Identification System (DVB-CID) for Satellite Transmission.** CDM-760s running Firmware Version 1.2.1 or later fully comply with this new specification.

The CDM-760 with MetaCarrier® is used in tandem with the Comtech EF Data MCDD-100 MetaCarrier® Detection Device to provide a complete MetaCarrier embedding and decoding solution.

H.1.1 About MetaCarrier

The DVB-CID (MetaCarrier) concept employs a low-speed data sequence containing identifying information about a host carrier that is spread using Direct Sequence Spread Spectrum (DSSS), and then combined, at a low power level, directly underneath that host carrier. The composite signal therefore carries its own embedded identification. The power level and bandwidth of the MetaCarrier is sufficiently low that it is completely hidden below the host carrier, and has minimal effect on system Eb/No (approximately 0.1 dB).

DVB-CID operates independent of the modulation and Forward Error Correction (FEC) rate of the host carrier. In configurations where the carrier is encrypted or uses cryptographic technologies, the information carried in the DVB-CID is not affected.

Traditionally, the method for identifying an interfering carrier involves using a geo-location system that, in turn, uses the phase offset from an adjacent satellite to triangulate the approximate location on the surface of the earth where the interference is being generated. While such “tried-and-true” geo-locating methods have proven beneficial to satellite operators and service providers, they are nevertheless imprecise. For example, to find the exact location of the transmission source in a densely populated area, you must dispatch a helicopter equipped with a feed horn and spectrum analyzer; the time and cost associated with such methods are significant.

By contrast, Comtech EF Data’s DVB-CID provides you with the interference source’s identification information within seconds. Once you identify the offending carrier, you may then contact the uplinking station and request that the station shut down or otherwise remove the identified transmission from service.

H.1.2 Functional Description

In a typical network, there can be many CDM-760s with DVB-CID, and one (or more) MCDD-100 MetaCarrier Detection Device(s) to verify the presence of the DVB-CID on each carrier. In an interference situation, the MCDD-100 may be used to decode the DVB-CID of an interfering carrier that may not be part of one’s own transmission network, as long as the interfering carrier has an embedded DVB-CID.

The CDM-760 creates a composite carrier by first sizing the appropriate MetaCarrier, and then by adding the spread spectrum CID (at a highly reduced power spectral density compared with that of the host carrier).

The size of the MetaCarrier is determined based purely on symbol rate and is totally independent of modulation and coding, resulting in two (2) discrete sizes of MetaCarrier being combined with the host carrier. The MetaCarrier parameters are shown below:

Host Carrier	Embedded DVB-CID MetaCarrier	DVB-CID psd relative to host carrier psd
128 ksps to < 512 ksps	112 kchips per sec *	-27.5 dB
512 ksps to < 2048 ksps	224 kchips per sec	-27.5 dB
2048 ksps to < 4096 ksps	224 kchips per sec	-24.5 dB
4096 ksps to < 8192 ksps	224 kchips per sec	-21.5 dB
8192 ksps to 12500 ksps	224 kchips per sec	-18.5 dB

***kchips per sec refers to the direct sequence spread spectrum chipping rate**

As shown here, the bandwidth of the host carrier is always wider than the MetaCarrier, the worst case being a 112 kcps MetaCarrier underneath a 128 ksps host carrier. In all configurations of the combined carrier, the MetaCarrier raises the transmission power less than 0.1 dB above the original carrier.

Note that in accordance with the DVB specification, Carrier ID is only available when the Transmit symbol rate is greater than, or equal to 128 ksps.

The CID message is composed of the following information:

- **CDM-760 MAC Address**
- **Contact Telephone number**
- **Device Location (Latitude and Longitude)**
- **CID Custom Message**

H.2 CDM-760 Carrier ID Operation

H.2.1 CDM-760 Operational Overview

Carrier ID operation requires that you first enable Carrier ID feature operation, and then create a MetaCarrier Custom Message. All other parameters (center frequency, symbol rate, and the CDM-760's MAC address) are set automatically. The CDM-760 provides several means for configuring Carrier ID operation:

- Local Control via the CDM-760 Front Panel keypad and VFD.
- Remote Control with a user-supplied PC via the:
  - CDM-760 HTTP (Web Server) Interface using a compatible Web browser.
  - Serial-based or Telnet-based Remote Control Interface using a terminal emulation program or Windows Command-line.
  - Ethernet-based Simple Network Management Protocol (SNMP) using a Network Management System (NMS) and Management Information Base (MIB) File Browser.

USE OF THE SERIAL-BASED REMOTE CONTROL INTERFACE, THE TELNET-BASED REMOTE CONTROL INTERFACE, AND THE ETHERNET-BASED SNMP INTERFACE ARE RECOMMENDED ONLY FOR ADVANCED USERS. COMTECH EF DATA STRONGLY ENCOURAGES USE OF THE CDM-760 FRONT PANEL OR HTTP (WEB SERVER) INTERFACE FOR MONITOR AND CONTROL (M&C) OF THE CDM-760.

H.2.2 CDM-760 CID Configuration – Front Panel Operation

See Chapter 6. FRONT PANEL OPERATION for in-depth information about the function and operation of the CDM-760 front panel.

Feature	Description	Function	Chapter 6 Sect.
1	**LED Indicators**	The LEDs indicate, in a summary fashion, the status of the modem.	**6.1.1**
2	**Keypad**	The keypad comprises six individual keyswitches. The keys have a positive 'click' action that provides tactile feedback. Enter data via the keypad. Data, prompts, and messages are displayed on the VFD.	**6.1.2**
3	**Vacuum Fluorescent Display (VFD)**	The VFD is an active display showing two lines of 24 characters each. It produces a blue light with adjustable brightness. Nested menus display all available options and prompt you to carry out a required action.	**6.1.3**

Figure H-1. CDM-760 Front Panel Features

Do these steps:

Typical for all screens, the flashing solid block indicates the cursor position.

1. **Access the CDM-760 front panel Carrier ID operations screen:**
   a. From the front panel main (**SELECT:**) menu, use the ◄ ► arrow keys to select the **Utility** menu branch. Press **ENTER** to proceed:

```
SELECT: Configuration  Monitor  Test
      Store/Ld  Utility  ODU  FAST  (◄ ►)
```

   b. From the **Utilities:** screen, use the ◄ ► arrow keys to select **CID**. Press **ENTER** to proceed:

```
Utilities: Set-RTC Display  EventLog
CID  LED 1:1  1:N Circuit-ID Firmware
```

2. **On the top line of the CID screen, use the ◄ ►▲▼arrow keys to set the modem's physical location in latitude and longitude:**
   a. Use the ◄ ► arrow keys to navigate to **Lat**. Press **ENTER** to proceed. The cursor jumps to the first alphanumeric character to edit:

```
CID:Lat:█0°25.43’N   Long:110°58.28’W
State:On     Telephone    Message     (♦)
```

b. Use the ▲▼arrow keys to change that character. Then, use the ◀ ▶ arrow keys to navigate to the next character to edit, and repeat. Press **ENTER** to save.

Latitude takes the form **DD^{0}MM.mm’C**, where:

- DD = degrees (00 through 90)
- MM = whole minutes (00 through 60)
- mm = fractional minutes (0 through 99 (tenths or hundredths))
- C = compass cardinal point (N = North, S = South)

c. Use the ◀ ▶ arrow keys to navigate to **Long**. Press **ENTER** to proceed. The cursor jumps to the first alphanumeric character to edit:

```
CID:Lat:30°25.43’N   Long:█10°58.28’W
State:On     Telephone    Message     (♦)
```

d. Use the ▲▼arrow keys to change that character. Then, use the ◀ ▶ arrow keys to navigate to the next character to edit, and repeat. Press **ENTER** to save.

Longitude takes the form **DDD^{0}MM.mm’C**, where:

- DDD = degrees (000 through 180)
- MM = whole minutes (00 through 60)
- mm = fractional minutes (0 through 99 (tenths or hundredths))
- C = compass cardinal point (E = East, W = West)

3. On the bottom line of the CID screen, enable transmission of CID information by the modem:

a. Use the ◀ ▶ arrow keys to navigate to **State**. Press **ENTER** to proceed. The cursor jumps to the operational control:

```
CID:Lat:30°25.43’N   Long:110°58.28’W
State:█n     Telephone    Message     (♦)
```

b. Use the ▲▼arrow keys to set the State as **On** or **Off**. The default is **On**. Press **ENTER** to save.

4. On the bottom line of the CID screen, create an Administrative contact (telephone) number:

a. Use the ◀ ▶ arrow keys to navigate to **Telephone**. Press **ENTER** to proceed:

```
CID Telephone Number:                      (◀▶⬍)
...........+15555555555          ..........
```

b. On the bottom line, use the ◀ ▶ arrow keys to select an alphanumeric character to edit, and then use the ▲▼arrow keys to change that character. Press **ENTER.**

You may use the following characters: **[*Space*], 0-9, +,** *and* **x**

Use the CID Telephone Number to provide a valid emergency contact number to call to resolve operational issues – e.g., in case the modulator's Tx output is causing interference on the satellite. Providing this phone number allows a satellite operator to quickly call the person(s) responsible for correcting any issues.

5. On the bottom line of the CID screen, create a CID Custom Message:

a. Use the ◀ ▶ arrow keys to navigate to **Message**. Press **ENTER** to proceed:

b. On the bottom line, use the ◀ ▶ arrow keys to select an alphanumeric character to edit, and then use the ▲▼arrow keys to change that character. Press **ENTER** to save.

```
CarrierID:Custom message:              (◀ ▶⬍)
----------- Comtech EF Data --------------
```

You may use the following characters: **[*Space*], 0-9, +,** *and* **x**

Use the CID Custom Message to provide additional information that may be useful in resolving operational issues, e.g., to quickly resolve interference.

H.2.3 CDM-760 CID Configuration – HTTP (Web Server) Interface

See Chapter 7. ETHERNET INTERFACE OPERATION for in-depth information about the function and operation of the CDM-760 HTTP Interface.

YOU MAY PROCEED WITH ETHERNET-BASED REMOTE PRODUCT MANAGEMENT (HTTP OR SNMP) UNDER THE ASSUMPTIONS THAT:

- **The CDM-760 is operating with the latest version firmware files.**
- **The CDM-760 is connected to a user-supplied, Windows-based PC, and:**
  - **The PC serial port is connected to the CDM-760 rear panel J3 | REMOTE port with a user-supplied serial cable.**
  - **The PC Ethernet port is connected to either the CDM-760 rear panel J4 | MGMT or the Packet Processor P0 | MGMT RJ-45 10/100/1000 BaseT Ethernet port with a user-supplied hub, switch, or direct Ethernet cable connection.**
  - **The PC is running a terminal emulation program (for operation of the CDM-760 Serial Interface) and a compatible web browser (for operation of the HTTP Interface)**.
- **The CDM-760 Management IP Address has been noted using the CDM-760 Serial Interface.**

Figure H-2 shows the menu tree for the CDM-760 HTTP Interface. Modem operations not specific to CDM-760 Carrier ID operation appear dimmed in this diagram and are explained in Chapter 7. This menu tree depicts the CDM-760 HTTP Interface as it appears with all FAST Features activated, and the optional High-Speed Packet Processor **installed and active**.

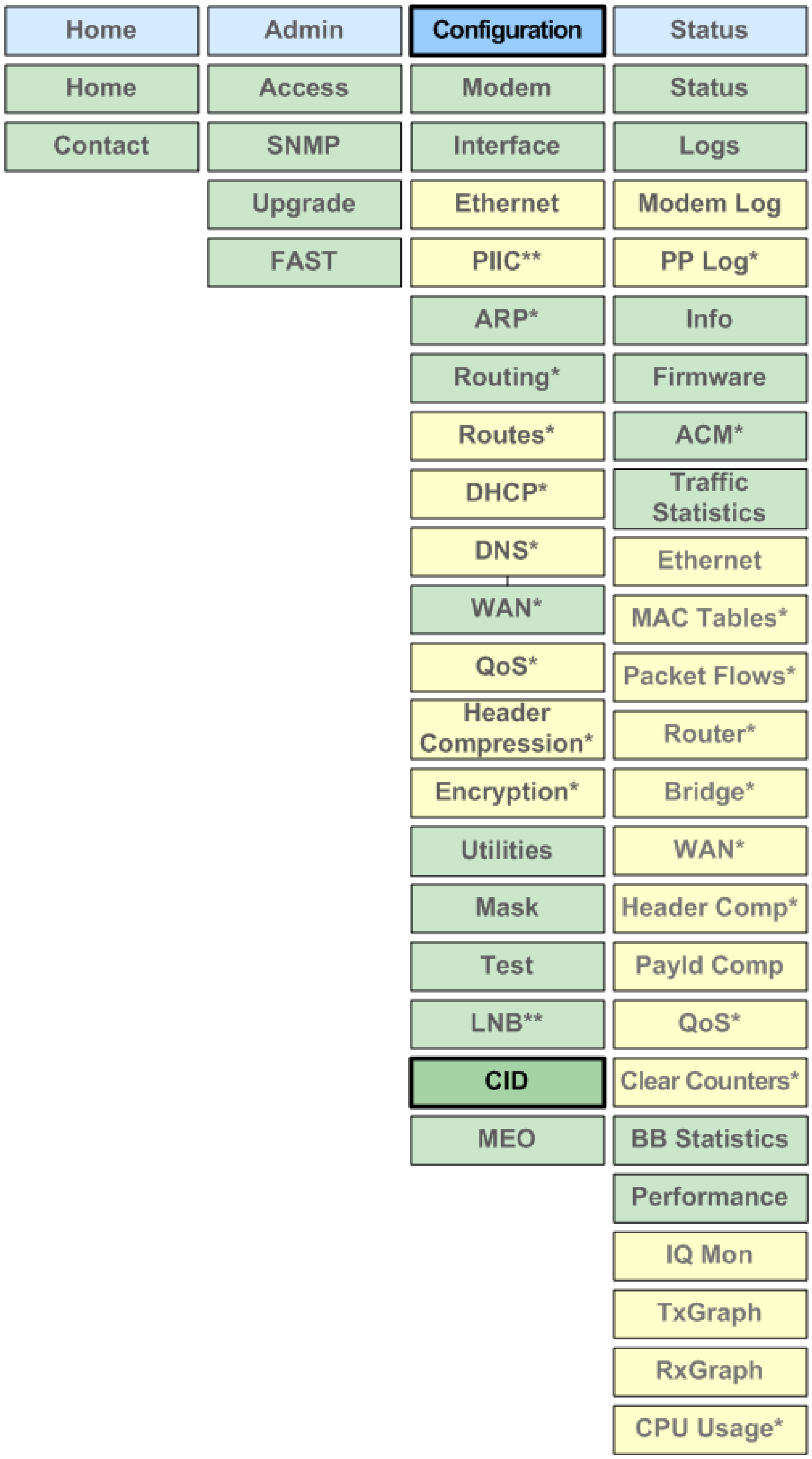


Figure H-2. CDM-760 HTTP Interface Menu Tree – Carrier ID Operation (FW Ver. 1.7.3)

To open the Carrier ID page (**Figure H-3**), click the **Configuration** navigation tab, and then select the **CID page** tab.

