



CDM-750

Advanced High-Speed Trunking Modem Installation and Operation Manual For Firmware Version 1.6.1 or higher

Part Number MN-CDM750
Revision 2

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

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TABLE OF CONTENTS

TABLE OF CONTENTS	III
TABLES	XII
FIGURES	XIII
PREFACE	XV
About this Manual	xv
Reporting Comments or Suggestions Concerning this Manual	xv
Conventions and References	xv
Patents and Trademarks	xv
Warnings, Cautions, and Notes	xv
Examples of Multi-Hazard Notices	xvi
Recommended Standard Designations	xvi
Metric Conversion	xvi
Safety and Compliance	xvi
Electrical Safety and Compliance.....	xvi
Electrical Installation.....	xvii
Operating Environment.....	xvii
European Union Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive (1999/5/EC) and EN 301 489-1	xvii
European Union Electromagnetic Compatibility (EMC) Directive (2004/108/EC)	xvii
European Union Low Voltage Directive (LVD) (2006/95/EC).....	xviii
European Union RoHS Directive (2002/95/EC).....	xviii
European Union Telecommunications Terminal Equipment Directive (91/263/EEC).....	xix
CE Mark.....	xix
Warranty Policy	xix
Limitations of Warranty	xix
Exclusive Remedies.....	xx
Getting Help	xxi
Contacting Comtech EF Data	xxi
Returning a Product for Upgrade or Repair	xxii
CHAPTER 1. INTRODUCTION	1-1
1.1 Overview	1-1

1.2	CDM-750 Functional Description	1-1
1.3	CDM-750 Features	1-5
1.3.1	Physical Description	1-6
1.3.2	Dimensional Envelope	1-7
1.3.3	CDM-750 External Physical Features	1-8
1.3.3.1	Front Panel	1-8
1.3.3.2	Rear Panel	1-9
1.3.3.2.1	Rear Panel Standard Features	1-9
1.3.3.2.2	Rear Panel Optional Features	1-10
1.4	CDM-750 Specifications	1-11
1.4.1	System Specifications	1-11
1.4.2	Environmental and Physical	1-11
1.4.3	Base Unit Connectors	1-12
1.4.4	Test Functions	1-12
1.4.5	Modulator (Dual IF)	1-12
1.4.6	Demodulator (Dual IF)	1-13
1.4.7	Adaptive Coding and Modulation (ACM)	1-14
1.4.8	DoubleTalk™ Carrier-in-Carrier® (CnC)	1-15
1.4.9	Regulatory Compliance	1-15
1.4.10	Standard Assemblies	1-15
1.4.11	Optional Assemblies	1-16
CHAPTER 2. INSTALLATION		2-1
2.1	Unpacking and Inspecting the Shipment	2-1
2.2	Installing into a Rack Enclosure	2-2
2.2.1	Installing the Optional Rear-Mounting Support Brackets Kit	2-4
2.2.2	Installing the Optional Bearingless Rack Slide Set	2-6
CHAPTER 3. REAR PANEL CONNECTIONS		3-1
3.1	Cabling Connection Types	3-1
3.1.1	Coaxial Cable Connections	3-1
3.1.1.1	Type 'BNC'	3-2
3.1.1.2	Type 'TNC'	3-2
3.1.1.3	Type 'N'	3-2
3.1.1.4	Type 'F'	3-3
3.1.1.5	Type 'SMA' (Subminiature Version 'A')	3-3
3.1.2	D-Subminiature Cable Connections	3-3
3.1.3	Circular Cable Connections	3-4
3.1.4	RJ-45, RJ-48 Cable Connections	3-4
3.2	CDM-750 Cabling Connections	3-5
3.2.1	IF Connector Group	3-7

3.2.1.1	Rx Connectors	3-7
3.2.1.2	Tx Connectors	3-7
3.2.1.3	J10 TX MON Connector, Type 'SMA'	3-7
3.2.2	Utility Connector Group	3-8
3.2.2.1	J1 ALARM Connector, DB-15M	3-8
3.2.2.2	J2 REDUNDANCY Connector, DB-9F	3-9
3.2.2.3	J3 REMOTE Connector, DB-9M	3-9
3.2.2.4	J4 MGMT Connector, RJ-45F	3-10
3.2.2.5	J8 EXT REF Connector, BNC	3-10
3.2.3	Terrestrial Data Connector Group	3-11
3.2.3.1	J5 DATA, J6 DATA Connections, RJ-45F	3-11
3.2.3.2	J7 OPTICAL Connection, 1000Base-SX Cage	3-12
3.2.3.2.1	Optional Optical Gigabit Ethernet Interface (CEFD P/N IC-0000058)	3-12
3.2.3.3	PIIC Data Interface Slots	3-13
3.3	CDM-750 Ground and Power Connections	3-14
3.3.1	Chassis Ground Interface	3-14
3.3.2	115V/230V Alternating Current (AC) Power Interface (Standard)	3-15
3.3.2.1	AC Operation – Applying Power	3-15
3.3.2.2	AC Operation – Replacing Fuses	3-16
3.3.3	48V Direct Current (DC) Power Interface (Optional)(FUTURE)	3-17
3.3.3.1	DC Operation – Applying Power	3-18
3.3.3.2	DC Operation – Replacing Fuses	3-19
CHAPTER 4.	UPDATING FIRMWARE	4-1
4.1	Updating Firmware via the Internet	4-1
4.2	Getting Started: Preparing for the Firmware Download	4-2
4.3	Downloading and Extracting the Firmware Update	4-6
4.4	Performing the Ethernet FTP Upload Procedure	4-8
CHAPTER 5.	FRONT PANEL OPERATION	5-1
5.1	Introduction	5-1
5.1.1	LED Indicators	5-2
5.1.2	Keypad	5-3
5.1.3	Vacuum Fluorescent Display (VFD)	5-4
5.1.3.1	Opening Screen	5-4
5.1.3.2	Screen Saver	5-4
5.2	CDM-750 Front Panel Menus	5-5
5.2.1	SELECT: (Main) Menu	5-6
5.2.2	SELECT: Configuration	5-6
5.2.2.1	CONFIG: Intf (Configure Interface)	5-7

5.2.2.1.1	Single Stream Mode vs. MultiStream Mode Operation	5-8
5.2.2.1.2	(CONFIG) INTF: PIICX = G703	5-10
5.2.2.1.3	(CONFIG) INTF: PIICX = OC3	5-14
5.2.2.1.4	(CONFIG) INTF: GBEIX	5-17
5.2.2.1.5	(CONFIG) INTF: Optical.....	5-20
5.2.2.2	CONFIG: Tx	5-20
5.2.2.2.1	(CONFIG) Tx: IF	5-20
5.2.2.2.2	(CONFIG) Tx: Freq (Frequency)	5-20
5.2.2.2.3	(CONFIG) Tx: Power	5-21
5.2.2.2.4	(CONFIG) Tx: Frame	5-21
5.2.2.2.5	(CONFIG) Tx: Mod (Modulation).....	5-22
5.2.2.2.6	(CONFIG) Tx: Data	5-22
5.2.2.2.7	(CONFIG) Tx: Pilot	5-24
5.2.2.3	CONFIG: Rx.....	5-26
5.2.2.3.1	(CONFIG) Rx: IF.....	5-26
5.2.2.3.2	(CONFIG) Rx: Freq (Frequency).....	5-26
5.2.2.3.3	(CONFIG) Rx: Frame	5-26
5.2.2.3.4	(CONFIG) Rx: Mod (Modulation).....	5-27
5.2.2.3.5	(CONFIG) Rx: Data	5-27
5.2.2.3.6	(CONFIG) Rx: Pilot	5-27
5.2.2.3.7	(CONFIG) Rx: EsNo	5-28
5.2.2.4	CONFIG: Clocks.....	5-29
5.2.2.4.1	(CONFIG) Clocking: Freq-Ref	5-29
5.2.2.4.2	(CONFIG) Clocking: Int-Ref-Adjust	5-29
5.2.2.5	CONFIG: ACM (Adaptive Coding and Modulation)	5-30
5.2.2.5.1	(CONFIG) ACM Config: Min/Max-ModCod	5-30
5.2.2.5.2	(CONFIG) ACM Config: Unlock-Action	5-30
5.2.2.5.3	(CONFIG) ACM Config: Target-Es/No-Margin	5-31
5.2.2.5.4	(CONFIG) ACM Config: Degradation	5-31
5.2.2.6	CONFIG: CnC.....	5-33
5.2.2.6.1	(CONFIG) Carrier-in-Carrier: Mode	5-33
5.2.2.6.2	(CONFIG) Carrier-in-Carrier: Search-Delay.....	5-33
5.2.2.7	CONFIG: Mask	5-34
5.2.2.8	CONFIG: Remote (Remote Control)	5-35
5.2.2.8.1	(CONFIG) Remote Control: Serial or Ser+Ethernet	5-35
5.2.2.8.2	(CONFIG) Remote Control: Inband	5-36
5.2.2.9	CONFIG: IP	5-37
5.2.2.9.1	(CONFIG) IP Config: Addresses.....	5-37
5.2.2.9.2	(CONFIG) IP Config: SNMP	5-38
5.2.2.10	CONFIG: Comp	5-40
5.2.3	SELECT: Test.....	5-41
5.2.3.1	TEST: Mode	5-41
5.2.3.2	TEST: BERT.....	5-43
5.2.3.2.1	TEST: BERT → Config	5-43
5.2.3.2.2	TEST: BERT → Monitor	5-43
5.2.3.3	TEST: Comp	5-44
5.2.4	SELECT: Monitor.....	5-45

5.2.4.1	Monitor: Live-Alarms	5-45
5.2.4.2	Monitor: Stored-Events.....	5-46
5.2.4.3	Monitor: ACM	5-46
5.2.4.4	Monitor: Rx-Params (Rx Parameters)	5-46
5.2.4.5	Monitor: CnC (Carrier-in-Carrier Parameters)	5-47
5.2.4.6	Monitor: Stats (Statistics).....	5-47
5.2.4.6.1	Monitor: Stats → IP	5-48
5.2.4.6.2	Monitor: Stats → BasebandFraming	5-49
5.2.4.6.3	Monitor: Stats → Compression	5-50
5.2.4.7	Monitor: Buffer	5-51
5.2.5	SELECT: Info (Information)	5-52
5.2.5.1	Info: ID.....	5-52
5.2.5.2	Info: Intf	5-52
5.2.5.3	Info: Tx	5-53
5.2.5.4	Info: Rx	5-53
5.2.5.5	Info: Clocks	5-54
5.2.5.6	Info: ACM	5-54
5.2.5.7	Info: CnC.....	5-54
5.2.5.8	Info: Misc.....	5-54
5.2.5.9	Info: Remote	5-55
5.2.5.10	Info: Comp.....	5-55
5.2.6	SELECT: Store/Ld (Store/Load).....	5-56
5.2.7	SELECT: Utility.....	5-57
5.2.7.1	Utility: Set-RTC	5-57
5.2.7.2	Utility: Display-Brightness	5-57
5.2.7.3	Utility: LED.....	5-57
5.2.7.4	Utility: 1:1.....	5-58
5.2.7.5	Utility: 1:N	5-58
5.2.7.6	Utility: Circuit ID	5-59
5.2.7.7	Utility: Firmware	5-59
5.2.7.7.1	(UTILITY) Firmware Images: Info.....	5-59
5.2.7.7.2	(UTILITY) Firmware Images: Select	5-60
5.2.8	SELECT: ODU (Outdoor Unit)	5-60
5.2.8.1	ODU: LNB:PwrSupply+Ref	5-60
5.2.8.1.1	(ODU) LNB:PwrSupply+Ref: PSU-and-10MHz	5-60
5.2.8.1.2	(ODU) LNB:PwrSupply+Ref: PSUmonitor	5-61
5.2.9	SELECT: FAST	5-62
5.2.9.1	FAST: Options.....	5-62
5.2.9.1.1	(FAST) FAST Options: Set	5-63
5.2.9.1.2	(FAST) FAST Options: View.....	5-63
5.2.9.2	FAST: Demo-Mode	5-63
5.2.9.3	FAST: CnC	5-64

CHAPTER 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT	6-1
6.1 Introduction	6-1
6.2 Ethernet Management Interface Protocols	6-2
6.3 SNMP Interface	6-2
6.3.1 Management Information Base (MIB) Files	6-3
6.3.2 SNMP Community Strings	6-3
6.3.3 SNMP Traps	6-4
6.4 Telnet Interface	6-5
6.4.1 Telnet Operation via HyperTerminal	6-5
6.5 Web Server (HTTP) Interface.....	6-7
6.5.1 User Login	6-7
6.5.2 Web Server Interface – Operational Features.....	6-8
6.5.2.1 Navigation	6-8
6.5.2.2 Page Sections	6-8
6.5.2.3 Action Buttons	6-8
6.5.2.4 Drop-down Lists	6-8
6.5.2.5 Text or Data Entry	6-9
6.5.3 Web Server Interface – Menu Tree	6-9
6.5.4 Web Server Interface Page Descriptions.....	6-10
6.5.4.1 Home pages	6-10
6.5.4.1.1 Home Home	6-10
6.5.4.1.2 Home Contact and Home Support	6-11
6.5.4.2 Admin (Administration) pages	6-12
6.5.4.2.1 Admin Access	6-12
6.5.4.2.2 Admin SNMP	6-14
6.5.4.3 Configuration pages	6-15
6.5.4.3.1 Configuration Modem.....	6-15
6.5.4.3.2 Configuration Utilities	6-16
6.5.4.3.3 Configuration Test.....	6-17
6.5.4.3.4 Configuration: LNB (Low Noise Block Down Converter).....	6-18
6.5.4.4 Status pages	6-19
6.5.4.4.1 Status Status.....	6-19
6.5.4.4.2 Status Logs	6-20
6.5.4.4.3 Status Info	6-21
6.5.4.4.4 Status Firmware	6-22
6.5.4.4.5 Status ACM.....	6-23
6.5.4.4.6 Status IP Statistics	6-24
6.5.4.4.7 Status BB Statistics	6-25
6.5.4.5 Interfaces pages	6-26
6.5.4.5.1 Interfaces Ethernet	6-27
6.5.4.5.2 Interfaces PIIC (Plug-In Interface Card).....	6-28
6.5.4.6 TxGraph pages (Minutes / Hours / Days).....	6-30

6.5.4.7	RxGraph pages (Minutes / Hours / Days).....	6-33
CHAPTER 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT.....		7-1
7.1	Introduction	7-1
7.2	EIA-485	7-2
7.3	EIA-232	7-3
7.4	Remote Commands and Queries Overview	7-3
7.4.1	Basic Protocol.....	7-3
7.4.2	Packet Structure.....	7-3
7.4.2.1	Start of Packet.....	7-4
7.4.2.2	Target Address	7-4
7.4.2.3	Address Delimiter.....	7-5
7.4.2.4	Instruction Code.....	7-5
7.4.2.5	Instruction Code Qualifier	7-5
7.4.2.6	Optional Message Arguments.....	7-6
7.4.2.7	End of Packet	7-6
7.5	Remote Commands and Queries.....	7-7
7.5.1	Table Indexes.....	7-7
7.5.2	Tx Parameters	7-10
7.5.3	Rx Parameters	7-13
7.5.4	IP Packet Parameters.....	7-16
7.5.5	Unit Parameters	7-18
7.5.6	ACM Parameters.....	7-26
7.5.7	PIIC Interface Parameters.....	7-27
7.5.8	Bulk Configuration Strings	7-30
7.5.9	ODU Parameters	7-32
7.5.10	Modem Information.....	7-33
7.5.11	Modem Performance Indication	7-37
7.5.12	Redundancy Control.....	7-42
APPENDIX A. FAST OPTIONS AND ACTIVATION PROCEDURE		A-1
A.1	FAST System Overview	A-1
A.2	FAST Activation Procedure.....	A-2
APPENDIX B. PIIC (PLUG-IN INTERFACE CARD) MODULES		B-1
B.1	Introduction	B-1
B.1.1	Typical PIIC Module Installation.....	B-2

B.2	Optional PIIC Modules	B-4
B.2.1	G.703 E3/T3/STS-1 PIIC Module (CEFD P/N PL-0000795)	B-4
B.2.1.1	G.703 E3/T3/STS-1 PIIC Module Summary of Specifications	B-5
B.2.1.1.1	General Specifications	B-5
B.2.1.1.2	Interface Specifications	B-5
B.2.2	STM-1 Copper PIIC Module Kit (CEFD P/N KT-0000255)	B-6
B.2.2.1	STM-1 Copper PIIC Module Summary of Specifications	B-7
B.2.3	OC-3 Single/Multi Mode PIIC Module Kits (CEFD P/N KT-000025X)	B-8
B.2.3.1	OC-3 Single/Multi Mode PIIC Module Summary of Specifications	B-9

APPENDIX C. ADAPTIVE CODING AND MODULATION (ACM) OPTION C-1

C.1	Introduction	C-1
C.2	Background	C-2
C.2.1	ACM Operational Link Example	C-4
C.3	ACM System Description.....	C-6
C.4	CDM-750 ACM Scheme	C-8
C.4.1	Target Es/No Margin.....	C-8
C.4.2	Distortion Adaptation / Modulation Type Impairment	C-9
C.4.3	Pilots.....	C-10
C.4.4	Long and Short Frames.....	C-10
C.4.5	Monotonic Operation.....	C-10
C.4.6	ModCod Selection.....	C-12
C.5	Configuring ACM in the CDM-750	C-14
C.5.1	ACM Configuration via the Front Panel.....	C-16
C.5.2	ACM Configuration via the CDM-750 Web Server Interface.....	C-17
C.6	Monitoring ACM Performance and Statistics.....	C-18
C.6.1	ACM Congestion Control.....	C-19
C.6.2	Notes and Recommendations	C-20
C.6.3	ACM – Summary of Specifications.....	C-21

APPENDIX D. DOUBLETALK CARRIER-IN-CARRIER (CNC) OPTION D-1

D.1	Introduction	D-1
D.1.1	What is DoubleTalk Carrier-in-Carrier?	D-1
D.2	Application Requirements	D-2
D.3	Operational Details.....	D-4
D.4	System Functionality and Operational Considerations	D-5
D.4.1	DoubleTalk Carrier-in-Carrier Cancellation Process	D-8

D.4.2	Margin Requirements.....	D-9
D.4.3	Carrier-in-Carrier Latency.....	D-9
D.4.4	Carrier-in-Carrier and Adaptive Coding and Modulation (ACM).....	D-10
D.4.5	Carrier-in-Carrier Link Design.....	D-10
D.4.6	Symmetric Data Rate Link.....	D-11
D.4.6.1	Asymmetric Data Rate Link.....	D-13
D.4.6.2	Power Limited Links.....	D-14
D.4.7	Commissioning and Deploying Carrier-in-Carrier.....	D-16
D.5	Operational References.....	D-17
D.5.1	Calculating a Carrier-in-Carrier Link Budget.....	D-17
D.5.2	Estimating / Calculating CnC Ratio.....	D-18
D.5.2.1	Estimating CnC Ratio from LST / EIRP.....	D-18
D.5.2.2	Calculating CnC Ratio from Carrier to Noise Ratio (C/N) on a Spectrum Analyzer.....	D-19
D.5.3	Calculating CnC Ratio and PSD Ratio from Satmaster.....	D-20
D.6	DoubleTalk Carrier-in-Carrier Specifications.....	D-20
D.7	Carrier-in-Carrier Summary.....	D-20
D.8	Glossary.....	D-21
APPENDIX E. ES/NO MEASUREMENT.....		E-1
APPENDIX F. ETHERNET NETWORK CONFIGURATION.....		F-1
F.1	Introduction.....	F-1
F.2	Ethernet Routers and Switches.....	F-1
F.3	Ethernet Configuration Examples.....	F-2
F.3.1	Ethernet Network Overview.....	F-2
F.4	CDM-750 Ethernet Overview.....	F-3
F.4.1	Ethernet Interfaces.....	F-3
F.4.2	Ethernet Overhead.....	F-4
APPENDIX G. ETHERNET STATISTICS AND STATUS REPORTING.....		G-1
G.1	Introduction.....	G-1
G.2	Data Flow Diagram.....	G-1
G.3	Statistics Items.....	G-3
G.3.1	Ethernet Data Statistics.....	G-3
G.3.2	Framing and Baseband Statistics.....	G-3
G.3.3	Status Items.....	G-4

G.3.4	BER Testing.....	G-4
G.3.5	ACM Modulator Status.....	G-4
G.3.6	ACM Demodulator Status	G-4
G.3.7	CnC Status.....	G-4
APPENDIX H. FEC (FORWARD ERROR CORRECTION).....		H-1
H.1	Introduction	H-1
H.2	DVB-S2: LDPC and BCH.....	H-1
H.2.1	Range of Data Rates.....	H-2
H.2.2	BER, QEF, Eb/No, Es/No Spectral Efficiency, and Occupied Bandwidth	H-2

TABLES

Table 1-1.	FAST and FAST-accessible Hardware Options.....	1-4
Table 3-1.	CDM-750 Rear Panel Connectors.....	3-6
Table 5-1.	CDM-750 Front Panel Menu Matrix.....	5-5
Table 5-2.	Symbol Rate / Data Rate Range for Standard FECFrame (DVB-S2 Standard FECFrame = 64,800 bits)	5-25
Table C-1.	ACM Example for Standard FECFrame (64,800 bits)	C-2
Table C-2.	ModCod Comparison: ACM vs. CCM.....	C-3
Table C-3.	Turning Margin into Additional Capacity.....	C-5
Table C-4.	Modulation Type Impairment.....	C-10
Table C-5.	Spectral Efficiency and Ideal Es/No by ModCod.....	C-11
Table C-6.	Data Rate by Option Symbol Rate.....	C-15
Table D-1.	Spectral Efficiency using DoubleTalk Carrier-in-Carrier	D-7
Table E-1.	CDM-750 Co+No/No to C/N (Es/No) and Eb/No (dB) for DVB-S2 QPSK and 8PSK	E-3
Table E-2.	CDM-750 Co+No/No to C/N (Es/No) and Eb/No (dB) for DVB-S2 16APSK and 32APSK	E-4

FIGURES

Figure 1-1. CDM-750 Advanced High-Speed Trunking Modem	1-1
Figure 1-2. CDM-750 Dimensional Envelope	1-7
Figure 1-3. CDM-750 Front Panel View.....	1-8
Figure 1-4. CDM-750 Rear Panel View	1-9
Figure 1-5. 70/140 MHz Input Level vs. Symbol Rate	1-13
Figure 1-6. L-Band Input Level vs. Symbol Rate	1-14
Figure 2-1. Unpacking and Inspecting the Shipment.....	2-1
Figure 2-2. Installing into a Rack Enclosure	2-3
Figure 2-3. Installing the Optional Rear-Mounting Support Brackets Kit	2-4
Figure 2-4. Installing the Optional Bearingless Rack Slide Set	2-6
Figure 3-1. Coaxial Connector Examples.....	3-1
Figure 3-2. D-Subminiature Connector Examples.....	3-3
Figure 3-3. CDM-750 Cabling Connections	3-5
Figure 3-4. Typical SFP Module Installation	3-12
Figure 3-5. Typical PIIC Module Installation	3-13
Figure 3-6. CDM-750 Chassis Ground Interface.....	3-14
Figure 3-7. CDM-750 AC Power Interface	3-15
Figure 3-8. Applying AC Power to the CDM-750.....	3-15
Figure 3-9. Replacing CDM-750 AC Fuses	3-16
Figure 3-10. CDM-750 DC Power Interface.....	3-17
Figure 3-11. Applying DC Power to the CDM-750.....	3-18
Figure 3-12. Replacing CDM-750 DC Fuses	3-19
Figure 5-1. CDM-750 Front Panel View.....	5-1
Figure 5-2. MAC Learning Operations.....	5-19
Figure 5-3. Loopback Test Modes	5-42
Figure 6-1. CDM-750 Home page.....	6-10
Figure 6-2. Home Contact and Home Support pages.....	6-11
Figure 6-3. Admin Access page.....	6-12
Figure 6-4. Admin SNMP page	6-14
Figure 6-5. Configuration Modem page	6-15
Figure 6-6. Configuration Utilities page	6-16
Figure 6-7. Configuration Test page	6-17
Figure 6-8. Configuration LNB page	6-18
Figure 6-9. Status Status page.....	6-19
Figure 6-10. Status Logs page.....	6-20
Figure 6-11. Status Info page	6-21
Figure 6-12. Status Firmware Info page	6-22
Figure 6-13. Status ACM Status page	6-23
Figure 6-14. Status IP Statistics page	6-24
Figure 6-15. Status BB Statistics page	6-25
Figure 6-16. Interfaces Ethernet page.....	6-27
Figure 6-17. Interfaces page	6-28
Figure 6-18. TxGraph pages (TxHours page shown)	6-30
Figure 6-19. RxGraph pages (RxHours page shown).....	6-33

Figure B-1. Typical PIIC Module Installation	B-2
Figure B-2. G.703 E3/T3/STS-1 PIIC Module	B-4
Figure B-3. G.703 E3/T3/STS-1 PIIC Module Block Diagram	B-4
Figure B-4. G.703 E3/T3/STS-1 PIIC Module Panel Connectors	B-4
Figure B-5. STM-1 Copper PIIC Module Kit (CEFD P/N KT-0000255)	B-6
Figure B-6. STM-1 Copper PIIC Module – SFP Installation	B-6
Figure B-7. OC-3 Single Mode or Multi Mode PIIC Module Kit (CEFD P/N KT-000025X).....	B-8
Figure B-8. OC-3 Single Mode or Multi Mode PIIC Module – SFP Installation.....	B-8
Figure C-1. Downlink Margin vs. Average Link Availability	C-4
Figure C-2. User Throughput vs. Time and Fades	C-5
Figure C-3. ACM-over-Satellite – Generic Example	C-7
Figure C-4. Single Hop Latency.....	C-9
Figure C-5. Spectral Efficiency vs. Ideal Es/No @ QEF	C-12
Figure C-6. Spectral Efficiency vs. Modem Es/No @ QEF (Pruned ModCods).....	C-13
Figure C-7. CDM-750 Web Server Interface – Configuration Modem page	C-17
Figure C-8. CDM-750 – ACM Congestion Control	C-19
Figure D-1. Conceptual Block Diagram	D-3
Figure D-2. Conventional FDMA Link	D-5
Figure D-3. Same Link Using CDM-750 and DoubleTalk Carrier-in-Carrier	D-6
Figure D-4. Duplex Link Optimization	D-6
Figure D-5. DoubleTalk Carrier-in-Carrier Signals	D-8
Figure D-6. Carrier-in-Carrier Signal Processing Block Diagram	D-9
Figure F-1. Networking Loop with Switches	F-2
Figure F-2. CDM-750 Ethernet Architecture Design	F-3
Figure F-3. Improper Use of External Switch with CDM-750	F-4
Figure G-1. CDM-750 Data Flow Diagram	G-2
Figure H-1. DVB-S2 QPSK Packet Error Rate versus Es/No	H-3
Figure H-2. DVB-S2 8PSK Packet Error Rate versus Es/No	H-4
Figure H-3. DVB-S2 16APSK Packet Error Rate versus Es/No.....	H-5
Figure H-4. DVB-S2 32APSK Packet Error Rate versus Es/No.....	H-6

PREFACE

About this Manual

This manual provides installation and operation information for the Comtech EF Data CDM-750 Advanced High-Speed Trunking Modem. This is an informational document intended for the persons responsible for the operation and maintenance of the CDM-750.

Reporting Comments or Suggestions Concerning this Manual

Comtech EF Data welcomes comments and suggestions regarding the content and design of this manual. Contact the Comtech EF Data Technical Publications Department:

TechnicalPublications@comtechefdata.com

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** gives information about a possible hazard that **MAY CAUSE DEATH** or **SERIOUS INJURY**.



A **CAUTION** gives information about a possible hazard that **MAY CAUSE INJURY** or **PROPERTY DAMAGE**.

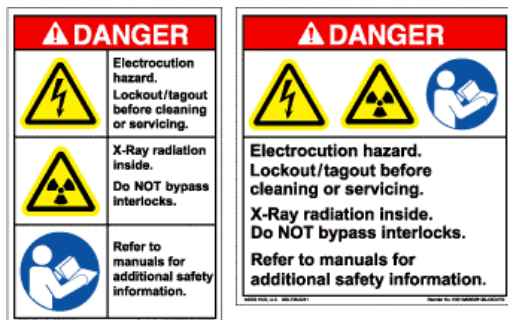


A **NOTE** gives important information about a task or the equipment.



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

Examples of Multi-Hazard Notices



Recommended Standard Designations

Recommended Standard (RS) Designations are superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations may be shown when depicting actual text (e.g., RS-232) displayed on the Web Server pages, serial remote interface, or unit rear panel. All other references in the manual refer to EIA designations.

Metric Conversion

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



The user 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.



IF THE UNIT IS OPERATED IN A VEHICLE OR MOVABLE INSTALLATION, MAKE SURE THE UNIT IS STABLE. OTHERWISE, EN 60950 SAFETY IS NOT GUARANTEED.

Electrical Installation



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.



Sect 3.3 CDM-750 Ground and Power Connections

Operating Environment



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 (*Electromagnetic compatibility and Radio spectrum Matters [ERM]; ElectroMagnetic Compatibility [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.**



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.

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.

Getting Help



Review the Warranty Policy before contacting Comtech EF Data Technical Support or Customer Service.

Contacting Comtech EF Data

Contact Comtech EF Data for:

- **Technical Support** – Product support or training.
- **Customer Service** – Information on returning an in-warranty or out-of-warranty product for upgrade or repair. **Be prepared to provide the product model number and its serial number.**

Contact Comtech EF Data Customer & Technical Support during normal business hours (Monday through Friday, 8 A.M. to 5 P.M Mountain Standard Time (MST)):

For:		Contact:
CDM-750 Technical Support and Service	Telephone	+1.480.333.4357
	Email	cdmipsupport@comtechefdata.com
	Fax	+1.480.333.2500
Comtech EF Data Web Site	Main Page	http://www.comtechefdata.com
	Customer and Technical Support	http://www.comtechefdata.com/support.asp
	RMA (Return Material Authorization)	http://www.comtechefdata.com/rmaform.asp
Comtech EF Data Main Number		+1.480.333.2200
Mailing Address		2114 West 7th Street Tempe, Arizona 85281 USA

Returning a Product for Upgrade or Repair

Step	Task
1	Go to the Comtech EF Data Home page (http://www.comtechefdata.com). From the SUPPORT column at the bottom of the page, select the Service hyperlink, and read the Return Material Authorization section in its entirety.
2	<p>Request a Return Material Authorization Number:</p> <ul style="list-style-type: none">• <i>On the Comtech EF Data Home page:</i> From the SUPPORT column at the bottom of the page, select the RMA Request hyperlink; <p>OR</p> <ul style="list-style-type: none">• <i>On the Comtech EF Data Support page:</i> Click [Send RMA Request]; <p>OR</p> <ul style="list-style-type: none">• <i>On the Comtech EF Data Service page:</i> Select the Return Material Authorizaion hyperlink;• Fill out the RMA form completely;• Click [Send Email]. <p>Alternately:</p> <ul style="list-style-type: none">• Send an e-mail providing this same detailed information to Comtech EF Data Customer Service (service@comtechefdata.com).• Contact Comtech EF Data Customer & Technical Support by phone or fax.
3	Pack the product in its original shipping carton and protective packaging.
4	Ship the product back to Comtech EF Data. Shipping charges should be prepaid.

Chapter 1. INTRODUCTION

1.1 Overview



Figure 1-1. CDM-750 Advanced High-Speed Trunking Modem

The CDM-750 Advanced High-Speed Trunking Modem (**Figure 1-1**) is intended for network operators, enterprise users, and service providers requiring maximum throughput while using minimal satellite resources in point-to-point links. The CDM-750 combines DVB-S2 modulation and coding with Comtech's DoubleTalk™ Carrier-in-Carrier® and throughput-maximizing Adaptive Coding and Modulation (ACM) technologies to optimize high speed satellite data links.

The CDM-750 architecture allows efficient networking and transport over satellite links while supporting a wide range of applications and network topologies.