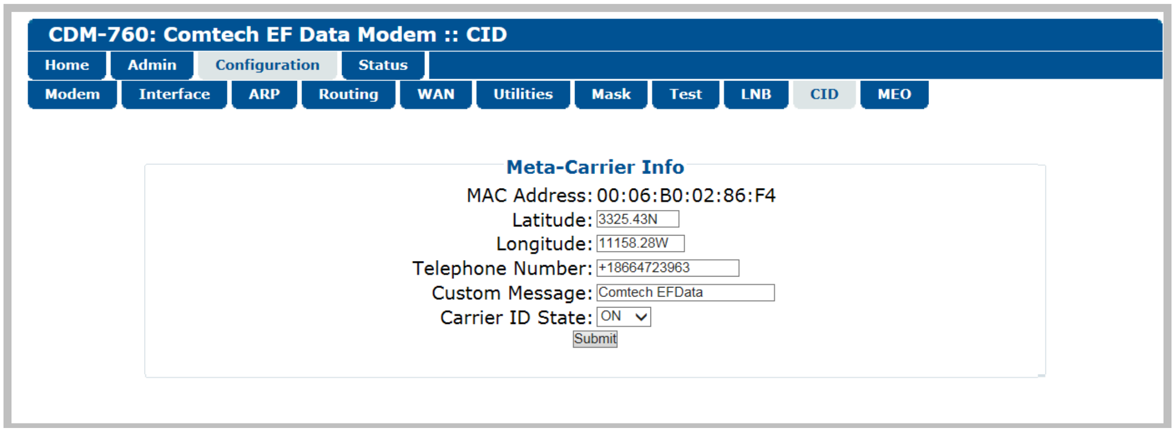


Figure H-3. Configuration | CID Page

Meta-Carrier Info

- The *read-only* **MAC Address** for the M&C card on the CDM-760 is displayed here.
- Set the modem's physical location in **Latitude** in the form DDMM.mmC, where:
  - o DD = degrees (00 through 90)
  - o MM = whole minutes (00 through 60)
  - o mm = fractional minutes (0 through 99 (tenths or hundredths))
  - o C = compass cardinal point (N = North, S = South)
- Set the modem's physical location in **Longitude** in the form DDDMM.mmC, where:
  - o DDD = degrees (000 through 180)
  - o MM = whole minutes (00 through 60)
  - o mm = fractional minutes (0 through 99 (tenths or hundredths))
  - o C = compass cardinal point (E = East, W = West)
- Enter a CID **Telephone Number** to provide a valid emergency contact number to call to resolve operational issues – e.g., in case the modulator's Tx output is causing interference on the satellite. Providing this phone number allows a satellite operator to quickly call the person(s) responsible for correcting any issues.
- Create a **Custom Message** to provide additional information that may be useful in resolving operational issues, e.g., to quickly resolve interference.
- Use the **Carrier ID State** drop-down list to select operation as **On** or **Off**. This setting enables the transmission of CID information by the modem. The default is **On**.

Click **[Submit]** to save your settings.

H.2.4 CDM-760 CID Configuration – Serial Remote Control

See Chapter 8. SERIAL INTERFACE OPERATION for in-depth information about the function and operation of the CDM-760 Serial Remote Control Interface.

The CDM-760's serial remote product management interface is an electrical interface that is either an EIA-485 multi-drop bus (for the control of multiple devices) or an EIA-232 connection (for the control of a single device). The interface uses ASCII characters in asynchronous serial form to transmit data between the Controller (e.g., a User PC) and Target (e.g., the modem and ODU). This data consists of control and status information, transmitted in packets of variable length in accordance with the structure and protocol explained in detail in Chapter 8.

The Controller is in charge of the process of monitor and control, and 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.

The exchange of information is transmitted, Controller-to-Target and Target-to-Controller, in '**packets**'. Each packet contains a finite number of bytes consisting of printable ASCII characters, excluding ASCII code 127 (DELETE).

In this context, the Carriage Return and Line Feed characters are considered printable. With one exception, all messages from Controller-to-Target require a response – 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.

Controller-to-Target (Issued Command or Query)						
Start of Packet	**Target Address**	**Address Delimiter**	**Instruction Code**	**Code Qualifier**	**Optional Arguments**	**End of Packet**
< ASCII Code 60 (1 character)	0000 (default) (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)

Packet "issued command" example: <0000/MSG=Comtech EF Data[cr]
Packet "issued query" example: <0000/MSG?[cr]

Target-to-Controller (Response to Command or Query)						
Start of Packet	**Target Address**	**Address Delimiter**	**Instruction Code**	**Code Qualifier**	**Optional Arguments**	**End of Packet**
> ASCII Code 62 (1 character)	0000 (default) (4 characters)	/ ASCII Code 47 (1 character)	(3 characters)	=, ?, !, *, #, ~ (ASCII Codes 61, 63, 33, 42, 35, or 126) (1 character)	(n characters)	Carriage Return ASCII Code 13 (1 character)

Packet example – response received for issued query: >0000/MSG=Comtech EF Data[cr][lf]

The operands available for Carrier ID configuration and operation through CDM-760 Serial-based Remote Product Management are identified in the following table – details on using these CID-specific remote commands and queries are explicitly defined in **Chapter 8.**

Operand	Description
LAT	Sets or returns device Longitude.
LNG	Sets or returns device Latitude.
MSG	Sets or returns the assigned Custom Message.
MUT	Sets or returns the mute mode (operational state).
PHN	Sets or returns the assigned Telephone Number.

Notes:

Appendix J. DOUBLETALK CARRIER-IN-CARRIER (CNC) OPTION

WARNING! BEFORE YOU ATTEMPT TO COMMISSION A SATELLITE LINK USING CARRIER-IN-CARRIER (CnC), YOU MUST ENSURE THAT THE LINK IS ROBUST ENOUGH FOR NORMAL OPERATION. ONLY WHEN YOU HAVE DONE THIS – AND YOU <u>RESOLVE</u> ALL SYSTEM ISSUES (E.G., ANTENNA-POINTING, CABLING, TERRESTRIAL INTERFERENCE, SATELLITE INTERFERENCE, ETC.) – SHOULD YOU ATTEMPT THE USE OF CARRIER-IN-CARRIER.

J.1 Overview

Space segment costs are typically the most significant operating expense for any satellite-based service, having a direct impact on the viability and profitability of the service. For a satellite transponder that has finite resources in terms of bandwidth and power, the leasing costs are determined by bandwidth and power used. Therefore, a satellite circuit should be designed for optimal utilization to use a similar share of transponder bandwidth and power.

The traditional approach to balancing a satellite circuit – once the satellite and earth station parameters are fixed – involves trade-off between modulation and coding. A lower order modulation requires less transponder power while using more bandwidth; conversely, higher order modulation reduces required bandwidth, albeit at a significant increase in power.

Comtech EF Data's DoubleTalk Carrier-in-Carrier option adds a new dimension to satellite communication optimization.

J.1.1 What is DoubleTalk Carrier-in-Carrier?

The CDM-760's DoubleTalk Carrier-in-Carrier (CnC) option uses a patented signal processing algorithm developed by Raytheon Applied Signal Technology that allows both the forward and reverse carriers of a full duplex link to share the same segment of transponder bandwidth, using patented "Adaptive Cancellation." Raytheon Applied Signal Technology uses the term DoubleTalk, and Comtech EF Data refers to it as DoubleTalk Carrier-in-Carrier (CnC)[1].

---

[1] 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.

CnC was first introduced in Comtech EF Data products such as the CDM-Qx Satellite Modem, CLO-10 Link Optimizer, and CDM-625 Advanced Satellite Modem. The implementation of DoubleTalk Carrier-in-Carrier in the CDM-760 has been further refined, and some of the limitations that existed in the prior offerings have been overcome.

CnC technology provides a significant improvement in bandwidth and power utilization, beyond what is possible with FEC and modulation alone, allowing users to achieve unprecedented savings. When combined with advanced modulation and FEC, it allows for multi-dimensional optimization:

- Reduced operating expense (OPEX) – e.g., Occupied Bandwidth & Transponder Power;
- Reduced capital expenditure (CAPEX) – e.g., Block Up Converter/High-Power Amplifier (BUC/HPA) size and/or antenna size;
- Increased throughput without using additional transponder resources;
- Increased link availability (margin) without using additional transponder resources;
- A combination of any of the above to meet different objectives.

Conclusion: When using the DoubleTalk Carrier-in-Carrier (CnC) option, up to 50% savings in transponder utilization is possible when carriers share common bandwidth.

J.2 Application Requirements

These conditions are necessary in order to operate DoubleTalk Carrier-in-Carrier:

- Link must be full duplex.
- A CDM-760 must be used at the end of the link where the cancellation needs to take place. Normally, this is both ends of the link.
- The transponder is operated as Loopback. That is, each end of the link must be able to see a copy of its own signal in the downlink path from the satellite. The looped back signal is then subtracted, which leaves the signal from the distant end of the link. **DoubleTalk Carrier-in-Carrier cannot be used in spot beam systems.**
- The transponder needs to be “bent-pipe” – meaning no on-board processing, demodulation, regeneration can be employed. Demodulation/remodulation does not preserve the linear combination of the forward and return signals and the resulting reconstituted waveform prevents recovery of the original constituent signals.

Figure J-1 shows a simplified conceptual block diagram of CnC processing. The two ends of the link are denoted '**A**' and '**B**' and the uplink and downlink are shown.

This performance is achieved through advanced signal processing algorithms that provide superior cancellation while tracking and compensating for these common link impairments:

1) **Time varying delay:** In addition to the static delays of the electronics and the round-trip delay associated with propagation to the satellite and back, there is a time-varying component due to movement of the satellite. The CnC module tracks and compensates for this variation.
2) **Frequency offset and drift:** Common sources are satellite Doppler shift, up and down converter frequency uncertainties, and other drift associated with the electronics in the CDM-760 itself. The CnC module tracks and compensates for this frequency offset and drift.

3) **Atmospheric effects:** Fading and scintillation can affect amplitude, phase, and spectral composition of the signal and the degree to which it correlates with the original signal. The CnC module tracks and compensates for these atmospheric related impairments.
4) **Link Asymmetries:** Various asymmetries in the forward and return link can produce differences in the relative power of the two received signal components. These can be both deterministic (static) or random (and time varying). An example of the former would be the differences resulting from antenna size/gain variations between the two ends of the link. An example of the latter would be transient power differences due to different levels of atmospheric fading in the uplinks. CnC compensates for the asymmetries, up to a certain extent.

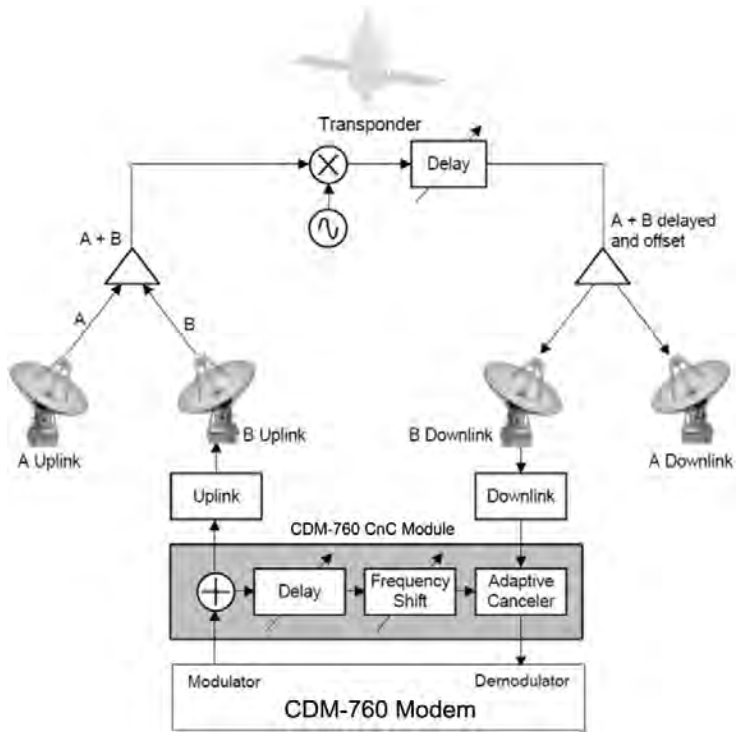


Figure J-1. Conceptual Block Diagram

In a number of ways, CnC carriers behave similar to conventional carriers in satellite links. Both are exposed to adjacent carriers, cross-polarization, and rain fade, and exhibit impairments when any of these become too great. CnC additionally operates in an environment where:

- Carriers intentionally occupy the same spectral slot, and
- Performance depends upon desired and co-located interfering carrier. The interfering carrier is canceled, leaving the desired carrier for demodulation.

J.3 Operational Details

The rules for CnC operation are summarized thusly:

- Both earth stations share the same satellite footprint, so each sees both carriers;
- CnC carriers are operated in pairs;
- One outbound with multiple return carriers is not allowed;
- Asymmetric operation is allowed up to a 3:1 ratio of symbol rate;
- The ratio of CnC (ratio of interferer power to desired power) is normally within ±7 dB;

- CnC operates with modems – not modulators only or demodulators only.
- During CnC acquisition, neither modem passes data. Only after both modems complete the CnC acquisition process does data flow.

For best operation:

- Keep the search delay range as narrow as possible – once the modem has reported the search delay, narrow the search delay range to the nominal reported value ±10 ms. **For example**, if the modem reported delay is 245 ms, narrow the search range to 235-255 ms. Factory default for search delay is 230-290 ms. Search delay programmable range is 0-300 ms, where 0 ms is used when doing loopback or bench testing.
- Use the CDM-760's Internal BERT Tester when evaluating CnC performance.

J.4 System Functionality and Operational Considerations

Figure J-2 illustrates a conventional, full duplex satellite link where two carriers are placed in non-overlapping channels. **Figure J-3** shows the same link using CDM-760s equipped with the CnC option. Note now that, with CnC used, only 50% of the bandwidth is being used, as both carriers are occupying the same bandwidth.

The transponder downlinks the composite signal containing both carriers on the same band to the CDM-760 which then translates the signal to near baseband where it can be filtered (decimated) and then processed as a complex envelope signal. The CDM-760 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.

To further illustrate in **Figure J-4**, without CnC, the two carriers in a typical full duplex satellite link are adjacent to each other. With CnC, only the composite signal is visible when observed on a spectrum analyzer. Carrier 1 and Carrier 2 (shown here for reference only) are overlapping, thus sharing the same spectrum.

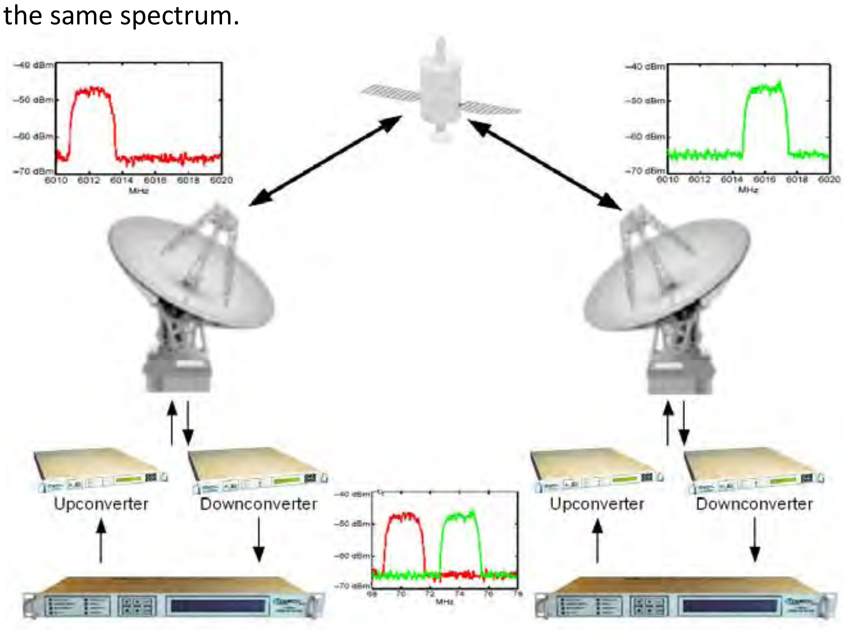


Figure J-2. Conventional FDMA Link

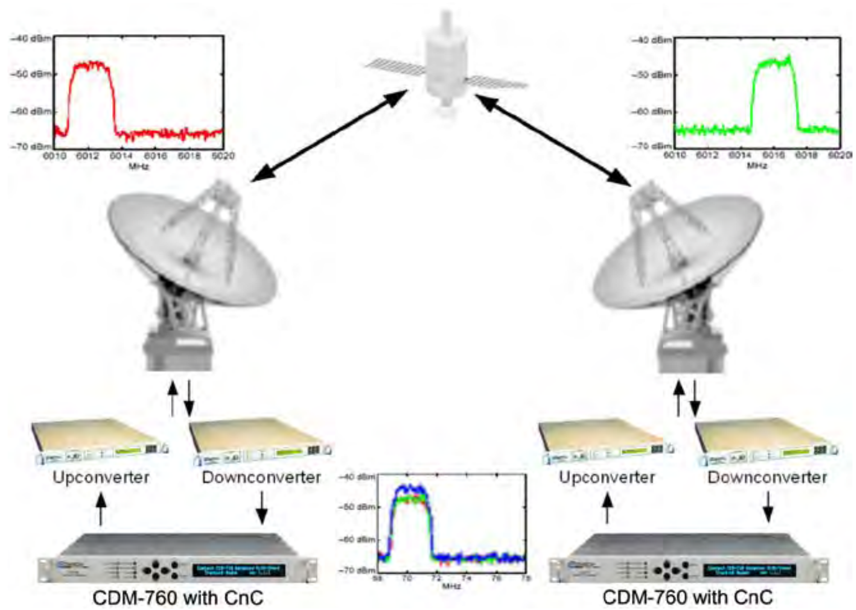
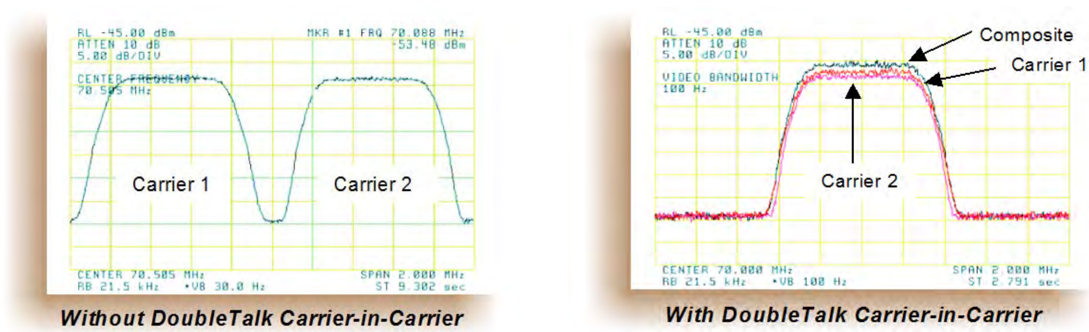