- **Sect. 1.3 CDM-750 Features**
- **Sect. 1.4 CDM-750 Specifications**

1.2 CDM-750 Functional Description

The CDM-750 Advanced High-Speed Trunking Modem:

- Features a high performance processor and a real-time operating system (RTOS) combined with multiple Field Programmable Gate Arrays (FPGAs). All non-volatile memory is provided by both onboard and Compact Flash devices.
- Runs on an embedded operating system and does not have moving parts for media storage. This design provides carrier class reliability and high speed, purpose-driven processing.

- Supports reception and transmission of IP data over satellite links via two fundamentally different types of interface – **IF** and **data**:
 - The **IF** interface provides a bidirectional link with the satellite via the uplink and downlink equipment.
 - The **data** interface is a bidirectional path that connects the customer's equipment (assumed to be the **Data Terminal Equipment**, or DTE) to the unit (assumed to be the **Data Communications Equipment**, or DCE). All terrestrial data is connected using up to two available 10/100/1000 Gigabit Ethernet interfaces. Two Plug-in Interface Card (PIIC) slots permit factory or field installation of optional data interfaces such as G.703 E3/T3/STS-1, Copper STM-1, OC-3 SONET, etc.
- Includes support for Adaptive Coding and Modulation (ACM) and Constant Coding and Modulation (CCM):
 - **ACM** allows optimization of throughput under all link conditions.
 - **CCM** allows operators to define groups of remotes having different modulation and coding parameters, as a means to improve efficiency on existing satellite capacity.

On the Tx (transmit) side: Transmit data from the Ethernet interface is converted for further processing. Generic Stream Encapsulation (GSE) captures the Ethernet frames and prepares them for DVB-S2 framing and modulation and coding. Synchronous data interfaces are mapped into the DVB-S2 frame directly. The modulated signal is sent to the modulator output for use at either 70/140 MHz via a BNC connector or L-Band at a Type-N connector. A fixed level L-Band sample of the modulated signal is available at the Tx Mon SMA connector depending on the mode of operation:

- Monitor for 70/140 MHz operation: $900 + 70/140$ MHz frequency;
- Monitor for L-Band operation: L-Band frequency.

Transmit data from non-IP interfaces, like the G.703 data interface, are serial streams that are not GSE encapsulated and are sent on to the rest of the modulator. In MultiStream mode, all data interfaces are encapsulated in the low overhead GSE structure and multiplexed to form an aggregated carrier.

On the Rx (receive) side: Signals from the link are recovered by a DVB-S2 demodulator, and the data is decapsulated (GSE) to extract the Ethernet frames. The data is sent to the Rx side of the Ethernet interface for user access via an RJ-45 connector.

A similar process without GSE for non-IP data is used in the receive side for serial data, e.g., the G.703 interface. Similarly, MultiStream traffic is decapsulated and demultiplexed to form the original data streams.

DVB-S2 Receiver: The CDM-750 supports DVB-S2 QPSK, 8PSK, 16APSK, and 32APSK modulation/demodulation up to 63 Msps with receive data rates up to 169 Mbps depending on the modulation type and code rate.

In DVB-S2 operation, the receiver operates in the CCM and ACM modes. The receiver automatically detects for pilots ON/OFF and supports spectral rolloff of 20%, 25% or 35%.



- **Sect. 1.3 CDM-750 Features**
- **Sect. 1.4 CDM-750 Specifications**
- **Appendix H. FEC (FORWARD ERROR CORRECTION)**

Verification: The CDM-750 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 the loopback, all of the receive configuration parameters are temporarily changed to match those of the transmit side, and an internal RF switch connects the modulator output to the demodulator input. When normal operation is again selected, all of the previous values are restored.

Monitor and Control Interfaces: The unit is managed through multiple interfaces providing options for both in-band and out-of-band monitor and control.



- **Chapter 5. FRONT PANEL OPERATION**
- **Sect. 6.3 (ETHERNET-BASED PRODUCT MANAGEMENT) SNMP Interface**
- **Sect. 6.4 (ETHERNET-BASED PRODUCT MANAGEMENT) Telnet Interface**
- **Sect. 6.5 (ETHERNET-BASED PRODUCT MANAGEMENT) Web Server (HTTP) Interface**
- **Chapter 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT**

On-site Firmware Updates: Field update of the operating system firmware is possible through file upload via satellite or the Ethernet port.



Chapter 4. UPDATING FIRMWARE

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



Appendix A. FAST OPTIONS AND ACTIVATING PROCEDURE

Table 1-1 shows the FAST and FAST-accessible hardware options available for the CDM-750.

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

Description and Comments	Option Installation Method
ACM (Advanced Coding and Modulation)Point-to-Point	FAST
63 Mbps Rx symbol rate	
63 Mbps Tx symbol rate	
Rx QPSK Demodulation	
Rx 8-PSK Demodulation	
Rx 16APSK Demodulation	
Rx 32APSK Demodulation	
Tx QPSK Modulation	
Tx 8-PSK Modulation	
Tx 16APSK Modulation	
Tx 32APSK Modulation	
Carrier-in-Carrier (CnC)	FAST & Hardware
K4 GZip Lossless Compression	
Optical Gigabit Ethernet Interface	
G.703 Data Interface E3/T3/STS-1 (34.368/ 44.768/51.84 Mbps)	Hardware
STM-1 Copper Data Interface (155.52 Mbps)	
OC-3 Single Mode Data Interface (155.52 Mbps)	
OC-3 Multi Mode Data Interface (155.52 Mbps)	

1.3 CDM-750 Features

Features include:

- Symbol Rate: 1-63 Msps
- Data Rate: 1-169 Mbps
- DVB-S2 ETSI EN 302 307 compliant
- DoubleTalk Carrier-in-Carrier bandwidth compression
- Adaptive Coding and Modulation (ACM) and Constant Coding and Modulation (CCM)
- Generic Stream Encapsulation (GSE) – industry standard encapsulation
- K4 GZip lossless compression
- Modulation: QPSK, 8PSK, 16APSK, 32APSK
- Coding: DVB-S2 LDPC/BCH
- Dual IF: 70/140 MHz (50-180 MHz), L-Band (950-2150 MHz) and L-Band Monitor (standard)
- Data Interfaces:
 - (2) Gigabit 10/100/1000BaseT Interfaces (standard)
 - (1) Optical Gigabit Interface (optional)
 - Process >300,000 pps simplex, >600,000 pps duplex
 - (2) Data interface slots for optional Plug-in Interface Cards (PIICs):
 - G.703 E3/T3/STS-1 [34.368/44.768/51.84 Mbps]
 - STM-1 Copper SDH (155.52 Mbps)
 - OC-3 SONET single mode or multi-mode 1300 nm (155.52 Mbps)
- MultiStream capable (Multi-Interface mux)
- Management: Web browser, SNMP, Telnet, EIA-232/485
- In-band (over satellite) M&C control

- 1:1 and 1:N redundancy switching available

1.3.1 Physical Description

The CDM-750 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.



- **Sect. 1.4 CDM-750 Specifications**
- **Sect. 2.1 Installing into a Rack Enclosure**

- The modem is modular in design and is comprised of two main card assemblies:
 - The main card includes all of the interface circuits (including Dual and Optical GigE, 10 MHz external reference, redundancy, etc.), the DVB-S2 Encapsulator/Decapsulator or alternate framing/deframing, and the EIA-232/422 and Ethernet M&C interfaces.
 - The modem card performs all signal processing functions of modulation, demodulation, and frequency conversion to 70/140 MHz or L-Band. This card provides ID capability so that M&C can identify which card is installed.

Additionally:

- Based on “Adaptive Cancellation” technology, the **DoubleTalk™ Carrier-in-Carrier®** option (referred to throughout this manual as **CnC**) allows transmit and receive carriers of a duplex link to share the same transponder space. This plug-in daughter card can either be factory-installed at the time of ordering, or field-installed by the user.



Appendix D. DOUBLETALK CARRIER-IN-CARRIER OPTION

- An optional K4 GZip lossless compression card plugs into an internal expansion slot on the modem card.

1.3.2 Dimensional Envelope

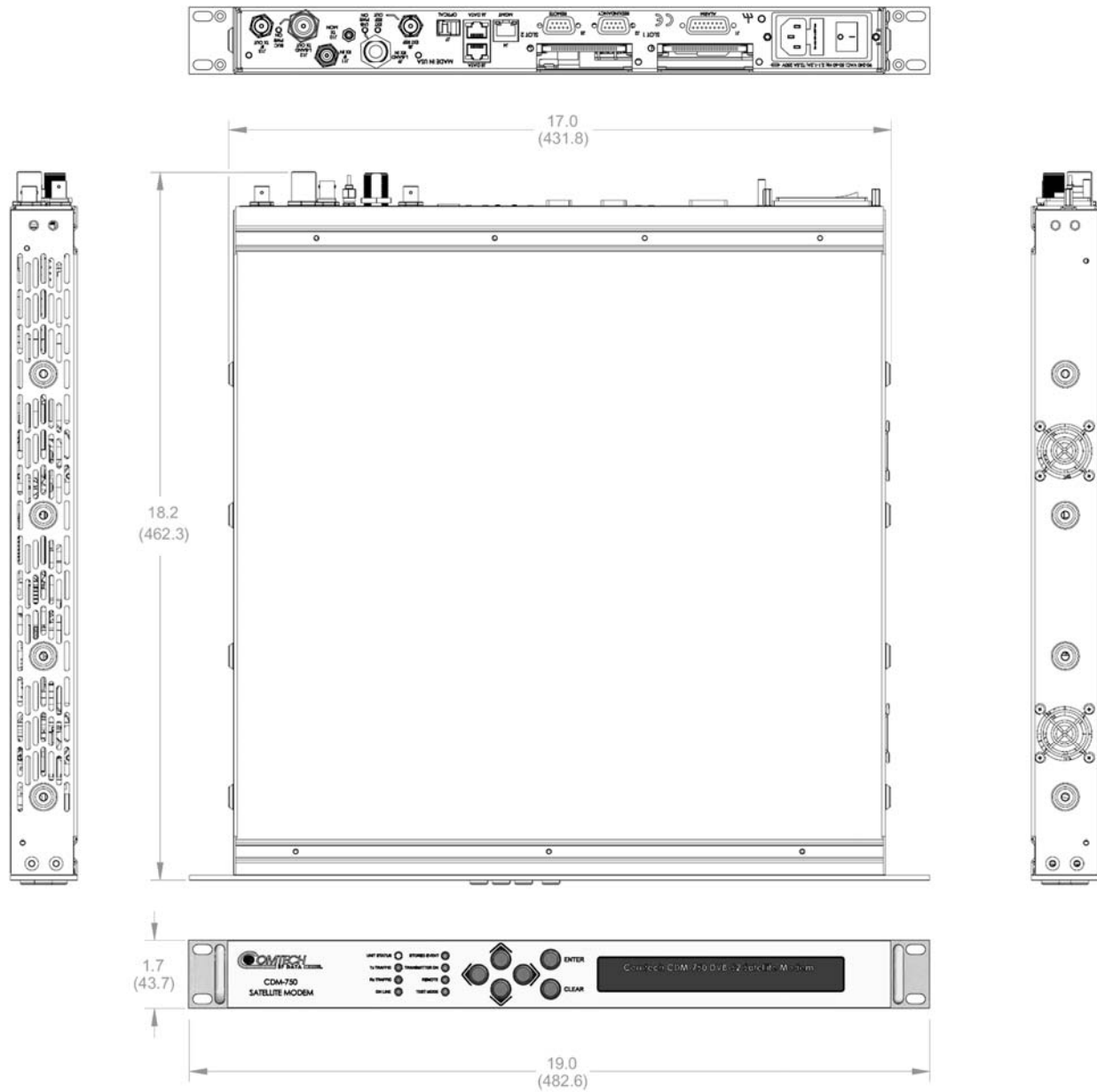


Figure 1-2. CDM-750 Dimensional Envelope

1.3.3 CDM-750 External Physical Features

1.3.3.1 Front Panel

The function and behavior of the LED indicators, keypad, and VFD (**Figure 1-3**) are described in detail in **Chapter 5. FRONT PANEL OPERATION**.



Feature	Description	Function	See Chapter Section...
1	LED Indicators	The LEDs indicate, in a summary fashion, the status of the modem.	5.1.1
2	Keypad	Enter data via the keypad. The keypad comprises six individual keyswitches. The keys have a positive 'click' action that provides tactile feedback. Data, prompts, and messages are displayed on the VFD.	5.1.2
3	Vacuum Fluorescent Display (VFD)	The VFD is an active display, with adjustable brightness, showing two lines of 40 characters each. Nested menus display all available options and prompts that guide you in carrying out required actions.	5.1.3
4	Rack Handles	These handles allow easy placement into and removal from a rack.	2.2

Figure 1-3. CDM-750 Front Panel View

1.3.3.2 Rear Panel

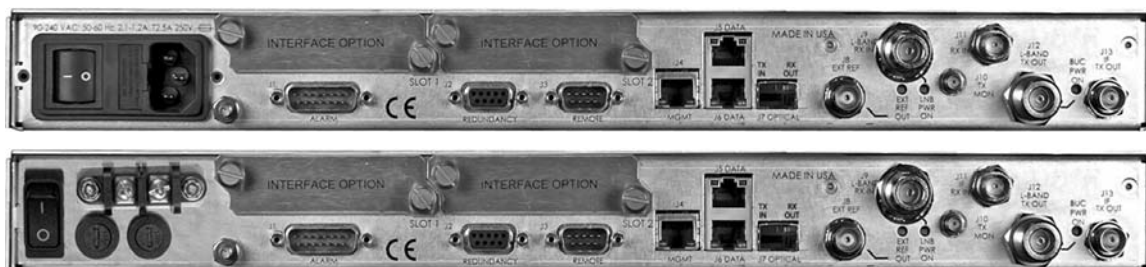


PROPER GROUNDING PROTECTION IS REQUIRED. The equipment must be connected to the protective earth connection at all times. It is therefore imperative that the unit is properly grounded, using the ground stud provided on the unit rear panel, during installation, configuration, and operation.



- Sect. 3.2 CDM-750 Cabling Connections
- Sect. 3.3 CDM-750 Grounding and Power Connections

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



(Top) Standard AC Unit
(Bottom) Optional 48V DC Unit (FUTURE)
Figure 1-4. CDM-750 Rear Panel View

1.3.3.2.1 Rear Panel Standard Features

The unit provides the following standard interfaces:

Data Interfaces:

- (2X) 10/100/1000 BaseT Gigabit Ethernet RJ-45 Interface: **J5|DATA** and **J6|DATA** ports for Ethernet traffic.
- (1X) 10/100 BaseT Fast Ethernet RJ-45 Interface for Ethernet-based management and control purposes (HTTP/Web and SNMP): **J4|MGMT** port.
- (1X) DB-9F EIA-232 connector for serial remote control: **J3|REMOTE** port.
- (1X) DB-15M connector for Form C unit alarms, analog Es/No, and Tx Mute: **J1|ALARMS** port.

IF Interfaces:

- (2X) Type 'N' female connectors for 50Ω L-Band (950 to 2150 MHz) input/output: **J9 | L-Band Rx In** and **J12 | L-Band Tx Out**

- (2X) Type ‘BNC’ female connectors for 75Ω (standard) or 50Ω (optional) 70/140 MHz input/output: **J11 | IF Rx In** and **J13 | IF Tx Out**.

Power Interface:

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

1.3.3.2.2 Rear Panel Optional Features

The following 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** port (a SFP [Small Form Factor Pluggable] Module socket).
- (2X) PIIC (Plug-In Interface Card) slots accommodate the following 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).
 - Additional PIIC data interface options (ASI, OC3, HSSI, etc.) will become available upon request.
- (1X) DB-9M EIA-232 connector (**J2|REDUNDANCY** port) for interoperability with a separately purchased Comtech EF Data redundancy switch:
 - For 1:1 redundant applications, the CDM-750 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 **only** for CDM-750 1:10 operation with the 10/100/1000 BaseT Gigabit Ethernet and G.703 E3/T3/STS-1 data interfaces. The CRS-500 **may not** be used with any other data interface, nor can it be used for redundancy in MultiStream mode.

The following 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

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

- 48 VDC Primary Input Power Supply with Screw-in Fuse Holders
- 24 VDC BUC 90 Watt Power Supply (AC Input or DC Input versions)
- 48 VDC BUC 150 Watt Power Supply (AC Input or DC Input versions)

1.4 CDM-750 Specifications

1.4.1 System Specifications

Symbol/Data Rate Range	Programmable in 1 sps increments
DVB-S2	<ul style="list-style-type: none"> • QPSK: 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 to 63 Msps / 112.6 Mbps max • 8-PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 to 63 Msps / 168.7 Mbps max • 16-APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 to 47 Msps / 167.6 Mbps max • 32-APSK: 3/4, 4/5, 5/6, 8/9, 9/10 to 38 Msps / 165.5 Mbps max
FECFrame	Standard (64,800 bits) or Short (16,200 bits)
Pilots	On or Off
Alpha (Rolloff)	20%, 25% or 35%
Management	Front panel keypad / display EIA-232 /485, or 10/100 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	<ul style="list-style-type: none"> • Reference Selections: Internal 10 MHz, External Input 1, 2, 5, 10 MHz at -6dBm to +10dBm (nominal 50/75 Ω, 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.

1.4.2 Environmental and Physical

Temperature	<ul style="list-style-type: none"> • Operating: 0 to 50°C (32 to 122°F) • Storage: -40 to 70°C (-40 to 158°F)
Humidity	95% maximum, non-condensing
Power Supply Input	90-240 VAC, 50-60 Hz
Power Consumption	
AC Power Consumption	With CnC Module, G.703, and GZIP Compression Installed: 90-240 VAC, 50-60 Hz, Power Factor = .94, 100 Watts maximum
DC Power Consumption	(FUTURE)
AC Receptacles	Includes restraint for standard IEC-320 inlet
Weight	15 lbs (6.8 kg)
Dimensional Envelope	19.0 W x 18.2 D x 1 RU (1.7) H inches (483 W x 462 D x 44 H mm)

1.4.3 Base Unit Connectors

Alarm Connector	DB-15 male: Form C; Tx, Rx and unit faults; External Tx Carrier Off; IQ test point
Unit Management	<ul style="list-style-type: none"> DB-9 male with EIA-232 and RS 485 2W/4W RJ-45 Ethernet (Maximum Ethernet packet size 1536 bytes including Ethernet header & CRC)
Tx & Rx IF Connectors	<ul style="list-style-type: none"> 70/140 MHz: BNC L-Band: Type 'N' female
L-Band Monitor	Type 'SMA' female
Traffic Data Interface	<ul style="list-style-type: none"> 2X RJ45 10/100/1000 BaseT Ethernet 1X Optical Gigabit Ethernet (optional) <p>Note: All Data Gig-E interfaces have a maximum Ethernet packet size of 1632 bytes including Ethernet header & CRC</p>

1.4.4 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

1.4.5 Modulator (Dual IF)

70 / 140 MHz Impedance / Connector Output Power Power Accuracy	50 to 180 MHz in 100 Hz steps, maximum symbol rate is within IF limits 75 Ω / BNC Female. Return Loss ≥ 18 dB 0 to -20 dBm, 0.1 dB steps (70/140 MHz) ±0.5 dB of nominal at 25°C. Within ±0.5 dB from 25°C value at same frequency			
L-Band Impedance / Connector Output Power Power Accuracy	950-2150 MHz in 100 Hz steps, modulator maximum symbol rate is within IF limits 50Ω, Type N Female. Return Loss ≥ 15 dB -5 to -40 dBm, 0.1 dB steps ±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	Frequency Offset	dBc/Hz	Frequency Offset	dBc/Hz
	10 Hz	-105	10 kHz	-148
	100 Hz	-125	100 kHz	-150
	1 kHz	-138		

1.4.6 Demodulator (Dual IF)

70 / 140 MHz Impedance / Connector Input Power Maximum Composite Level	50 to 180 MHz in 100 Hz steps 75 Ω / BNC Female. Return loss 15 dB min Desired Carrier = $-58 + 10\log(\text{Symbol Rate in Msps})$ dBm min and -18 dBm max – See Fig. 1-5 The lesser of +20 dBc – $10\log(\text{Symbol Rate in Msps})$ or -3 dBm						
L-Band Impedance / Connector Input Power Maximum Composite Level	950-2150 MHz in 100 Hz steps, demodulator 50Ω, Type N Female. Return loss 10 dB min Desired Carrier = $-65 + 10\log(\text{Symbol Rate in Msps})$ dBm min and -25 dBm max – See Fig. 1-6. The lesser of +30 dBc – $10\log(\text{Symbol Rate in Msps})$ or -10 dBm						
Acquisition Range	± 150 KHz ≤ 5 Msps, ≤ 500 KHz > 5 Msps.						
Es/No performance as per DVB-S2 QEF PER 1E-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]	Mod/Cod		Es/No	Mod/Cod		Es/No	
	QPSK	1/2	1.4	16-APSK	2/3	9.9	
		3/5	2.7		3/4	11.2	
		2/3	3.4		4/5	12.0	
		3/4	4.6		5/6	12.4	
		4/5	5.1		8/9	13.8	
		5/6	5.6		9/10	14.0	
		8/9	6.7		32-APSK	3/4	14.6
		9/10	6.8			4/5	15.8
	8-PSK	3/5	6.4	5/6	16.6		
		2/3	7.4	8/9	19.1		
		3/4	8.5	9/10	19.5		
		5/6	10.0				
		8/9	11.3				
9/10		11.6					

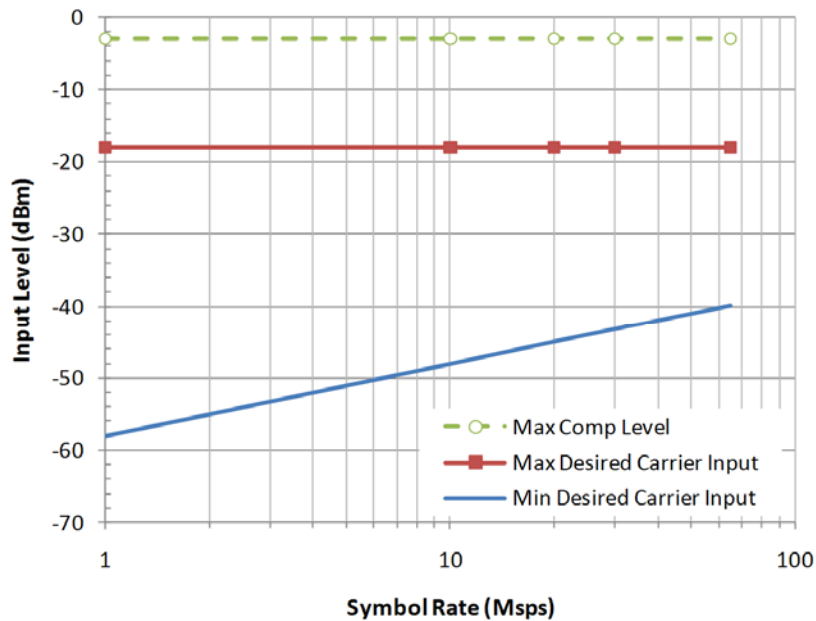


Figure 1-5. 70/140 MHz Input Level vs. Symbol Rate

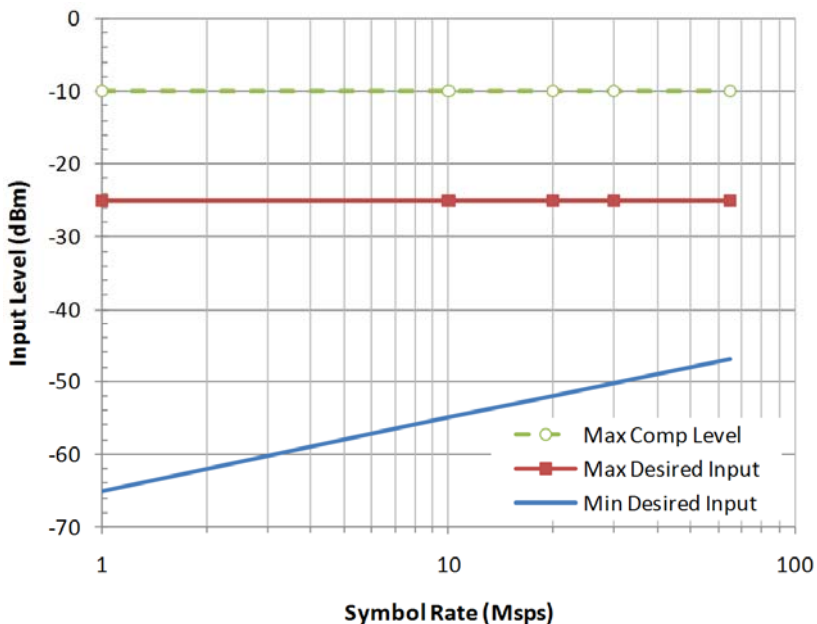


Figure 1-6. L-Band Input Level vs. Symbol Rate

1.4.7 Adaptive Coding and Modulation (ACM)

System type	Adaptive Coding and Modulation, using DVB-S2 QPSK, 8PSK, 16APSK, 32APSK with Normal Frames: Total of 25 ModCods (QPSK 1/4, 1/3 and 2/5 are excluded)
Symbol Rate Range	1 to 63 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	>160:1 over range of adaptation
Switch point (decreasing Es/No)	Corresponds to Es/No (plus impairments) at QEF, ~PER = 10 ⁻⁷
Switch point hysteresis	Configurable from 0.0 to 0.5 dB
Max fading rate	Configurable Target Es/No margin from 0.0 to 4.5 dB
Max ModCod update rate	1 update every second (no restriction on distance between ModCods)
Configurable parameters	Minimum and Maximum ModCod (ModCod4 through ModCod28) Remote Demodulator Unlock options: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Impairment for QPSK, 8PSK, 16APSK and 32APSK: 0 to 9.9 dB in 0.1 dB steps. • Impairment for QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK
Monitored parameters	<ul style="list-style-type: none"> • Tx and Rx ModCods • Local and Remote Es/No: (-3.0 dB to +22.0dB, 0.1dB resolution) • Config and monitor menus displaying data rate, modulation and code rate update dynamically with ModCod

1.4.8 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.
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 - 400 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, 0.6 dB 32-APSK, 1.0 dB
Monitor Functions	<ul style="list-style-type: none"> • 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

1.4.9 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		

1.4.10 Standard Assemblies

Assembly	Description	Where Installed
PL-0000571	Modem Card	In chassis (top cover access)
PL-0000612	Main Card (includes Ethernet Interfaces)	
PL-0000626	PIIC Motherboard Assembly	
KT-0000150	AC Power Supply for modem (not BUC)	

1.4.11 Optional Assemblies

Assembly	Description	Where Installed	Chapter Sect.
PL-0000572	Carrier-in-Carrier Card	In chassis (top cover access), modem card plug-in	N/A
PL-0000635	K4 GZip Lossless Compression Card	In chassis (top cover access), modem card plug-in	N/A
KT-0000168	Rear-Mounting Support Bracket (4")	At rear sides of chassis, and rack rear mounting rails	2.2.1
KT-0000195	Rear-Mounting Support Bracket (10")	At rear sides of chassis, and rack rear mounting rails	2.2.1
FP/SL0006	Bearingless Side Railings	On sides of chassis	2.2.2
IC-0000058	SFP Optical Gigabit Ethernet Data Interface	Rear Panel J7 Optical port	3.2.3.2
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module	Real Panel PIIC Slots 1 and 2	B.2.1
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module	Real Panel PIIC Slots 1 and 2	B.2.2
KT-0000256	SFP OC-3 Single Mode PIIC Module	Real Panel PIIC Slots 1 and 2	B.2.3
KT-0000257	SFP OC-3 Multi Mode PIIC Module	Real Panel PIIC Slots 1 and 2	

Chapter 2. INSTALLATION

2.1 Unpacking and Inspecting the Shipment

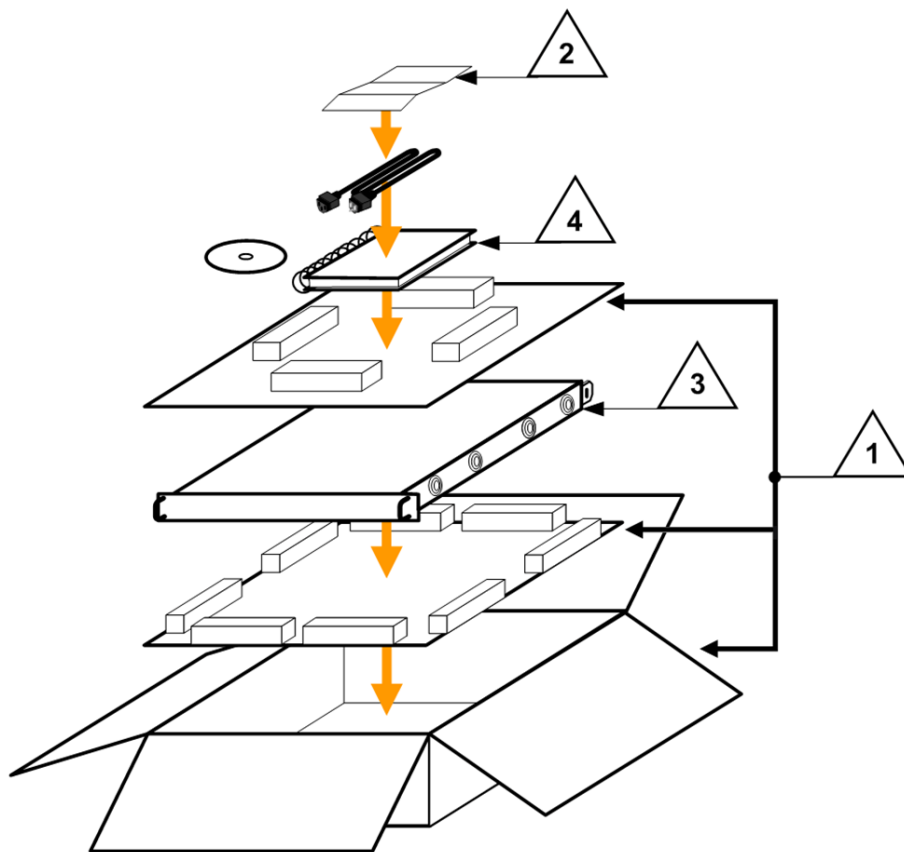


Figure 2-1. Unpacking and Inspecting the Shipment



The CDM-750 Advanced High-Speed Trunking Modem, its Installation and Operation Manual, and its power cord were packaged and shipped in a reusable cardboard carton containing protective foam spacing.



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 (Figure 2-1):

Step	Task
1	Keep all shipping materials for storage or reshipment.
2	Check the packing list to ensure the shipment is complete.
3	Inspect the equipment for any possible damage incurred during shipment. Contact the carrier and Comtech EF Data immediately to submit a damage report if damage is evident.
4	 <i>Review this CDM-750 Advanced High-Speed Trunking Modem Installation and Operation Manual carefully to become familiar with operation.</i>
5	 <i>Proceed to Sect. 2.2 Installation into a Rack Enclosure.</i>

2.2 Installing into a Rack Enclosure



When mounting the CDM-750 into a rack enclosure (Figure 2-2):

- ***PROPER GROUNDING PROTECTION IS REQUIRED. The equipment must be connected to the protective earth connection at all times. It is therefore imperative that the unit is properly grounded, using the ground stud provided on the unit rear panel, during installation, configuration, and operation.***
- ***PROPER AIR VENTILATION IS REQUIRED. In a rack system where there is high heat discharge, provide forced-air cooling with top- or bottom-mounted fans or blowers.***
 - ***Make sure there is adequate clearance inside the enclosure, especially at the side for air ventilation.***
 - ***Air temperature inside the rack enclosure should **never** exceed 50°C (122°F).***

For information about custom rack enclosures, contact Comtech EF Data Customer Support during normal business hours or visit Comtech EF Data's Web site (www.comtechefdata.com/support.asp).