Figure J-3. Same Link Using CDM-760 and DoubleTalk Carrier-in-Carrier



Traditional Full Duplex Link | **Duplex Link with DoubleTalk Carrier-in-Carrier**

Figure J-4. Duplex Link Optimization

The CDM-760 CnC module operates on the near-zero signal before the demodulator, and is waveform agnostic. This means that no prior knowledge of the underlying modulation, FEC, or any other waveform specific parameter is required in order to perform the signal cancellation operation. The only caveat to this is that the waveform must be *sufficiently random*.

CDM-760 CnC operates from 1 to 63 Msps. Interference will compromise CnC links just as they do non-CnC links. Acquisition of the demodulator is improved by minimizing the delay search range; **for example**, if the delay is known to be around 240ms, set the minimum search delay to 230ms and the maximum search delay to 250ms.

As advances in modem technologies – including advanced modulation and FEC techniques – approach their theoretical limits of power and bandwidth efficiencies, CnC allows satellite users to achieve spectral efficiencies (bps/Hz) that cannot be achieved with modulation and FEC alone. **Table J-1** illustrates how QPSK, when used with CnC, approaches the bandwidth efficiency of 16APSK.

Table J-1. Spectral Efficiency using DoubleTalk Carrier-in-Carrier

Modulation and Code Rate	Spectral Efficiency (bps/Hz)	
	Traditional SCPC	Carrier-in-Carrier
QPSK 1/2	0.965	1.930
QPSK 2/3	1.291	2.582
QPSK 3/4	1.452	2.904
QPSK 8/9	1.724	3.448
8PSK 2/3	1.936	3.872
16APSK 3/4	2.896	5.792
16APSK 5/6	3.222	6.440
32APSK 3/4	3.623	7.246
32APSK 8/9	4.301	8.602

As shown here, CnC allows equivalent spectral efficiency using a lower order modulation and/or FEC Code Rate; CAPEX is therefore reduced by allowing the use of a smaller BUC/HPA and/or antenna. And, as CnC can be used to save transponder bandwidth and/or transponder power, it can be successfully deployed in bandwidth-limited as well as power-limited scenarios.

J.4.1 DoubleTalk Carrier-in-Carrier Cancellation Process

The state-of-the-art signal processing technology employed via CnC continually estimates and tracks all parametric differences between the local uplink signal and its image within the downlink. Through advanced adaptive filtering and phase locked loop implementations, it dynamically compensates for these differences by appropriately adjusting the delay, frequency, phase and amplitude of the sampled uplink signal, resulting in excellent cancellation performance.

When a conventional full duplex satellite connection is established between two sites, separate satellite channels are allocated for each direction. If both directions transmitted on the same channel, each side would normally find it impossible to extract the desired signal from the aggregate due to interference originating from its local modulator. However since this interference is produced locally, it is possible to estimate and remove its influence prior to demodulation of the data transmitted from the remote location.

For the CnC cancellation, it is necessary to provide each demodulator with a copy of its local modulator's output.

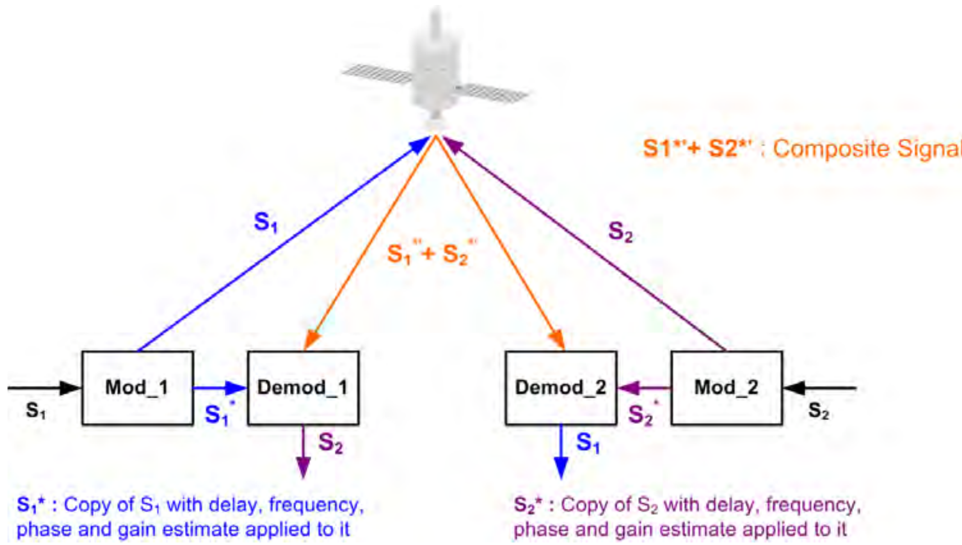


Figure J-5. DoubleTalk Carrier-in-Carrier Signals

Referring to Figure J-5: Modem 1 and Modem 2 transmit signals S1 and S2 respectively. The satellite receives, translates, and retransmits the composite signal. The composite downlink signal S1* + S2* is received at Modem 1 and Modem 2. The modem's returned image of the uplink signal (not including the desired carrier) differs from the originally-transmitted signal primarily in terms of phase, frequency, and delay offsets.

Referring to Figure J-6: For round trip delay estimation, a search algorithm is utilized that correlates the received satellite signal to a stored copy of the local modulator's transmitted signal. The interference cancellation algorithm uses the composite signal and the local copy of S1 to estimate the necessary parameters of scaling (complex gain/phase), delay offset and frequency offset. The algorithm continuously tracks changes in these parameters as they are generally time-varying in a satellite link.

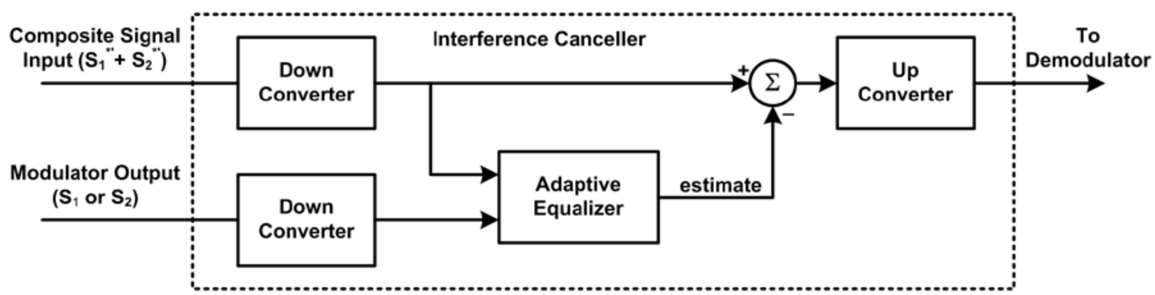


Figure J-6. Carrier-in-Carrier Signal Processing Block Diagram

The resulting estimate of the unwanted interfering signal is then subtracted from the composite signal. In practical applications, the estimate of the unwanted signal can be extremely accurate. Unwanted interfering signal suppression of 30 dB or more has been achieved in commercial products with minimal degradation of the demodulator performance.

J.4.2 Margin Requirements

Depending on the product, typical interfering signal cancellation is 28 to 35 dB. The residual interfering signal appears as noise, causing a slight degradation in received Es/No. To compensate for the residual noise, a small amount of additional link margin is required to improve the Es/No and maintain the QEF performance. Margin requirements depend on the product, modulation and power ratios; for the CDM-760, these additional margin requirements are:

Modulation	Nominal Margin*
QPSK	0.3 dB
8PSK	0.3 dB
16APSK	0.6 dB
32APSK	1.0 dB

* Equal power and equal symbol rate for the interfering carrier and the desired carrier, i.e., 0 dB CnC ratio. Measured at IF with AWGN, +7 dBc Adjacent Carriers, 1.3 spacing.

J.4.3 Carrier-in-Carrier Latency

DoubleTalk Carrier-in-Carrier has no measurable impact on circuit latency.

J.4.4 Carrier-in-Carrier and Adaptive Coding and Modulation (ACM)

DoubleTalk Carrier-in-Carrier is fully compatible with the Adaptive Coding and Modulation (ACM) mode of operation in the CDM-760. CnC combined with ACM can provide 100 – 200% increase in average throughput.

J.4.5 Carrier-in-Carrier Link Design

CnC link design involves finding the FEC and modulation combination that provides optimal bandwidth utilization. Just like conventional link design, it is an iterative process that involves trying different FEC and modulation combinations with CnC until an optimal combination is found.

For optimal CnC performance, it is recommended that the two carriers have similar symbol rate and power. This can be achieved by selecting appropriate ModCods, as shown in the appendix sections that follow.

Normally, a CnC link results in saving bandwidth and power, so there are satellite resources recovered that are deployable for additional links and more throughput over the existing capacity. When sizing the link to transform existing carriers into CnC links, also consider how the recovered capacity is best deployed. In other words, evaluate the bandwidth and power (or power equivalent bandwidth) tradeoffs with an eye to the future.

J.4.6 Symmetric Data Rate Link

Consider this example:

Satellite & Transponder	Galaxy 18 @ 123º W, 13K/13K
Earth Station 1	Phoenix, AZ – 8.1 m
Earth Station 2	Phoenix, AZ – 8.1 m
Data Rate (Mbps)	34.368 (E3) / 34.368 (E3)

The traditional link was based on 8PSK TPC 7/8 and required 36 MHz of leased bandwidth. This is the LST[2] summary for the traditional link:

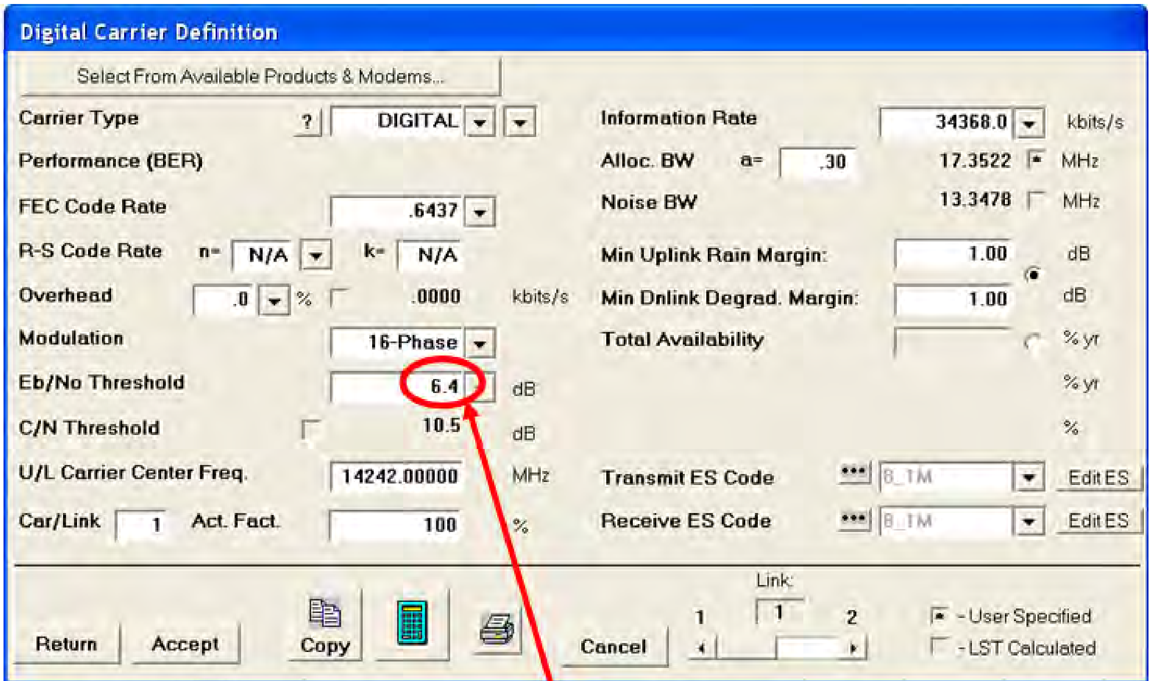
Link Analysis Description:			
MultiCarrier Txpdr Lease	**Link 1**	**Link 2**	
Number of links: 2			
Modulation	8-Phase	8-Phase	
Information Rate	34368.0	34368.0	kbit/s
FEC Code Rate	.8480	.8480	
R-S Code Rate	N/A	N/A	
Clear Sky Eb/No Available	8.8	8.8	dB
Number of Assigned Carriers	1	1	
Transmit ES Code	8_1M	8_1M	
Transmit ES Size	8.1	8.1	m
Receive ES Code	8_1M	8_1M	
Receive ES Size	8.1	8.1	m
Receive ES G/T	36.5	36.5	dB/K

Total Leased Resource Usage:					
LST calculated			Total BW allocated	35.1245	MHz
(MultiCarrier Txpdr Lease)			Total BW PEB	35.9610	MHz
Total EIRP utilized	36.5	dBW	Total BW utilized	35.9610	MHz
Total EIRP available	36.5	dBW	Total BW available	36.0000	MHz
Margin (available-utilized)	.0	dB	Margin (available-utilized)	.0390	MHz

Allocated BW = 35.1245 MHz
PEB = 35.9610 MHz
Leased BW = 35.9610 MHz

[2] LST is Intelsat's Lease Transmission Plan Program.

These are the Link parameters and LST summary for 16APSK 2/3 with Carrier-in-Carrier:



Include IF and RF Margin and CnC Margin

Link Analysis Description:			
MultiCarrier Txpdr Lease	Link 1	Link 2	
Number of links: 2			
Modulation	16-Phase	16-Phase	
Information Rate	34368.0	34368.0	kbit/s
FEC Code Rate	.6437	.6437	
R-S Code Rate	N/A	N/A	
Clear Sky Eb/No Available	7.4	7.4	dB
Number of Assigned Carriers	1	1	
Transmit ES Code	8_1M	8_1M	
Transmit ES Size	8.1	8.1	m
Receive ES Code	8_1M	8_1M	
Receive ES Size	8.1	8.1	m
Receive ES G/T	36.5	36.5	dB/K

Total Leased Resource Usage:					
LST calculated			Total BW allocated	34.7044	MHz
(MultiCarrier Txpdr Lease)			Total BW PEB	25.1159	MHz
Total EIRP utilized	34.9	dBW	Total BW utilized	34.7044	MHz
Total EIRP available	36.4	dBW	Total BW available	34.8000	MHz
Margin (available-utilized)	1.4	dB	Margin (available-utilized)	.0956	MHz

CnC Allocated BW = 34.70 ÷ 2 = 17.35 MHz
CnC PEB = 25.1 MHz
CnC Leased BW = 25.1 MHz

The link budget summary for the different ModCod combinations is:

S. No.	Modulation & FEC	Allocated BW (MHz)	PEB (MHz)	Leased BW (MHz)	Savings Compared to Original	PSD Ratio (dB)
1	S2 8PSK 5/6	18.2	26.9	26.9	25%	0.0
2	S2 8PSK 8/9	17.9	34.9	34.9	4%	0.0
3	S2 16APSK 2/3	17.35	25.1	25.1	31%	0.0
4	S2 16APSK 5/6	13.9	38.3	38.3	-9.7%	0.0

Based on this analysis, S2 16APSK 2/3 with CnC provides the maximum savings of 31%.

J.4.6.1 Asymmetric Data Rate Link

As occupied (or allocated) bandwidth of a CnC circuit is dictated by the larger of the two carriers, it is strongly recommended that the smaller carrier be spread as much as possible using a lower order modulation and/or FEC, while meeting the CnC ratio spec. Spreading the smaller carrier using a lower order modulation has multiple benefits:

- Lower order modulation is always more robust;
- Lower order modulation uses less transponder power – this reduces total required transponder power, and increases available link margin;
- Lower order modulation uses less transmit power on the ground – this can significantly reduce the BUC/SSPA size not only by reducing the transmit EIRP, but also by reducing the BUC/SSPA backoff.

Consider this example:

Satellite & Transponder	IS-901 @ 342º W, 22/22 (EH/EH)
Earth Station 1	Africa – 4.5 m
Earth Station 2	Africa – 3.6 m
Data Rate	30 Mbps / 10 Mbps

While the traditional link was based on 8PSK, TPC 3/4 and required 27.8 MHz of leased bandwidth, the CnC link was based on 8PSK 3/4 and 8PSK 3/5 and required 19.3 MHz of leased bandwidth.

The savings summary is (note TPC 7/8 is 20/23 actual):

Item	Original Link			With Carrier-in-Carrier and LDPC			Savings
	Hub to Remote	Remote To Hub	Total	Hub to Remote	Remote to Hub	Total	
Data Rate (kbps)	30 Mbps	10 Mbps		30 Mbps	10 Mbps		
Modulation	8PSK	8PSK		8PSK	8PSK		
FEC	TPC 3/4	TPC 7/8		S2 3/4	S2 3/5		
Occupied BW (MHZ)	19.1	5.5	24.6	19.3	8.0	19.3	
Power Eq. BW (MHz)	22.0	5.8	27.8	13.5	3.4	16.9	
Leased BW (MHz)			**27.8**			**19.3**	**30.5%**
Hub HPA (W)	503			310			**38.3%**
Remote HPA (W)	219			129			**41.1%**

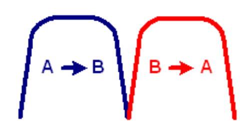
If the CnC link was designed using S2-8PSK 3/4 in both directions, it would require:

- **Occupied BW –** 19.3 MHz;
- **Power Eq. BW –** 17.9 MHz (a 5.9% **increase** in Power Eq. BW);
- **Leased BW –** 19.3 MHz;
- **Hub HPA –** 310 W;
- **Remote HPA –** 166 W (a 28.7% **increase** in Remote power).

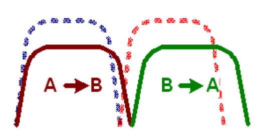
J.4.6.2 Power Limited Links

Carrier-in-Carrier can provide substantial savings even when the original link is power limited. Spreading the carrier by using a lower modulation and/or FEC along with latest FEC such as DVB-S2 LDPC can substantially reduce the total power which can then be traded with bandwidth using Carrier-in-Carrier. The concept is illustrated with these examples:

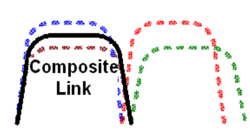
The conventional link is using 8PSK, TPC 3/4:



Switching to DVB-S2 8PSK 3/4 slightly increases the total occupied bandwidth, while substantially reducing the total power equivalent bandwidth:



Now, using CnC, the second 8PSK 3/4 carrier can be moved over the first carrier – thereby significantly reducing the total occupied bandwidth and total power equivalent bandwidth when compared to the original side-by-side 8PSK, TPC 3/4 carriers:



To continue, consider this example:

Satellite & Transponder	IS-901 @ 342º W, 22/22 (EH/EH)
Earth Station 1	Africa – 9.1 m
Earth Station 2	Africa – 4.5 m
Data Rate	20.48 Mbps / 20.48 Mbps

Whereas the original link used 8PSK TPC 3/4, the CnC link uses DVB-S2 8PSK 3/4. Using CnC and DVB-S2 reduces the leased bandwidth by almost 50% and HPA power by almost 60%. The savings summary is:

Item	Original Link			With Carrier-in-Carrier			Savings
	Hub to Remote	Remote To Hub	Total	Hub to Remote	Remote to Hub	Total	
Data Rate (kbps)	20.48	20.48	-	20.48	20.48	-	
Modulation	8PSK	8PSK	-	8PSK	8PSK	-	
FEC	TPC 3/4	TPC 3/4	-	S2 3/4	S2 3/4	-	
Occupied BW (MHZ)	13.1	13.1	26.2	13.2	13.2	13.2	
Power Eq. BW (MHz)	10.3	4.9	15.2	6.4	2.0	8.4	
Leased BW (MHz)	-	-	26.2	-	-	13.2	49.6%
Hub HPA (W)	44			27			38.3%
Remote HPA (W)	112			47			58.3%

Note: 1 dB HPA BO for QPSK, 2 dB HPA BO for 8PSK, 1 dB Feed Loss.

J.4.7 Commissioning and Deploying Carrier-in-Carrier

Prior to commissioning a Carrier-in-Carrier link, it is critical that you fully test the link in non-CnC mode **and that you resolve all system issues – this includes external interference, antenna pointing, cabling, and SSPA backoff. You should attempt to turn on CnC *only after* you verify that the link is robust.**

Comtech EF Data recommends that you do these steps to commission and deploy CnC:

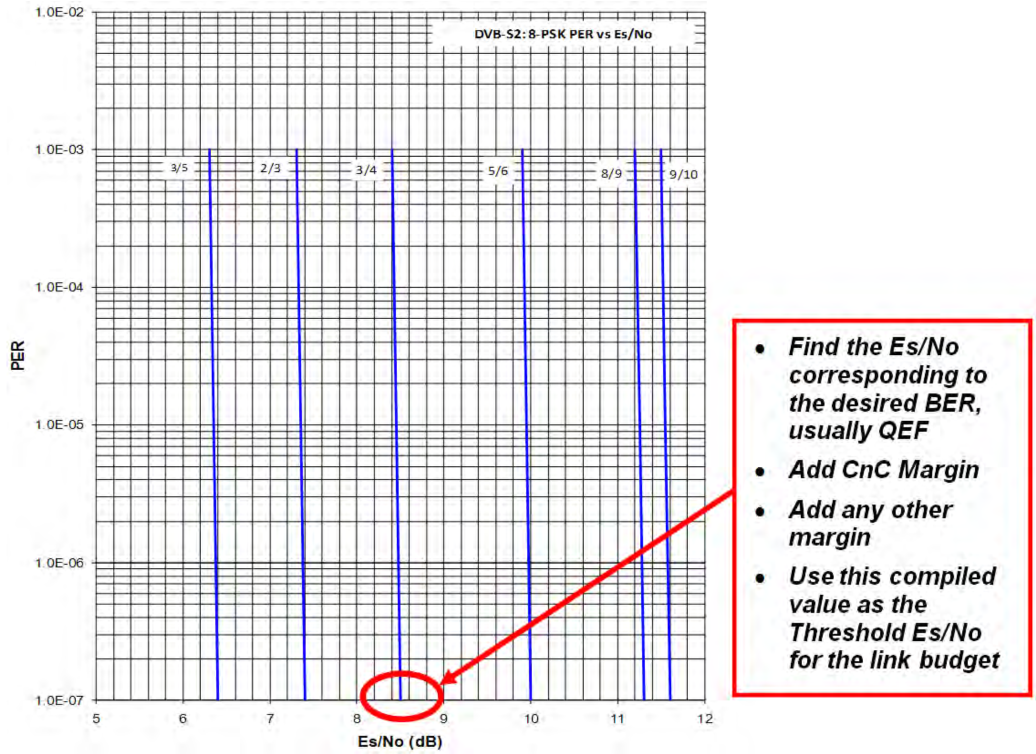
Step	Task
1	Turn **ON** the carrier at *Site A*. Carrier from *Site B* is **OFF**. CnC function is **OFF** at *both sites*. ➢ Using a spectrum analyzer, measure Co+No/No at the input to the modem at *Site A*. ➢ Using a spectrum analyzer, measure Co+No/No at the input to the modem at *Site B*. ➢ Measure/record Es/No at *Site B*. Make sure there is sufficient margin to account for CnC. ➢ Measure/record Receive Signal Level (RSL) at *Site B,* usually midrange.
2	Turn **OFF** the carrier at *Site A*. Turn **ON** the carrier at *Site B*. CnC function is **OFF** at *both sites*. ➢ Using a spectrum analyzer, measure Co+No/No at the input to the modem at *Site A*. ➢ Using a spectrum analyzer, measure Co+No/No at the input to the modem at *Site B*. ➢ Measure/record Es/No at *Site A*. Make sure there is sufficient margin to account for CnC. ➢ Measure/record RSL at *Site B*.
3	Using Co+No/No readings, calculate CnC ratio at *Sites A* and *B*. If it is not within specification, make necessary adjustments to bring it within specification and repeat measurements in **Steps 1** and **2**. ➢ Also verify that the RSL is within spec.
4	Now, without changing the transmit power levels, turn **ON** *both* the carriers (on the same frequency) and turn CnC **ON**. ➢ Measure/record Es/No at *Sites A* and *B*. ➢ Measure/record RSL at *Sites A* and *B*. ➢ Now, compare Es/No in the presence of two overlapping carriers with CnC with Es/No when only one carrier was **ON**. Es/No variation should be within spec for that modulation and SR ratio.
5	You may repeat the test for different SR ratios and modulation types.

J.5 Operational References

J.5.1 Calculating a Carrier-in-Carrier Link Budget

Do these steps to calculate the link budget for a CnC Link:

<table>
<tr><th>Step</th><th>Task</th></tr>
<tr><td>1</td><td>Calculate the link budget for both carriers in the duplex link, with required CnC margin:



</td></tr>
<tr><td>2</td><td>Verify that the CnC ratio is within spec for the CDM-760.</td></tr>
<tr><td>3</td><td>Calculate the Allocated Bandwidth (BW) and Power Equivalent Bandwidth (PEB) for the duplex link:

- $BW_{Duplex\ Link}$ = Greater of ($BW_{Carrier\ 1}$, $BW_{Carrier\ 2}$)
- $PEB_{Duplex\ Link} = PEB_{Carrier\ 1} + PEB_{Carrier\ 2}$
- Leased $BW_{Duplex\ Link}$ = Greater of ($BW_{Duplex\ Link}$, $PEB_{Duplex\ Link}$)
</td></tr>
<tr><td>4</td><td>For an optimal link, the Leased Bandwidth and the Power Equivalent Bandwidth are equal or nearly equal.</td></tr>
<tr><td>5</td><td>Repeat the link budget process by selecting different Modulation and FEC until the BW and PEB is nearly balanced.</td></tr>
</table>

J.5.2 Estimating / Calculating CnC Ratio

CnC Ratio can be derived either from the downlink carrier levels or from the Carrier to Noise Ratio (C/N).

J.5.2.1 Estimating CnC Ratio from LST / EIRP

The CnC Ratio is the difference in power of the interferer carrier to the desired carrier. For this reason a positive value represents a stronger interfering carrier, and a negative value represents a stronger desired carrier. The reason why the CnC ratio is an "estimate" when looking at BE EIRP is because BE EIRP assumes that the actual BW used and the PEB are balanced, and therefore the BE EIRP is an accurate proxy for the actual power of the carrier.

For this example, assume *Site A* is running a link to *Site B* (referred to as Link 1), and *Site B* is running a link to *Site A* (referred to as Link 2).

- **`CnC Ratio = Interferer BE EIRP – Desired BE EIRP`**
- **`CnC Ratio at Site A = BE EIRP Link 1 – BE EIRP Link 2`**
- **`CnC Ratio at Site B = BE EIRP Link 2 – BE EIRP Link 1`**

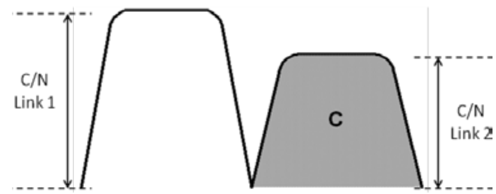
Per Carrier UL & DL eirp (Clr-Sky	Link 1	Link 2	
Transmit ES elevation angle	48.8	48.6	deg.
Uplink EIRP per carrier	57.7	58.6	dBW
Pathloss at uplink frequency	206.9	206.9	dB
Gain of 1 m2 antenna	44.3	44.3	dBi
Per carrier FD @SC	-104.8	-104.0	dBW/m2
SC pattern advantage @ES	5.0	3.3	dB
Per carrier BE FD arriving @ SC	-99.8	-100.6	dBW/m2
Transponder BE SFD	-83.6	-83.6	dBW/m2
Per carrier input back-off	-16.2	-17.0	dB
Per carrier output back-off	-14.1	-14.9	dB
Transponder BE saturation EIRP	46.7	46.7	dBW
Downlink BE EIRP	32.6	31.8	dBW
LINK BUDGET			

Notes:

- From the standpoint of *Site A*:
  `CnC Ratio = 32.6 – 31.8 = +0.8`
- From the standpoint of *Site B*:
  `CnC Ratio = 31.8 – 32.6 = -0.8`

J.5.2.2 Calculating CnC R atio from Ca rrier t o Noise Rati o (C/ N) on a Spectrum Analyzer

For this example, assume *Site A* is running a link to *Site B* (referred to as Link 1), and *Site B* is running a link to *Site A* (referred to as Link 2):