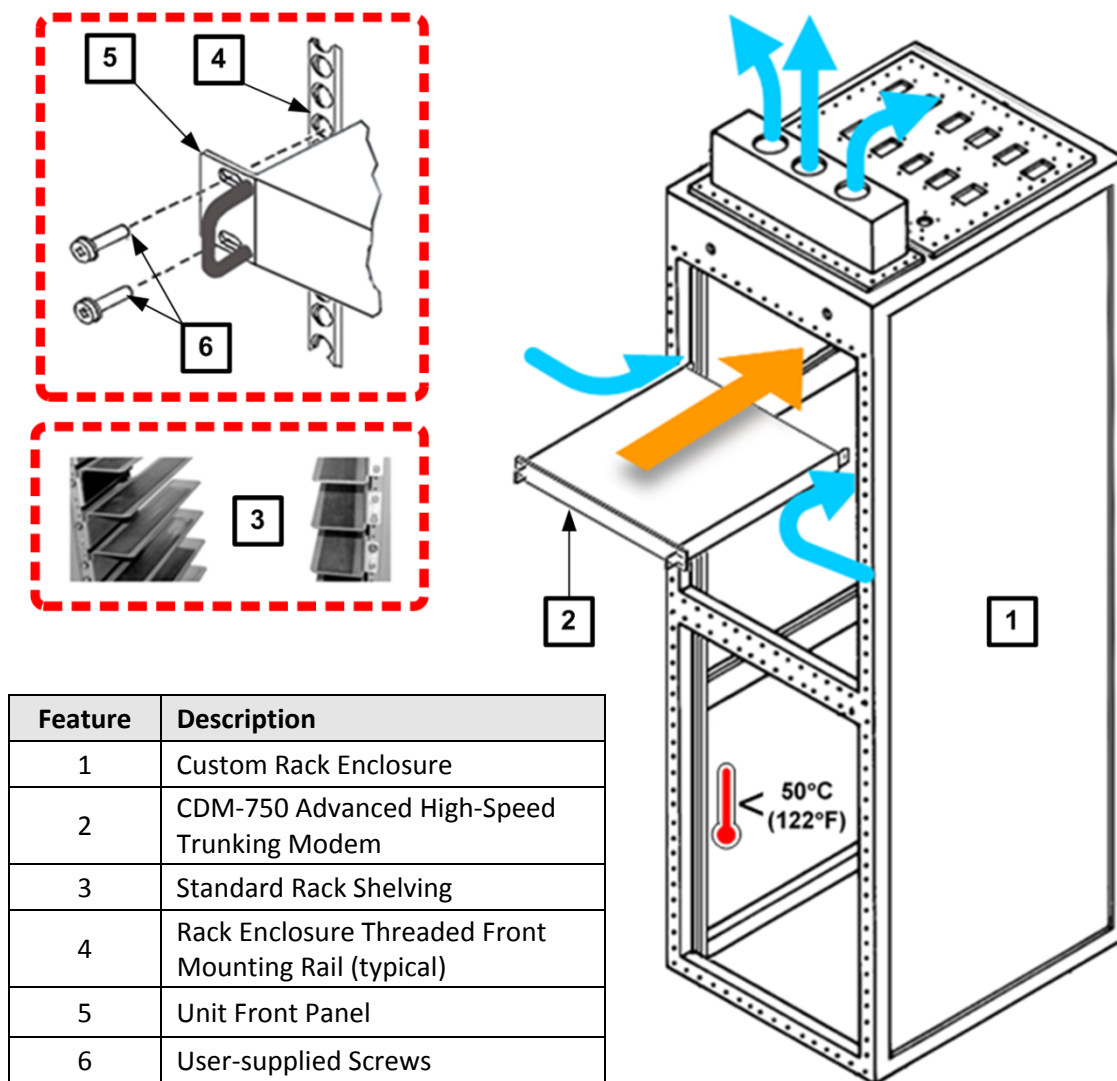
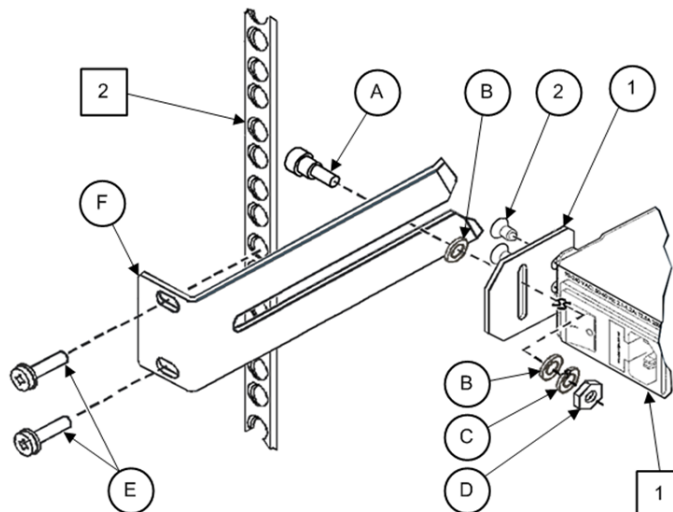


Figure 2-2. Installing into a Rack Enclosure

Mount the CDM-750 in its assigned position in the rack enclosure. 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-Mounting Support Brackets Kit (**Figure 2-3**).
- Comtech EF Data’s optional FP/SL0006 Bearingless Rack Slide Set

2.2.1 Installing the Optional Rear-Mounting Support Brackets Kit



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

KT-0000XXX Primary Rear Support Bracket 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. Installing the Optional Rear-Mounting Support Brackets Kit

Tools needed to install the KT-0000168 (4") or KT-0000195 (10") Bracket Kit (**Figure 2-3**):

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

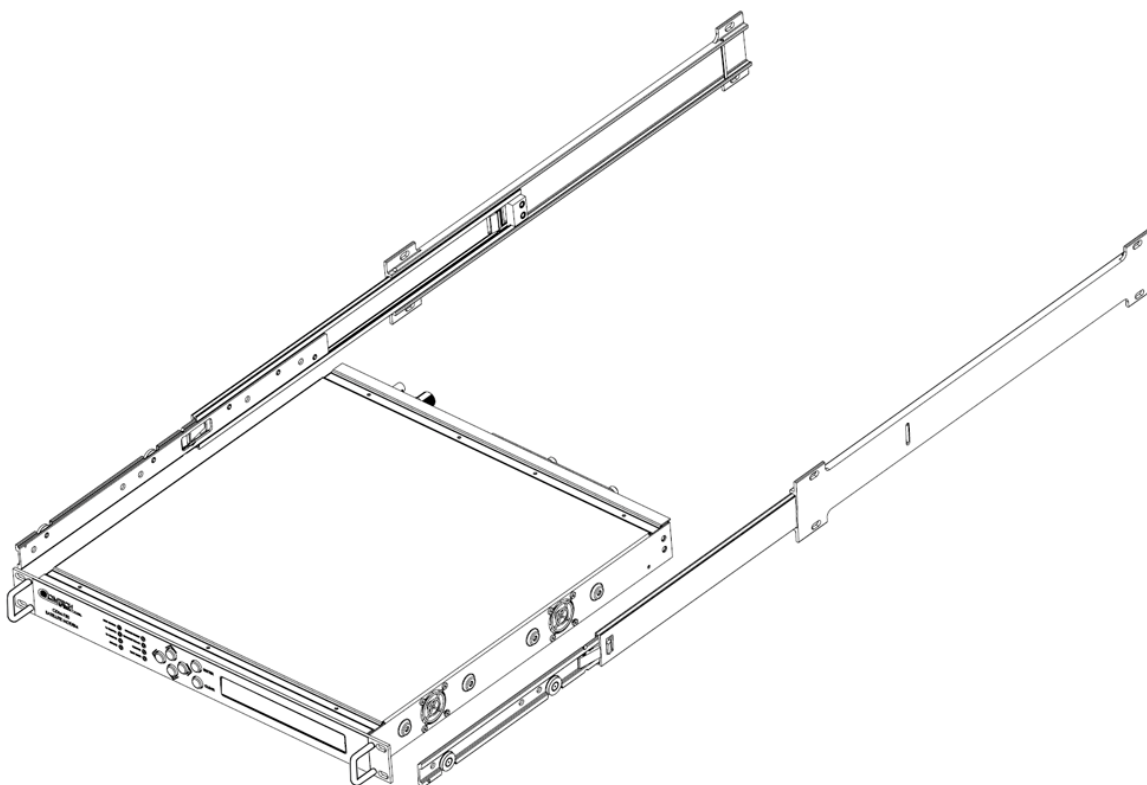
Follow these steps to install the *Radyne-style chassis* kit:

Step	Description
1	Assemble the Adapter Plates to the back side of the CDM-750 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-750 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 Installing 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-750 as shown in **Figure 2-4**. Follow these steps to install the rack slides:

Step	Task
1	Use the provided mounting hardware to install one slide onto each side of the CDM-750 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 enclosure to its final operating position. Then, use four user-provided screws to secure the modem to the enclosure's right and left threaded front mounting rails (through the modem front panel mounting slots).



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

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

Chapter 3. REAR PANEL CONNECTIONS

3.1 Cabling Connection Types

The CDM-750 Advanced High-Speed Trunking Modem uses a number of different cables. Each cable type is typically dedicated to a specific mode of operation.



Not all of these operational interface types may be available with this product.

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.

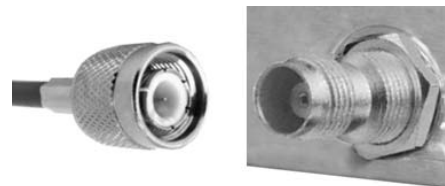
3.1.1.1 Type 'BNC'

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



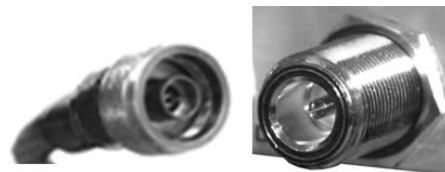
3.1.1.2 Type 'TNC'

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.



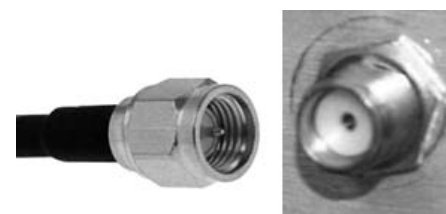
3.1.1.4 Type 'F'

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
<p>Chassis Receptacles: Female (top) Male (bottom)</p>	
<p>Type 'D' Cable with Jack Screws (female shown)</p>	

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.

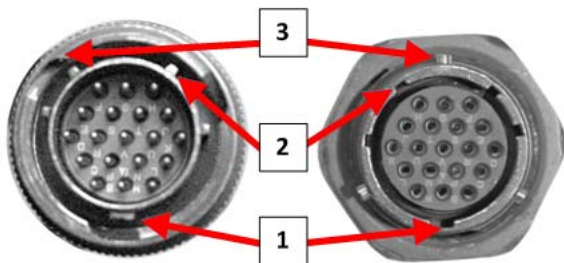
Either chassis receptacle gender features two jack nuts for secure assembly of the cable plug to the chassis receptacle.

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.

3.1.3 Circular Cable Connections

Circular connectors are intended for weatherproof outdoor applications. The connector pairs feature a sleeve lock configuration, with an array of pins (male side) coupled to mating sockets (female side).

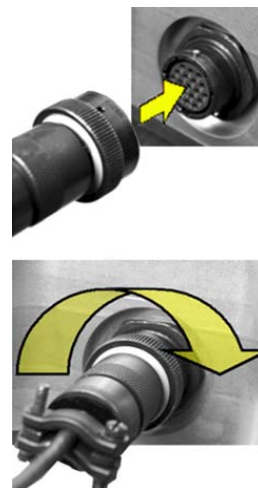


Feature	Description
1	Primary Alignment features
2	Secondary Alignment features
3	Sleeve Lock features

Connection Instructions: Engage all of the alignment and lock features between the male connector (on the interconnection cable) and female socket (e.g., the ODM/R-840 CONSOLE/REDUNDANCY port or the POWER port).

To install the male connector into the female connector:

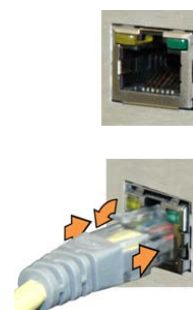
1. Engage the primary and secondary alignment tabs on the male connector with the mating cutouts on the female socket.
2. Push the male connector into the female socket.
3. Turn the male connector sleeve clockwise until the sleeve lock cutouts engage fully with the female socket tabs and you hear a “click” sound



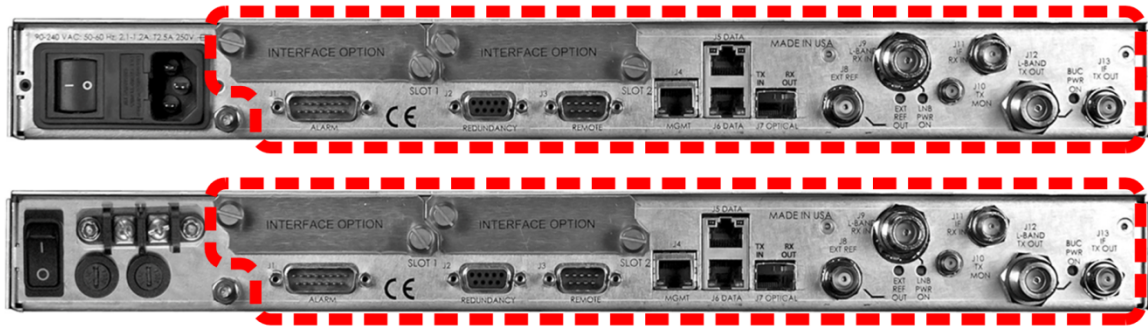
3.1.4 RJ-45, RJ-48 Cable Connections

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-4x jack. The connection is complete when the tab ‘clicks’ into position inside the jack.



3.2 CDM-750 Cabling Connections



(Top) Standard AC Unit
(Bottom) Optional 48V DC Unit (FUTURE)

Figure 3-3. CDM-750 Cabling Connections

The CDM-750 rear panel connectors (Figure 3-3) provide all necessary external connections between the unit and other equipment. Table 3-1 summarizes the available connectors, grouped according to service function.

Table 3-1. CDM-750 Rear Panel Connectors

Connector Group (Chapter 3 Sect.)	Ref Des	Name	Connector Type	Function
IF (Sect. 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 (Sect. 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 BaseT M&C
	J8	EXT REF	BNC female	External Reference Input / Output
Terrestrial Data (Sect. 3.2.3)	J5	DATA	RJ-45 female	10/100/1000 BaseT Gigabit Ethernet traffic
	J6	DATA		
	J7	OPTICAL	SFP (Small Form Factor Pluggable) Module cage	Accepts optional hot-pluggable SFP 1000Base-SX 850nm 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		



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



See Sect. 3.1 Cabling Connections Types for information about each connector type and its connection instructions.

3.2.1 IF Connector Group



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 Type 'N' **J9 | L-BAND RX IN** 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 Type 'N' **J12 | L-BAND TX OUT** connector features an LED labeled "BUC PWR ON". When a Block Up Converter (BUC) 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)
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 15-pin Type 'D' male (DB-15M) **J1 | ALARM** 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 LVTTTL 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 9-pin Type 'D' female (DB-9F) **J2 | REDUNDANCY** connector provides the 1:1 control interface. It provides serial communications to transfer configuration information from the Prime 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	LVTTTL 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)	LVTTTL Input
8	SER_DATA	Fault Serial Data Signal from modem	LVTTTL Output
3	TX_IF_MUTE_B	Capability to mute modem's Tx IF (Low=Mute) (Use pull-up on Modem side input)	LVTTTL Input
7	SER_CLK	Fault Serial Clock Signal 64KHz	LVTTTL Output
2	MDM_COM_IN	UART comm to modem from controller (9600 to115.2BUAD)	LVTTTL Input
6	MDM_COM_OUT	UART comm. from modem to controller (9600 to115.2BUAD)	LVTTTL Output
1	GND	Chassis Ground	Gnd

3.2.2.3 J3 | REMOTE Connector, DB-9M



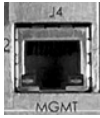
The 9-pin Type 'D' male (DB-9M) **J3 | REMOTE** connector provides the remote control interface via an M&C computer or terminal device. It is user selectable for either EIA-232 or EIA-485.

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 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 Connector, BNC



The female BNC **J8 | EXT REF** (External Reference) 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).

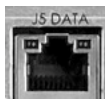
Ref Des	Name	Connector Type	Description	Direction (I/O)
J8	EXT REF OUT	BNC	External Reference	I/O

3.2.3 Terrestrial Data Connector Group

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



It is strongly suggested that the user does 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), as this may 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.

Each port features two LEDs that provide the following operational indicators:

LED	State	Activity
1 (left-hand)	Green	1000 Mbit activity (GigE) detected
	Amber	100 Mbit activity detected
	Off	10 MBit activity detected
2 (right-hand)	Yellow	Link detected
	Blinking Yellow	Activity detected
	Off	No Link detected

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



It is strongly suggested that the user does 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), as this may 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-750 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 (CEFD P/N IC-0000058)

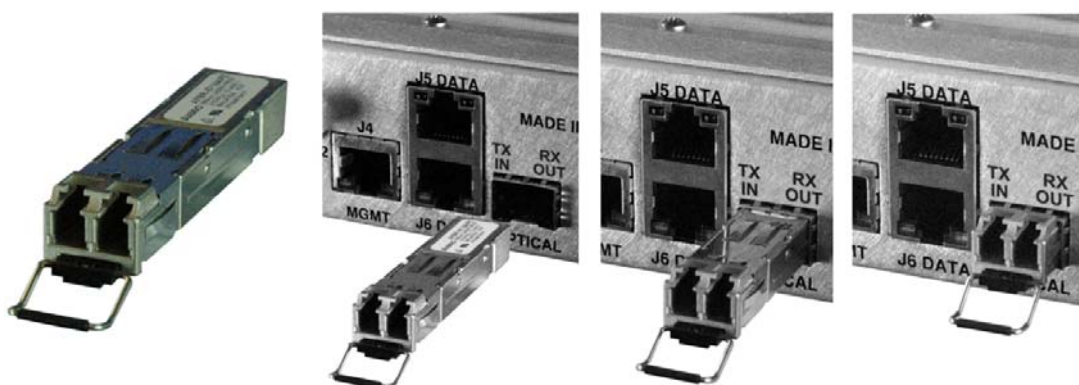


Figure 3-4. Typical SFP Module Installation

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-750 chassis **J7 | OPTICAL** port, or using the optional STM-1 Copper or OC-3 Single/Multi Mode PIIC module kits.

3.2.3.3 PIIC Data Interface Slots

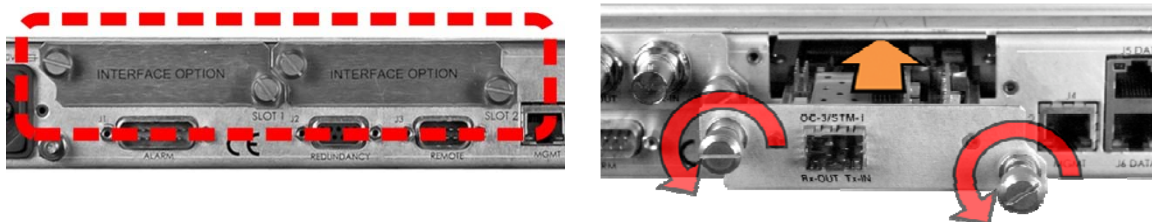


Figure 3-5. Typical PIIC Module Installation

The CDM-750 rear panel features two slots that accommodate optional PIIC (Plug-in Interface Card) data modules. The available PIIC modules are as follows:

CEFD Kit / Assembly	Description	For Details See Appendix B Sect.
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module	B.2.1
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module	B.2.2
KT-0000256	SFP OC-3 Single Mode PIIC Module	B.2.3
KT-0000257	SFP OC-3 Multi Mode PIIC Module	



Additional PIIC module data options (ASI, HSSI, etc.) will become available upon request.

Follow these steps to install the optional PIIC module(s) (Figure 3-5):

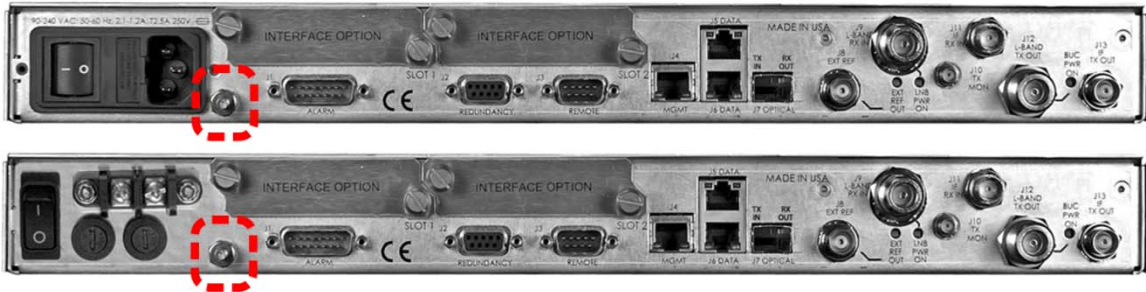
Step	Task
1	Remove the PIIC slot blank panel(s) by loosening the captive thumbscrews.
2	Install the data module(s) into position using the chassis' internal card guides. Slide the module straight back into the chassis until the module is firmly plugged into the mating receptacle(s).
3	Secure the captive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

3.3 CDM-750 Ground and Power Connections

3.3.1 Chassis Ground Interface



PROPER GROUNDING PROTECTION IS REQUIRED. The equipment must be connected to the protective earth connection at all times. It is therefore imperative that the unit is properly grounded, using the ground stud provided on the unit rear panel, during installation, configuration, and operation.



(Top) Standard AC Unit
(Bottom) Optional 48V DC Unit (FUTURE)

Figure 3-6. CDM-750 Chassis Ground Interface



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



The AC power interface provides the safety ground.

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

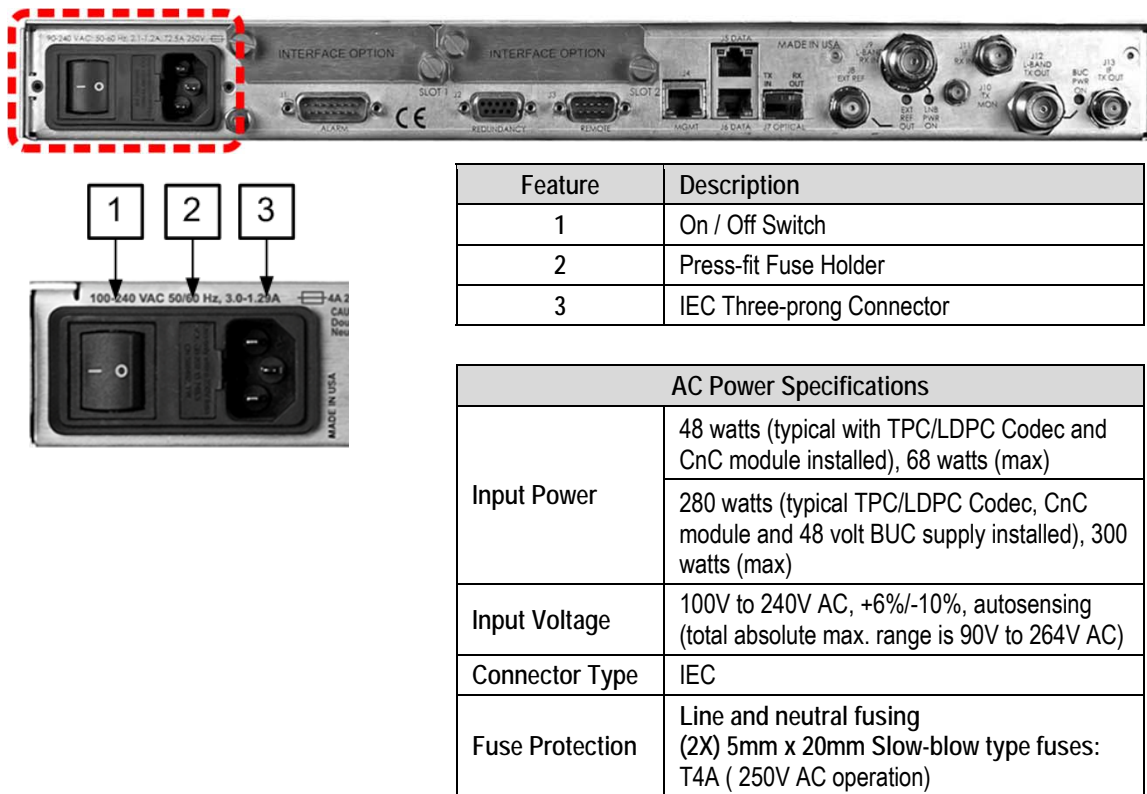


Figure 3-7. CDM-750 AC Power Interface

3.3.2.1 AC Operation – Applying Power



Figure 3-8. Applying AC Power to the CDM-750

To apply AC power to the CDM-750, follow these steps (Figure 3-8):

- First, plug the provided AC power cord female end into the unit.
- Then, plug the AC power cord male end into the user-supplied power source.
- Finally, switch the unit ON.

3.3.2.2 AC Operation – Replacing Fuses

For AC operation the CDM-750 uses two *common* 5mm x 20mm Slow-blow fuses – one each for line and neutral connections. The fuses are contained within a fuse holder that is press-fit into the body of the IEC power module (located on the rear panel, **Figure 3-9**).

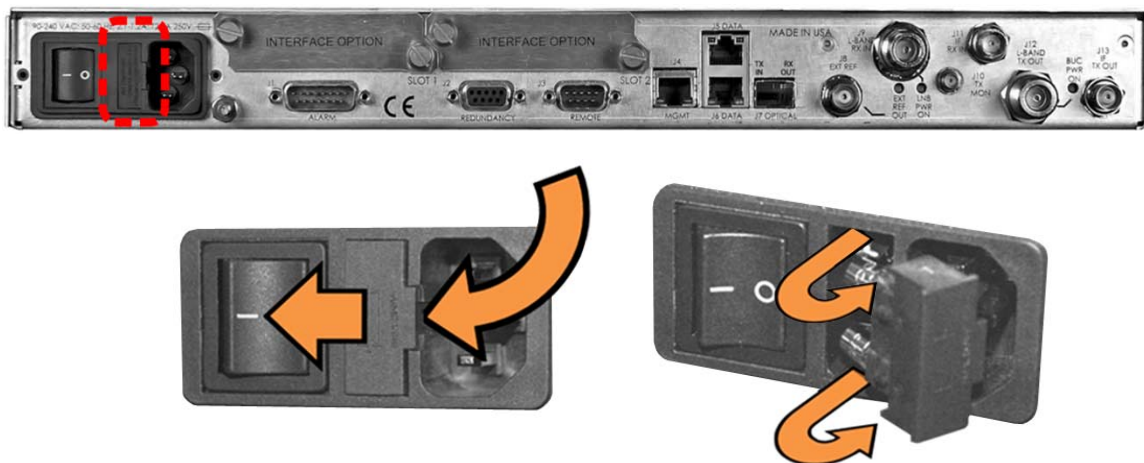


Figure 3-9. Replacing CDM-750 AC Fuses

To replace the fuse(s), follow these steps (Figure 3-9):



DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING!

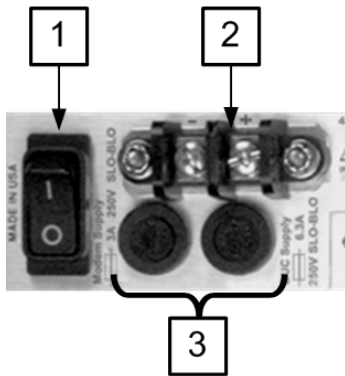
- First, unseat the fuse holder from the IEC power module.
 - Use the slot to pry the holder outward from the IEC power module.
 - Pull the holder straight out, and then swing the holder away from the module.
- Then, remove and replace the T4A (4 Amp) fuses as needed.



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

- Finally, re-seat the fuse holder in the IEC power module.

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



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 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 3-10. CDM-750 DC Power Interface

3.3.3.1 DC Operation – Applying Power

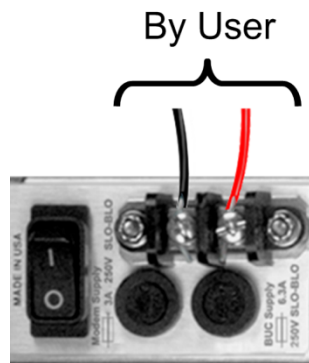


Figure 3-11. Applying DC Power to the CDM-750

To apply DC power to the CDM-750, follow these steps (Figure 3-11):

- First, connect the user-supplied (+) and (-) DC power leads to their respective terminals. *Number 18 AWG minimum wires are recommended.*
- Then, connect the user-supplied DC power leads to the power source.
- Finally, switch the unit ON.

3.3.3.2 DC Operation – Replacing Fuses

For DC operation the CDM-750 requires two *different* fuses that are contained within the individual screw-in receptacles below the terminal block (located on the rear panel, **Figure 3-12**).

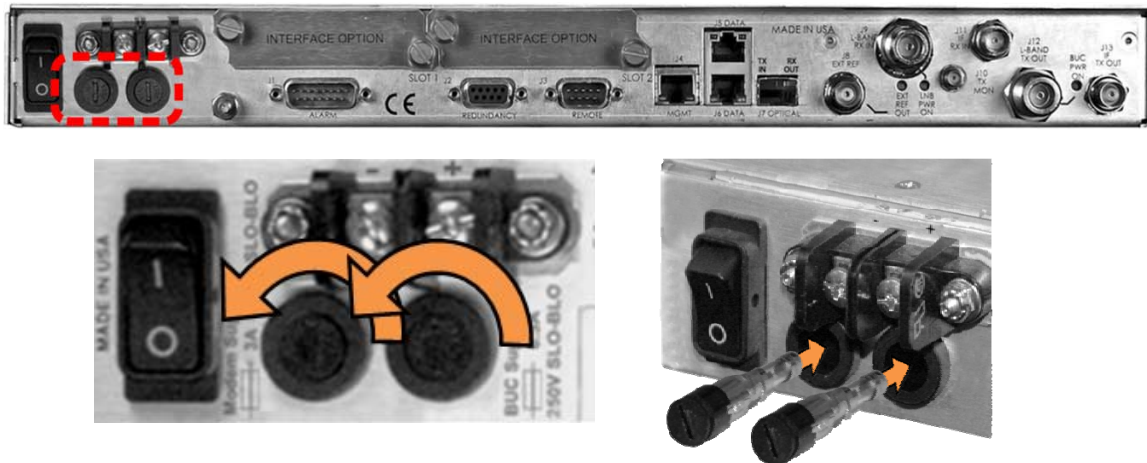


Figure 3-12. Replacing CDM-750 DC Fuses

To replace the fuses, follow these steps (Figure 3-12):



DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING!

- First, unscrew either fuse holder from its receptacle. Then, remove and replace the modem and/or the BUC 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 Upconverter (BUC) is installed (right-hand receptacle).



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

- Screw either fuse holder back into its receptacle.

Chapter 4. UPDATING FIRMWARE

4.1 Updating Firmware via the Internet



TO ENSURE OPTIMAL PERFORMANCE, IT IS IMPORTANT TO OPERATE THE CDM-750 WITH ITS LATEST AVAILABLE FIRMWARE.

BEFORE ATTEMPTING ANY ETHERNET FTP UPLOAD (SECT. 4.4), BE SURE TO READ THE IMPORTANT NOTE REGARDING CONDITIONAL FIRMWARE UPGRADE REQUIREMENTS.

The CDM-750 Advanced High Speed Trunking Modem is factory-shipped with its latest version of operating firmware. If a firmware update is needed, it can be acquired by download from the Comtech EF Data Web site (www.comtechefdata.com); or from Comtech EF Data Customer Support during normal business hours via e-mail or on CD by standard mail delivery.

The CDM-750 Firmware Update process is as follows:

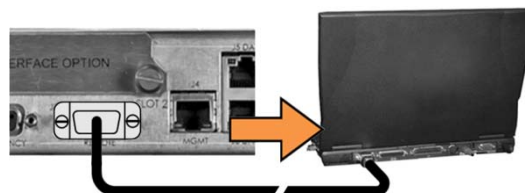
- Perform the update without opening the CDM-750 by connecting the rear panel 'J4 | MGMT' 10/100 Fast Ethernet port to the Ethernet port of a user-supplied PC.
- Download the firmware update via the Internet to the user PC.
- Transfer the firmware update, via File Transfer Protocol (FTP), from the user PC to the CDM-750.

4.2 Getting Started: Preparing for the Firmware Download

1. First, identify the CDM-750 assigned Management IP Address, and the firmware number/revision letter/version number.

User-supplied items needed:

- 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).
 - A 9-pin serial cable to connect the PC to the CDM-750.
 - A CAT5 Ethernet cable to connect the PC Ethernet port to the CDM-750.
- A. Use the 9-pin serial cable to connect the CDM-750 rear panel 'J3 | REMOTE' port to a serial port on the user PC.