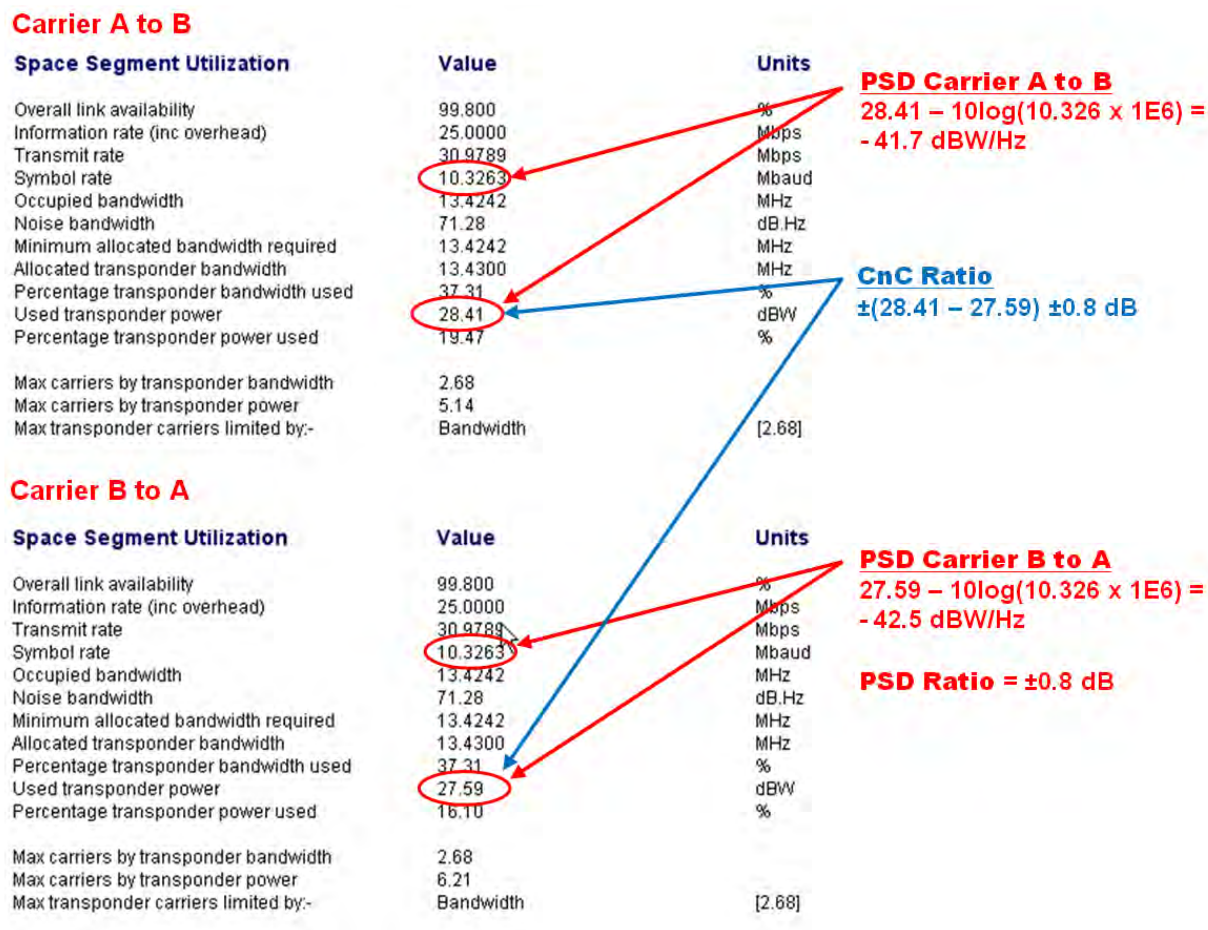
- **CnC Ratio = C/N Interferer – C/N Desired + 10log(SR Interferer / SR_Desired)**
- **CnC Ratio at Site A = C/N Link 1 – C/N Link 2 + 10log(SR Link 1 / SR Link 2)**
- **CnC Ratio at Site B = C/N Link 2 – C/N Link 1 + 10log(SR Link 2 / SR Link 1)**

CnC Ratio from C/N					
C/N (dB)		Symbol Rate (Msps)		CnC Ratio (by Carrier Direction)*	
Link 1	Link 2	SR Link 1	SR Link 2	CnC A (Site A → Site B)	CnC B (Site B → Site A)
9.5	7.5	5.0	6.5	+0.86 dB	-0.86 dB

Notes:

- From the standpoint of *Site A*:
  CnC Ratio = 9.5 – 7.5 + 10log(5.0 / 6.5) = +0.86
- From the standpoint of *Site B*:
  CnC Ratio = 7.5 – 9.5 + 10log(6.5 / 5.0) = -0.86

J.5.3 Calculating CnC Ratio and PSD Ratio from Satmaster



Carrier A to B

Space Segment Utilization	Value	Units
Overall link availability	99.800	%
Information rate (inc overhead)	25.0000	Mbps
Transmit rate	30.9789	Mbps
Symbol rate	10.3263	Mbaud
Occupied bandwidth	13.4242	MHz
Noise bandwidth	71.28	dB.Hz
Minimum allocated bandwidth required	13.4242	MHz
Allocated transponder bandwidth	13.4300	MHz
Percentage transponder bandwidth used	37.31	%
Used transponder power	28.41	dBW
Percentage transponder power used	19.47	%
Max carriers by transponder bandwidth	2.68	
Max carriers by transponder power	5.14	
Max transponder carriers limited by:-	Bandwidth	[2.68]

Carrier B to A

Space Segment Utilization	Value	Units
Overall link availability	99.800	%
Information rate (inc overhead)	25.0000	Mbps
Transmit rate	30.9789	Mbps
Symbol rate	10.3263	Mbaud
Occupied bandwidth	13.4242	MHz
Noise bandwidth	71.28	dB.Hz
Minimum allocated bandwidth required	13.4242	MHz
Allocated transponder bandwidth	13.4300	MHz
Percentage transponder bandwidth used	37.31	%
Used transponder power	27.59	dBW
Percentage transponder power used	16.10	%
Max carriers by transponder bandwidth	2.68	
Max carriers by transponder power	6.21	
Max transponder carriers limited by:-	Bandwidth	[2.68]

J.6 DoubleTalk Carrier-in-Carrier Specifications

See Chapter **1. INTRODUCTION** for the complete table of specifications.

J.7 Carrier-in-Carrier Summary

Comtech EF Data's DoubleTalk Carrier-in-Carrier can provide significant savings in operational expenses. Takes these considerations into account when evaluating CnC:

- CnC can only be used for full duplex links where the transmitting earth station is able to receive itself.
- CnC can be used in both bandwidth-limited and power-limited situations.
- The maximum savings is generally achieved when the original link is symmetric in data rate.

J.8 Glossary

Bandwidth, Allocated or Occupied

Bandwidth or Allocated Bandwidth or Occupied Bandwidth is the frequency space required by a carrier on a transponder.

For example: A Duplex 10 Mbps Circuit with 8PSK Modulation, FEC Rate 3/4 and 1.4 Spacing requires:
Allocated BW = (Data Rate) / (Spectral Efficiency) x (Carrier Spacing Factor)
Allocated BW = 6.43 MHz = (10 / 2.177/) * 1.4
For a 36 MHz transponder, 2.548 MHz corresponds to 17.9% Bandwidth Utilization.

Bandwidth, Leased (LBW)

Almost all satellite operators charge for the Leased Bandwidth (LBW). Leased Bandwidth or Leased Resource is the greater of the Allocated Bandwidth and Power Equivalent Bandwidth.

For example: If a carrier requires 3 MHz of Allocated BW and 4.5 MHz of PEB, the Leased Bandwidth is 4.5 MHz

Bandwidth, Power Equivalent (PEB)

Power Equivalent Bandwidth (PEB) is the transponder power used by a carrier, represented as bandwidth equivalent.

PEB Calculation Example:

- Transponder EIRP = 37 dBW
- Output Backoff (OBO) = 4 dB
- Available EIRP = 37 – 4 = 33 dBW = $10^{3.3}$ = 1955.26 Watts
- Transponder Bandwidth = 36 MHz
- Power Available / MHz = 1955.26 / 36 = 54.424 W
- If a carrier uses 24 dBW, its PEB = $10^{2.4}$ / 54.424
  = 4.532 MHz

This corresponds to 12.59% of available transponder power.

CnC Ratio

Ratio of Interfering Carrier Power *to* Desired Carrier Power (unit in dB).
The interfering carrier is the Tx Carrier from Local Modulator and the Desired Carrier is the carrier from the distant end received by the local demodulator.

At the station transmitting C1:
CnC Ratio (in dB) = PowerC1 (in dBm) – PowerC2 (in dBm)

Eb/No

Ratio of Energy per bit (Eb) *to* Noise density (No) (unit in dB):

Eb/No = C/No – 10log(DR) (where DR is the Data Rate)

Eb/No = Es/No – 10log(SE) (where SE is Spectral Efficiency)

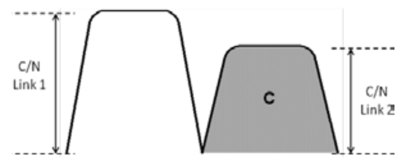
Es/No

Ratio of Energy per symbol (Es) *to* Noise density (No) (unit in dB):
Es/No = C/No – 10log(SR) (where SR is the Symbol Rate)
Es/No = Eb/No + 10_{log}(SE) (where SE is Spectral Efficiency)

C/N

Ratio of Carrier Power (C) *to* Noise (N) (unit in dB):

Equivalent to Es/No when calculated in the Symbol Rate bandwidth.



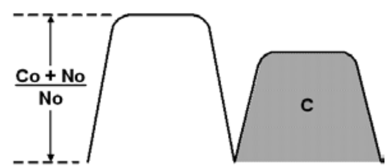
C/No

Ratio of Carrier Power (C) *to* Noise Density (N_o) (unit in dBHz)

Co+No/No

Ratio of Carrier Density (C_o) + Noise (N_o) *to* Noise Density (N_o) (unit in dB):

C/N = C/N_o – 10_{log}(B) [*where B is bandwidth in Hz*]
E_b/N_o = C/N_o – 10_{log}(DR) [*where DR is data rate in bits/sec*]
= C/N + 10_{log}(B) – 10_{log}(DR)
= C/N – 10_{log}(SE) (where SE is Spectral Efficiency)
E_b/N_o = 10_{log}($10^{((Co+No/No)/10)}$ – 1) – 10_{log}(SE) (where SE is Spectral Efficiency)
[***Note:*** *Spectral Efficiency is in bps / Hz*]



Power Spectral Density (PSD)

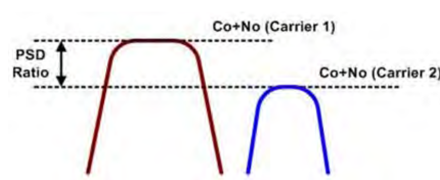
Power Spectral Density (PSD) is the signal power per unit bandwidth: dBW / Hz *or* dBm / Hz

For example: Signal power = 20 dBm
Signal bandwidth = 5 MHz
PSD = 20 – 10 *log (5,000,000)
= -46.99 dBm / Hz

PSD Ratio

Ratio of Power Spectral Density (PSD) of the interfering carrier to the desired carrier.

If looking at the two carriers side-by-side on a spectrum analyzer:



Quasi Error Free (QEF)

Quasi Error Free (QEF) corresponds to PER ~10^{-7}
PER (packet error rate) is based upon a 188 byte MPEG frame size.

Spectral Efficiency (SE)

Ratio of the Data Rate to the Symbol Rate.

Symbol Rate & Data Rate

Symbol Rate and Data Rate are related:

```
DR = SR * SE (Data Rate = Symbol Rate * Spectral Efficiency)
SR = DR / SE (Symbol Rate = Data Rate / Spectral Efficiency)
```

Notes:

Appendix K. QUALITY OF SERVICE (QoS)

K.1 Overview

Quality of Service (QoS) is available when the CDM-760 Advanced High-Speed Trunking Modem is equipped with the optional High-Speed Packet Processor. Use of WAN QoS is typically required either to filter traffic or perform traffic shaping. WAN QoS should be considered if your traffic or satellite link meets either criteria and the traffic is packet-based.

K.2 QoS Characteristics

K.2.1 Traffic Filtering

Traffic Filtering prevents certain types of traffic from traversing the network. The need for Traffic Filtering exists to:

- Block a certain type of service (VOIP, Video, Non-IP, Port Number, etc.).
- Block a subnet or range of subnets.
- Block VLANs or a VLAN range.
- Block certain traffic with MPLS-EXP (Multi-Protocol Label Switching Experimental) bits.

K.2.2 Traffic Shaping

Traffic Shaping ensures that high-priority/high-value traffic is more protected than low-priority/low-value traffic. The need for Traffic Shaping exists when:

- The traffic on the LAN to be sent over satellite exceeds the WAN capacity.
- A non-static WAN capacity such as Adaptive Coding and Modulation (ACM) is used, where user throughput varies.
- A non-static WAN capacity such as dynamic Single Carrier Per Channel (dSCPC) is used, where circuits are being set-up, torn down and re-sized.

It is important to note that traffic shaping takes effect on the traffic moving from the LAN to the WAN. Traffic shaping does not impact WAN-to-LAN traffic.

K.3 Traffic Shaping Functionality (QoS)

The high-speed Packet Processor functions in a Layer 2 or Layer 3 mode of operation. Traffic Shaping or QoS can be thought of as three separate processes:

- **Classification**
- **Prioritization**
- **Drain**

Classification, Prioritization and Drain for DiffServ is specific to DiffServ QoS selection. See Sect. K.3.3.3.

K.3.1 Classification

Classification of traffic is the basic mechanism by which a packet or frame can be sorted and associated with a particular priority. Each classification can be considered a classification rule or "QoS rule". The more flexible a classification engine is, the more likely the high value services can be protected.

The CDM-760 offers a very flexible classification engine. If a packet satisfies more than one classification, Table K-1 lists the classification types that determine which rule is chosen. The table shows a precedence from 1 to 8, where any packet satisfying more than one rule is classified by the order of precedence from first to last.

For example: A packet or frame satisfies both an MPLS tag rule and a Source IP/Mask rule. The MPLS rule takes precedence and is acted on accordingly.

Classification for DiffServ does not follow this precedence. See Sect. K.3.3.3.

Table K-1. Rule Preference and Classification

Order Precedence	Classifier
1 (First)	Protocol (in this order) • RTP_VOICE • RTP_VIDEO • RTP_SIG • RTP • FTP • HTTP • TELNET • SMTP • SNMP • UDP • TCP • ICMP • All-IP • Non-IP • All
2	MPLS
3	VLAN
4	TOS
5	Source IP/Mask

Order Precedence	Classifier
6	Destination IP/Mask
7	Source Ports
8 (Last)	Destination Ports

K.3.2 Prioritization

Prioritization of traffic is a method of assigning various value levels to a particular classification rule. Prioritization ensures that the packets/frames are "ordered" such that the highest level of protection is provided to the most valuable traffic.

The CDM-760 offers eight priority levels (**Table K-2**), with Level 1 being the highest priority and Level 8 the lowest priority.

Table K-2. Rule Priorities

Priority Level	Rank
1	Highest Priority
2	Second Highest Priority
3	Third Highest Priority
4 – 7	Fourth through Seventh Priorities
8	Lowest Priority

K.3.3 Drain

Once you classify and prioritize the packets or frames, you need to determine how to drain the traffic. Does your network require you to pass all high level traffic in a strict priority manner such that lower priority traffic could be "starved" in times of overdriving the WAN bandwidth? Or, can determinations be made about the maximum and minimum levels of service you can accept on a per classification rule basis?

The CDM-760 Packet Processor provides a number of choices. You may select from three top-level QoS drain algorithms:

- **Max/Priority**
- **Min/Max**
- **DiffServ**

K.3.3.1 Max/Priority Mode

Max/Priority QoS mode is commonly used in ACM circuits in conjunction with Weighting (see **Sect. K.4**).
In Max/Priority mode, every classification rule is assigned a "not to exceed" Maximum Data Rate and a Priority Level. You may assign up to 32 classification rules using any combination of the classifiers listed in **Table K-2**.

If you do not need to limit the total traffic that can be assigned to a particular rule, then you may set the Maximum Data Rate to a number that is excessively large, e.g. 999999 kbps.
In Max/Priority mode, the highest priority level traffic (i.e., Priority Level 1) will be drained until empty or until the Maximum Data Rate is met for all Priority Level 1 classification rules before attempting to drain any lower-priority level (i.e., Priority Level 2) classification rules. If, at any

point, a packet arrives into the modem that has a higher priority than what the modem is currently draining, the modem will stop draining the lower-priority traffic and will immediately drain the higher-priority traffic until all higher-priority traffic is drained, or until the Maximum Data Rate of the QoS classification is met. If two or more rules are assigned to the same priority and Weighting is not being used, the drain of the classification rules will be in round-robin fashion (i.e., 1, 2, 3, 1, 2, 3, 1, 2, 3) regardless if each has a different Maximum Data Rate.

This type of drain mechanism ensures that the highest-priority traffic is always attended to. This type of drain algorithm can “starve” lower-priority traffic, completely blocking that lower-priority traffic.

You may enable **WRED** (Weighted Random Early Detection) on a per-classification rule basis. With WRED enabled, a QoS classification will randomly drop packets after reaching 50% of the QoS classification buffer depth (2500 packets of the same classification).

When you enable the **Filter** option for a rule, all packets that meet this classification rule will be discarded.

K.3.3.2 Min/Max Mode

Min/Max QoS mode is commonly used in ACM circuits in conjunction with Weighting (see **Sect. K.4**).

In Min/Max mode, every classification rule is assigned a Minimum Date Rate and a “not to exceed” Maximum Data Rate. You may assign up to 32 classification rules using any combination of the classifiers listed in **Table K-2**.

If you do not require minimum bandwidth for every classification, then you may set this value to 0 kbps.

If you do not need to limit the total traffic that can be assigned to a particular rule, then you may set the maximum data rate to a number that is excessively large, e.g., 999999 kbps.
In Min/Max mode, traffic for each rule will drain in a round-robin fashion until every Minimum Data Rate is met. Once all the minimums are met, only then can the Packet Processor begin to drain any additional data associated with that rule, until either the Maximum Data Rate is met or the rule has no more data to drain.

Once the Packet Processor finishes servicing every rule’s Minimum Data Rate and Weighting is not being used, the drain of the classification rules Maximum Data Rate begins in round-robin fashion (i.e., 1, 2, 3, 1, 2, 3, 1, 2, 3) regardless if each has a different Minimum or Maximum Data Rate.

This type of drain mechanism ensures that every classification rule can get some fraction of the overall capacity of the link and will not starve certain classifications rule.
You may enable **WRED** (Weighted Random Early Detection) on a per-classification rule basis. With WRED enabled, a QoS classification will randomly drop packets after reaching 50% of the QoS classification buffer depth (2500 packets of the same classification).

When you enable the **Filter** option for a rule, all packets that meet this classification rule will be discarded.

K.3.3.3 DiffServ Mode

DiffServ (Differentiated Services) QoS mode is fully compliant with RFC standards. In this mode, the system automatically configures the rules with dSCPC code points, priority values, and WRED. You can only configure the service rate and drop precedence levels for Assured Forwarding (ASFD) classes.

K.4 Weighting

K.4.1 Overview

This section describes weighted QoS scheduling in addition to the round-robin scheduling for queues. You may enter the weights while configuring queues, similar to configuring other QoS parameters such as Min BW (minimum bandwidth), Max BW (maximum bandwidth), Priority, etc.

K.4.2 Weights

Weight is a user-configurable parameter. Enter a weight in the range from 1 to 100. You cannot assign a null value (0) – this is invalid. The default value is 100. The scheduler drains more data from a weight=8 queue than a weight=7 queue under the same priority, and so on.

Weights are applicable in Min/Max and Max/Priority mode. However, when Max/Priority Mode is selected as the QoS mechanism, weights are considered only if multiple queues are configured in same priority group, and at least one of the weight entries is different from the others. When queue weights are the same within the same priority group, that group is handled by round-robin scheduling.

K.4.2.1 Order of Scheduling

For Max/Priority Mode – Weights are applied to all queues that have not reached the assigned Max BW limit.
Once the Max BW has been reached, the scheduler will not drain any more data irrespective of the weights.

For Min/Max Mode – The Min BW is served first. Once the minimum BW is met, then the weights are applied until the Max BW is met. Once the max BW is reached, the scheduler will not drain any more data irrespective of the weights

K.4.2.2 Weighted Scheduling

In weighted scheduling mode, the QoS scheduler calculates each quantum based on available bandwidth, total weights, and per-queue weights as follows:

$$\boldsymbol{Per - queue\ quantum = Available\ Bandwidth * \frac{Per\ queue\ weight}{Total\ weights}}$$

There are three exceptions when assigning per-queue quantum to each queue:

1. **Per-queue quantum is greater than the maximum configured data rate (Max BW).**

   When the LAN egress data rate is greater than the assigned Max BW, the scheduler drains the packets up to the maximum bandwidth only, and drops all other packets. In this scenario, weight factor will not be applied.

2. **Per-queue quantum is less than the maximum configured data rate but more than the minimum configured data rate.**

   In this scenario, when the available bandwidth is greater than the total Min BW but less than total Max BW, the scheduler will first schedule all queues until the minimum bandwidth is met.

3. **Per-queue quantum is less than minimum bandwidth configured.**

K.4.2.3 Operational Examples

K.4.2.3.1 Example 1

- Select **Max/Priority** as the QoS Mode.
- Configure each queue with maximum bandwidth (Max BW), priority, and weight as shown in **Table K-3**.
- The total available bandwidth is 30000 kbps.

Calculate each individual allocated kbps.

Table K-3. Example 1 – QoS Classification

Queue	Priority	Max BW (kbps)	Weight	Allowed BW
Q1	1	999999	100	– –
Q2	2	999999	100	– –
Q3	4	16000	2	– –
Q4	4	8000	4	– –
			Total ►	30000

Table K-4. Example 1 – Ingress Traffic

Queue	Ingress DR (kbps)	Max BW (kbps)	Weight	Allowed BW
Q1	4000	999999	100	– –
Q2	2000	999999	100	– –
Q3	14000	50000	2	– –
Q4	14000	50000	4	– –
			Total ►	30000

Table K-5. Example 1 Solution – Calculated BW Allocation

Queue	1st Round			2nd round			Nth round			Final kbps
	Weight	Given	Leftover	Weight	Given	Leftover	Weight	Given	Leftover	
Q1	100	30000	26000	– –	– –	– –	– –	– –	– –	4000
Q2	– –	– –	– –	100	26000	24000	– –	– –	– –	2000
Q3	– –	– –	– –	– –	– –	– –	2	8000	– –	8000
Q4	– –	– –	– –	– –	– –	– –	4	16000	– –	16000
Total ►	– –	30000	26000	15	– –	268	6	0	0	30000

Table K-5 displays the solution for Example 1.

Step 1 – The total available bandwidth for the Priority 1 queue is 30000 kbps, but the Ingress DR is only 4000 kbps. Hence the Priory 1 queue takes only 4000 kbps and the remaining bandwidth is left for lower-priority queues.

Step 2 – The leftover 26000 kbps is available for the Priority 2 queue. Remember that the Priority 2 queue only requires 2000 kbps. The Priority 2 queues therefore take only 2000 kbps, and the remaining bandwidth is left for lower-priority queues.

Step 3 – The leftover 24000 kbps is available for Priority 4 queues (this example specifies no Priority 3 queues). The Ingress DR in the Priority 4 queues is 28000 kbps. Because the available bandwidth is only 24000 kbps, the bandwidth is therefore shared as per the configured weights.

The total weights are (2+4) = 6.

Step 4 – Calculate each bandwidth share, based on the total weights (6) and bandwidth availability (24 000 kbps):

- Q3 = 24000 * (2/6) = 8000 kbps
- Q4 = 24000 * (4/6) = 16000 kbps

K.4.2.3.2 Example 2

- Select **Min/Max as** the QoS Mode.

- Configure each queue with minimum bandwidth (Min BW), maximum bandwidth (Max BW), and weight as shown in **Table K-6**.

- The total available bandwidth is 30000 kbps.

Calculate each individual allocated kbps.

Table K-6. Example 2 – QoS Classification

Queue	Min BW (kbps)	Max BW (kbps)	Delta Max BW (Max-Min) (kbps)	Weight	Allowed BW
Q1	2000	4000	2000	9	– –
Q2	4000	8000	4000	8	– –
Q3	6000	16000	8000	7	– –
Q4	8000	8000	0	6	– –
Total ►	20000	40000	14000	30	30000

Table K-7. Example 2 Solution – Calculated BW Allocation

Queue	1st Round			2nd round			Nth round			Final kbps
	Weight	Given	Leftover	Weight	Given	Leftover	Weight	Given	Leftover	
Q1	9	3750	1750	– –	– –	– –	– –	– –	– –	2000
Q2	8	3334	– –	8	934	268	– –	– –	– –	4000
Q3	7	2916	– –	7	816	– –	7	268	– –	4000
Q4	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Total ►	24	10000	1750	15		268	7	0	0	10000

Table K-7 displays the solution for Example 2.

Step 1 – The sum of all queues' minimum bandwidth (20000 kbps + total available bandwidth) = 30000 kbps. Once the sum of all minimums are met, there is a remainder of 10000 kbps overage available for use.

The overage bandwidth is distributed to all non-served maximum bandwidth queues. In this example, only Q1, Q2, and Q3 still have unmet maximum bandwidth.

Since Q4's minimum and maximum bandwidths are the same, Q4 is therefore excluded from the remaining overage distribution.

The remaining total weights are (9+8+7) = 24.

Step 2 – Calculate each bandwidth share, based on total weights (24) and bandwidth availability (10000 kbps) after the minimum is served (20000 kbps):

- Q1 = 10000 * (9/24) = 3750 kbps
- Q2 = 10000 * (8/24) = 3334 kbps
- Q3 = 10000 * (7/24) = 2916 kbps

Step 3 – After the initial round of quantum distribution, Q1 required only 2000 kbps, so the remaining 1750 kbps is therefore returned to the allocation pool for distribution to the remaining queues.

Step 4 – Calculate each bandwidth share, based on total remained weights (15) and remain bandwidth (1750 kbps):

- Q3 = 1750 * (8/15) = 934 kbps
- Q1 = 17500 * (7/15) = 816 kbps

Step 5 – After the second round, Q2 can be assigned a maximum of 4000 kbps, and the remaining kbps is again returned to the allocation pool.

Step 6 – In the third round, only one queue remains and its maximum is not yet met. That queue therefore takes the remaining quantum. Since there is no more leftover bandwidth, the calculation loop stops here.

Step 7 – Each queue's share after all rounds:

- Q1 = 2000 kbps
- Q2 = 4000 kbps
- Q3 = 4692 kbps
- Q4 = 0 kbps

Note that the per-queue quantum is less than the configured minimum bandwidth.

K.4.2.3.3 Example 3

- Select **Min/Max** as the QoS Mode.
- Configure each queue with minimum bandwidth and cost as shown in **Table K-8**.
- The total available bandwidth is 5000 kbps.

Calculate each individual allocated kbps.

Table K-8. Example 3 – QoS Classification

Queue	Min BW (kbps)	Weight	Allowed BW
Q1	2000	9	– –
Q2	4000	8	– –
Q3	6000	7	– –
Q4	8000	6	– –
Total ►	20000	30	5000

Table K-9. Example 3 Solution – Calculated BW Allocation

Queue	1st Round			2nd round			Nth round			Final kbps
	Weight	Given	Leftover	Weight	Given	Leftover	Weight	Given	Leftover	
Q1	9	1500	– –	– –	– –	– –	– –	– –	– –	1500
Q2	8	1334	– –	– –	– –	– –	– –	– –	– –	1334
Q3	7	1166	– –			– –	– –	– –	– –	1166
Q4	6	1000	– –			– –	– –	– –	– –	1000
Total ►	30	5000	0			0	0	0	0	5000

Table K-9 displays the solution for Example 3.

Step 1 – Calculate each bandwidth share, based on total weights (30) and available bandwidth (5000 kbps):

- Q1 = 5000 * (9/30) = 1500 kbps
- Q2 = 5000 * (8/30) = 1334 kbps
- Q3 = 5000 * (7/30) = 1166 kbps
- Q4 = 5000 * (6/30) = 1000 kbps

Step 2 – After the first round, there is no more leftover bandwidth and the calculation loop stops here.

Step 3 – Each queue's share after all rounds:

- Q1 = 1500 kbps
- Q2 = 1334 kbps
- Q3 = 1166 kbps
- Q4 = 1000 kbps

K.4.2.3.4 Example 4

- Select **Min/Max** as the QoS Mode.
- Configure each queue with minimum bandwidth and cost as shown in **Table K-10**.
- The total available bandwidth is 8000 kbps.

Calculate each individual allocated kbps.

Table K-10. Example 4 – QoS Classification

Queue	Min BW (kbps)	Weight	Allowed BW
Q1	1000	9	– –
Q2	2000	8	– –
Q3	3000	7	– –
Q4	4000	6	– –
Total ►	10000	30	8000

Table K-11. Example 4 Solution – Calculated BW Allocation

Queue	1st Round			2nd round			Nth round			Final kbps
	Weight	Given	Leftover	Weight	Given	Leftover	Weight	Given	Leftover	
Q1	9	2400	1400	-	-	-	-	-	-	1000
Q2	8	2134	134	-	-	-	-	-	-	2000
Q3	7	1866	-	7	826	-	-	-	-	2692
Q4	6	1600	-	6	708	-	-	-	-	2308
Total ►	30	8000	1534	13	1534	0	0	0	0	8000

Table K-11 displays the solution for Example 4.

Step 1 – Calculate each bandwidth share, based on the total weights (30) and available bandwidth (8000 kbps):

- Q1 = 8000 * (9/30) = 2400 kbps
- Q2 = 8000 * (8/30) = 2133 kbps
- Q3 = 8000 * (7/30) = 1866 kbps
- Q4 = 8000 * (6/30) = 1600 kbps

Step 2 – After the first round, only Q3, and Q4 still have unmet max bandwidth queues. Calculate each bandwidth share, based on the total remaining weights (13) and available bandwidth (1534 kbps):

- Q3 = 1534 * (7/13) = 826 kbps
- Q1 = 8000 * (6/30) = 708 kbps

Step 3 – After the second round, there is no more leftover bandwidth so the calculation loop stops here.

Step 4 – Each queue's share after all rounds:

- Q1 = 1000 kbps
- Q2 = 2000 kbps
- Q3 = 2692 kbps
- Q4 = 2308 kbps

Notes:

Appendix L. DYNAMIC PREDISTORTION (DPD) OPTION

WARNING! BEFORE YOU ATTEMPT TO COMMISSION A SATELLITE LINK USING DYNAMIC PREDISTORTION (DPD), YOU MUST ENSURE THAT THE LINK IS ROBUST ENOUGH FOR NORMAL OPERATION. ONLY WHEN YOU HAVE DONE THIS – AND YOU <u>RESOLVE</u> ALL SYSTEM ISSUES (E.G., ANTENNA-POINTING, CABLING, TERRESTRIAL INTERFERENCE, SATELLITE INTERFERENCE, ETC.) – SHOULD YOU ATTEMPT THE USE OF DYNAMIC PREDISTORTION.

L.1 Overview

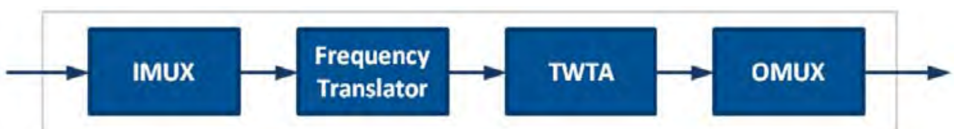


Figure L-1. Satellite Transponder

Space segment costs are typically the most significant operating expense for any satellite-based service, having a direct impact on the viability and profitability of the service. When a single-carrier utilizes an entire satellite transponder, e.g. 36-MHz or 72-MHz bandwidth, there is an opportunity to capture additional link efficiency not available in a multi-carrier setting. This is done by operating the transponder, specifically the traveling-wave-tube amplifier (TWTA) diagrammed in Figure L-1, in the nonlinear saturation region.

The disadvantage to operating in this regime is that amplifiers suffer from nonlinear distortion – commonly characterized by *amplitude-to-amplitude* modulation (AM-AM) conversion as well as *amplitude-to-phase* modulation (AM-PM). Amplifiers additionally incorporate short-term memory arising from physical device phenomena that adds a filtering-like effect to the transponder. Further, input and output multiplexing filters (IMUX and OMUX) add linear distortion as signal bandwidths approach the limit of the transponder.

The in-band distortion produces degradation in bit error rates relative to that of an ideal transponder. The traditional approach to mitigating these effects is to reduce the transponder output power, i.e. increase output backoff. However, a reduction in the transponder output power typically forces a lower modulation and coding order in the modem, decreasing the space segment efficiency and further increases costs.

Comtech EF Data provides an option for the CDM-760 to continuously optimize satellite communication efficiency – *Dynamic Predistortion (DPD)*.

L.1.1 What is Dynamic Predistortion (DPD)?