- B. On the PC – Open the terminal emulator program.

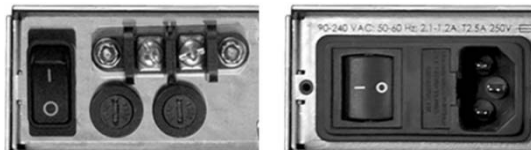


Refer to your terminal emulator program HELP feature or user guide for operating and configuration instructions.

Configure the utility program serial port communication and terminal display operation:

- 38400 bps (Baud Rate)
- 8 Data Bits
- 1 Stop Bit
- Parity = NO
- Port Flow Control = NONE
- Display New line Rx/Tx: CR
- Local Echo = ON

- C. On the CDM-750 – Turn on the power.



(Left) Optional CDM-750 48V DC Unit (**FUTURE**)
(Right) Standard CDM-750 115V/230V AC Unit

- D. Obtain the firmware information via one of the following methods:

- Using the CDM-750 Front Panel Keypad / VFD (Vacuum Fluorescent Display) – The firmware version number is displayed on the top-level 'splash' screen. Press the [CLR] several times to get to this display if not visible. Additionally, review the information provided on the **SELECT: Utility → Firmware → Info → Image#1** or **Image#2** screens.

- **On the user PC** – Use the terminal emulator program to log in to the CDM-750, and then use Serial or Telnet Remote Control to obtain, and make note of, the firmware information:
 - **Detailed:** Type (without the quotes) “<0/FRW?x<cr>” (where: x = B (Boot), 1 (Image 1) or 2 (Image 2)) at the command prompt to query the CDM-750 for its Firmware Number and Release Version.
 - **Abbreviated:** Type (without the quotes) “<0/SWR?<cr>”.



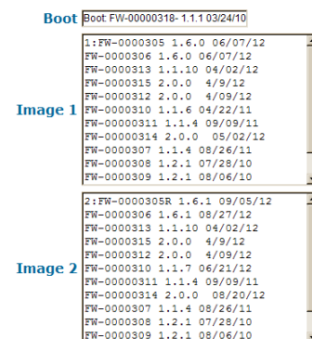
See Chapter 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT for information and instructions on using Serial Remote Control.

- **On the user PC** – Use the CDM-750 Web Server Interface ‘Status | Firmware’ page:

- First, use an Ethernet hub, switch, or direct cable connection to connect the CDM-750 rear panel ‘J4 | MGMT’ 10/100 Fast Ethernet port to an Ethernet port on the user PC.



- Then, use a Web browser (e.g., Internet Explorer) to log in to the CDM-750 Web Server Interface and review the ‘Status | Firmware’ page. There, make note of the firmware loads.



See Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT for information and instructions on using the CDM-750 Web Server Interface.

2. Next, create a temporary folder (subdirectory) on the user PC for the firmware archive download.



- While these examples use drive letter “c:” any valid writable drive letter can be used.
- Typical for all tasks: Type the command, without quotes, and then press Enter to execute.

There are several ways to create a temporary folder on a Windows-based PC:

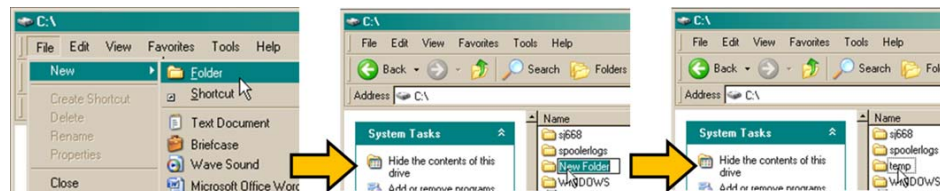
- A. Use the Windows Desktop to create and rename the temporary folder.

- Right-click anywhere on the desktop to open the popup submenu, and then select **New > Folder** to create the temporary folder. The new folder will be created on the desktop.
- Right-click on the new folder and then select **“Rename”** from the popup submenu. Rename this folder to **“temp”** or some other convenient, unused name.



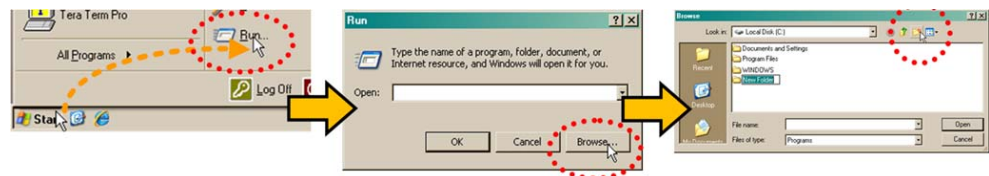
B. Use Windows Explorer to create and rename the temporary folder.

- Select **File > New > Folder** to create the temporary folder. The new folder will be created in the active folder.
- Right-click the **“New Folder”** folder name, and then rename this folder to **“temp”** or some other convenient, unused name.



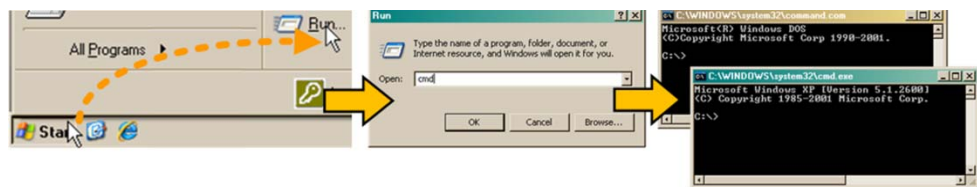
C. Use the ‘Run’ and ‘Browse’ windows to create and rename the temporary folder.

- Select **[Start]** on the Windows taskbar, and then click the **Run...** icon. The **‘Run’** window will open.
- Click **[Browse]** in the **‘Run’** window. The **‘Browse’** window will open.
- Click the **Create New Folder** icon in the **‘Browse’** window. The new folder will be created.
- Right-click the **“New Folder”** folder name, and then rename this folder to **“temp”** or some other convenient, unused name.

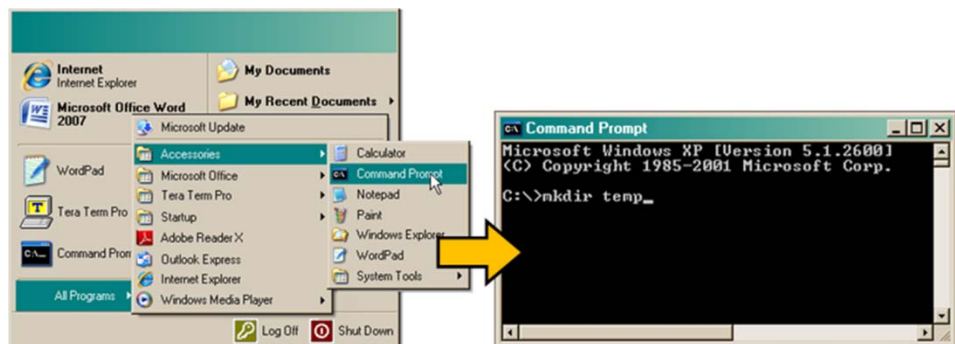


D. Use Windows Command-line to create the temporary folder.

- **First**, click **[Start]** on the Windows taskbar, and then click the **Run...** icon (or, depending on Windows OS versions *prior* to Windows 95, click the **MS-DOS Prompt** icon from the Main Menu).
- **Next**, 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 **All Programs > Accessories > Command Prompt**.
- Finally, from the **Command-line** prompt (**c:\>**), type “**mkdir temp**” or “**md temp**” (*mkdir* and *md* stand for *make directory*), and then click **[OK]**.



There should now be a "temp" folder created and available for placement of the firmware file download.

4.3 Downloading and Extracting the Firmware Update

1. First, download the firmware update file from the Comtech EF Data Web site:

- A. Go online to www.comtechefdata.com.
- B. On the *Main* page – under **Support Information** or the **Support** tab, select the **Software Downloads** hyperlink.
- C. On the *Software Downloads* page – click **Download Flash and Software Update Files**.
- D. On the *Flash & Software Update Files* page – select the **(Select a Product Line) Satellite Modems** hyperlink.
- E. On the *Satellite Modems* product page – select the **CDM-750** product hyperlink;
- F. Select the appropriate firmware archive EXE or ZIP file download hyperlink.



- **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-750 firmware download hyperlink appears as **F0000305X_V###**, where 'X' denotes the revision letter, and '###' represents the firmware version (e.g., V123 = Version 1.2.3).

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

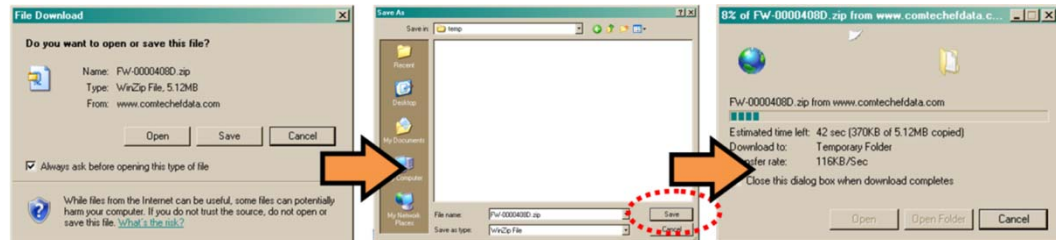
The ***.exe** file does not require a file archiver and compression utility program such as *PKZIP for Windows*, *WinZip*, *ZipCentral*, etc. (*PKZIP for DOS* is not supported due to file naming conventions). **Comtech EF Data does not provide this utility program.**

Some firewalls do not allow the download of ***.exe** files. Download the ***.zip** file instead, and extract the firmware files from the archive download with a user-supplied utility program. For detailed information on handling archived files, refer to the utility program Help documentation.

G. Download the archive file to the temporary folder.

- Once the **EXE** or **ZIP** hyperlink is selected, the **'File Download'** window opens and prompts selection of **[Open]** or **[Save]**:

- Click **[Open]** to turn over file extraction to the user-supplied utility program. Be sure to extract the firmware files to the “**temp**” folder created earlier.
- Click **[Save]** to open the ‘**Save As**’ window. Be sure to select and **[Save]** the archive ***.exe** or ***.zip** file to the “**temp**” folder created earlier.
- Otherwise, click **[Cancel]** to quit and exit the file download process.



2. Next, extract the firmware files from the archive file.

- (If not already done with **File Download > [Open]**) 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, at a minimum, two files:
 - **FW0000305x.bin** – the Firmware Bulk image file (where ‘x’ denotes the revision letter), and
 - **CDM-750_ReleaseNotes_v###.pdf** – the Firmware Release Notes PDF file (where ‘###’ denotes the firmware version number).

3. Confirm availability of the firmware files in the temporary folder.

There are several ways you may view the contents of the temporary folder on a Windows-based PC:

A. From the Windows Desktop:

- Double-left-click the “**temp**” folder saved to the Windows Desktop.
- Use **Windows Explorer** to locate, and then double-left-click the “**temp**” folder.
- Use the **Browse** window (**[Start] > ...Run > [Browse]**) to locate, and then double-click the “**c:\temp**” folder.

B. Using Command-line:

- Type “**cd c:\temp**” at the **Command-line** prompt to change to the temporary directory created earlier using **Command-line**.

- Type “**dir**” to list the files extracted to the temporary directory from the downloaded archive file.

The firmware files have been successfully downloaded and are now available for transfer to the CDM-750.

4.4 Performing the Ethernet FTP Upload Procedure



To proceed with the firmware update procedure, assumptions are made that:

- ***The CDM-750 is connected to a user-supplied, Windows-based PC, and:***
 - ***The PC serial port is connected to the CDM-750 ‘J3 | REMOTE’ port.***
 - ***The PC Ethernet port is connected to the CDM-750 ‘J4 | MGT’ 10/100 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-750 Serial or Telnet Remote Interfaces) and a compatible Web browser (for operation of the CDM-750 Web Server Interface).***
- ***The CDM-750 Management IP Address has been noted, and the firmware has been identified using the Front Panel, the Remote Interface, or the CDM-750 Web Server Interface ‘Status | Firmware’ page.***
- ***The latest firmware files have been downloaded or otherwise received from Comtech EF Data and are available on the user PC in an accessible temporary folder.***
- ***NOTE THAT CONDITIONAL FIRMWARE UPDATE REQUIREMENTS APPLY.***

If you are currently running Firmware Ver. 1.4.4 or earlier, before updating your unit with Firmware Ver. 1.6.0 or newer you must first update your unit with Firmware Ver 1.5.1. If your currently running Firmware is Ver. 1.5.1 or newer, this step is not necessary. Note that Firmware Ver. 1.5.1. is a gateway load that allows firmware versions newer than Ver. 1.4.4 to be loaded onto a CDM-750 – otherwise, Ver. 1.5.1 is identical in functionality to Firmware Ver. 1.4.4.

1. Use Command-line to send a “PING” command to confirm proper connection and communication between the user PC and the CDM-750:
 - ***If the Management IP Address of the unit is still not known, obtain this information via one of the following methods:***
 - ***Using the CDM-750 Front Panel Keypad / VFD – Review the information provided on the **SELECT: Configuration** → **IP** → **Addresses** → **Add/Range** screen.***

- **On the user PC** – Use the terminal emulator program to log in to the CDM-750, and then use Serial or Telnet Remote Control to obtain, and make note of, the IP address by typing (without quotes) “<0/IPA?<cr>”. The unit returns the configured Management IP Address in the form:

>0000/IPA=XXX.XXX.XXX.XXX/YY

- **On the user PC** – Use a Web browser (e.g., Internet Explorer) to log in to the **CDM-750 Web Server Interface** and review the ‘Admin | Access’ page. There, make note of the Management IP Address.

- **Once the Management IP Address is known, use Command-line to PING:**

Type “ping xxx.xxx.xxx.xxx” at the **Command-line** prompt (where ‘xxx.xxx.xxx.xxx’ denotes the unit Management IP Address). The response should confirm that the unit is properly connected and communicating.

2. Use Command-line to transfer (FTP) the files from the user PC to the CDM-750:

- Type “ftp xxx.xxx.xxx.xxx” (where ‘xxx.xxx.xxx.xxx’ denotes the unit Management IP Address).
- Enter the username and password assigned to the unit. The default username and password is “comtech”.
- Type “bin” to set the binary transfer mode.
- Type “prompt” and then “hash” to facilitate the file transfers.
- Type “put FW-0000305x.bin bulk:” (where ‘x’ denotes the revision letter) at the **Command-line** prompt to begin the file transfer. Bulk must be typed in lower case.

Once the upgrade file is transferred, the image is written to Flash memory. The process sequences through several blocks – during this time, the CDM-750 will report:

FTP Is In Progress
...PLEASE WAIT



1. *This screen will display for only a few seconds. Take care to observe this progress report to confirm when programming is complete.*
2. *In the event you receive the “Connection closed by remote host.” message, wait another minute before continuing. The CDM-750 update sometimes takes longer than the FTP client allows.*

- Type "bye" to terminate the FTP session, and then close the **Command-line** window.
- 3. Verify that the PC-to-Unit FTP file transfer was successful. Use the Front Panel, the Remote Control Interface, or the CDM-750 Web Server Interface '**Status | Firmware**' page to review the loaded firmware (per the methods explained in **Sect. 4.2, Step 1D**).
- 4. **Use the CDM-750 Front Panel or the Web Server Interface to select the firmware boot image and reboot the unit:**
 - **From the CDM-750 Front Panel / VFD** – First, use the keypad ◀ ▶ arrow keys to navigate to the **SELECT: Utility → Firmware → Select** screen. Then, use the keypad ▲ ▼ arrow keys to select the other image. Press **ENTER** when done.

The CDM-750 front panel will then display:

```
Cycle power now  
to boot from the selected image.
```

Use the rear panel ON/OFF switch to cycle the power as prompted. Be sure to note the firmware version that displays on the front panel 'splash' screen upon successful reboot:

```
Comtech CDM-750 Advanced High-Speed  
Trunking Modem      ver x.x.x
```



When booting into a new image, if the Top Card Application has been changed, an additional step will occur as the CDM-750 downloads to a different flash memory. This additional upload takes approximately two minutes.

During the reboot cycle, the following messages appear on the CDM-750 front panel display:

```
Programming ModemApp to ModemCard Flash.  
...PLEASE WAIT
```

Then:

```
ModemCard Flash programming was successfully  
completed.
```

- **On the user PC** – Use the CDM-750 Web Server Interface to select the **Boot Image** and **reboot the modem**.
 - Select the desired Boot Image slot from the *Firmware Image Config* section of the '**Configuration | Utilities**' page. Use the **Next Reboot Image:** drop-down list to select **Image1** or **Image2**.

- Click **[Submit]** to save this boot setting.



- Click **[Reboot Modem]** to reboot the CDM-750 from the *Firmware Image Config* section of the 'Configuration | Utilities' page. Wait while the CDM-750 reboots.



The CDM-750 is now operating with its latest firmware. The firmware update process is now complete.

Chapter 5. FRONT PANEL OPERATION

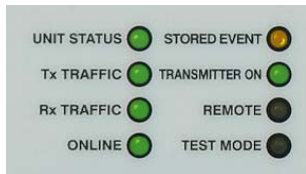
5.1 Introduction



Feature	Description	Function	See Chapter Section...
1	LED Indicators	The LEDs indicate, in a summary fashion, the status of the modem.	5.1.1
2	Keypad	Enter data via the keypad. The keypad comprises six individual keyswitches. The keys have a positive 'click' action that provides tactile feedback. Data, prompts, and messages are displayed on the VFD.	5.1.2
3	Vacuum Fluorescent Display (VFD)	The VFD is an active display, with adjustable brightness, showing two lines of 40 characters each. Nested menus display all available options and prompts that guide you in carrying out required actions.	5.1.3
4	Rack Handles	These handles allow easy placement into and removal from a rack.	2.2

Figure 5-1. CDM-750 Front Panel View

5.1.1 LED Indicators



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

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

LED	Indication	Description
UNIT STATUS	Green	No Unit Faults, or Traffic (Tx or Rx) Faults
	Amber	A Unit, Tx, or Rx Alarm exits
	Red	A Unit, Tx or Rx Fault exists (Example: PSU fault)
Tx TRAFFIC	Green	The Tx Traffic path hardware and firmware are <u>not</u> faulted
	Off	The Tx Traffic path hardware and/or firmware are <u>faulted</u>
Rx TRAFFIC	Green	Tx Traffic is passing normally (demod and decoder are locked, everything is OK)
	Off	An Rx Traffic fault exists (the demod may still be OK) NOTE: By convention demodulator unlock is a fault – even though it is likely due to a missing carrier
ONLINE	Green	The Unit is <i>online</i> , and carrying traffic
	Off	The Unit is <i>offline</i> (standby) – forced by externally connected 1:1 or 1:N redundancy system
STORED EVENT	Amber	There is a Stored Event in the log, which can be viewed from the front panel, or retrieved via the remote control interface
	Off	There are no Stored Events
TRANSMITTER ON	Green	The Tx IF is ON.
	Off	The Tx IF is OFF.
REMOTE	Amber	The Unit is in Remote Mode – Remote monitoring and control is available. Local monitoring and control is always available.
	Off	The Unit is in Local Mode – remote <i>monitoring</i> is possible, but remote <i>control</i> is <u>not</u> available.
TEST MODE	Amber	A Test Mode is selected (Example: IF Loopback)
	Off	There is no Test Mode currently selected

5.1.2 Keypad



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

The function of the keypad is as follows:

Key	Use this key to...
ENTER	...display the nested menu for a selected function, or to execute (save) a configuration change. From the opening screen, press ENTER <i>once</i> to display the SELECT: (Main) menu.
CLEAR	...back out of a selection or to cancel a configuration change that has not been executed using ENTER . Press [CLR] to return to the previous menu screen or, if pressed <i>repeatedly</i> , to the opening screen. From the opening screen, press CLEAR <i>once</i> to display the SELECT: (Main) menu.
◀ ▶ (Left, Right)	...navigate between available selections, or to move the cursor position, on any menu screen.
▲ ▼ (Up, Down)	...scroll through pre-defined parameter settings that are available at the current cursor position, and to change (edit) the alphanumeric selection (i.e., numbers for configuration data, letters for text strings) at the current cursor position.

5.1.3 Vacuum Fluorescent Display (VFD)

The CDM-750 features 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.

5.1.3.1 Opening Screen



The opening screen is displayed whenever power is first applied to the unit. After turning on the prime power, this VFD 'splash' display identifies the product – i.e., 'CDM-750 Advanced High-Speed Trunking Modem' – and the version number of the installed firmware.

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

You may access the opening screen from any location within the CDM-750 menu structure by pressing the **[CLEAR]** key repeatedly. Otherwise, press any key to access the top-level **SELECT:** (main) menu.

5.1.3.2 Screen Saver



If the operating unit is left displaying the same screen for weeks at a time, the VFD could become 'burnt' with this image. To prevent such 'burn-in' a 'screen saver' feature activates after 1 hour. The message moves from right to left across the screen, and then wraps around.

The top line of the display shows the user-definable Circuit ID. The bottom line displays the demod lock status message (either 'Demod not locked' or the circuit Eb/No value when the demod is locked) followed by 'Press any key....' Press any key to return to the previous screen.

5.2 CDM-750 Front Panel Menus

Table 5-1 identifies the primary and nested menu branches available via the CDM-750 front panel; the chapter sections providing detailed instructions for using the submenus available within these menu branches are also listed here.

Table 5-1. CDM-750 Front Panel Menu Matrix

Menu Branch	Sect.	Branch Functional Description and Available Nested Selections
Opening Screen	5.1.3.1	Press ENTER to access the SELECT: (main) menu or, from any other screen, press CLEAR to return to this screen. This top-level (splash) screen identifies the product and its running firmware version.
Select (Main) Menu	5.2.1	<i>SELECT: Configuration Test Monitor Info Store/Ld Utility ODU FAST</i> Use to access all monitor and control submenus.
Configuration	5.2.2.	<i>CONFIG: Intf Tx Rx Clocks ACM CnC Misc Mask Remote IP Comp</i> Select to fully configure the modem.
Test	5.2.3	<i>TEST: Mode BERT Comp</i> Use to configure the modem into one of several test modes or to configure/monitor the BER Tester.
Monitor	5.2.4	<i>Monitor: Live-Alarms Stored-Events ACM Rx-Params CnC Stats Buffer</i> Use to monitor the current status of the modem and view the log of stored events for the modem.
Info	5.2.5	<i>(Information) Info: ID Intf Tx Rx Clocks ACM CnC Misc Mask Remote Comp</i> Use to view information on the modem, without having to go into the Configuration screens.
Store/Ld	5.2.6	<i>(Store/Load) (Select from Configuration #0 through #9): Load Store</i> Use to store and retrieve up to 10 different modem configurations.
Utility	5.2.7	<i>Utilities: Set-RTC Display-Brightness LED 1:1 1:N Circuit-ID Firmware</i> Use to perform miscellaneous functions, such as setting the Real-Time Clock, adjusting the display brightness, etc.
ODU	5.2.8	<i>ODU: BUC: PwrSupply+Ref LNB PwrSupply+Ref FSK-control</i> When installed and available, use to configure Outdoor Unit (BUC – Block Up Converter or LNB – Low-Noise Block Down Converter) operations.
FAST	5.2.9	<i>FAST: Options Demo-Mode CnC</i> Use to verify installed options and configure different Fully Accessible System Topology options, e.g., extended data rates, interfaces, etc. Contact Comtech EF Data Customer Support for details.



The actual choices displayed in the submenus may vary according to which FAST options are enabled. Where a FAST option affects a menu, this is identified in descriptive sections that follow in this chapter.

5.2.1 SELECT: (Main) Menu

```
SELECT: Configuration  Test  Monitor
Info Store/Ld Utility  ODU  FAST ◀ ▶
```

The **SELECT:** (main) menu provides user access to all modem configuration, monitor and control menu branches. See **Table 5-1** for the functional description/overview, and pertinent chapter section for each menu branch.

Use the ◀ ▶ arrow keys to select **Configuration, Test, Monitor, Info, Store/Ld, Utility, ODU, or FAST**, and then press **ENTER**.

5.2.2 SELECT: Configuration

```
CONFIG:          Intf  Tx  Rx  Clocks  ACM
CnC  Misc  Mask  Remote  IP  Comp  ◀ ▶
```

Use the ◀ ▶ arrow keys to select from the submenu choices shown, and then press **ENTER**.

CONFIG Submenu	Sect.	Description
Intf	5.2.2.1.	Use to configure the operating status of the installed optional Plug-in Interface Cards (PIICs) and optional Optical port (J7 OPTICAL), plus the operating speed of Gigabit Ethernet Interface Ports 1 (J5 DATA) and 2 (J6 DATA).
Tx	5.2.2.2	(Transmit) Use to define, on a parameter-by-parameter basis, the Tx configuration of the unit.
Rx	5.2.2.3	(Receive) Use to define, on a parameter-by-parameter basis, the Rx configuration of the unit.
Clocks	5.2.2.4	Use to select and configure the Frequency Reference as External or Internal and fine-adjust the Internal Hi-Stability 10 MHz Reference.
ACM	5.2.2.5	(Adaptive Coding and Modulation) Use to configure ACM operating parameters.
CnC	5.2.2.6	(DoubleTalk Carrier-in-Carrier) Use to select DoubleTalk Carrier-in-Carrier (CnC) options.
Misc	N/A	MENU ITEM CURRENTLY NOT AVAILABLE
Mask	5.2.2.7	Use to determine if certain operational criteria should be treated as faults or alarms, or if you desire to mask (ignore) the conditions.
Remote	5.2.2.8	(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	5.2.2.9	Use to configure various IP parameters, including IP address/range and gateway addresses, and to view MAC addresses.
Comp	5.2.2.10	Use to configure optional K4 GZip lossless compression and decompression operation.

5.2.2.1 CONFIG: Intf (Configure Interface)

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

Use this screen to view the installed availability of each available data interface type and its currently configured state. The *read-only top line* specifies each interface; directly below each heading, the **bottom line** displays the current configured installed and configured state for that interface. On the bottom line, use the ◀ ▶ arrow keys to select a configurable interface, and then press **ENTER**. Then, use the ▲ ▼ arrow keys to change the setting for that interface. Press **ENTER** when done. Note the following display states for this submenu:

Interface (Top line)	Indication (Bottom Line)	Description
<i>Gigabit Ethernet:</i> GBE1 (J5 DATA port) and GBE2 (J6 DATA port)	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.
<i>Optional Plug-In Interface Card Slots:</i> PIIC1 (Interface Slot1) and PIIC2 (Interface Slot 2)	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)).
<i>Optional Optical Ethernet:</i> J7 OPTICAL port	NONE	The interface is either disabled or there is no SFP module present.
	Off	The interface is enabled, and the SFP is present but it is not in use.
	On	The interface is enabled and the SFP is present. All communications via this port is 1000 Base-T (GbE), auto-negotiating only .



User selections on this screen are dependent on whether the modem is in Single Stream Mode or MultiStream Mode.

5.2.2.1.1 Single Stream Mode vs. MultiStream Mode Operation

Single Stream Mode is the conventional way to transport a single type of traffic data over satellite, whereas MultiStream Mode allows more than one type of traffic data to be active at the same time. Note the following:

- **For Single Stream Mode:**
 1. A single PIIC module is installed and active and all other interfaces are either not installed (i.e., **NONE**) or are installed but not active (i.e., **Off**), or
 2. Any combination of Gigabit Ethernet (**GBE1 / J5 | DATA** port, **GBE2 / J6 | DATA** port, or **Optical / J7 | OPTICAL** port) is enabled, but neither PIIC slot is active (i.e., **NONE** or **Off**).



The three Gigabit Ethernet data interfaces are considered a single data interface type, regardless if one or more of these interfaces are active.

- **For MultiStream Mode:**
 1. MultiStream Mode is an internal multiplexing (MUX) and de-multiplexing (De-MUX) of data interface types, which allows two or more data traffic types to co-exist simultaneously in a single carrier.
 2. 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.
 3. Adaptive Coding and Modulation (ACM) is non-functional while in MultiStream Mode. All other WAN optimization features (Carrier-in-Carrier, GZip compression, etc.) are functional in MultiStream Mode.
 4. 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, using 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 $(34.368 + 34.368) * 1.015 = 69.768$ Mbps. Any data rate that is ABOVE this minimum data rate is given to the GbE interfaces – meaning, per the preceding computation, if the modem Tx was set to 100 Mbps, then the remaining 30.232 Mbps ($100\text{Mbps} - 69.767\text{Mbps} = 30.232\text{Mbps}$) would be allocated to the Ethernet traffic type.

5. The best practice when entering or leaving MultiStream Mode is to perform the following procedures:

A. ENTERING INTO MULTISTREAM MODE

Step	Task
1	Use the ◀▶ arrow keys to select the CONFIG: Intf menu.
2	Select any combination of GbE interface operation (GBE1 / J5 DATA port, GBE2 / J6 DATA port, or Optical / J7 OPTICAL port), and ensure that both interface slots (PIIC1 and PIIC2) are either not installed (NONE) or not active (Off).
3	Configure the modem settings for MultiStream Mode operation: <ul style="list-style-type: none"> • Select the Tx parameters for the carrier that will act as the aggregate carrier of all interface types to be transmitted. • Choose the proper ModCods, Pilots, Symbol Rate, etc. to ensure that your total Tx uplink can accommodate all of the interface types that you intend to multiplex together.
4	Once you have completed Step 2, you will know your total Tx data rate that the modem can accommodate, This Tx data rate must be able to support the aggregate interface type services you plan to transmit.
5	Return to the CONFIG: Intf menu to enable one or both of the PIIC data interface traffic types.
6	If the PIIC interface type(s) requires more Tx data rate capacity than what had been configured for the modem, the CONFIG: Intf type selection for the PIIC interface(s) will reject the PIIC settings executed in Step 5. Return to Step 1 to make the necessary corrections.

B. EXITING OUT OF MULTISTREAM MODE

Step	Task
1	Use the ◀▶ arrow keys to select the CONFIG: Intf menu.
2	FIRST, disable both interface slots (PIIC1 and PIIC2), ensuring that both are either not active (Off), or not installed (NONE).
3	NEXT, disable all GbE interfaces, ensuring that all three are either not active (Off) or, as it applies to the J7 OPTICAL port SFP module, not installed (NONE).
4	Enable a single PIIC interface, or any combination of the GbE interfaces.
5	Use the ◀▶ arrow keys to select the CONFIG: Tx → Data → Tx Data Rate menu. There, confirm that the Tx Data Rate MIN_DR variable is displayed as 000000.000 .

After configuring the Tx side of the link, configure the Rx side of the link for Single Stream or MultiStream Mode. You only need to configure the Rx Symbol Rate, Gold-n Index Code, and the correct selection of interfaces:

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 Gold-n Index Code. Use the ◀ ▶ arrow keys to select the CONFIG: Rx→ Pilot menu. Set the Rx Gold-n Index Code to match the far side modem Tx Gold-n Code.
3	The interfaces should already have been properly selected and configured during the Tx configuration tasks explained in 5(A).

5.2.2.1.2 (CONFIG) INTF: PIICX = G703



This menu is not accessible if a PIIC G.703 E3/T3/STS-1 module is not installed in a PIIC slot.

```
PIICX: IntfType ClkSource RxBuffer Mask
G703-Off                ( ◀ ▶ )
```

Where **X** designates the optional G.703 interface as being installed in Plug-In Interface Card slot **1** (PIIC1) or slot **2** (PIIC2): Use the ◀ ▶ arrow keys to select **IntfType**, **ClkSource**, **RxBuffer**, or **Mask**, and then press **ENTER**.

Typical for all configurations, the state of the PIIC interface is displayed on the bottom line. The first half of this indication displays the installed state of the module – in this example, this display confirms that the G.703 E3/T3/STS-1 module is *installed* into the PIIC slot. The second indication displays the operational state of the installed module – this display example confirms that, while the module is *installed*, the interface is **Off** (i.e., not in use).

(CONFIG: INTF) PIICX (G703) → IntfType

```
Interface Type: NONE
                ( ◀ ▶ )
```

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



Selecting NONE disables the interface. The CONFIG: Intf menu will display the operational status for that slot as Off. Otherwise, All other selections enable the PIIC interface for the appropriate interface type.

In Single Stream (non-multistream) Mode, enabling a G.703 PIIC interface and the selection of T3, E3 or STS1 will fix the data rate of the modem to the appropriate speed. Symbol rate will be

slaved to this fixed data rate and will change when modulation, coding, pilots or Tx frame block size is changed. Selection of these interfaces may not be possible if the symbol rate license or CnC license will not support the symbol rate or data rate.

(CONFIG: INTF) PIICX (G.703) → ClkSource

```
Clock Source: ExtClock TxClock RxClock  
              1 MHz      TXC      RXS (◀ ▶)
```

Use the ◀ ▶ arrow keys to select **ExtClock**, **TxClock**, or **RxClock**, and then press **ENTER**. The bottom line displays the current setting for each parameter.

(CONFIG: INTF) PIICX (G.703) → ClkSource → ExtClock

```
ExtClock: 1 MHz  
                                                (◀ ▶)
```

To set the expected clock rate for the external clock source located 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), and then press **ENTER**.

(CONFIG: INTF) PIICX (G.703) → ClkSource → TxClock

```
Tx Clock Source: TX CLK  
                                                (◀ ▶)
```

To lock the Tx symbol rate of the modulator to the appropriate clock source: Use the ▲ ▼ arrow keys to select **EXT CLK**, **RX SAT**, or **TX CLK**, and then press **ENTER**.



Comtech EF Data strongly suggests that TX CLK is selected here, 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 (G.703) → ClkSource → RxClock

```
Rx Clock Source: RX CLK  
                                                (◀ ▶)
```

To set the clock source by which Rx data will be 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**, and then press **ENTER**.



Comtech EF Data strongly suggests that RX CLK is selected here, 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 (G.703) → RxBuffer

```
Rx Buffer: BufferSize ReCenter
          Fill Status = 00%      ( ◀ ▶ )
```

Use the ◀▶ arrow keys to select **BufferSize** or **ReCenter**, and then press **ENTER**.

The bottom line displays the present RxBuffer Fill Status as a percentage. If the RxBuffer Fill Status is *dropping* (approaching 0%), this indicates that the Rx traffic is not keeping up with the Rx Clock setting and a **data underflow** is occurring. If the RxBuffer Fill Status is *increasing* (approaching 100%) the Rx traffic is coming in faster than the Rx Clock setting accommodates, and a **data overflow** is occurring.

(CONFIG: INTF) PIICX (G.703) → RxBuffer → BufferSize

```
Rx Buffer Size: 02.0 ms
                                     ( ◀ ▶ )
```

Use the ▲▼ arrow keys to increment/decrement the Rx Buffer Size time value (from 2 ms to 75 ms in 0.5 ms steps), and then press **ENTER**.

(CONFIG: INTF) PIICX (G.703) → RxBuffer → ReCenter

```
Rx Buffer: ReCenter
                                     ( ◀ ▶ )
```

In the event of data underflow or overflow (as indicated by the Fill Status percentage reported on the RxBuffer menu) press **ENTER** to ReCenter the Rx Buffer depth to 50%.

(CONFIG: INTF) PIICX (G.703) → Mask

```
Masks: TxPll      InpSigLoss ExtClkAct
          RxPll      RxOF      RxUF      ExtClkInRange
```

To define how many or how few of the interface alarm or fault states are reported: Use the ◀▶ arrow keys to select **TxPll**, **InpSigLoss**, **ExtClkAct**, **RxPll**, **RxOF**, **RxUF**, or **ExtClkInRange**, and then press **ENTER**. Note the following:

Item	Description
TxPLL	(Alarm) The Tx Clock PLL is railed high or low indicating that the Tx Clock Source is substantially different than the rate of the Tx data.
InpSigLoss	(Alarm) Input Signal Loss indicates that no traffic is being seen by the G.703 interface on the TX-IN connector.
ExtClkAct	(Alarm) External Clock Activity indicates that the External Clock is selected by either the TxClock or RxClock but no clock is present on J8.

Item	Description
RxPLL	(Alarm) The Rx Clock PLL is railed high or low indicating that the Rx Clock Source is substantially different than the rate of incoming data.
RxOF	(Alarm) Rx Overflow indicates that the traffic received by the demod is exceeding the clock RxClock setting and is therefore overflowing the buffer causing the buffer to re-center and take a data hit.
RxUF	(Alarm) Rx Underflow indicates that the traffic received by the demod is not keeping up with the clock RxClock setting and is therefore underflowing the buffer causing the buffer to re-center and take a data hit.
ExtClkInRange	External Clock In Range indicates that the External Clock is selected by either the TxClock or RxClock but the clock rate on J8 does not meet the expected rate by the modem. Note: When ExtClkAct IS NOT in an Alarm or Fault condition but the ExtClkInRange IS in Alarm or Fault condition, it is an indication that the clock source rate and the modem's programmed External Clock rate are different.

Using the **TxPLL** menu as the example:

```
Tx Pll Mask:Fault
Alarm Fault Mask Fault-Tx On
```

The top line notes the active mask selection. On the bottom line, use the ◀ ▶ arrow keys to select **Alarm**, **Fault**, **Mask**, or **Fault-Tx On**, and then press **ENTER**. (For the **RxPll**, **RxOF** and **RxUF**, menus, only **Alarm**, **Fault**, and **Mask** are provided.) Note the following:

Mask Type	Description	Redundancy Switchover and Tx Mute
Alarm	Alarms can be viewed from the Monitor: Live Alarms menu (Sect.5.2.4.1). Alarms cause the Unit Status LED to turn AMBER.	An alarm WILL NOT cause a redundancy switch and WILL NOT mute the Tx carrier
Fault	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2) . Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault 	A fault WILL cause a redundancy switch and WILL mute the Tx carrier
Mask	Masking the event has the effect of ignoring the event – it can no longer be logged and is not seen in any menu.	Mask WILL NOT cause a redundancy switch and WILL NOT mute the Tx carrier
Fault-Tx On	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2) . Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault 	A Fault-Tx On WILL cause a redundancy switch and WILL NOT mute the Tx carrier

5.2.2.1.3 (CONFIG) INTF: PIICX = OC3



This menu is not accessible if a PIIC OC-3 Single or Multi Mode module, or an STM-1 Copper module is not installed in a PIIC slot.

```
PIICX: IntfType ClkSource RxBuffer Mask
OC3-Off                               ( ◀ ▶ )
```

Where **X** designates the optional OC-3 or STM-1 interface as being installed in Plug-In Interface Card slot 1 (PIIC1) or slot 2 (PIIC2): Use the ◀ ▶ arrow keys to select **IntfType**, **ClkSource**, **RxBuffer**, or **Mask**, and then press **ENTER**.

The state of the PIIC interface is displayed on the bottom line. The first half of this indication displays the installed state of the module and its SFP – in this example, this display confirms that the OC-3 Single or Multi Mode SFP, or the STM-1 Copper module and accompanying SFP are installed into the PIIC slot. The second indication displays the operational state of the SFP – this display example confirms that, while the module SFP is plugged in, the interface is **Off** (i.e., not in use).

(CONFIG: INTF) PIICX (OC3) → IntfType

```
Interface Type: NONE
                                                    ( ◀ ▶ )
```

Use the ▲▼ arrow keys to select **NONE** or **OC3/STM-1** and then press **ENTER**.



Selecting NONE disables the interface. The CONFIG: Intf menu will display the operational status for that slot as Off. Otherwise, Selecting STM-1 enables the PIIC interface for this interface type.

(CONFIG: INTF) PIICX (OC3) → ClkSource

```
Clock Source: TxClock RxClock
                TXC      RXS          ( ◀ ▶ )
```

Use the ◀ ▶ arrow keys to select **TxClock**, or **RxClock**, and then press **ENTER**. The bottom line displays the current setting for each parameter.

(CONFIG: INTF) PIICX (OC3) → ClkSource → TxClock

```
Tx Clock Source: TX CLK
                                                    ( ◀ ▶ )
```

To lock the Tx symbol rate of the modulator to the appropriate clock source: Use the ▲▼ arrow keys to select **RX SAT** or **TX CLK**, and then press **ENTER**.

(CONFIG: INTF) PIICX (OC3) → ClkSource → RxClock

```
Rx Clock Source: RX CLK          ( ◀ ▶ )
```

To set the clock source by which Rx data is clocked out of the OC3/STM-1 interface to the external baseband equipment: Use the ▲▼ arrow keys to select **RX SAT**, **INT CLK**, or **TX CLK**, and then press **ENTER**.

(CONFIG: INTF) PIICX (OC3) → RxBuffer

```
Rx Buffer: BufferSize  ReCenter  
          Fill Status = 00%      ( ◀ ▶ )
```

Use the ◀▶ arrow keys to select **BufferSize** or **ReCenter**, and then press **ENTER**.

The bottom line displays the present RxBuffer Fill Status as a percentage. If the RxBuffer Fill Status is *dropping* (approaching 0%), this indicates that the Rx traffic is not keeping up with the Rx Clock setting and a **data underflow** is occurring. If the RxBuffer Fill Status is *increasing* (approaching 100%) the Rx traffic is coming in faster than the Rx Clock setting accommodates, and a **data overflow** is occurring.

(CONFIG: INTF) PIICX (OC3) → RxBuffer → BufferSize

```
Rx Buffer Size: 02.0 ms          ( ◀ ▶ )
```

Use the ▲▼ arrow keys to increment/decrement the Rx Buffer Size time value (from 2 ms to 75 ms in 0.5 ms steps), and then press **ENTER**.

(CONFIG: INTF) PIICX (OC3) → RxBuffer → Recenter

```
Rx Buffer: ReCenter              ( ◀ ▶ )
```

In the event of data underflow or overflow (as indicated by the Fill Status percentage reported on the RxBuffer menu) press **ENTER** to ReCenter the Rx Buffer depth to 50%.

(CONFIG: INTF) PIICX (OC3) → Mask

```
Masks: TxP11  InpSigLoss  
        RxP11  RxOF   RxUF
```

To define how many or how few of the interface alarm or fault states are reported: Use the ◀▶ arrow keys to select **TxP11**, **InpSigLoss**, **RxP11**, **RxOF**, or **RxUF**, and then press **ENTER**. Note the following:

Item	Description
TxPLL	(Alarm) The Tx Clock PLL is railed high or low indicating that the Tx Clock Source is substantially different than the rate of the Tx data.
InpSigLoss	(Alarm) Input Signal Loss indicates that no traffic is being seen by the OC3/STM-1 interface on the TX-IN connector.
RxPLL	(Alarm) The Rx Clock PLL is railed high or low indicating that the Rx Clock Source is substantially different than the rate of incoming data.
RxOF	(Alarm) Rx Overflow indicates that the traffic received by the demod is exceeding the clock RxClock setting and is therefore overflowing the buffer causing the buffer to re-center and take a data hit.
RxUF	(Alarm) Rx Underflow indicates that the traffic received by the demod is not keeping up with the clock RxClock setting and is therefore underflowing the buffer causing the buffer to re-center and take a data hit.

Using **TxPLL** as the example:

```
Tx Pll Mask: Masked
Alarm Fault Mask Fault-Tx On
```

The top line notes the active mask selection. On the bottom line, use the ◀ ▶ arrow keys to select **Alarm**, **Fault**, **Mask**, or **Fault-Tx On** for the **TxPll** and **InpSigLoss** menus, or **Alarm**, **Fault**, or **Mask** for the **RxPll**, **RxOF** and **RxUF** menus. Press **ENTER** when done. Note the following:

Mask Type	Description	Redundancy Switchover and Tx Mute
Alarm	Alarms can be viewed from the Monitor: Live Alarms menu (Sect.5.2.4.1). Alarms cause the Unit Status LED to turn AMBER.	An alarm WILL NOT cause a redundancy switch and WILL NOT mute the Tx carrier
Fault	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2) . Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault 	A fault WILL cause a redundancy switch and WILL mute the Tx carrier
Mask	Masking the event has the effect of ignoring the event – it can no longer be logged and is not seen in any menu.	Mask WILL NOT cause a redundancy switch and WILL NOT mute the Tx carrier
Fault-Tx On	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2) . Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault 	A Fault-Tx On WILL cause a redundancy switch and WILL NOT mute the Tx carrier

5.2.2.1.4 (CONFIG) INTF: GBEIX

```
GBEIX: IntType  FlowControl  Learning
```

Where *X* designates the interface as GBE1 (J5 | DATA port) or GBE2 (J6 | DATA port): Use the ◀▶ arrow keys to select **IntType**, **FlowControl**, or **Learning**, and then press **ENTER**.

(CONFIG: INTF) GBEIX → IntType



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

```
Interface Type:
Auto
```

To configure the interface type of the selected port: On the bottom line, use the ▲▼ arrow keys to select **AUTO**, **1000 Base-T Full Duplex**, **100 Base-T Full Duplex**, **100 Base-T Half Duplex**, **10 Base-T Full Duplex**, or **10 Base-T Half Duplex**. Press **ENTER** when done.

Note the following:

External Equipment Capability	External Equipment Port Setting	Correct Port Configuration Selection on CDM750
10 Base-T, 10/100/ 1000 Base-T	Auto	Auto
10 Base-T	Full Duplex	10 Base-T Full Duplex
10 Base-T	Half Duplex	10 Base-T Half Duplex
100 Base-T	Full Duplex	100 Base-T Full Duplex
100 Base-T	Half Duplex	100 Base-T Half Duplex
1000 Base-T (Gigabit)	Full Duplex**	1000 Base-T Full 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) GBEX → FlowControl

```
Flow Control: Disabled
Applies To All Ports
```

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 can act as a traffic valve in an ACM environment.

On the top line, use the ▲▼ arrow keys to set Flow Control as **Enabled** or **Disabled**, and then press **ENTER**.

When Flow Control is **Enabled**, the modem will begin to send Pause Frames when the WAN buffer is approximately 87% full. Pause Frames will be 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 Ethernet ports (**J5 | DATA**, **J6 | DATA**, or **J7 | OPTICAL**) does not honor Pause Frames, Flow Control should be set to **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 **Sect. 5.2.2.8.2 (CONFIG) Remote Control: Inband**), any device connected to the management port (**J4 | MGMT**) must also honor Pause Frames to properly ensure system operation.

(CONFIG: INTF) GBEX → Learning

**MAC Learning: Disabled
Applies To All Ports**

On the top line, use the ▲▼ arrow keys to set Flow Control as **Enabled** or **Disabled**, and then press **ENTER**. Note the following:

- With MAC Learning set as **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 set as **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 as follows:

FRAME GOING FROM LAN TO WAN (Tx)		
Source MAC	Destination MAC	Action
Don't care	Unknown	Packet is sent to WAN, Source MAC is learned to exist on LAN
Don't care	Known to exist on LAN side	Packet is 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 set as **Enabled**, is “aging”. This is why MAC Learning is also referred to as “learning and aging”. When a MAC Address is seen by the modem is “learned” to exist as previously described. This learned address will remain learned, and it will continue to exist in the modem’s Content Addressable Memory (CAM) table for a period of five (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 will remain in the table and the aging clock will reset once more to five minutes.



It is important to note that, by enabling MAC Learning, the amount of traffic over the satellite link can be reduced when the modem is one element on the LAN (see Figure 5-2, Detail ‘A’). However, if there is the chance that a second Layer 2 path exists to the far side equipment, this will cause data flow failure. This condition is known as “Spanning Tree” (see Figure 5-2, Detail ‘B’). This means that 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.

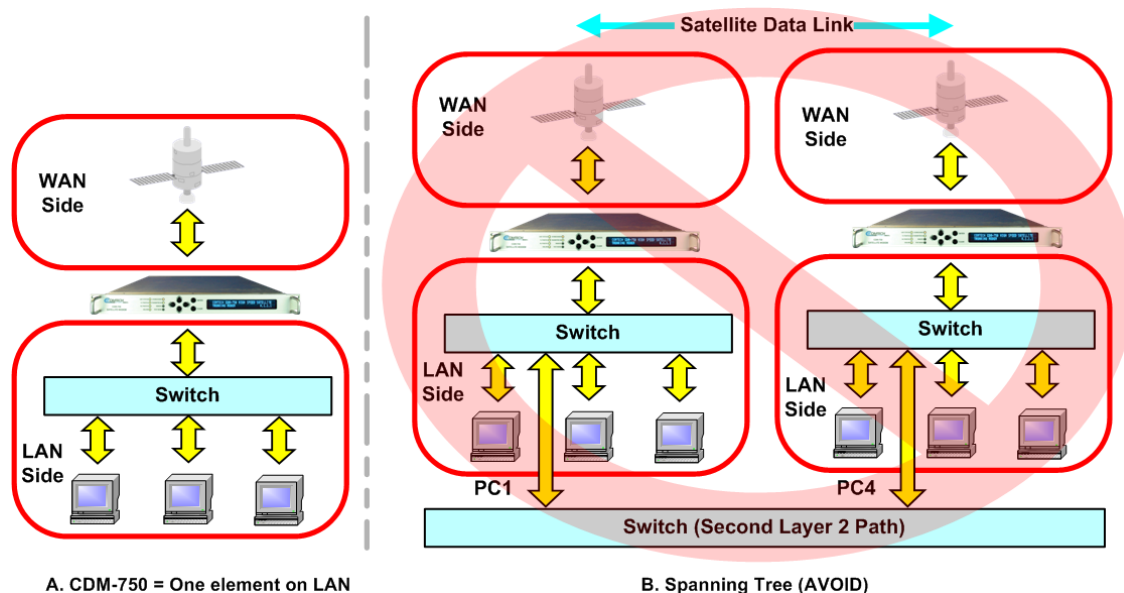


Figure 5-2. MAC Learning Operations

5.2.2.1.5 (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 Access Code is not activated. See Sect. 3.2.3.2 for further information about this optional interface.

5.2.2.2 CONFIG: Tx

```
Tx: IF Freq Power Frame Mod Data Pilot
Data 130706.252kbps, 030000.000ksps (◀ ▶)
```

On the top line, use the ◀ ▶ arrow keys to select **IF**, **Freq**, **Power**, **Frame**, **Mod**, **Data**, or **Pilot**, and then press **ENTER**. The read-only bottom line displays the current operating values.

5.2.2.2.1 (CONFIG) Tx: IF

```
Tx: Carrier=On (Off,On)
SpectrumInvert=Off Txα=.35 (.35, .25) (◀ ▶ ⬆)
```

First, use the ◀ ▶ arrow keys to select **Tx Carrier**, **Spectrum Invert**, or **Txα**. On the top line, use the ▲ ▼ arrow keys to set the **Tx Carrier** as **On** or **Off**.

On the bottom line:

- Use the ▲ ▼ arrow keys to set the **Spectrum Invert** as **On** or **Off**.



When the CDM-750 is in CnC (Carrier-in-Carrier) mode, the modem itself will determine the Tx spectral inversion. The operator will not have control of spectral inversion selection while CnC mode is ON and any changes to this field will be rejected.

- Use the ▲ ▼ arrow keys to set the **Txα** (Tx Rolloff). Valid selections are .20 (20%), .25 (25%) or .35 (35%) – the default Txα setting is .20 (20%).

Press **ENTER** when done.

5.2.2.2.2 (CONFIG) Tx: Freq (Frequency)

```
Tx-IF Frequency: 0050.0000 MHz
(◀ ▶ ⬆)
```

To configure the Tx-IF Frequency: First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to change that digit. Note the following:

- The available frequency ranges are 50-180 MHz, and 950-2150 MHz (L-Band).
- The resolution is 100 Hz.

Press **ENTER** when done.

5.2.2.2.3 (CONFIG) Tx: Power

```
Output Power Level= -20.0 dBm          ( < > ◆ )
```

To configure the Tx Output Power Level: First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Note the following:

- For Tx frequencies of 50-180 MHz, the permitted level range is 0 to –25 dBm.
- For 950-2150 MHz (L-Band), the range is 0 to –40 dBm.

Press **ENTER** when done.

5.2.2.2.4 (CONFIG) Tx: Frame

```
Tx Framing: Normal  
DVB-S2 Framing Mode          ( < > ◆ )
```

Use the ▲▼ arrow keys to select **Normal** or **Short Block**, and then press **ENTER**. Note the following:

- With the default value of **Normal** is selected, the standard FECFRAME = 64,800 bits is enabled.
- If **Short Block** is selected, FECFRAME = 16,200 bits is enabled.



You should consider the use of Short Block Framing only when there is a concern about data latency. See Figure C-4 Single Hop Latency in Appendix C. ADAPTIVE CODING AND MODULATION (ACM) OPTION for an illustration of how Normal and Short Block Framing affects overall system latency. Short Block Framing will perform 0.2 db to 0.3 db worse in terms of required Es/No for all ModCods. In all other circumstances, Normal Block Framing should be used.

5.2.2.2.5 (CONFIG) Tx: Mod (Modulation)

```
Modcod=QPSK 1/2 (◀▶◆)
```

Use the ▲▼ arrow keys to select the modulation and FEC type, and then press **ENTER**. Note the following:

- Use the ModCod setting “Auto (ACM)” when running in ACM mode. In ACM mode, you do not directly control the ModCod used at any given moment, but rather the ModCod chosen for the Tx carrier is based on the rules and configuration of the ACM parameters. See **Sect. 5.2.2.5 CONFIG: ACM** for configuration of ACM parameters.
- The upper range of modulation and coding as well as Auto (ACM) capability is dictated by the FAST option(s) installed.

5.2.2.2.6 (CONFIG) Tx: Data

```
Tx Data Rate Tx Symbol Rate (◀▶)
```

Use the ◀▶ arrow keys to select **Tx Data Rate** or **Tx Symbol Rate**, and then press **ENTER**.

(CONFIG) Tx: Data → Tx Data Rate



To configure the Tx Data Rate of the modem, the modem must be in Single Stream Mode with only the Ethernet interfaces active. You can tell when the modem is in Single Stream Mode / Ethernet only when the minimum data rate (MIN_DR) is zero (000000.000) and the Read Only (RO) indication does not appear at the upper right-hand of the menu.

If the screen displays any minimum data rate other than zero, this indicates that the modem is in MultiStream Mode – the data rate cannot be changed while in MultiStream Mode. See Sect.5.2.2.1.1 Single Stream Mode vs. MultiStream Mode Operation for instructions on entering into or exiting out of MultiStream Mode.

```
ETH_DR + MIN_DR = TOT_DR (RO)
019484.479__034883.520__054367.999Kbps
```

Referring to the example shown here: Per the **ETH_DR + MIN_DR = TOT_DR (RO)** equation provided on the top line, note the following:

Operand	Means	Description
ETH_DR	Ethernet Data Rate	This is all data associated with the Ethernet data interfaces. It is always TOT_DR - MIN_DR

Operand	Means	Description
MIN_DR	Minimum Data Rate	This value will always be zero (000000.000) when 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 is the aggregate data rate of the modem and correlates with the modems TX symbol rate and spectral efficiency (Modcod) setting.
(RO)	Read Only	Appears only when in MultiStream Mode.

To configure the Tx Data Rate: On the bottom line, edit the **ETH_DR** value (the **MIN_DR** and **TOT_DR** values are *read-only* and cannot be edited). First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Note the following:

- The maximum limits for the Data Rate are based on a symbol rate range from 1 Msps to 63 Msps.
- See **Table 5-2** for available modulation and code rate combinations. Note that, in this table, in the Data Rate Range columns there is some roundoff of the last digit.
- The actual minimum and maximum data rates are dependent on Framing mode, Interface type, Modulation type and FEC Code Rate.
- When the user changes any of the higher-priority parameters – causing the data rate to become invalid – the **Data Rate** adjusts automatically. The upper range of data rate is also dictated by the **FAST option(s)** installed.

Press **ENTER** when done.

(CONFIG) Tx: Data → Tx Symbol Rate



Unlike with the Tx Data Rate, the Tx Symbol Rate can be changed while the modem is in MultiStream Mode.

Tx Symbol Rate = 30000.000 ksps



To configure the Tx Symbol Rate: First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Note the following:

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

See **Table 5-2** for available modulation and code rate combinations. Note that, in this table, in the Data Rate Range columns there is some roundoff of the last digit.

- When you change the modulation, code rate, or other parameters, the modem attempts to maintain the same Symbol Rate, provided it is still in range when one of the other parameters is changed.
- When programming, the modulator will not accept a new data or symbol rate unless it is in the range, and it will turn off the Tx Carrier. If a new rate is not accepted, change the Modulator Code Rate or mode.

Press **ENTER** when done.

5.2.2.2.7 (CONFIG) Tx: Pilot

```
Tx: Pilot=Off   Pilot Location=Peak
Goldcode=000000   ( ◀ ▶ ◆ )
```

Use the ◀▶ arrow keys to select **Pilot** or **Goldcode**, and then refer to the subsections that follow to continue.



Pilot Location is read-only and fixed at Average. When Pilots are enabled (i.e., Pilot=On), they will always be located at the “average” power point of any constellation.

(CONFIG) Tx: Pilot → Pilot

Use the ▲▼ arrow keys to select **Pilot** as **On** or **Off**. Note the following:

- Select **Off** to disable insertion of pilot symbols into the physical layer frame.
- Select **On** to enable insertion of pilot symbols into the physical layer frame.

Press **ENTER** when done.

(CONFIG) Tx: Pilot → Goldcode



It is critical that the Tx Gold-n Index Code value matches the Rx Gold-n Index Code value of the distant end modem.

The Gold-n Index Code indicates the Physical Layer spreading sequence number.

First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER** when done. Note the following:

- The code can be set from **000000** to **262,141**.
- The default setting is all **0s**.

**Table 5-2. Symbol Rate / Data Rate Range for Standard FECFrame
(DVB-S2 Standard FECFrame = 64,800 bits)**

Modcod #	Modulation	Inner Code Rate	Symbol Rate (MSPs)		Spectral Efficiency Pilot OFF	Data Rate (Mbps) Pilot OFF		Spectral Efficiency Pilot ON	Data Rate (Mbps) Pilot ON	
			Min	Max		Min	Max		Min	Max
1	QPSK	1/4 ^{Note 1}	1	63	0.490243	0.490243	30.885319	0.478577	0.478577	30.150352
2		1/3 ^{Note 1}			0.656448	0.656448	41.356233	0.640827	0.640827	40.372093
3		2/5 ^{Note 1}			0.789412	0.789412	49.732964	0.770627	0.770627	48.549486
4		1/2			0.988858	0.988858	62.298061	0.965327	0.965327	60.815576
5		3/5			1.188304	1.188304	74.863158	1.160026	1.160026	73.081666
6		2/3			1.322253	1.322253	83.301939	1.290788	1.290788	81.319632
7		3/4			1.487473	1.487473	93.710803	1.452076	1.452076	91.480800
8		4/5			1.587196	1.587196	99.993352	1.549426	1.549426	97.613845
9		5/6			1.654663	1.654663	104.243767	1.615288	1.615288	101.763115
10		8/9			1.766451	1.766451	111.286427	1.724416	1.724416	108.638183
11		9/10			1.788612	1.788612	112.682548	1.746049	1.746049	110.001082
12	8PSK	3/5	1	63	1.779991	1.779991	112.139419	1.739569	1.739569	109.592863
13		2/3			1.980636	1.980636	124.780083	1.935658	1.935658	121.946472
14		3/4			2.228124	2.228124	140.371784	2.177525	2.177525	137.184104
15		5/6			2.478562	2.478562	156.149378	2.422276	2.422276	152.603406
16		8/9			2.646012	2.646012	166.698755	2.585924	2.585924	162.913220
17	9/10	2.679207	2.679207	168.790041	2.618365	2.618365	164.957015			
18	16APSK	2/3	1	47	2.637201	2.637201	123.948435	2.574613	2.574613	121.006832
19		3/4			2.966728	2.966728	139.436219	2.896320	2.896320	136.127053
20		4/5			3.165623	3.165623	148.784285	3.090495	3.090495	145.253266
21		5/6			3.300184	3.300184	155.108656	3.221863	3.221863	151.427544
22		8/9			3.523143	3.523143	165.587723	3.439530	3.439530	161.657917
23	9/10	3.567342	3.567342	167.665071	3.482680	3.482680	163.685964			
24	32APSK	3/4	1	38	3.703295	3.703295	140.725211	3.623332	3.623332	137.686610
25		4/5			3.951571	3.951571	150.159693	3.866247	3.866247	146.917379
26		5/6			4.119540	4.119540	156.542529	4.030589	4.030589	153.162393
27		8/9			4.397854	4.397854	167.118467	4.302894	4.302894	163.509972
28		9/10			4.453027	4.453027	169.215019	4.356875	4.356875	165.561254

Note: QPSK 1/4, 1/3 and 2/5 data are included for informational purposes only.

5.2.2.3 CONFIG: Rx

```
Rx:IF Freq Frame Mod Data Pilot EsNo
Data 130706.252kbps 030000.000ksps (◀ ▶ ⬆)
```

On the top line: Use the ◀ ▶ arrow keys to select **IF**, **Freq**, **Frame**, **Mod**, **Data**, **Pilot**, or **EsNo**, and then press **ENTER**.

On the bottom line: **Read-only** Data Rate and Symbol Rate information displays here.

5.2.2.3.1 (CONFIG) Rx: IF

```
Rx:=SpectrumInvert=Off(Off,On) Read Only
RxA=.35(.35,.25,.20) Read Only
```

This **read-only** screen identifies the current Spectrum Inversion status on the top line. The bottom line identifies the active **RxA** (Rx Rolloff) value. Press **ENTER** or **CLEAR** to return to the previous menu.

5.2.2.3.2 (CONFIG) Rx: Freq (Frequency)

```
Rx-IF Frequency: 0050.0000 MHz
(◀ ▶ ⬆)
```

To edit the Rx Frequency: First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to change that digit. Press **ENTER** when done. Note the following:

- The available frequency ranges are 50 to 180 MHz, and 950-2150 MHz (L-Band).
- The band edge of the spectrum fits within IF limits.
- The resolution is 100Hz.

5.2.2.3.3 (CONFIG) Rx: Frame

```
Rx Framing: Normal Read Only
DVB-S2 Framing Mode
```

This **read-only** screen identifies the active DVB-S2 Framing Mode. Press **ENTER** or **CLEAR** to return to the previous menu.

5.2.2.3.4 (CONFIG) Rx: Mod (Modulation)

Modcod=QPSK 1/2 Read Only

This *read-only* screen identifies the active modulation type. Press **ENTER** or **CLEAR** to return to the previous menu.

5.2.2.3.5 (CONFIG) Rx: Data

Rx Data Rate Rx Symbol Rate
(◀ ▶)

Use the ◀ ▶ arrows keys to select **Rx Data Rate** or **Rx Symbol Rate**, and then press **ENTER**.

(CONFIG) Rx: Data → Rx Data Rate

Rx Data Rate = 070000.000 kbps
(◀ ▶ ⬆)

This *read-only* screen identifies the active Rx Data Rate. To properly lock an Rx path and automatically obtain the Rx Data Rate, you need to make changes as necessary to the Rx Symbol Rate, Gold-n Index Code (Goldcode), and Rx IF Frequency of the modem. Press **ENTER** or **CLEAR** to return to the previous menu.

(CONFIG) Rx: Data → Rx Symbol Rate

Rx Symbol Rate = 30000.000 ksps
(◀ ▶ ⬆)

To change the Symbol Rate: First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to change that digit. Press **ENTER** when done.

Once the Rx path is synchronized, the correct data rate, modulation type, code rate, pilots ON/OFF, FEC frame length spectral inversion, etc. appear in the appropriate Rx menus.

5.2.2.3.6 (CONFIG) Rx: Pilot



In order to properly lock to a carrier, it is critical that the Rx Goldcode value matches the Tx Goldcode value of the distant end modem.

Rx: Pilot=Off Read Only
Goldcode=000000 (◀ ▶ ⬆)

On the top line: The active Pilot setting displays here.

On the bottom line: The user-programmed Goldcode displays here.

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

5.2.2.3.7 (CONFIG) Rx: EsNo

```
Receive EsNo Alarm Point = 02.0 dB
                               ( ◀ ▶ ⬆ )
```

To edit the EsNo Alarm Point: First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrows keys to change that digit. Note the following:

- The permitted range is from 00.1 to 16.0 dB.
- If the Rx Es/No falls below this value and the fault is NOT masked, a receive traffic fault will be generated.

Press **ENTER** when done.