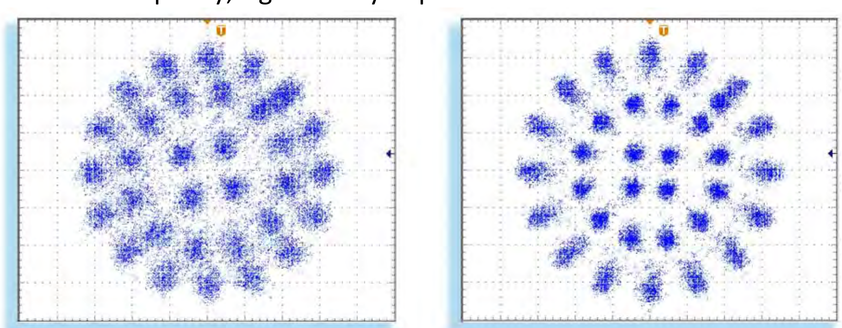
Dynamic Predistortion works in tandem with a *Crest Factor Reduction (CFR)* technique that is dynamically applied to enhance performance. These technologies, collectively labeled and referred to as DPD, create high signal integrity while operating the satellite transponder in the higher efficiency nonlinear region. They work to provide a significant increase in link margin by as much as 2 dB, and/or an increase in spectral efficiency by as much as 6%. These improvements can translate to:

- Reduced operating expense (OPEX) – e.g., Occupied Bandwidth & Transponder Power;
- Reduced capital expenditure (CAPEX) – e.g., Block Up Converter/High-Power Amplifier (BUC/HPA) size and/or antenna size;
- Increased throughput without using additional transponder resources;
- Increased link availability (margin) without using additional transponder resources;
- A combination of any of the above to meet different objectives.

See **Figure L-2**. Predistortion works as an alternative to simply backing off a power amplifier by employing an approximate inverse nonlinearity ahead of the power amplifier, at a low power level to a digital baseband signal, such that the cascade operation is closer to ideal. Additionally, when DPD is enabled, CFR precedes the predistorter to reduce the signal's magnitude range. Working together, both preempt the degrading effects of the satellite transponder when attempting to operate a link with highest spectrally efficiency.

Figure L-2. DPD Operation

Figure L-3 illustrates the benefit of DPD when applied to a 32-APSK constellation. All distortion pictured is induced by driving the TWTA into its nonlinear region, i.e. additive noise is not included in the plots. While maintaining the same output backoff a significant proportion of the distortion is removed when DPD is applied. Here, the modulation error ratio (MER), a common measure of constellation quality, significantly improves from 18.5 dB to 22.5 dB.



(LEFT) Without DPD, MER=18.5 dB
(RIGHT) With DPD, MER=22.5 dB

Figure L-3. Constellation – 32-APSK Improvement Example

L.1.2 Predistortion

Predistortion preemptively compensates the uplink waveform by expanding the signal peaks that will be compressed by the satellite amplifier. Because a nonlinear satellite channel is not a fully invertible system, residual distortion will still be present even when the predistorter is applied. Note also that, while the linear filtering effects of the link are compensated by DPD, the effects cannot be fully removed due to inherent limits in computational capacity.

Since the best predistorter for a particular satellite transponder is unknown, one must be identified through a training process. See **Figure L-4.** The CDM-760 can train the predistorter according to either of these approaches:

- **Locally**, using a single modem and ground station, or
- **Remotely**, using two modems and ground stations.

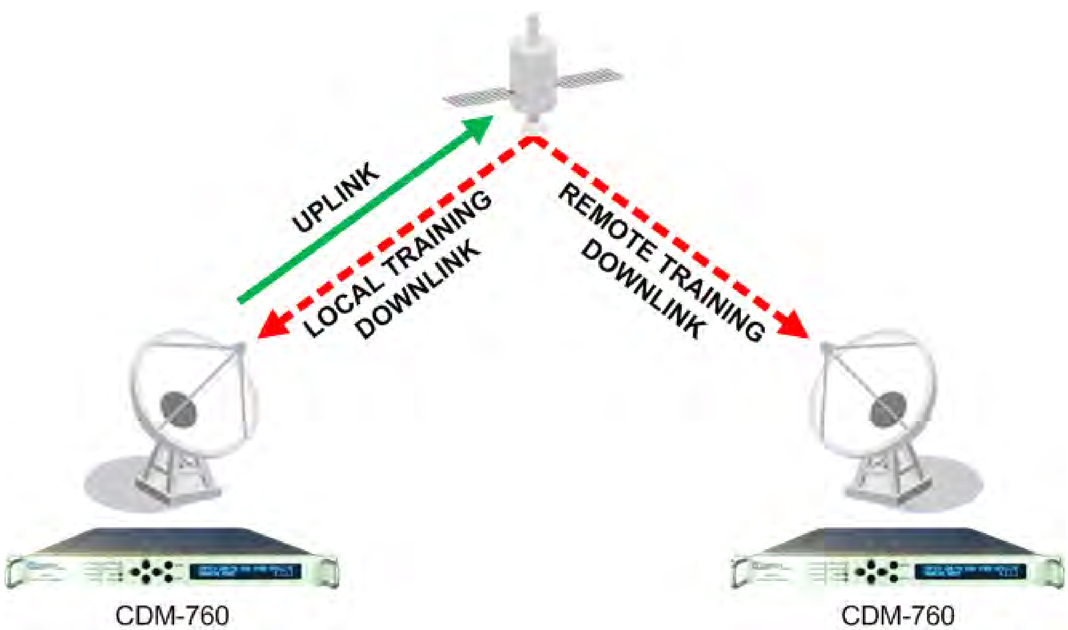


Figure L-4. Satellite Training Link

The **Local** training approach requires the CDM-760 to “listen” to its own outbound undergoing distortion imparted primarily by the non-linearity, along with the input/output multiplexing filters, on the satellite.

The **Remote** training approach does not require the full signal loopback. Instead, additional processing is required at the remote end. Using the same messaging approach as Adaptive Modulation and Coding (ACM) control, a return link is required to the original transmit modem to pass trained coefficients.

Under both approaches, the predistorter is trained according to the ‘indirect learning’ architecture. **Figure L-5** and **Figure L-6** illustrate the training procedure for local and remote training, respectively.

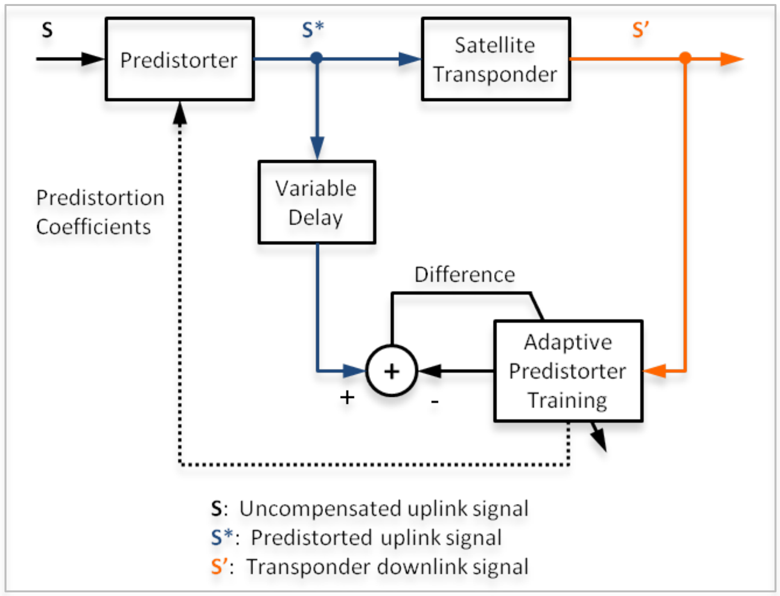


Figure L-5. Indirect Learning – Local Approach

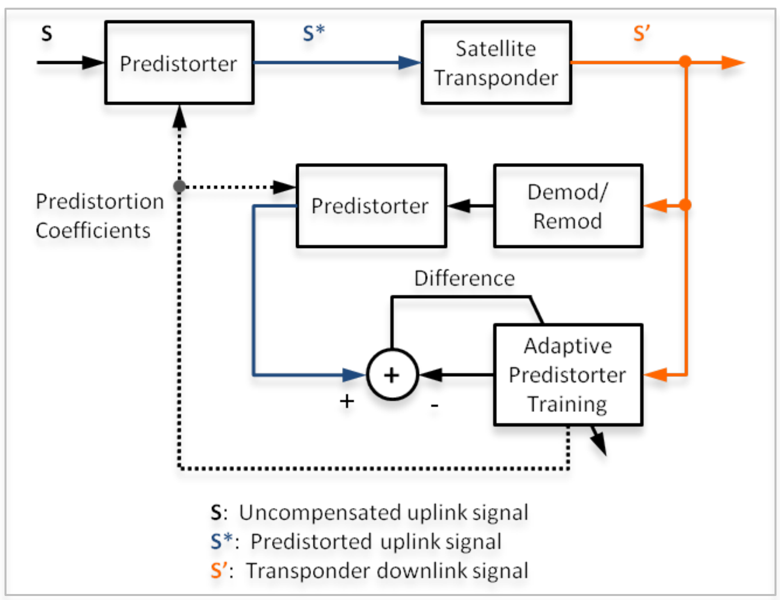


Figure L-6. Indirect Learning – Remote Approach

In both approaches, the training procedure is essentially the same. The training procedure starts by initializing the predistorter to be a pass-through system, i.e. signal **S*** equals signal **S**. Then, the downlink signal **S'** is time-aligned with the uplink signal such that the difference, created by the satellite channel, can be monitored. Next, based on minimizing the difference signal an adaptive inverse nonlinear system is trained by adapting complex-valued predistorter coefficients. The predistorter in training is positioned following the satellite channel, forming a so call 'post-inverse' system. Finally, the trained coefficients are relayed internally to the predistorter.

The predistorter alters the uplink signal particularly in terms of the signal's magnitude distribution. Due to this, the new 'best' inverse system identified on the next iteration will differ slightly. After several iterations (typically 5-10), the complex coefficients converge for the current conditions. The trained coefficients are relayed to the predistorter on a regular interval of every 0.5 seconds. In addition to providing initial convergence, the dynamic nature of the predistorter continues the optimization process in the midst of varying link conditions or user-applied transmit configuration changes. Furthermore, the constantly updating approach automatically optimizes for physical changes over the life cycle of the satellite transponder.

When adjusting for the best transponder output backoff power, as detailed later in this appendix, the predistorter adaptively determines the best predistorter for the particular backoff. Additionally, the best predistorter is identified and stored for the 15 most recent ModCods employed. This is particularly valuable with ACM, where switching between ModCods can occur frame by frame. Many of these tradeoffs are challenging or impossible to fully optimize with a stagnant predistorter.

L.1.3 Crest Factor Reduction (CFR)

The objective of CFR is to preemptively act upon the uplink waveform so that the downlink received signal has less distortion. Though the objective is similar, how CFR achieves this is conceptually quite different from predistortion.

CFR reduces the magnitude peaks of the uplink waveform by applying a scaled, opposing compensation pulse to the signal's largest magnitude peaks. Since this process includes the possibility of creating new magnitude peaks when cancelling others, the technique is re-applied in successive stages. Additionally, the compensation pulses are shaped so the frequency spectrum of the uplink signal is unchanged from that of the normal square-root raised-cosine shape.

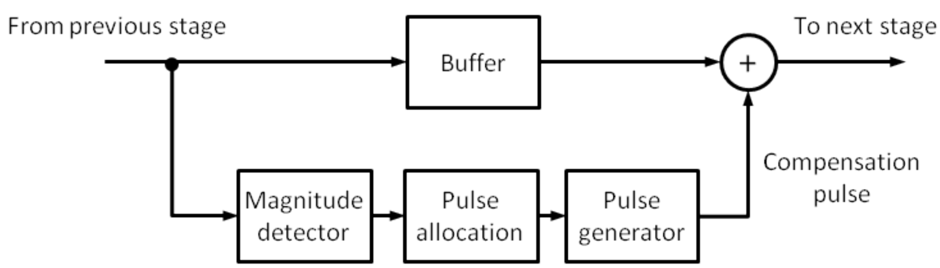


Figure L-7. Peak Cancellation Block Diagram

Similar to predistortion, this process intentionally introduces distortion to the uplink signal. Also comparable to predistortion, the level of CFR applied is determined dynamically depending on the amount of non-linear compression in the satellite link. But, different from predistortion, the added distortion from CFR is not intended to invert the effects of the transponder. Instead, the aim is essentially to avoid the most distorting effects of the transponder that would have been applied to the largest magnitude peaks. Though limited distortion is intentionally applied, on balance there is less overall less distortion on the downlink signal than if the technique were not applied. Compounding the benefit, with CFR the predistorter concentrates resources on reducing distortion over a narrower range of signal magnitudes, further improving performance.

L.2 DPD – Operational Requirements

Predistortion and CFR are typically applied in a digital system collocated with the nonlinear amplifier. However, in this application these techniques must be applied remotely from a ground-based modem to compensate for the nonlinearity of the orbiting satellite transponder. Due to the removed nature of this implementation some operational requirements must be met.

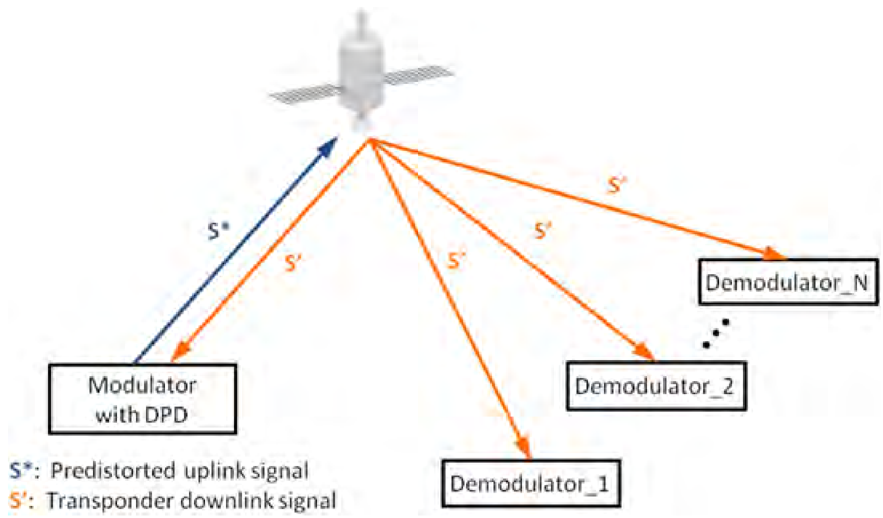


Figure L-8. Local DPD – Satellite Links

See **Figure L-8.** In the *local* implementation, the transmitting modem must receive its own outbound (**S'**) for the predistortion training described in **Sect. L.1.2**. As such, local DPD can only be employed under the following conditions:

- The link must include a "loop-back" circuit (i.e. the transmitting station must be able to receive its own outbound).
- Local DPD requires the use of the modem's Rx signal chain. Consequently, the CDM-760 will operate in Transmit Only mode when local DPD is enabled. ACM cannot be employed as a result.

For a remote implementation, see Figure L-9. There must be a full-duplex circuit so the trained coefficients can be returned to the predistorter. As such, remote DPD can only be employed under the following condition:

- There must be a full-duplex circuit to return trained coefficients. Note that sending the coefficients adds a very low overhead burden and are automatically passed much the same as ACM messaging.

For both local and remote DPD, if the satellite transponder were processing other carriers, or other processing was applied, the nonlinear transponder's operation on the carrier of interest would become unpredictable. Therefore, additional operational restrictions are applicable to both local and remote DPD:

- The link must be over a single-channel-per-transponder configuration. That is, multiple carriers, even in a CnC configuration, cannot be operated on the transponder to which DPD will be applied.

- The satellite must be a "non-processing" satellite (i.e. does not demodulate/remodulate the signal).