5.2.2.4 CONFIG: Clocks

```
Clocking:  Freq-Ref  Int-Ref-Adjust
                                     ( ◀ ▶ )
```

Use the ◀▶ arrow keys to select **Freq-Ref** or **Int-Ref-Adjust**, and then press **ENTER**.

5.2.2.4.1 (CONFIG) Clocking: Freq-Ref

```
Frequency Reference: Internal
(Internal (with O/P) , 1 , 2 , 5 , 10MHz)
                                     ( ⬆ )
```

Use the ▲▼ arrow keys to select **Internal**, **Internal+O/P**, **Ext 1MHz**, **Ext 2MHz**, **Ext 5MHz**, or **Ext 10MHz**, and then press **ENTER**. Note the following:

- Selection of **Internal** mode frequency-locks the modem to the high stability ± 0.06 ppm 10 MHz internal oscillator.
- In the **Internal+O/P** (Internal with Output) mode, the 10 MHz internal reference is used as 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 the user that the connector, normally used as input, now has an output signal present.
- Selection of the **Ext 1 MHz**, **Ext 2 MHz**, **Ext 5 MHz**, or **Ext 10 MHz** modes will frequency lock the modem to an injected external reference on the rear panel **J8 | Ext Ref** BNC connector.

5.2.2.4.2 (CONFIG) Clocking: Int-Ref-Adjust

```
Internal Hi-Stability 10MHz Reference
Fine Adjust: +048 (+/-999)
                                     ( ◀ ▶ ⬆ )
```

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.

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



Changes made to the adjustment value take effect immediately, not after the ENTER key is pressed.

5.2.2.5 CONFIG: ACM (Adaptive Coding and Modulation)



Appendix C. ADAPTIVE CODING AND MODULATION (ACM) OPTION.

```
ACM Config: Min/Max-ModCod  Unlock-Action  
Target-EbNo-Margin Degradation  (◀ ▶ ⬆)
```

Use the ◀ ▶ arrow keys to select **Min/Max-ModCod**, **Unlock-Action**, **Target-EbNo-Margin**, or **Degradation**, and then press **ENTER**.

5.2.2.5.1 (CONFIG) ACM Config: Min/Max-ModCod



If the user wishes to constrain the system to run at a fixed ModCod, set the Min and Max ModCod values to be equal.



The value of Max ModCod may be limited by other FAST Access Codes installed for Modulation and Symbol Rate.

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

To define the range of ModCods over which the system will operate (i.e., the range for the modem's Tx capability): First, use the ◀ ▶ arrow keys to select the **Min** or **Max ModCod**. Then, use the ▲ ▼ arrow keys to select the available ModCod (see **Table 5-2** for the available ModCod, modulation, and code rate combinations). Press **ENTER** when done.

5.2.2.5.2 (CONFIG) ACM Config: Unlock-Action

```
When distant-end demod loses lock:  
Go to min Tx ModCod (Maintain,Min)  (⬆)
```

Use this submenu to establish the desired action when the remote demod loses lock. This is important, as the ACM system depends on the feedback of the SNR metric from the remote demod to determine the optimum ModCod.

On the bottom line: Use the ▲ ▼ arrow keys to select **Go to min Tx ModCod** (*recommended*) or **Maintain Tx ModCod**, and then press **ENTER**. The **ACM → Unlock** selection will trigger when three consecutive ACM messages are missed (ACM messages are sent and received roughly every 250 ms).

5.2.2.5.3 (CONFIG) ACM Config: Target-Es/No-Margin



The ACM system is designed to switch based on thresholds that correspond to a QEF $\approx 10^{-7}$ PER for each ModCod.

```
Target Es/No Margin = 1.0 dB (0.0 - 4.5)
                      (◆)
```

Use the ▲▼ arrow keys to select a margin value between 0.0 and 4.5 dB, in 0.1 dB increments. Press **ENTER** when done.

The Target Es/No Margin value, used as a tool to compensate for Rain Fade, is added to the QEF specification for all ModCods. The QEF specification for a ModCod *plus* the Target Es/No Margin *plus* the Modulation Degradation for a modulation type will set the “Shift Down” Es/No point in ACM operation.

For example: The far end side of a link has a maximum rain fade slope of 1 dB per second. ACM messages are sent roughly every 250 ms and it will take 290 ms for the message to reach the near side modulator. Assuming worst-case scenario of a strong rain fade that begins just after sending an ACM message:

- There could be 250 ms of delay before the next message;
- The message will take 290 ms to traverse across the satellite link;
- There will be some minimal processing time of 20 ms to act on the new message and change to the new ModCod;
- The new ModCod signal will land at the far end site in another 290 ms.

This equates to $250+290+20+290=550$ ms. If there is a maximum rain fade of 1dB per second, there could be as much as .55 dB of fade before the new ModCod is received at the fading site’s demodulator. To ensure that missing a single ACM message does not drop the link, the user may want to add another 250 ms, so now the max fade could be 800 ms – or 0.8 dB – of fade. For this reason, it is preferred that the Target Es/No margin be at least 0.8 dB. *Factory default is set to 1dB.*

5.2.2.5.4 (CONFIG) ACM Config: Degradation

```
Degradation: QPSK=0.0   8PSK=0.0
              16QAM=1.0 32APSK=2.0  ◀ ▶ ◆
```

An additional level of signal margin can be added to the QEF switch points in ACM operation by adding a degradation figure per modulation type. This degradation figure further increases the Es/No required to switch to a ModCod having a degradation figure above 0.0.

First, use the ◀▶ arrow keys to select the parameter to update. Then, use the ▲▼ arrow keys to edit the value for that setting (factory default for *all settings* is **0.0**). Press **ENTER** when done.

Degradation figures can be used to further ensure that switching to higher order Modulation will not cause errors, as may be the case in systems with higher levels of phase noise or non-linearities that can impact higher-order modulation schemes (e.g., 16APSK and 32APSK operation) more dramatically than QPSK or 8PSK operation.

5.2.2.6 CONFIG: CnC



Appendix D. DOUBLETALK CARRIER-IN-CARRIER OPTION

```
Carrier-in-Carrier: Mode
                    Search-Delay  (◀ ▶)
```

Use the ◀▶ arrow keys to select **Mode** or **Search-Delay**, and then press **ENTER**.

5.2.2.6.1 (CONFIG) Carrier-in-Carrier: Mode



CnC operation requires installation of the DoubleTalk Carrier-in-Carrier module. In addition to installing the CnC module, the user needs to purchase one of several available FAST options to provide capability to a maximum of 155 Mbps.



Appendix A. FAST OPTIONS AND ACTIVATION PROCEDURE

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

Use the ▲▼ arrow keys to select **Off** or **On**, and then press **ENTER**. With no module installed, CnC Mode is forced **Off** and this submenu is inoperable.

5.2.2.6.2 (CONFIG) Carrier-in-Carrier: Search-Delay

```
CnC Search Delay:      (range 0-300ms)
Min: 010 ms  Max: 290 ms  (◀ ▶ ◄)
```

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.



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.

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

5.2.2.7 CONFIG: Mask

```
Masks : RxAGC  EsNo  Reference  DeCompInv
        LNB
```

Use the ◀ ▶ arrow keys to select **RxAGC**, **EsNo**, **Reference**, **DeCompInv**, or **LNB**, and then press **ENTER**.

For the **RxAGC**, **EsNo**, and **LNB** submenu selections, three masking options are available. Using the **RxAGC** submenu as an example:

```
Rx AGC Mask :
        Alarm  Fault  Mask
```

Use the ◀ ▶ arrow keys to select **Alarm**, **Fault**, or **Mask**, and then press **ENTER** to accept the selection and return to the previous menu. Note the following:

Mask Type	Description
Alarm	Alarms can be viewed from the Monitor: Live Alarms menu (Sect. 5.2.4.1). Alarms cause the Unit Status LED to turn AMBER.
Fault	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2). Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault
Mask	Masking the event has the effect of ignoring the event – it can no longer be logged and is not seen in any menu.

For the **Reference** and **DeCompInv** masking option selections, **Alarm**, **Fault**, and **Mask** (as previously described), plus an addition masking option, are available:

Mask Type	Description
Fault-Tx On	Faults can be viewed in the Monitor: Stored-Events log (Sect. 5.2.4.2). Faults cause: <ul style="list-style-type: none"> • The Unit Status LED to turn RED • The J1 Alarm Connector to show a Fault

5.2.2.8 CONFIG: Remote (Remote Control)

```
Remote Control=Local                Inband
(Local, Serial, Ethernet, Ser+Ethernet) (◆)
```

Use the ▲▼ arrow keys to select **Local**, **Serial**, **Ethernet**, or **Ser+Ethernet**, or the ◀▶ arrow keys to select **Inband**, and then press **ENTER**. Note the following:

- Selecting **Local** allows monitor and control (M&C) of the unit only through the front panel.



Local control using the front panel is always available, regardless of which setting is selected on this menu

- Selecting **Serial** enables remote EIA-232/485 or Telnet M&C of the modem.
- Selecting **Ethernet** enables remote SNMP, Telnet, or Web Server Interface M&C to the modem.
- Selecting **Serial+Ethernet** allows all methods of remote access to the modem.

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

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

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

If selecting either **Serial** or **Ser+Ethernet** remote control, use the ◀▶ arrow keys to select **Interface**, **Address**, or **(Baudrate)**. Then:

- **Interface** – Use the ▲▼ arrow keys to select **RS-232**, **RS-485-2W**, or **RS-485-4W**.
- **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 to edit, and then use the ▲▼ arrow keys to change that digit. Address 0000 is reserved for universal addressing. The permitted address range is 0001 to 9999.
- **(Baudrate)** – Use the ▲▼ arrow keys to select **2400**, **4800**, **9600**, **19200**, **38400**, or **57600** baud.

Press **ENTER** when done.

5.2.2.8.2 (CONFIG) Remote Control: Inband

Enable Inband Modem Control: Enable



Inband Modem Control allows remote Ethernet access via the Gigabit Ethernet data interfaces. Use the ▲▼ arrow keys to **Enable** or **Disable** this feature, and then press **ENTER**.



When Inband is enabled, there is a physical connection between a Layer 2 switch on the data IP interface ports (J5 | DATA, J6 | DATA, and J7 | OPTICAL) and a separate Layer 2 switch tied to the physical management port (J4 | MGMT). For this reason, if Inband control is enabled, a physical jumper connection should never be connected from any data IP interface port to the physical management port, as this will cause a networking loop and create a broadcast storm.

Similarly, when Inband is enabled, the data IP interface ports and management port may not be physically connected to a single external switch, as this will cause the same networking loop/broadcast storm environment. When Inband control is desired along with external control, the physical connection between the data IP interface ports and management port must be separated by a router or two independent networks.



See Appendix F.ETHERNET NETWORK CONFIGURATION for further information and illustrations about avoiding networking loops and broadcast storms

5.2.2.9 CONFIG: IP

```
IP Config:
  Addresses  SNMP          ( < > )
```

Select **Addresses** or **SNMP** using the ◀▶ arrow keys, and then press **ENTER**.

5.2.2.9.1 (CONFIG) IP Config: Addresses

```
IP Addresses:      MAC      Gateway
  Addr/Range          ( < > )
```

Select **MAC**, **Gateway**, or **Addr/Range** using the ◀▶ arrow keys, and then press **ENTER**.

(CONFIG) IP Config: Addresses → MAC

```
Ethernet MAC Address:
  00-06-B0-00-01-06      (read-only)
```

This *read-only* screen displays the unit MAC address. Press **ENTER** or **CLEAR** to return to the previous menu.

(CONFIG) IP Config: Addresses → Gateway

```
Ethernet IP Gateway:
  192.168.001.002      ( < > ⬇ )
```

The Gateway Address is the default next hop address used by the M&C to send traffic to when the M&C is sending a datagram to an IP address outside of its subnet mask or Address/Range. This address must be one that is within the M&Cs subnet address/range.

To configure the unit's IP Gateway Address for the J4 | MGMT (Ethernet M&C) port: First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER** when done.

(CONFIG) IP Config: Addresses → Address/Range

```
Ethernet IP Address/Range:
  192.168.001.002/24      ( < > ⬇ )
```

To configure the unit's IP Address for the J4 | MGMT (Ethernet M&C) port: First, use the ◀▶ arrow keys to select a digit to edit, and then use the ▲▼ arrow keys to change that digit. Press **ENTER** when done.

5.2.2.9.2 (CONFIG) IP Config: SNMP

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

Use the ◀ ▶ arrow keys to select **Communities** or **Traps**, and then press **ENTER**.

(CONFIG) IP Config: SNMP → Communities

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

Use the ◀ ▶ arrow keys to select the **Read** or **Write** community, and then press **ENTER**.

(CONFIG) IP Config: SNMP → Communities → Read

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

To edit the SNMP Read Community string: First, 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 this string. All trailing spaces are removed from the Read Community string upon entry.

(CONFIG) IP Config: SNMP → Communities → Write

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

To edit the SNMP Write Community string: First, 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 this string. All trailing spaces are removed from the Write Community string upon entry.

(CONFIG) IP Config: SNMP → Traps

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

Use the ◀ ▶ arrow keys to select **Community**, **Version**, **IP-Addr#1**, or **IP-Addr#2**, and then press **ENTER**.

(CONFIG) IP Config: SNMP → Traps → Community

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

To edit the SNMP Traps Community string: First, 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 this string. All trailing spaces are removed from the Traps Community string upon entry.

(CONFIG) IP Config: SNMP → Traps → Version

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

Use the ◀ ▶ arrow keys to select **SNMP-ver1** or **SNMP-ver2**, and then press **ENTER**.

(CONFIG) IP Config: SNMP → Traps → IP-Addr#X

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

To edit the SNMP Trap Destination IP Address (where X designates the submenu as Trap IP Address #1 or Trap IP Address #2): First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to edit that digit. Press **ENTER** when done.



If both Trap IP Addresses are 000.000.000.000, it means Trap is disabled.

5.2.2.10 CONFIG: Comp



K4 GZip lossless compression and decompression in an optional feature that requires installation of the compression card in the modem.



Appendix A. FAST OPTIONS AND ACTIVATION PROCEDURE

Compression: Disabled
Decompression: Disabled



Use the ◀▶ arrow keys to select **Compression** or **Decompression**, and then use the ▲▼ arrow keys to set either feature as **Enabled** or **Disabled**. Press **ENTER** when done. Note the following:

- **Compression** enables or disables the Tx compression path (LAN to Satellite). When **Enabled**, ALL traffic on all active ports and all active PIIC interfaces will be routed through the compression card and will be compressed.

Tx Compression (LAN to Satellite) requires activation of a software license or FAST Access Code. Tx compression rate licenses are sold by the symbol rate, so maximum data rates will depend on modulation and coding schemes used.

When **Compression** is **Enabled**, the Tx side of the modem will be symbol rate-limited by the lesser of the Tx symbol rate purchased or the Tx compression symbol rate purchased. All other licenses (e.g., CnC data rate) will still apply.

- **Decompression** enables or disables the Rx decompression path (Satellite to LAN). The decompression setting must match the far side CDM-750 Tx compression setting. A mismatch will cause all data to be dropped.

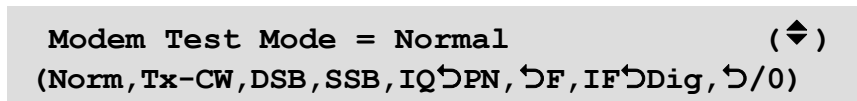
Rx decompression does not require a software license or FAST Access Code; Rx decompression will work at all data rates regardless of the Tx compression license purchased.

5.2.3 SELECT: Test



Use the ◀▶ arrow keys to select **Mode**, **BERT**, or **Comp**, and then press **ENTER**.

5.2.3.1 TEST: Mode



Use the ▲▼ arrow keys to select **Normal** modem operation or to select an available Test Mode, and then press **ENTER** to execute. Available selections are as follows:

Selection	Description
Norm	(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).
DSB	(Dual Side Band) <i>This mode should not be enabled over the satellite.</i> Two carriers on both sides of the nominal center Tx Frequency, whose frequency difference is equal to the configured Tx symbol rate.
SSB	(Single Side Band) <i>This mode should not be enabled over the satellite.</i> 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	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.
↻IF	(IF Loopback) This mode invokes an internal IF loop. It is a particularly useful test in that it permits the user 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 5-2 for the flow diagram for this test.
↻F	(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 5-2 for the flow diagram for this test.
IF↻Dig	(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 5-2 for the flow diagram for this test.
↻I/O	(Inward/Outward 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.

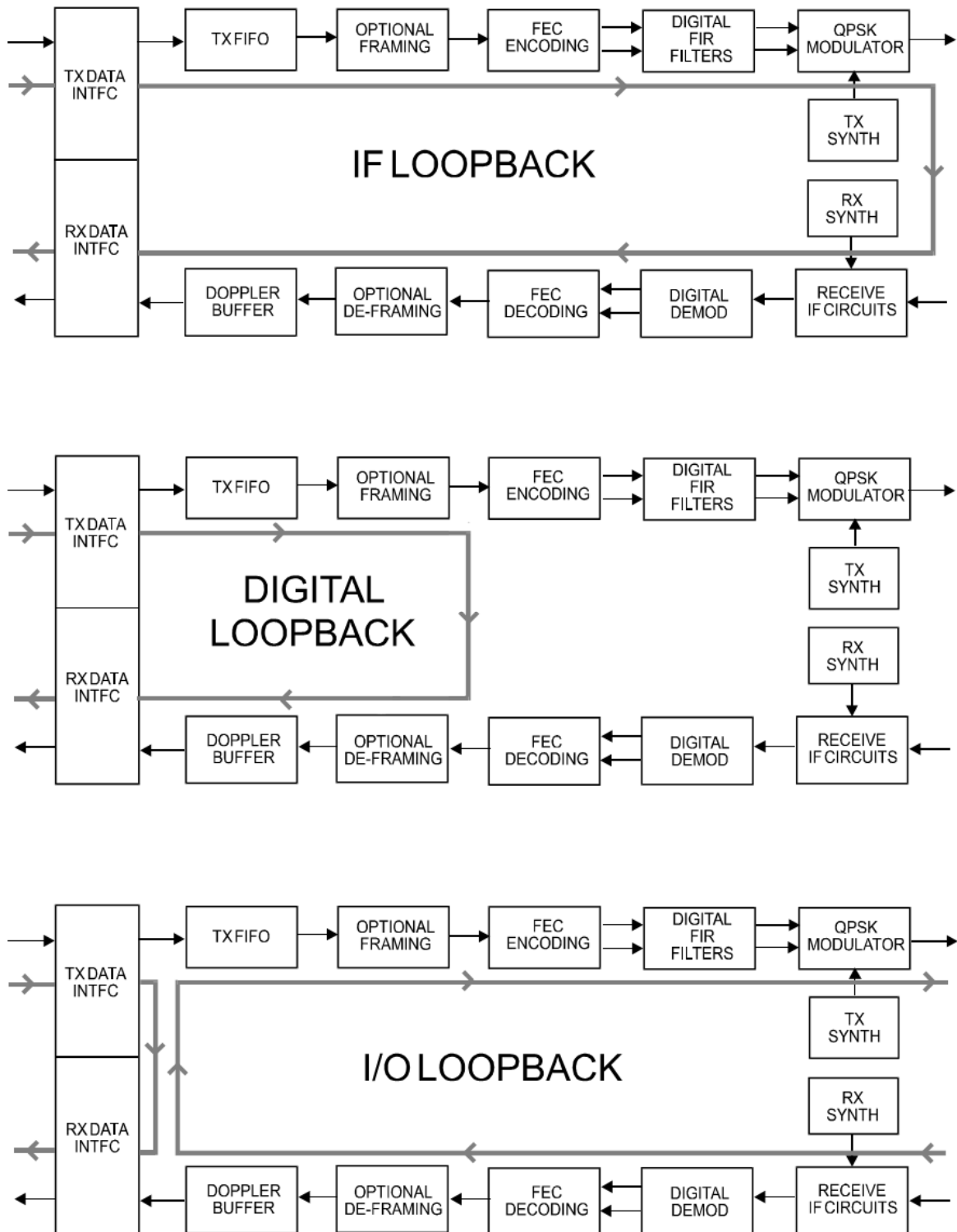


Figure 5-3. Loopback Test Modes

5.2.3.2 TEST: BERT

```
BERT: Config Monitor (◀ ▶)
```

Use the ◀ ▶ arrow keys to select **Config** or **Monitor**, and then press **ENTER**.

5.2.3.2.1 TEST: BERT → Config



BERT Tx must selected as ON in order to monitor BERT testing, as this changes the format of the DVB frame sent and expected DVB frame received.

```
BERT Tx: On
BERT Pattern: 2047 (◀ ▶ ⬇)
```

Use the ◀ ▶ arrow keys to select the BERT configuration parameters, and then use the ▲ ▼ arrow keys to edit that parameter setting. Note the following:

Feature	Selection
BERT Tx	Off, On
BERT Pattern	2047, 2 ¹⁵ -1 (2 ¹⁵ -1), 2 ²³ -1 (2 ²³ -1)

5.2.3.2.2 TEST: BERT → Monitor



BERT Tx must selected as ON in order to monitor BERT testing, as this changes the format of the DVB frame sent and expected DVB frame received.

```
BER=NoSync Count=0.0E+00 Errs=0.0E+00
Restart Insert Error
```

Press **ENTER** to start the BERT Monitor. To clear all counts and re-initiate testing, use the ◀ ▶ arrow keys to select **Restart**, and then press **ENTER**.

If you previously selected **BERT Tx: Off** and you attempt to access this menu, the display appears as follows:

```
BER= CTx BERT State is OFF!
Restart Press CLEAR to exit.
```

Press **CLEAR** as prompted to return to the **TEST: BERT → Config** menu to select **BERT Tx: On**.

5.2.3.3 TEST: Comp



K4 GZip lossless compression and decompression is an optional feature that requires installation of the compression card in the modem.



Appendix A. FAST OPTIONS AND ACTIVATION PROCEDURE

Bypass: **Enable**



Use the ▲▼ arrow keys to select **Enable** or **Disable**, and then 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).

5.2.4 SELECT: Monitor

```

Monitor: Live-Alarms   Stored-Events   ACM
Rx-Params   CnC   Stats   Buffer           ( ◀ ▶ )
    
```

Use the ◀▶ arrow keys to select **Live-Alarms**, **Stored-Events**, **ACM**, **Rx-Params**, **CnC**, or **StatsP**, and then press **ENTER**.

5.2.4.1 Monitor: Live-Alarms

```

Live      Unit=None
Alarms    Rx=Demod Lock   Tx=None    ( ◆ )
    
```

An example of an Alarm screen is shown here. Six alarm types are available between two screens. **Note the arrows:** Additional information is available by pressing the ▲▼ arrow keys:

```

Live      BUC=None
Alarms    LNB=None        ( ◆ )
    
```

The **highest** priority alarm currently active for each of the alarm types is as follows:

Type	Alarm	State
Unit	MainPs X.X	Main Board Power Supply Fault (3.3V, 1.5V, 1.2V, 1.8V, 1.9V, 2.5V, 1.25V)
	MdmBdPs X.X	Modem Board Power Supply Fault (5.5V, 3.8V, 2.3V, 3.3V, 1.8V, 1.2V)
	Pwr Cal	Transmit power is not factory calibrated. Contact factory.
	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.
Tx (Transmit)	Input Data	For enabled optional synchronous interfaces this alarm indicates a problem with input data. Not applicable to Ethernet Interfaces.
	Tx PLL	Transmit Phase-Lock Loop fault.
Rx (Receive)	Demod Lock	Demodulator is not locked to a signal.
	AGC Alarm	Receive Power Level has tripped AGC alarm point.
	CnC Lock	Carrier-in-Carrier is enabled but not locked.
	OutputData	For enabled optional synchronous interfaces this alarm indicates a problem with output data. Not applicable to Ethernet Interfaces.
	EsNo	Receive EsNo is below configured alarm point.
	Rx PLL	Receive Phase-Lock Loop fault.

5.2.4.2 Monitor: Stored-Events

```
Stored Events: Clear-All: No (No, Yes)
#199 FT- Frame Sync 25/10/10 16:25:24
```

An example of a Stored Events screen is shown here. Use the ◀▶ arrow keys to navigate to the bottom line, and then use the ▲▼ arrow keys to browse through the available event log entries.

The event log can store up to 255 entries (events). When a fault condition occurs, it is time- and date-stamped, and then stored in the event log. Similarly, when the fault condition *clears*, this is also recorded.

Note that, in accordance with European convention, the log shows the date in **DAY-MONTH-YEAR** format. Time is displayed in military (24-hour) format.

Press **ENTER** or **CLEAR** to return to the previous menu or, to flush the event log buffer use the ◀▶ arrow keys to select **Clear-All**. Then, use the arrow keys to select **Yes** or **No**.

When **Yes** is selected, **Clear-All** clears the event log, and then returns the user directly to the previous menu. However, if there are faults present on the unit at this time, they will be time-stamped once again, and new log entries will be generated.

Press **ENTER** when done.

5.2.4.3 Monitor: ACM

```
Tx Modcod=QPSK 1/2      RemEsNo:+99.9 db
Rx Modcod=PL Dummy     LocEsNo:+99.9 db
```

This *read-only* screen provides the active ACM mode information:

Item	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.

5.2.4.4 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 ½          RxLevel= -31dBm
```

Note the following:

Item	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.
ΔF	The frequency offset of the received carrier, in kHz, with a displayed resolution of 100 Hz.
Rx-Level	A dBm reading indicating the signal level of the desired receive carrier. Resolution: 0.5dB.
ModCod	The current ModCod.

5.2.4.5 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. Note the following:

- The **Monitor: CnC** screen refreshes once every second.
- CnC parameters need to be within the tolerances specified in **Sect. 1.4.8 DoubleTalk™ Carrier-in-Carrier® (CnC)**.
- Ideal operation occurs when the CnC **Ratio** is 0 db. Ratios that are higher or lower – 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.

5.2.4.6 Monitor: Stats (Statistics)

```
IP   BasebandFraming  Compression  ◀ ▶
```

Use the ◀ ▶ arrow keys to select **IP**, **BasebandFraming**, or **Compression**, and then press **ENTER**.

5.2.4.6.1 Monitor: Stats → IP

IPstats: WAN	Total	Last10s	(◀ ▶ ⬇)
Bytes to WAN	0.0E+00	0.0E+00	Clr:N

Typical for each display, the tally of Bytes or Packets sent/received is presented in scientific notation in two columns – **Total** and **Last10s**:

- **Total** – The total number of Bytes or Packets sent/received since the statistics log was last cleared.
- **Last10s** – Total number of Bytes or Packets sent/received in the last 10 seconds.

Use the ◀▶ arrow keys to select between the **IPstats** port selection on the *top line*, or to select the operational statistics or **CLR** (clear statistics) function on the *bottom line*.

First, on the top line: Use the ▲▼ arrow keys to select the desired **IPstats** port:

IPstats Port Selection	Ref Rear Panel Connector
GbE 1	J5 DATA port
GbE 2	J6 DATA port
WAN	N/A
M&C	J4 MGMT M&C 10/100 port
Opt	J7 OPTICAL port

Next, use the ◀▶ arrow keys to navigate to the **bottom line**. There, use the ▲▼ arrow keys to browse the available operational statistics for the selected port:

IPstats Port Selection (top line)					Statistic (bottom line)	Description
GbE 1	GbE 2	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 GbE 1, GbE 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 GbE 1, GbE 2, M&C, and Opt
		X			Bytes from WAN	Total number of Bytes received on WAN destined for GbE 1, GbE 2, Opt 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 GbE 1, GbE 2, Opt, and M&C
			X		Packets to M&C	Total number of Ethernet Packets sent to M&C from WAN and from GbE 1, 2 and Opt (does not count packets from J4 MGMT)
			X		Packets from M&C	Total number of Ethernet Packets sent from M&C to WAN and to GbE 1, 2 and Opt (does not count packets to J4 MGMT)

After viewing the desired statistics screen(s), should it be desired to clear the statistics log and re-initialize this screen, use the ◀ ▶ arrow keys on the bottom line to navigate to the **Clr**: setting. Use the ▲ ▼ arrow keys to select **Y** or **N**, and then either press **ENTER** (to wipe the buffer) or press **CLEAR** (to back out of the command and return to the previous menu).

5.2.4.6.2 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 available operational statistics. Typical for each parameter display, the tally of frames is depicted in scientific notation on the bottom line of the display.

You may then use the ▲ ▼ arrow keys to browse through the desired operational statistics:

Tx Count	Rx Count	RxErrFrms	Rx Frames Drppd
Tx Count (QPSK 1/2)	Rx Count (QPSK 1/2)	RxErrFrms (QPSK 1/2)	16APSK Rx Frames Drppd
Tx Count (QPSK 3/5)	Rx Count (QPSK 3/5)	RxErrFrms (QPSK 3/5)	32APSK Rx Frames Drppd
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 (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)	

Note the following:

Item	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.

Item	Description
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).

After viewing the desired statistics screen(s), should it be desired to clear the statistics buffer and re-initialize this screen, use the ◀ ▶ arrow keys on the bottom line to navigate to the **Clr:** setting. Use the ▲ ▼ arrow keys to select **Y** or **N**, and then either press **ENTER** (to wipe the buffer), or press **CLEAR** (to back out of the command and return to the previous menu).

5.2.4.6.3 Monitor: Stats → Compression

LanToWan WanToLan

Use the ◀ ▶ arrow keys to select **LanToWan** or **WanToLan**, and then press **ENTER**. The screen for either selection is *read-only*:

```
Bytes In  0.0E+00  Savings  00%      ◀ ▶ ◆
Bytes Out 0.0E+00  Last 10s 00%      CLR:N
```

Select **LanToWan** to view the Tx compression statistics of the modulator's transmission path:

- **Bytes In** – X.XE+XX value represents the total number of bytes sent to the compressor.
 - **Bytes Out** – X.XE+XX value equals the total number of bytes including compression and encapsulation overhead to be sent over the satellite. **Bytes Out** is the same as **Bytes to WAN** (see Sect. 5.2.4.6.1 Monitor: Stats → IP).
- **Savings** – XX% (percentage) value is calculated using the following formula:

$$100 * (1 - (\text{Bytes Out} / \text{Bytes In}))$$

- **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 an operator can see what compression is being accomplished on current data

Select **WanToLan** to view the Rx decompression statistics of the demodulator reception path:

- **Bytes In** – X.XE+XX value represents the total number of bytes including compression and encapsulation overhead sent to the decompressor.
- **Bytes Out** – X.XE+XX value equals the total number of bytes output from the decompressor. This represents all the traffic received by the modem.

- **Savings** – XX% (shown as a percentage) is calculated using the following formula:

$$100 * (1 - (\text{Bytes Out}/\text{Bytes In}))$$

- **Last 10s** – Calculated is calculated using the exact same formula as Savings XX% but uses the Bytes In and Bytes Out for the past 10 seconds so an operator can see what compression is being accomplished on current data.

After viewing the desired statistics screen(s), should it be desired to clear the statistics buffer and re-initialize this screen:

- First, use the ▲▼ arrow keys select the **CLR:** setting as **Y** or **N** (the cursor position defaults to the **CLR:** setting on the on the bottom line);
- Then, either press **ENTER** to wipe the buffer, or press **CLEAR** to back out of the command and return to the previous menu.

5.2.4.7 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 Sect. 5.2.2.1.4 (CONFIG: INTF) GBEX → FlowControl), 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.

5.2.5 SELECT: Info (Information)

INFO screens provide *read-only* information on the modem’s current configuration without risking inadvertent changes.

```
Info: ID  Intf  Tx  Rx  Clocks  ACM  CnC
      Misc  Mask  Remote  Comp
```

Use the ◀ ▶ arrow keys to select **ID**, **Intf**, **Tx**, **Rx**, **Clocks**, **ACM**, **CnC**, **Misc**, **Mask**, **Remote**, or **Comp**, and then press **ENTER**.

Typical for all INFO screens, Press **ENTER** or **CLEAR** to return to the **SELECT: INFO** menu.

5.2.5.1 Info: ID

```
Modem Circuit ID:
CIRCUIT_ID_TEST_MESSAGE
```

This screen displays the user-defined Circuit ID string (24 characters maximum) created previously using the **Utility** → **Circuit-ID** submenu.

5.2.5.2 Info: Intf



Chapter 3. REAR PANEL CONNECTORS provides detailed information about all of the interfaces that are available on CDM-750 rear panel.