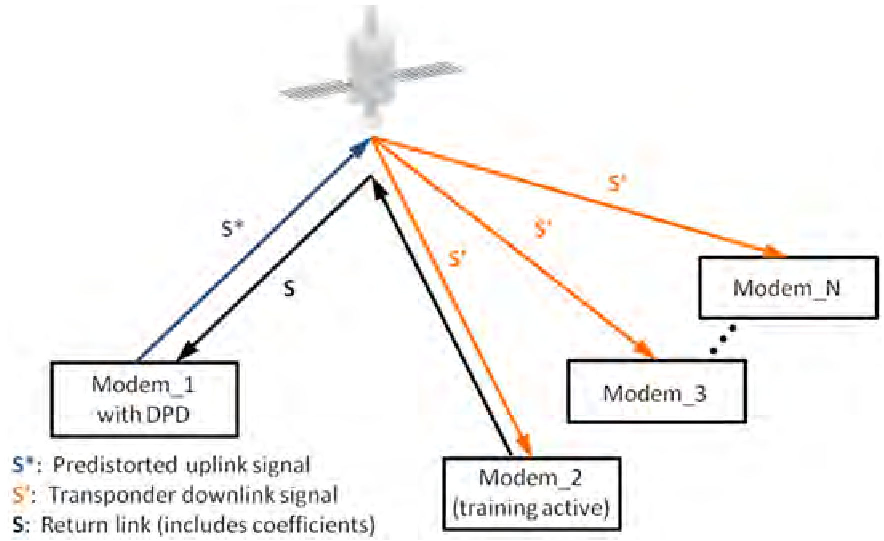


Figure L-9. Remote DPD – Satellite Links

L.3 DPD – Operational Recommendations

The DPD function has not been shown to provide significant benefit with smaller constellations of QPSK or 8-PSK since these are not affected as much by nonlinear distortion. The technique does not harm these links but doesn't provide significant benefit either. Nonetheless, DPD is strongly recommended for use with larger constellations.

In addition, to minimize "False" feedback acquisition, keep the search delay range as narrow as possible:

- Once the modem has reported the search delay, narrow the search delay range to the nominal reported value +/- 5 ms, e.g. if the modem reported delay is 245 ms, narrow the search range to say 240 –250ms.

Use an external data source (e.g. Fireberd) or internal BER tester when testing DPD performance.

L.4 DPD Link Design

DPD link design involves finding the FEC, modulation combination, and transmit power level that provides optimal bandwidth utilization. Just like conventional link design, it is an iterative process that involves trying different FEC, modulation, and transmit power combinations with DPD until an optimal combination is found. This process is described in the next section.

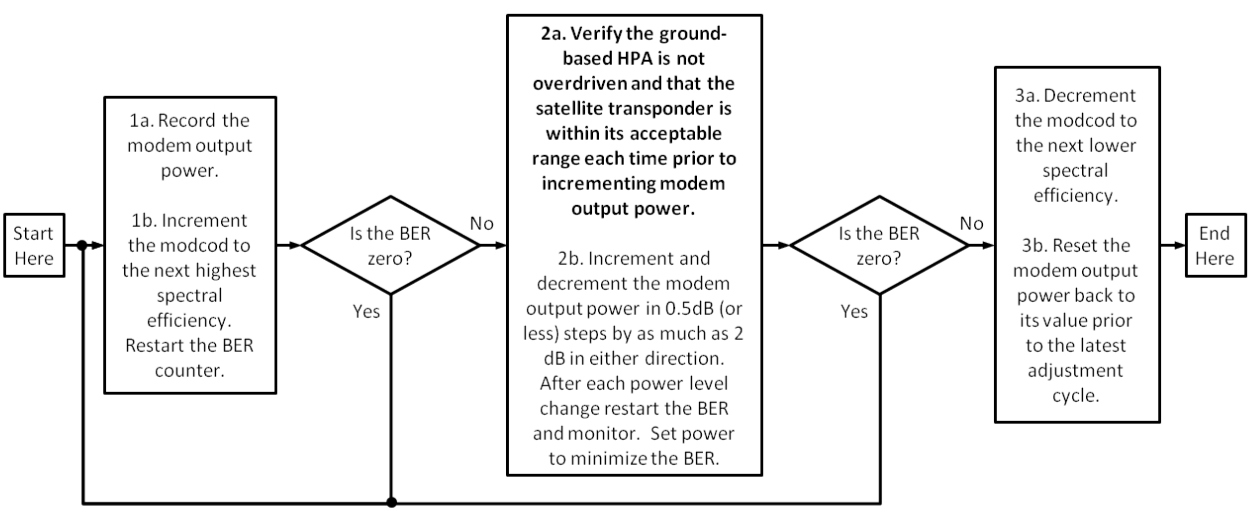
L.4.1 Commissioning and Deployment

L.4.1.1 Local DPD Commissioning and Deployment

Comtech EF Data recommends the following procedure for ***local*** DPD commissioning. Though a loop-back is created in this procedure, this does not create a loop in the user network since the received data is intentionally prevented from leaving the modem when in local DPD mode.

Do these steps:

1. Setup the transmit configuration.
   a. Use a Modulation and Coding (ModCod) scheme with slightly lower spectral efficiency than expected to close the link.
   b. Leave the DPD function OFF.
2. Turn ON the carrier. Leave the DPD function OFF.
   a. Setup the receiver configuration to receive the looped-back signal.
   b. Verify that the demodulator is locked.
   c. Verify that the received signal level is within specifications.
   d. Measure/record the Es/No.
3. Turn the DPD function to LOCAL.
   a. After the demodulator has relocked, wait 30 seconds to allow the predistorter to fully converge to the current transponder conditions.
   b. Measure/record the DPD compensation.
   c. Measure/record the Es/No and compare to previous result without DPD. If the DPD compensation level is low <1.0 dB, then the Es/No improvement may be small since the transponder is not driven deep into compression yet.
   d. Enable the BER test mode.
4. Follow this flow chart to maximize spectral efficiency and optimize the uplink power:



5. Basic performance validation:
   a. Measure/record the DPD compensation.
   b. Measure/record the Es/No.

c. Turn DPD function OFF and compare the measured Es/No and BER, assuming the demodulator is able to achieve lock.

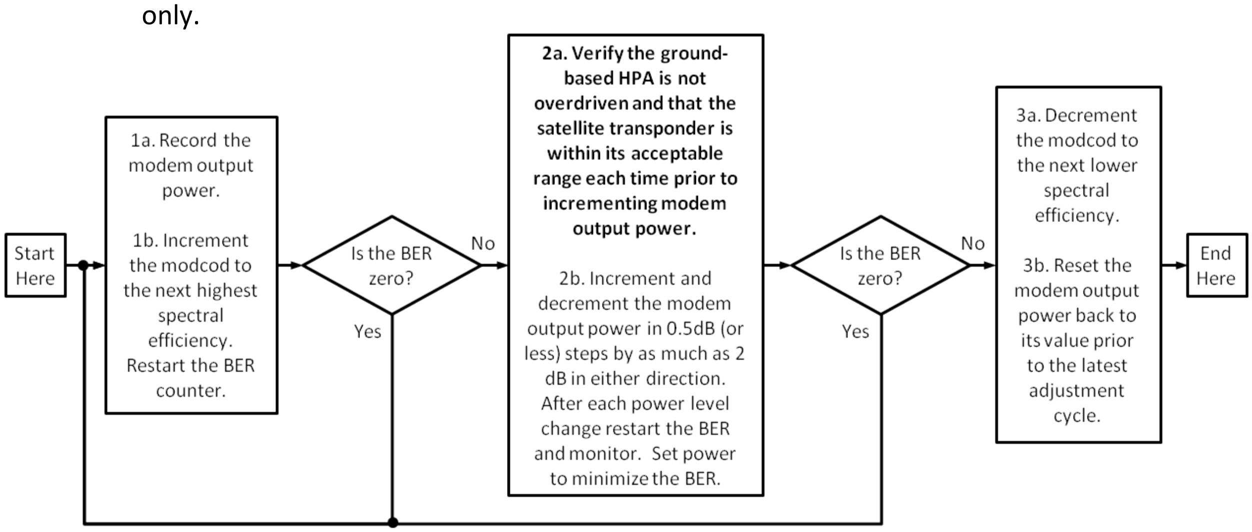
6. Initiate service:
    a. Turn DPD back to LOCAL.
    b. Disable BER test mode.

L.4.1.2 Remote DPD Commissioning and Deployment

Comtech EF Data recommends the following procedure for ***remote*** DPD commissioning. In this procedure, DPD is applied to the link originating from Site A. DPD training is conducted at Site B. Since the bandwidth of the link originating from Site B is expected to be below 20 Msps, DPD will not be applied to this carrier even though DPD will be 'enabled' at this site.

Do these steps:

1. Setup the transmit configuration at both sites.
    a. Site A should use a modulation and coding (ModCod) scheme with slightly lower spectral efficiency than expected to close the link.
    b. Leave the DPD function OFF at both sites.
2. Turn ON the carrier at both sites. Leave the DPD function OFF at both sites.
    a. Setup the receiver configuration at both sites.
    b. Verify that the demodulators are locked at both sites.
    c. Verify that the received signal level at both sites are within specifications.
    d. Measure/record the Es/No at Site B.
3. Turn the DPD function to REMOTE at both sites.
    a. After the demodulators have locked, wait 30 seconds to allow the predistorter to fully converge to the current transponder conditions.
    b. Measure/record the DPD compensation at Site A.
    c. Measure/record the Es/No and compare to previous result without DPD. If the DPD compensation level is low <1.0 dB, then the Es/No improvement may be small since the transponder is not driven deep into compression yet.
    d. Enable the BER test mode.
4. Follow the flow chart to maximize spectral efficiency and optimize the uplink power at Site A only.



5. Basic performance validation:
    a. Measure/record the DPD compensation at Site A.
    b. Measure/record the Es/No at Site B.
    c. Turn DPD function OFF at both sites and compare the measured Es/No and BER, assuming the demodulator is able to achieve lock.
6. Initiate service
    a. Turn DPD back to REMOTE mode at both sites. If the demodulator cannot relock, you must repeat this procedure starting from Step 1, without returning to Step 5.
    b. Disable BER test mode.

L.4.1.3 Example Results

As mentioned, DPD can provide a significant link margin increase. The increase comes in the form of two separate link budget categories:

- First, the link margin required to accommodate transponder nonlinear effects may be reduced.
- Second, the transponder output back off (OBO) may be reduced.

Example results for a C-band, 36 MHz transponder are described here. Note the performance improvement will vary from transponder to transponder and link to link depending on the exact characteristics.

Figure L-10 and **Figure L-11** display the total degradation reduction provided by digital predistortion for 16-APSK and 32-APSK, respectively, with DVB-S2 EB1. The tests used a 5% square-root raised cosine rolloff factor and 34.28 Msps. Additionally, the OBO was optimized for each configuration, which varied between 1.2 dB and 3.2 dB. The balance between the reduced margin for nonlinear distortion versus the reduction in the OBO is shown by the stacked bar graph format.

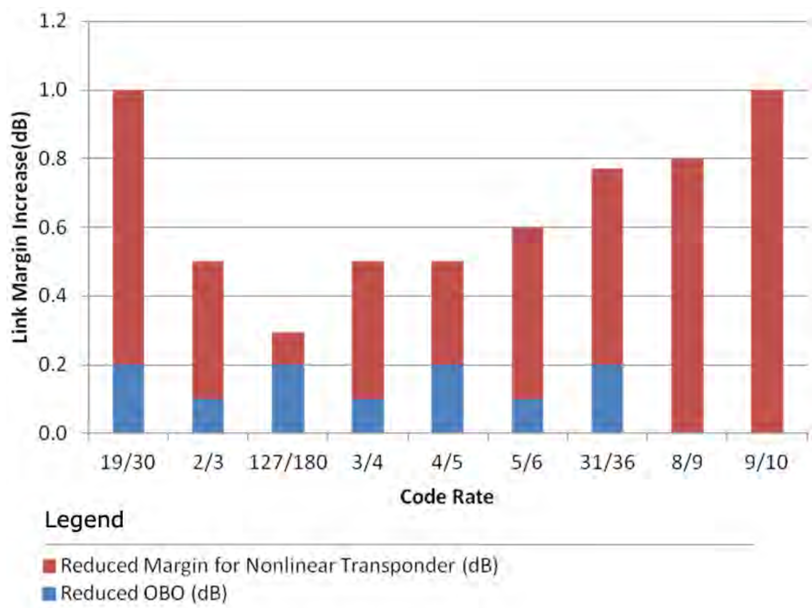


Figure L-10. Link Margin Increase for 16-APSK DVB-S2 EB-1 ModCods, C-Band, 36MHz Transponder

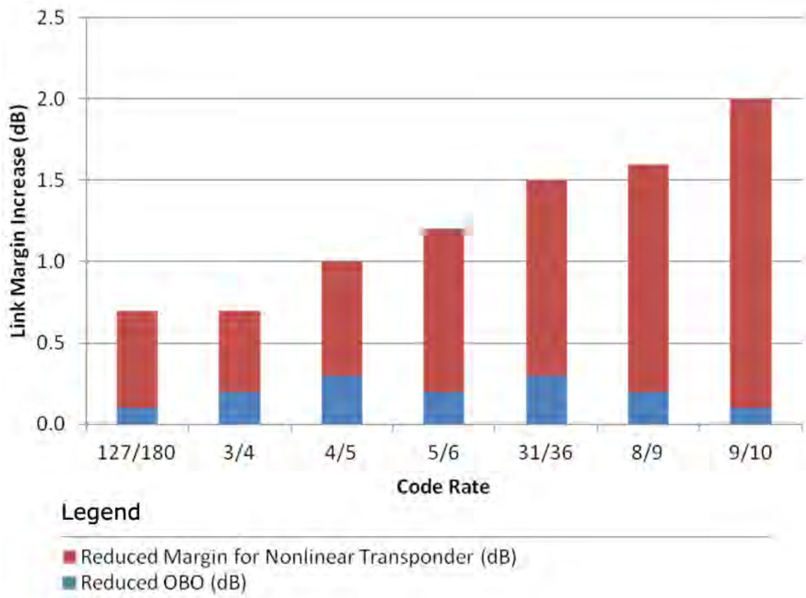


Figure L-11. Link Margin Increase for 32-APSK DVB-S2 EB-1 ModCods, C-Band, 36MHz Transponder

L.5 DPD – Specifications

Symbol Rate Range	Minimum of 20 Msps up to a maximum symbol rate dependent on constellation size and training approach, as follows: • **Local:** QPSK: 72 Msps 8PSK: 72 Msps 16-points, e.g. 16-APSK: 72 Msps 32-points, e.g. 32-APSK: 72 Msps 64-points, e.g. 64-APSK: 54 Msps • **Remote:** QPSK: 75 Msps 8PSK: 60 Msps 16-points, e.g. 16-APSK: 45 Msps 32-points, e.g. 32-APSK: 36 Msps 64-points, e.g. 64-APSK: 27 Msps
Coefficient Update Rate	Every 0.5 seconds
Coefficient Database Storage	15 sets, immediately loaded with modulation and coding change
Satellite Round Trip Delay Range	0 – 300 milliseconds
Monitor Functions	• Round trip delay, in microseconds (Local only) • Frequency offset (between transmitted outbound and received outbound): 100 Hz resolution (Local only) • DPD compensation, in tenths of a dB (ratio of peak-to-average power ratios, predistorter output to input)

L.6 Other Considerations

L.6.1 DPD and DoubleTalk® Carrier-in-Carrier®

DPD cannot be used with DoubleTalk Carrier-in-Carrier since this would involve transmitting two carriers simultaneously over the same transponder. DPD can only compensate for the nonlinear transponder in a single-carrier-per-transponder application.

L.6.2 DPD and Adaptive Coding and Modulation (ACM)

Local DPD can operate in constant coding and modulation (CCM) mode only, because the modem uses the Rx port to receive predistortion feedback. Because of this, since the distant-end modem cannot signal Es/No readings back to the transmit modem, the ACM system does not have the information it needs to select the best modulation and coding combination.

Remote DPD is fully compatible with both ACM and CCM.

L.6.3 DPD and Automatic Uplink Power Control (AUPC)

DPD is fully compatible with AUPC.

L.6.4 DPD Latency

DPD has no measureable effect on signal latency.

2114 WEST 7TH STREET TEMPE ARIZONA 85281 USA
480 • 333 • 2200 PHONE
480 • 333 • 2161 FAX