```
INTF:          PIIC1=G703      PIIC2=NONE
GBEI1=Auto     GBEI2=Auto      OptInst:N
```

This screen displays the presence of/operational parameters for:

- The optional dual Plug-In-Interface Card slots – Referred to in this chapter as **PIIC1** and **PIIC2**.
- The dual Gigabit Ethernet ports – **J5 | DATA**, also referred to in this chapter as **GBE1**; and **J6 | DATA**, referred to as **GBE2**.
- The optional Optical Gigabit Ethernet Interface Module as installed in the **J7 | OPTICAL** socket.

5.2.5.3 Info: Tx

```
Tx : On 0050.0000MHz Pwr=-25.0 TSI=I
DVB-S2 NOR 130706.253kbps 32APSK 9/10
```

This screen displays the current **Tx** configuration and operating parameters. Note the following:

Display Line	Item	Status Description
Top line	Tx Carrier	On or Off
	Tx Frequency	xxxx.xxxx MHz
	Power	Power Level (dBm)
	TSI	Tx Spectral Inversion: I=Inverted (on), N=Not inverted (off)
Bottom line	Encoder	FEC type:DVB-S2
	Tx Framing	Framing Type: NOR = Normal, SB = Short Block
	Tx Data Rate	xxxxx.xxx kbps (an asterisk * indicates that the data sense is inverted)
	(Modulation)	QPSK, 8PSK, 16APSK, 32APSK
	(FEC Rate)	Displays the FEC rate.

5.2.5.4 Info: Rx

```
Rx : 0070.0000MHz 02.0dB RSI=N
01544.000kbps QPSK 1/2
```

This screen displays the current **Rx** configuration and operating parameters. Note the following:

Display Line	Item	Status Description
Top line	Rx Frequency	xxxx.xxxx MHz
	Es/No	12.3 dB (Alarm Point)
	RSI	Rx Spectral Inversion, I=Inverted (on), N=Not inverted (off)
Bottom line	Data Rate	xxxxx.xxx kbps (an asterisk * indicates that the data sense is inverted)
	(Demodulation)	QPSK, 8PSK, 16APSK, 32APSK
	(FEC Rate)	1/2, 2/3, 3/4, 7/8, 0.95, 5/16, 21/44 or 1/1

5.2.5.5 Info: Clocks

```
REF=Internal+O/P
```

This screen shows the Frequency Reference as configured using the **CONFIG: Clocking** → **Freq-Ref** menu.

5.2.5.6 Info: ACM

```
Tx ModCod=QPSK 3/4      RemEsNo:+21.9 dB  
Rx ModCod=QPSK 3/4      LocEsNo:+21.9 dB
```

This screen shows the current ACM operating parameters (when enabled).

5.2.5.7 Info: CnC

```
CnC-Status:           Freq-offset:+000.0kHz  
Ratio:<-11 dB         Delay: 000000us
```

This screen shows the current CnC operating parameters (when enabled).

5.2.5.8 Info: Misc

```
1:1 Redundancy Status: Online  
1:1 Switch=Connected Link=Good
```

This screen provides the following information.

On the Top line: **1:1 Redundancy Status = Offline or Online.**

On the Bottom line:

- **1:1 Switch** – The connection status is either **Connected** or, if there is no connection recognized to the rear panel **J2 | Redundancy** port, **Not Connected**.
- **Link** – When a connection is recognized, the **Link** quality is also provided (e.g., **Link=Good**).

5.2.5.9 Info: Remote

```
Remote-Control= Local      Address= 0000  
Interface= RS-232         9600 baud
```

This screen shows whether the unit is in **Local** or **Remote** Mode, and identifies the selected electrical interface type, the unit's address, and the baud rate.

5.2.5.10 Info: Comp

```
Comp=Disabled   DeComp=Disabled
```

This screen shows whether the optional K4 GZip lossless compression and decompression is **Enabled** or **Disabled**.

5.2.6 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, and 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, and then 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.

Store/Load: Override

Whether storing into a location and an existing configuration is already stored at this location, or 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**.

5.2.7 SELECT: Utility

```
Utilities:  Set-RTC  Display-Brightness  
LED  1:1  1:N  Circuit-ID  Firmware
```

Use the ◀ ▶ arrow keys to select **Set-RTC**, **Display-Brightness**, **LED**, **1:1**, **1:N**, **Circuit-ID**, or **Firmware**, and then press **ENTER**.

5.2.7.1 Utility: Set-RTC

```
Edit Real-Time Clock:  
Time: 12:01:02  Date:26/10/06  (◀ ▶ ⬆ ⬇)
```

To edit the time and date settings of the Real-Time Clock: First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to change that digit. Press **ENTER** when done.



In accordance with European convention, the date is shown in DAY-MONTH- YEAR format. Time is shown in Military (24-hour) format.

5.2.7.2 Utility: Display-Brightness

```
Edit Display Brightness:  
100%  (⬆ ⬇)
```

To edit the brightness of the VFD (Vacuum Fluorescent Display): Use the ▲ ▼ arrow keys to select a suitable brightness level. The available levels are **25%**, **50%**, **75%** or **100%**. Press **ENTER** when done.

5.2.7.3 Utility: 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.

5.2.7.4 Utility: 1:1

1:1 Manual/Auto Force

Use the ◀ ▶ arrow keys to select **Manual/Auto** or **Force**, and then press **ENTER**. Note the following:

Selection		Description
Manual/Auto <i>(Use the ▲ ▼ arrow keys to select Manual or Auto, and then press ENTER)</i>	Manual	The currently online modem remains online regardless of any current or future faults. Online and offline modems remain in this state until you Force the switchover.
	Auto	The redundancy switch chooses which modem is online based on fault conditions: <ul style="list-style-type: none"> • If the original online modem, Unit 'A' becomes faulted, then switch occurs to the offline modem, Unit 'B' only if it is fault-free. • Operation can not revert back to the original online modem, Unit 'A', until it clears its faults. • Switchover back to Unit 'A' occurs only if the new online Unit 'B' becomes faulted and Unit 'A' is clear of any faults.
Force <i>(press ENTER to force switchover, subject to the conditions specified here)</i>		The conditional states for forced switchover are identified on this screen as follows: <ul style="list-style-type: none"> • 1:1 redundancy is Not Connected This message indicates that the modem's rear panel J2 REDUNDANCY connector is <i>not</i> connected to a supported 1:1 redundancy switch such as the CRS-170A or CRS-180. • This Unit is in Standby (1:1 only) This message indicates that the modem is properly connected to a supported 1:1 redundancy switch but the modem is the backup. You can only "Force" a switch to the backup by forcing the Online modem to go Offline. You can not force the backup to go online. • Press ENTER key to force Unit into Standby (1:1 only) This message indicates that the modem <i>is</i> connected to a 1:1 switch and the modem <i>is</i> online. Press ENTER to force this modem <i>offline</i> and bring the alternate modem <i>online</i>.

5.2.7.5 Utility: 1:N

1:N Redundancy: Disabled

Use the ▲ ▼ arrow keys to select 1:N Redundancy as **Enabled** or **Disabled**, and then 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.

5.2.7.6 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.

The following characters may be used:

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

Press **ENTER** once you compose your desired Circuit ID string.

5.2.7.7 Utility: Firmware



THESE SUBMENUS ARE INTENDED FOR DIAGNOSTIC PURPOSES ONLY. DO NOT CHANGE AN IMAGE UNLESS OTHERWISE DIRECTED BY COMTECH EF DATA CUSTOMER SUPPORT.

These submenus permit you to view information about the CDM-750 internal firmware. The modem can store two complete firmware images. You can select which image is loaded the next time the unit reboots.

```
Firmware Images: Active Image=2
Info      Select      (◀ ▶)
```

Use the ◀▶ arrow keys to select **Info** or **Select**, and then press **ENTER**.

5.2.7.7.1 (UTILITY) Firmware Images: Info

```
Firmware Information:
Boot-ROM  Image#1  Image#2      (◀ ▶)
```

Use the ◀▶ arrow keys to select **Boot-ROM**, **Image#1**, or **Image#2**, and then press **ENTER** to view the selected firmware information. Per the following example:

```
Image #1 Bulk:      01/26/10
FW-00000305        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.

5.2.7.7.2 (UTILITY) Firmware Images: Select

```
Current Active Image is #1
Next Reboot, will use Image: #1
```

The top line shows the current active image. On the bottom line, use the ▲▼ arrow keys to select the other image (#2) if needed, and then press **ENTER**. You are then prompted to reboot the unit.

5.2.8 SELECT: ODU (Outdoor Unit)



The BUC:PwrSupply+Ref and FSK-control selections are reserved for future use and are non-operational at this time.

```
ODU: BUC:PwrSupply+Ref
      LNB:PwrSupply+Ref  FSK-control (◀ ▶)
```

Use the ◀▶ arrow keys to select **LNB: PwrSupply+Ref**, and then press **ENTER**.

5.2.8.1 ODU: LNB:PwrSupply+Ref

```
LNB control/monitor:
PSU-and-10MHz          PSUmonitor (◀ ▶)
```

Use the ◀▶ arrow keys to select **PSU-and-10MHz** or **PSUmonitor**, and then press **ENTER**.

5.2.8.1.1 (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 the **Voltage**, **10MHz**, or the **Alarm** low and high limits (range) settings, and then use the ▲▼ arrow keys to configure each setting. Press **ENTER** when done. Note the following:

Selection	Description
Voltage	Use the ▲▼ arrow keys to select Off , 13V DC , 18V DC , or 25V DC . Any setting other than Off configures the rear panel J9 L-BAND RX IN Type 'N' connector.
10MHz	Use the ▲▼ arrow keys to select Off or On . Selecting On enables a high stability 10MHz reference clock with ± 0.06 ppm on the rear panel J9 L-BAND RX IN Type 'N' connector.

Selection	Description
Alarm limits	<p>The CDM-750 constantly monitors the LNB power supply source. Use this selection to define an alarm range that alerts you to problems with the LNB. You may define this range from a minimum of 000 mA to a maximum of 500 mA.</p> <p><i>To establish your low and high alarm limit values: 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 when done.</i></p>

5.2.8.1.2 (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 reads **0000mA, 00.0V**.

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

5.2.9 SELECT: FAST



Appendix A. FAST OPTIONS AND ACTIVATION PROCEDURE

FAST (Fully Accessible System Topology) provides the means to enable new options in the modem. Contact Comtech EF Data during normal business hours to obtain the **FAST Access Code** for the desired option.

```
FAST:  Options      Demo-Mode  CnC  (◀ ▶)
Baseboard S/N 123456789  HW RevXX.XX
```

Use the ◀ ▶ arrow keys to select **Options**, **Demo-Mode**, or **CnC**, and then press **ENTER**.

5.2.9.1 FAST: Options

```
FAST  1: Set  View 2: Set  View
OPTIONS 3: Set  View  (◀ ▶◆)
```

FAST options are organized under three internal EEPROM registers. Each register requires a unique **FAST Access Code**. It is important during upgrade to use the *register-specific* **FAST Access Code** with the *appropriate register*. Use the ◀ ▶ arrow keys to first select the **correct** register, and again to select **Set** or **View**. Press **ENTER** when done. Note the following:

Register No.	Contains the lockdowns for:	
1	01	63 Mbps Rx symbol rate
	02	63 Mbps Tx symbol rate
	03	ACM Point to Point
	04	155 Mbps Full CnC
	05	Reserved for future option
2	01	Rx QPSK Demodulation
	02	Rx 8-PSK Demodulation
	03	Rx 16APSK Demodulation
	04	Rx 32APSK Demodulation
	05	Tx QPSK Modulation
	06	Tx 8--PSK Modulation
	07	Tx 16APSK Modulation
	08	Tx 32APSK Modulation
	09	Optical Gigabit Ethernet Interface
10 – 15	Reserved for future options	
3	01	63 Msps GZip symbol rate

5.2.9.1.1 (FAST) FAST Options: Set

```
FAST: Set register1: Enter code below  
88888888888888888888 then [ENTER] (◀ ▶ ⬆)
```

To enable new FAST options in the modem, you must first obtain the **FAST Access Code** for the new option from Comtech EF Data Customer Support. Once obtained, the FAST Access Code must be entered *carefully*. First, use the ◀ ▶ arrow keys to select a digit to edit, and then use the ▲ ▼ arrow keys to change that digit. Press **ENTER** once you fully enter the *correct* FAST Access Code.

Once you **correctly** enter the FAST Access Code, the modem **accepts** the code and displays the message “**Configured correctly.**”

If you **incorrectly** enter the FAST Access Code, the modem **rejects** the code, resets to its default configuration, and displays the message “**Failed to configure. Re-enter code.**”

Re-enter the code as instructed. Should the code entry error persist after repeating the procedure, contact Comtech EF Data Customer Support for further assistance.

5.2.9.1.2 (FAST) FAST Options: View

```
FAST: View options1: 01 (installed)  
63 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 *bottom line* identifies the FAST option.

5.2.9.2 FAST: Demo-Mode

```
FAST Options Demo Mode: Off (Off,On) (⬆)  
Time remaining: 29:23:59:50
```

FAST Options Demo Mode allows access to ALL CDM-750 FAST options for 30 calendar days. On the *top line*, use the ▲ ▼ arrow keys to select Demo Mode as **Off** or **On**, and then 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.

5.2.9.3 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 has a full CnC license, and the backup modem(s) has a Fractional CnC license. A Fractional CnC license 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 operation.

As per the previous screen examples, if Fractional CnC is not installed in the CDM-750, 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 the modem can be run in CnC mode. This counter decrements under the following conditions:
 - The modem has a 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
 - 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 the **FractionalCnCTime Remaining** to 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.



Fractional CnC:Time Remaining cannot be reset or refilled in the field. Once the timer has run out, your only options are to:

- 1) Upgrade the modem to a full license***
- 2) Wait until "Time Remaining Refills In" reaches 00:00:00:00.***

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, every 12 hours the modem generates a phantom fault, allowing the Full License CnC modem to return online if its fault has cleared.***

Notes:

Lined area for notes, consisting of multiple horizontal lines.

Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT

6.1 Introduction

Ethernet-based Remote Product Management is available through the CDM-750 rear panel 'J4 | MGMT' RJ-45 10/100 BaseT Fast Ethernet M&C port.



1. TO PROCEED WITH ETHERNET-BASED REMOTE PRODUCT MANAGEMENT (SNMP OR WEB SERVER), ASSUMPTIONS ARE MADE THAT:

- *The CDM-750 is operating with the latest version firmware files.*
- *The CDM-750 is connected to a user-supplied, Windows-based PC, and:*
 - *The PC serial port is connected to the CDM-750 rear panel 'J3 | REMOTE' port with a user-supplied serial cable.*
 - *The PC Ethernet port is connected to the CDM-750 rear panel 'J4 | MGMT' 10/100 BaseT Ethernet port with a user-supplied hub, switch, or direct Ethernet cable connection.*
 - *The user PC is running a terminal emulation program (for operation of the CDM-750 Serial Interface) and a compatible Web browser (for operation of the CDM-750 Web Server Interface).*
- *The CDM-750 Management IP Address has been noted using the CDM-750 Serial Interface.*

2. USE OF THE ETHERNET-BASED SNMP INTERFACE IS RECOMMENDED ONLY FOR ADVANCED USERS. ALL OTHER USERS ARE STRONGLY ENCOURAGED TO USE THE CDM-750 WEB SERVER INTERFACE FOR MONITOR AND CONTROL (M&C) OF THE CDM-750.

6.2 Ethernet Management Interface Protocols

The user PC facilitates access to Ethernet-based remote monitor and control (M&C) of the CDM-750 through three separately-operated protocols:

- **Simple Network Management Protocol (SNMP).** This *non-secure* interface requires a user-supplied Network Management System (NMS) and a user-supplied Management Information Base (MIB) File Browser.
- **Telnet Interface.** This *non-secure* interface is accessed via Windows Command-line or a user-supplied terminal emulation program, such as HyperTerminal, installed on the user PC.
- **CDM-750 Web Server (HTTP) Interface.** This *non-secure* interface requires a compatible user-supplied Web browser such as Internet Explorer.

6.3 SNMP Interface

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-750 Advanced High-Speed Trunking Modem.
- **The SNMP Agent.** This is the software that runs on the CDM-750. The CDM-750 SNMP Agent supports both **SNMPv1** and **SNMPv2c**.
- **The user-supplied Network Management System (NMS).** This is the software that runs on the manager.

6.3.1 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. These MIB files should be compiled in a user-supplied MIB Browser or SNMP Network Monitoring System server. The following MIB files are associated with the CDM-750:

MIB File/Name (where 'x' is revision letter)	Description
FW10874-2-.mib ComtechEFData Root MIB file	ComtechEFData MIB file gives the root tree for ALL Comtech EF Data products and consists of only the following OID: Name: comtechEFData Type: MODULE-IDENTITY OID: 1.3.6.1.4.1.6247 Full path: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).comtechEFData(6247) Module: ComtechEFData
FW-0000083L .mib CDM-750 MIB file	MIB file consists of all of the OIDs for management of the modem functions
FW-0000084- .mib CDM-750 Traps MIB file	Trap MIB file is provided for SNMPv1 traps common for modem.

6.3.2 SNMP Community Strings



In SNMP v1/v2c, the SNMP Community String is sent unencrypted in the SNMP packets. Caution must be taken by the network administrator to ensure that SNMP packets travel only over a secure and private network if security is a concern.

The CDM-750 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 proper SNMP operation, the CDM-750 MIB files must be used with the associated version of the CDM-750 modem M&C. Refer to the CDM-750 FW Release Notes for information on the required FW/SW compatibility.

6.3.3 SNMP Traps

The modem has the ability to send out SNMP traps when certain events occur in the modem. The modem sends out traps when an alarm or a fault occurs in the modem. These include unit faults, Tx faults, Rx faults, and ODU faults. A trap is sent both when a fault occurs and is cleared.

The modem supports both **SNMPv1** traps and **SNMPv2** notifications. Which style of traps the modem sends can be configured by the user using the CDM750SNMPTrapVersion OID:

- The CDM-750 supports the following MIB2 SNMPv1traps / 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-750 supports the following Alarms and Faults **SNMPv1** traps:

cdm750UnitAlarmV1	6247600
cdm750TxTrafficAlarmV1	6247601
cdm750RxTrafficAlarmV1	6247602
cdm750TrapStoredEventAlarm	6247603
cdm750RedundancySwitch	6247604

- The CDM-750 supports the following Alarms and Faults **SNMPv2** notifications:

cdm750UnitAlarm	1.3.6.1.4.1.6247.55.2.1.1.1
cdm750TxTrafficAlarm	1.3.6.1.4.1.6247.55.2.1.1.2
cdm750RxTrafficAlarm	1.3.6.1.4.1.6247.55.2.1.1.3
cdm750TrapStoredEventAlarm	1.3.6.1.4.1.6247.55.2.1.1.4
cdm750RedundancySwitch	1.3.6.1.4.1.6247.55.2.1.1.5

6.4 Telnet Interface

A Telnet interface is provided for the purpose of Equipment M&C via the standard Remote Control protocol. The Telnet interface requires login at the **Administrator** and **Read/Write** User Access Levels. An example of the login process is shown here:

```

Telnet 192.168.1.2
COMTECH EF DATA CDM-750 TELNET INTERFACE
You must have an account to use this interface.
Please see your administrator.
Enter name: comtech
Enter password: comtech
Name and Password accepted. Please review your modem manual for command syntax.
<Q=Quit> Telnet-->_
    
```

Once logged into the Telnet interface as the Administrator, the standard Remote Control interface is operable and accessible as explained in **Chapter 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT**.

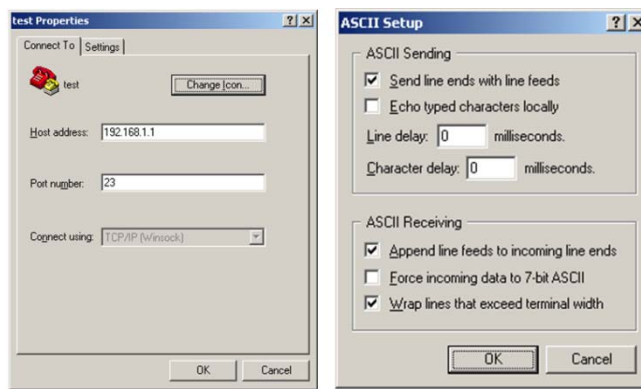
6.4.1 Telnet Operation via HyperTerminal

There is a disadvantage when using Windows Command-line as a Telnet client. Since Command-line cannot translate a '\r' (i.e., carriage return or "CR") to a '\r\n' (i.e., CR+line feed "LF") for the messages coming from Telnet Server, any multi-line Target-to-Controller response (e.g., the response to the FRW? query) will be displayed as one line, with the latter lines overwriting the previous lines.

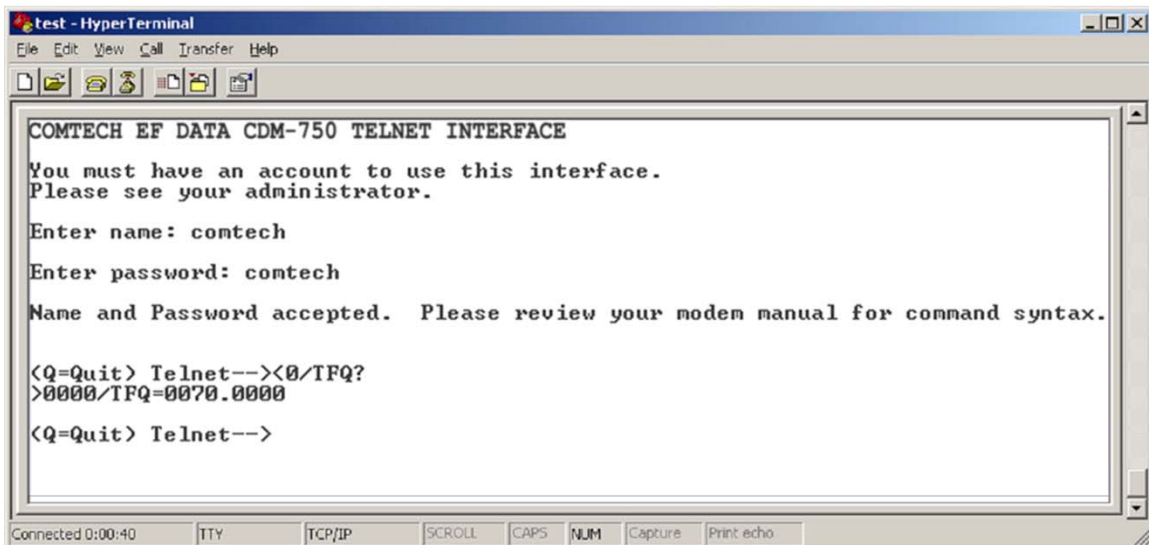
In order to view the full response messages, Comtech EF Data recommends use of the HyperTerminal terminal emulation program, configured as a Telnet client.

Configure HyperTerminal as follows:

1. Ensure that the connection is made using **TCP/IP (Winsock)** instead of COM1 or COM2, as shown at the near right.
2. ASCII Setup (File → Properties → Settings → ASCII Setup): Check the **"Send line ends with line feeds"** option in the **ASCII Sending** section, and the **"Append line feeds to incoming line ends"** option in the **ASCII Receiving** section, as shown at the far right.



Examples of login and remote command/query execution, when using HyperTerminal as the interface, appear as follows:



```
test - HyperTerminal
File Edit View Call Transfer Help
COMTECH EF DATA CDM-750 TELNET INTERFACE
You must have an account to use this interface.
Please see your administrator.
Enter name: comtech
Enter password: comtech
Name and Password accepted. Please review your modem manual for command syntax.
<Q=Quit> Telnet--><0/TFQ?
>0000/TFQ=0070.0000
<Q=Quit> Telnet-->
```

Connected 0:00:40 | TTY | TCP/IP | SCROLL | CAPS | NUM | Capture | Print echo

6.5 Web Server (HTTP) Interface

A user-supplied Web browser allows the full monitoring and control (M&C) of the CDM-750 from its Web Server Interface. This *non-secure* embedded Web application is designed for, and works best with, Microsoft Internet Explorer Version 7.0 or higher.

6.5.1 User Login

Type the CDM-750 Management IP Address (shown here as *http://xxx.xxx.xxx.xxx*) into the **Address** area of the user PC Web browser:



Once the valid IP address is entered, Before any further access to the pages can granted, the user is prompted for a user Name and Password via the Login Window, similar to the example shown at right.



Default User name – **comtech**

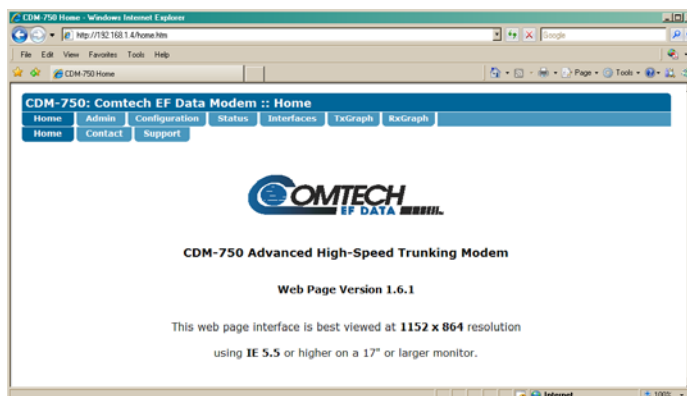
Default Password – **comtech**

Type the User Name and Password, then click **[OK]**.

HTTP Login Access Levels are defined as follows:

User Login Access Levels		
Admin User	Read/Write User	Read Only User
Full Access to all Web Pages	No Access to Admin or Encryption Web pages	No Access to Admin or Encryption Web pages

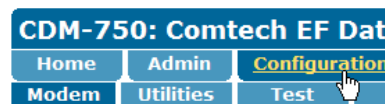
If the User Name and Password are accepted: The CDM-750 Web Server Interface Home page, similar to the example shown here, appears:



6.5.2 Web Server Interface – Operational Features

6.5.2.1 Navigation

The CDM-750 Web Server Interface features navigation tabs, located at the top of each page. After you click a navigation tab, you may click an available Web page tab.

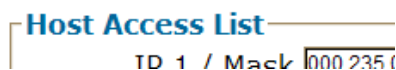


This manual uses a naming format for all Web pages to indicate the depth of navigation needed to view the subject page: “**Navigation Tab | Web Page Tab**”.

For example: “**Configuration | Modem**” means “*first* click the ‘**Configuration**’ navigation tab; *then*, click the ‘**Modem**’ Web page tab.

6.5.2.2 Page Sections

Each page features one or more sections. The title at the upper-left corner of each page or page section provides indicates its operational features. Each section can feature editable fields, action buttons, and read-only displays that are specific to that section.

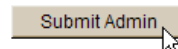


This manual explains the purpose and operation for each Web page on a **per-page, per-section** basis.

6.5.2.3 Action Buttons

Action buttons are important in the Web Server Interface. Click an action button to do one of these tasks:

/ Mask 000.235.000.000



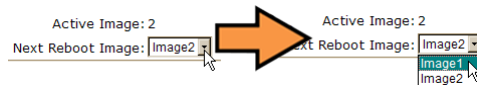
- Reset changed parameters to remove **unsaved** changes.
- Permanently save changes.
- Refresh the page with current data.



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 not saved.

6.5.2.4 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.



6.5.2.5 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.

System Account Access Info

Read Only Name	<input type="text" value="moni"/>
Read/Write Name	<input type="text"/>
Admin Name	<input type="text"/>



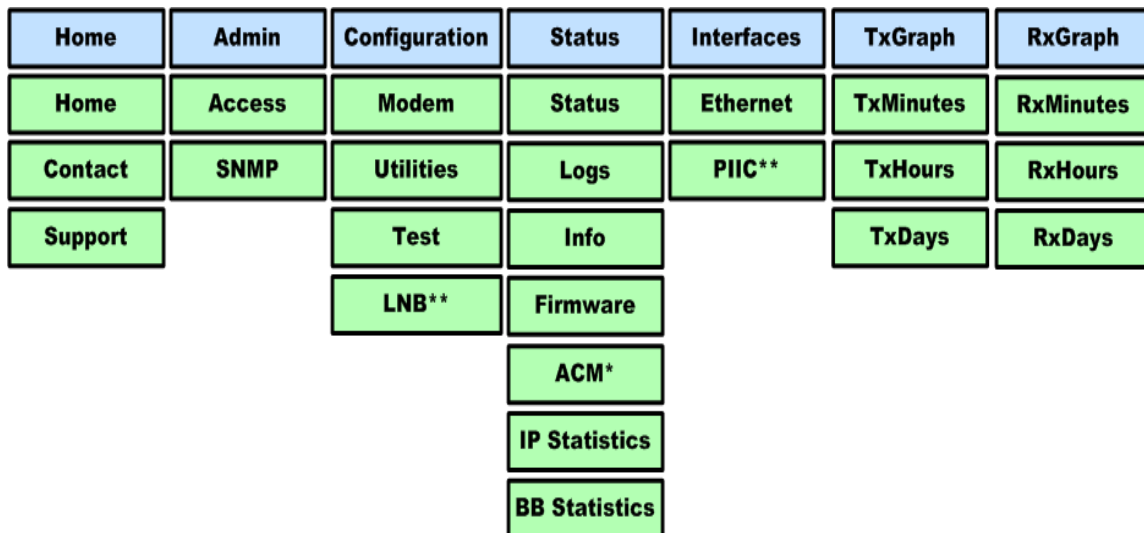
If you edit any field, make sure to click the action button before you leave the page. If you go to another page without first clicking the action button, your changes are not saved.

6.5.3 Web Server Interface – Menu Tree



Any diagram block that is marked with (*) denotes a page that is functional only when that particular FAST feature has been purchased and activated. The diagram blocks marked with (**) denote pages that are functional only when optional or auxiliary equipment such as a Block Up Converter (BUC), a Low Noise Block Down Converter(LNB), or PIIC (Plug-In Interface Card) Modules are installed and recognized as operational.

The CDM-750 Web Server Interface features seven navigation tabs (shown in blue) located at the top of each page. The primary page tabs (green) grant access to individual Web pages.



Click any navigation tab to continue.

6.5.4 Web Server Interface Page Descriptions



Access to and availability of certain CDM-750 Web Server Interface pages is dependent upon the FAST options purchased for operation as well as the detected presence of auxiliary or optional products (e.g., LNBS or BUCs, PIICs, etc.) installed and configured for use with the CDM-750. Such operational restrictions will be noted in the subsections that follow through the end of this chapter.

6.5.4.1 Home pages

Click the **Home** navigation tab, and then select the **Home**, **Contact**, or **Support** page tab to continue.

6.5.4.1.1 Home | Home

Use this page to identify the product and its current operating firmware version. Click the **Home** navigation tab and/or the nested page tab to return to this page from anywhere in the Web Server Interface.

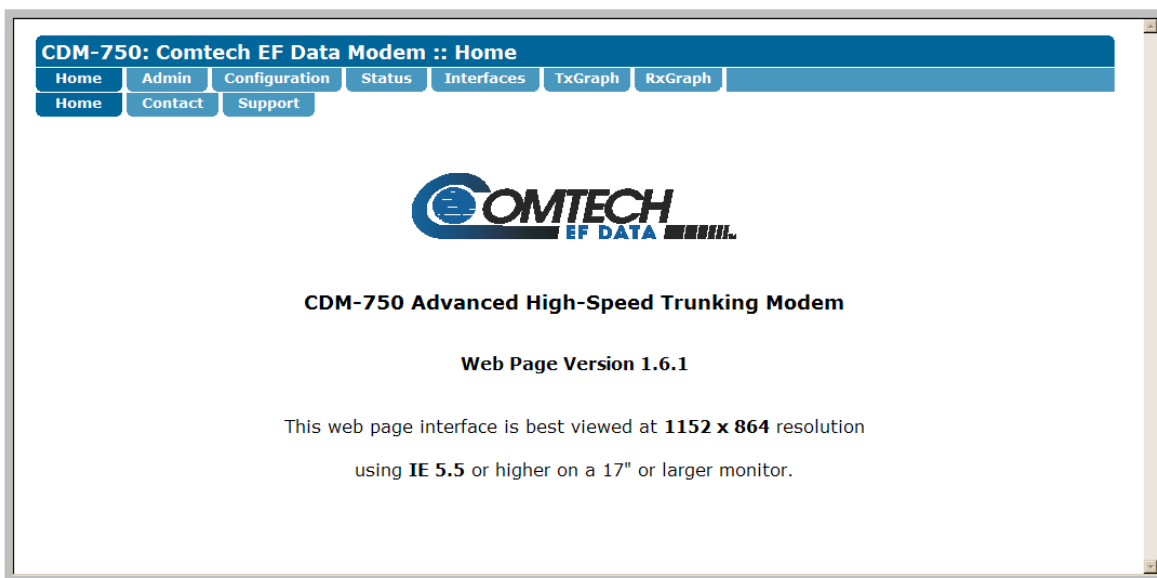


Figure 6-1. CDM-750 Home page

6.5.4.1.2 Home | Contact and Home | Support

Use either page to see the contact information (phone, fax, or Web/e-mail hyperlinks) for Comtech EF Data Sales or Customer Support.

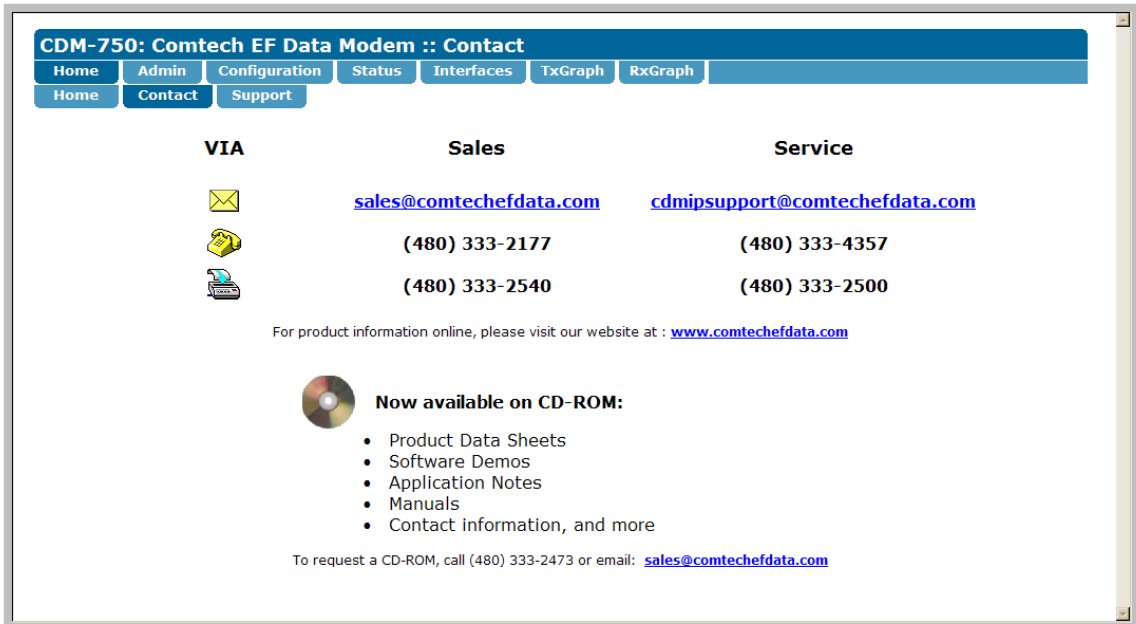


Figure 6-2. Home | Contact and Home | Support pages

6.5.4.2 Admin (Administration) pages

Use these pages to set up user access features.



The Admin pages are available only to users who have logged in using the Administrator Name and Password.

Click the **Admin** navigation tab, and then select the **Access** or **SNMP** page tab to continue.

6.5.4.2.1 Admin | Access

The Administrator must use this page to manage the CDM-750 Web Server Interface user access settings.

CDM-750: Comtech EF Data Modem :: Access

Home Admin Configuration Status Interfaces TxGraph RxGraph Access SNMP

System Account Access Information

Read Only Name Read Only Password SMTP Server

Read/Write Name Read/Write Password SMTP Domain Name

Admin Name Admin Password SMTP Destination

Host Access List

IP 1 / Mask / IP 2 / Mask / Access List

IP 3 / Mask / IP 4 / Mask /

Use 0.0.0.0 To Delete Access Entry
Be sure to include yourself!

Figure 6-3. Admin | Access page

System Account Access Information



The SMTP (Simple Mail Transport Protocol) features of this page are non-functional at this time.

- 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

- **IP (#) / Mask** – The Host Access List allows a user to define which remote clients can connect when the Access List is **Enabled**. Each entry allows a user to specify an IP address and a subnet mask to define a unique class of machines that are allowed access.

For example, if a user wanted to grant access to a PC with an IP Address of 10.10.10.1 and any PC on a subnet of 192.168.10.xxx, then the Access List would be defined as:

IP 1 / Mask: 10.10.10.1/32
IP 2 / Mask: 192.168.10.0/24

For **IP 3 / Mask** and **IP 4 / Mask**, make sure they are **not** 0.0.0.0/0. An entry with 0.0.0.0/0 simply means any machine is allowed to access.

- **Access List** – The Access List allows a user to grant access via HTTP and SNMP to a defined list of client machines. Use the drop-down list to select **Enable** or **Disable**. If **Disabled**, then any client machine will be able to connect via HTTP and SNMP.

Click [**Submit Admin**] to save these settings.

6.5.4.2.2 Admin | SNMP



- **Sect. 5.2.2.9.2 (CONFIG) IP Config: SNMP in Chapter 5. FRONT PANEL OPERATION**
- **Sect. 6.3 SNMP INTERFACE**

The Administrator must use this page to manage the CDM-750 SNMP (Simple Network Management Protocol) settings.

CDM-750: Comtech EF Data Modem :: SNMP

Home Admin Configuration Status Interfaces TxGraph RxGraph

Access SNMP

SNMP

Simple Network Management: Enabled

Read Community String: public

Write Community String: private

SNMP Contact:

SNMP Name:

SNMP Location:

Enable Authentication Trap: Enabled

Trap IP 1: 000.000.000.000

Trap IP 2: 000.000.000.000

Trap Version: SNMPv1

Trap Community String: comtech

Submit Admin

Figure 6-4. 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-750.
- 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 these settings.

6.5.4.3 Configuration pages

Use these pages to configure all unit parameters. Click the **Configuration** navigation tab, and then select the **Modem**, **Utilities**, **Test**, or **LNB** page tab to continue.

6.5.4.3.1 Configuration | Modem



The Tx / Rx Interface Types and Framing Modes have higher priority than other parameters, and should be configured before setting other parameters.



See Chapter 5. FRONT PANEL OPERATION for details pertaining to configuration parameters available on this page:

Web Page Section	Chapter 5 Section Reference
Transmit	5.2.2.2 CONFIG: Tx
Receive	5.2.2.3 CONFIG: Rx
ACM	<ul style="list-style-type: none"> 5.2.2.5 CONFIG: ACM Appendix C. ADAPTIVE CODING and MODULATION (ACM) OPTION
Carrier-in-Carrier (CnC)	<ul style="list-style-type: none"> 5.2.2.6 CONFIG: CnC Appendix D. DOUBLE TALK CARRIER-IN-CARRIER OPTION

CDM-750: Comtech EF Data Modem :: Modem Configuration

Home Admin **Configuration** Status Interfaces TxGraph RxGraph

Modem Utilities Test Lnb

Transmit

DVB-S2 Frame: Normal
 ModCod: ModCod 15 - 8PSK 5/6
 Data Rate: 072668.289 kbps
 Symbol Rate: 030000.000 ksps
 Frequency: 0070.0000 MHz
 Spectrum: Normal
 Goldcode: 000000
 Pilots: On
 Alpha Rolloff: 0.20
 Pilot Location: Average
 Power Level: 25.0 dBm
 Carrier: ON
 Compression: OFF

Receive

DVB-S2 Frame: Normal
 ModCod: ModCod 15 - 8PSK 5/6
 Data Rate: 072668.289 kbps
 Symbol Rate: 030000.000 ksps
 Frequency: 0070.0000 MHz
 Spectrum: Normal
 Goldcode: 000000
 Pilots: On
 Alpha Rolloff: 0.20
 Es/No Alarm Pt: 01.2 dB
 Decompression: OFF

Carrier-in-Carrier (CnC)

Search Delay Range Min: 000
 Search Delay Range Max: 010

ACM

Minimum ModCod: ModCod 4 - QPSK 1/2
 Maximum ModCod: ModCod 28 - 32APSK 9/10
 When distant-end demod loses lock: Go to min Tx ModCod
 Target EsNo Margin: 1.0
 Degradation QPSK: 0.0
 Degradation 8PSK: 0.0
 Degradation 16APSK: 0.0
 Degradation 32APSK: 0.0

Figure 6-5. Configuration | Modem page

Once the desired configuration settings have been made in each section, click **[Submit]** to save the settings for that section.

6.5.4.3.2 Configuration | Utilities



See Chapter 5. FRONT PANEL OPERATION for details pertaining to configuration parameters available on this page:

Web Page Section	Chapter 5 Section Reference
Circuit ID	5.2.7.6 Utility: Circuit ID
Date & Time	5.2.7.1 Utility: Set-RTC
Clocks	5.2.2.4 CONFIG: Clocks
InBand Modem Control	5.2.2.8.2 (CONFIG) Remote Control: Inband
1:1 Redundancy Control	5.2.7.4 Utility: 1:1
1:N Redundancy Control	5.2.7.5 Utility: 1:N
Firmware Image Config	5.2.7.7 Utility: Firmware
Save/Load	5.2.6 SELECT: Store/Ld (Store/Load)

Figure 6-6. Configuration | Utilities page



In addition to the operational parameters detailed in Chapter 5, the Firmware Image Config section allows you to reboot the modem. Click [Reboot Modem] to execute this feature. You will need to re-enter your user name and password to continue using the CDM-750 Web Server Interface upon successful reboot of the modem.

Once the desired configuration settings have been made in each section, click [Submit] to save the settings for that section.

6.5.4.3.3 Configuration | Test



See the following sections under Sect. 5.2.3 SELECT: Test in Chapter 5. FRONT PANEL OPERATION for details pertaining to configuration parameters available on this page:

<i>Web Page Section</i>	<i>Chapter 5 Section Reference</i>
<i>Unit</i>	<i>5.2.3.1 TEST: Mode</i>
<i>BERT Config</i>	<i>5.2.3.2.1 TEST: BERT→Config</i>
<i>BERT Monitor</i>	<i>5.2.3.2.2 TEST: BERT→Monitor</i>

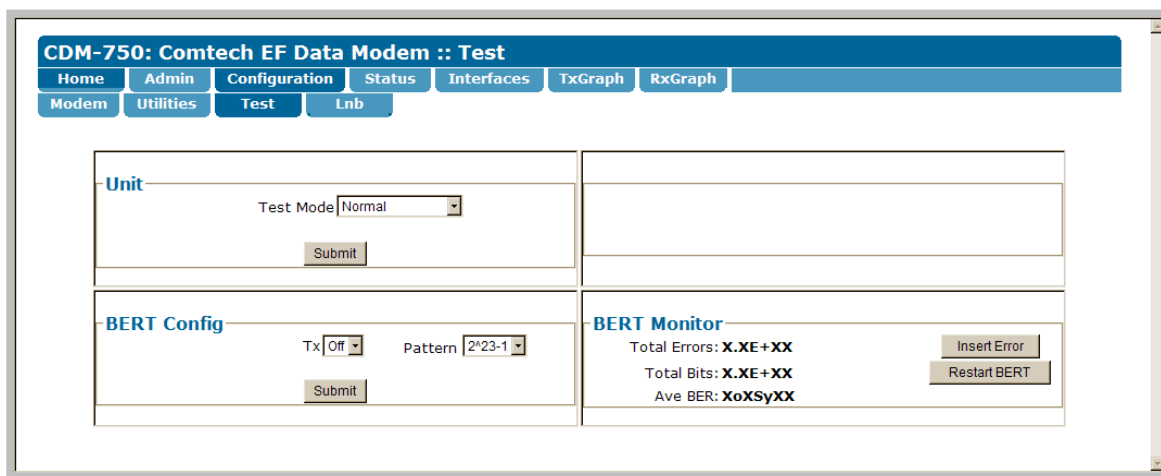


Figure 6-7. Configuration | Test page

Once the desired configuration settings have been made in each section, click **[Submit]** to save the settings for that section.

6.5.4.3.4 Configuration: LNB (Low Noise Block Down Converter)



*This page is functional only when an optional **LOW-NOISE BLOCK DOWN CONVERTER** is installed.*

Use this page to configure Low-Noise Block Down Converter parameters, and to view the LNB status for L-Band operation.

The screenshot shows a web browser window with the title "CDM-750: Comtech EF Data Modem :: Lnb". The navigation bar includes "Home", "Admin", "Configuration", "Status", "Interfaces", "TxGraph", "RxGraph", "Modem", "Utilities", "Test", and "Lnb". The "LNB Control" section has the following fields: "LNB DC Power" (OFF), "LNB Reference Enable" (OFF), "LNB Current Threshold Low" (0 mA), and "LNB Current Threshold High" (500 mA). A "Submit LNB Controls" button is located below these fields. The "LNB Status (Refreshes every 5 seconds)" section shows "LNB Current" (0 mA) and "LNB Voltage" (00.0 volts).

Figure 6-8. Configuration | LNB page

LNB Control

The acceptable/valid operating range for each item in this section is provided in parentheses.

- **LNB DC Power** – Use the drop-down list to select the power as **OFF**, **13V**, **18V**, or **24V**.
- **LNB Reference Enable** – Use the drop-down list to set LNB Reference operation as **ON** or **OFF**.
- **LNB Current Threshold (Low and High)** (0-500) – Enter a value (in mA) for either function.

Set the desired LNB configurations. Click [**Submit LNB Controls**] to save these settings.

LNB Status

This *read-only* section provides the **LNB Current** (in mA) and **LNB Voltage** (in volts) information. The report updates every five seconds. This interface displays both values as 0 when no LNB is connected or is otherwise available for reporting.

6.5.4.4 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**, **IP Statistics**, or **BB Statistics** page tab to continue.

6.5.4.4.1 Status | Status

Use this *read-only* page to review and monitor information pertaining to:

- Alarms Status
- Rx Parameters
- ACM Status
- CnC (Carrier-in-Carrier) information (including Fractional CnC Counters)
- General Operating Status (Redundancy and Unit Temperature)

CDM-750: Comtech EF Data Modem :: Modem Status			
Home	Admin	Configuration	Status
Interfaces	TxGraph	RxGraph	
Status	Logs	Info	Firmware
ACM	IP Statistics	BB Statistics	
Alarms		RX Parameters	
Unit:	None	Local EsNo :	>23.5
Tx:	P1 InSigLo	ModCod :	ModCod 15 - 8PSK 5/6
Rx:	None	Freq Offset:	+000.0
		Rx Level:	= -24 dBm
ACM		CnC	
Tx ModCod:	ModCod 15 - 8PSK 5/6	Delay:	999999
Rx ModCod:	ModCod 15 - 8PSK 5/6	Offset:	9999.9
Remote EsNo:	+23.5	Ratio:	99.9
Demo and Fractional CnC Timers		General Status	
Demo time remaining:	029:23:59:50	Redundancy:	Not Connected
Fractional CnC time remaining:	Fractional CnC is not installed.	Temperature:	+43 °C
Time until Fractional CnC refills:			

Figure 6-9. Status | Status page

6.5.4.4.2 Status | Logs

Use this page to view logged faults and alarms, and to control how faults, alarms, and stored statistics are processed by the unit. You may also to configure **Alarm Masks** for the unit with this page.

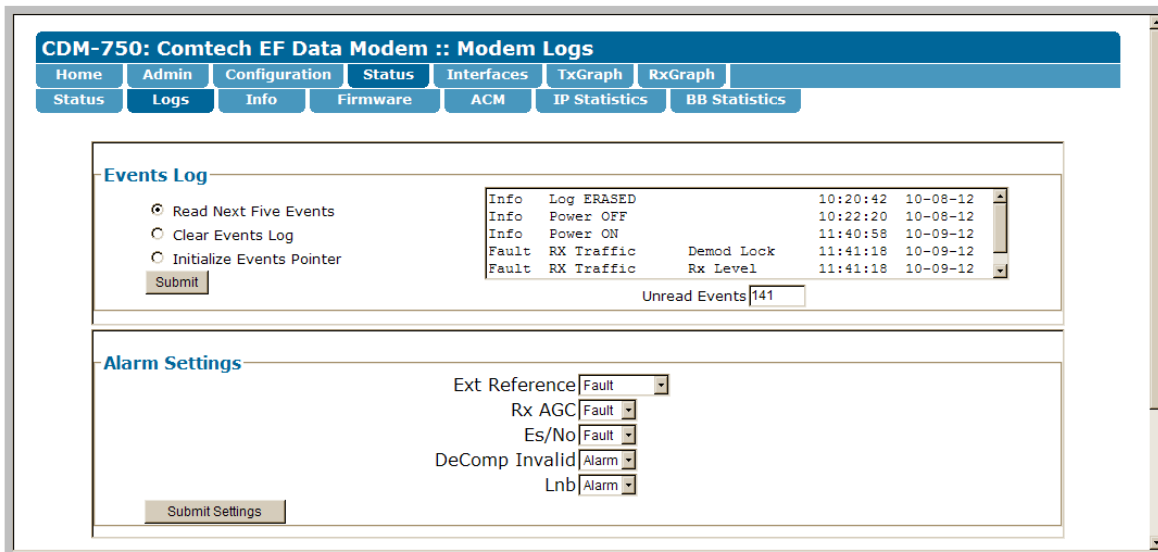


Figure 6-10. Status | Logs page

Events Log

The scrollable window in this section provides a visual records of stored events. Up to 255 events may be displayed, sorted by order of occurrence in blocks of five. Note the following:

- **Read Next Five Events** – Select to buffer the next group of five stored events into the scrollable **Events** window
- **Clear Events Log** – Select to purge the stored events log
- **Initialize Events Pointer** – Select to reset the log's internal pointer
- **Unread Events** – Displays the total number of *unread* stored events in the **Events** window. As stored event groups are displayed, this number decrements accordingly.

Click **[Submit]** to execute update of the scrollable window contents.

Alarm Mask

Set an available alarm as **Alarm**, **Fault**, or **Mask** (plus **Fault (Tx On)** for Decompression). Click **[Submit Settings]** to execute update of the unit's handling of faults and alarms.

6.5.4.4.3 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 and activated* hardware and FAST Options
- The scrollable **Uninstalled Options** window lists the *available but uninstalled* hardware and FAST Options

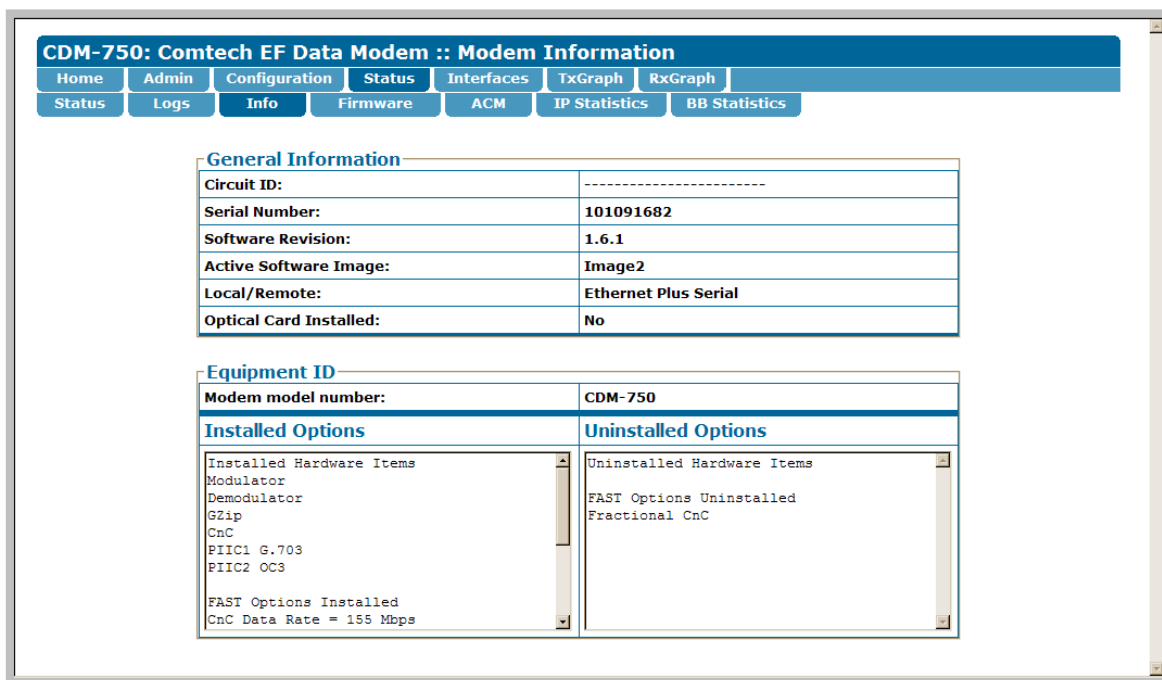


Figure 6-11. Status | Info page

6.5.4.4 Status | Firmware

Use this *read-only* page to review status windows pertaining to the unit's operational firmware loads:

- The scrollable **Boot** section provides information about the currently loaded Bootrom
- The scrollable **Image 1** and **Image 2** windows provide information for boot Image 1 and boot Image 2

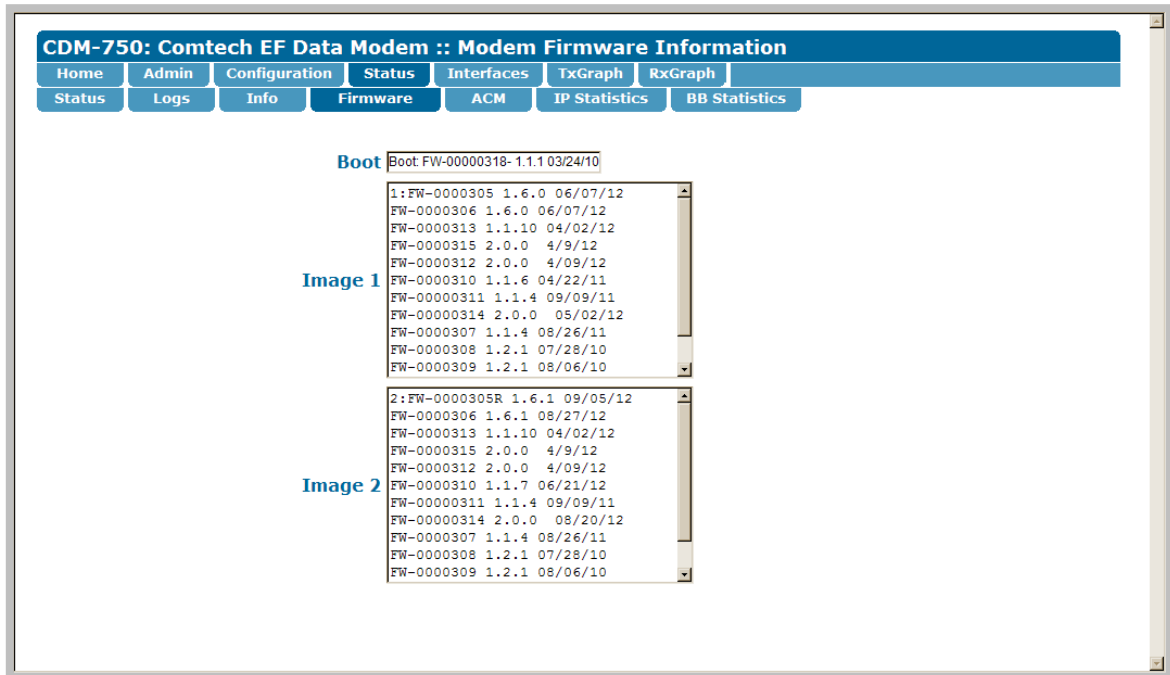


Figure 6-12. Status | Firmware Info page

6.5.4.4.5 Status | ACM



- Sect. 5.2.2.5 CONFIG: ACM (Adaptive Coding and Modulation) in Chapter 5. FRONT PANEL OPERATION
- Appendix C. ADAPTIVE CODING AND MODULATION (ACM) OPTION

Use this scrollable *read-only* page to view ACM operating statistics.

CDM-750: Comtech EF Data Modem :: Modem ACM Information

Home Admin Configuration Status Interfaces TxGraph RxGraph
Status Logs Info Firmware ACM IP Statistics BB Statistics

ACM Status

ACM Table:
 QPSK_Deg = 0.000000
 8PSK_Deg = 0.000000
 16APSK_Deg = 0.000000
 32APSK_Deg = 0.000000
 MinMODCOD = QPSK 1/2 , MaxMODCOD = 32APSK 9/10
 EsNoTargetMargin = 1.000000, Hysteresis = 0.500000
 MODCOD specEff EsNo skip?

MODCOD	specEff	EsNo	skip?
QPSK 1/2	0.988858	2.400000	NO
QPSK 3/5	1.188304	3.700000	NO
QPSK 2/3	1.322253	4.400000	NO
QPSK 3/4	1.487473	5.600000	NO
QPSK 4/5	1.587196	6.100000	YES
QPSK 5/6	1.654663	6.600000	NO
QPSK 8/9	1.766451	7.700000	YES
8PSK 3/5	1.779991	7.400000	YES
QPSK 9/10	1.788612	7.800000	NO
8PSK 2/3	1.980636	8.400000	NO
8PSK 3/4	2.228124	9.500000	NO
8PSK 5/6	2.478562	11.000000	YES
16APSK 2/3	2.637201	10.900000	NO
8PSK 8/9	2.646012	12.300000	YES
8PSK 9/10	2.679207	12.600000	YES
16APSK 3/4	2.966728	12.200000	NO
16APSK 4/5	3.165623	13.000000	YES
16APSK 5/6	3.300184	13.400000	NO
16APSK 8/9	3.523143	14.800000	YES
16APSK 9/10	3.567342	15.000000	NO
32APSK 3/4	3.703295	15.600000	NO
32APSK 4/5	3.951571	16.800000	NO
32APSK 5/6	4.119540	17.600000	NO
32APSK 8/9	4.397854	20.100000	YES
32APSK 9/10	4.453027	20.500000	NO

Figure 6-13. Status | ACM Status page

6.5.4.4.6 Status | IP Statistics



- Sect. 5.2.4.6.1 Monitor: Stats → IP in Chapter 5. FRONT PANEL OPERATION
- Appendix G. ETHERNET STATISTICS AND STATUS REPORTING

Use this *read-only* page, which updates automatically every 10 seconds, to view IP operating statistics as processed via the standard **GIGE 1 (J5 | DATA)**, **GIGE 2 (J6 | DATA)**, **Monitor and Control (J4 | MGMT)** ports, and the optional **Optical (J7 | OPTICAL)** port located on the CDM-750 rear panel. This page also provides statistics pertaining to the **WAN** interface and the optional K4 GZip Lossless **Compression / Decompression** features.

CDM-750: Comtech EF Data Modem :: Modem Status			
Home	Admin	Configuration	Status
Status	Logs	Info	Firmware
Interfaces	TxGraph	RxGraph	
ACM	IP Statistics	BB Statistics	
Clear IP Statistics Clear Comp/Decomp Stats Clear All Statistics			
IP Statistics			
GIGE 1 Statistics		GIGE 2 Statistics	
Packets From LAN :	0.0E+00	Packets From LAN :	0.0E+00
Packets To LAN :	0.0E+00	Packets To LAN :	0.0E+00
Bytes From LAN :	0.0E+00	Bytes From LAN :	0.0E+00
Bytes To LAN :	0.0E+00	Bytes To LAN :	0.0E+00
WAN Statistics		Optical Statistics	
Packets From WAN	3.5E+06	Packets From LAN :	0.0E+00
Packets To WAN	3.5E+06	Packets To LAN :	0.0E+00
Bytes From WAN	5.3E+09	Bytes From LAN :	0.0E+00
Bytes To WAN	5.3E+09	Bytes To LAN :	0.0E+00
Monitor And Control Statistics			
Packets To M&C :	0.0E+00		
Packets From M&C :	0.0E+00		
Compression Statistics (LAN To WAN)		Decompression Statistics (WAN To LAN)	
Bytes In:	0.0E+00	Bytes In:	0.0E+00
Bytes Out:	0.0E+00	Bytes Out :	0.0E+00
Savings:	00%	Savings :	00%
Last 10s :	00%	Last 10s :	00%

Figure 6-14. Status | IP Statistics page

IP Statistics

Click **[Clear IP Statistics]** to clear/reset the IP-related section statistics buffers.

Click **[Clear Comp/Decomp Stats]** to clear/reset the **Compression Statistics (LAN to WAN)** and **Decompression Statistics (WAN to LAN)** section statistics buffers.

Click **[Clear All Statistics]** to clear/reset **all** statistics buffers on this page.

6.5.4.4.7 Status | BB Statistics



Sect. 5.2.4.6.2 Monitor: Stats → BaseBandFraming in Chapter 5. FRONT PANEL OPERATION

Use this scrollable *read-only* page to view Modem Baseband operating statistics.

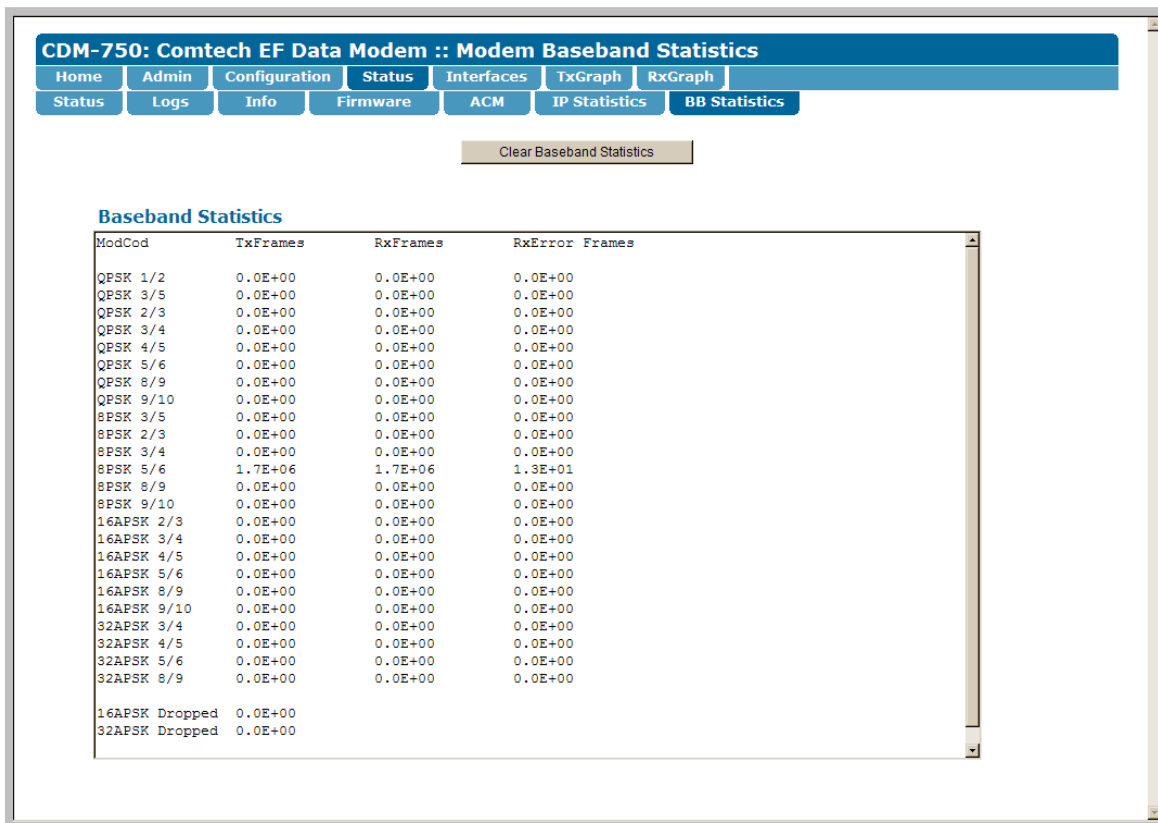


Figure 6-15. Status | BB Statistics page

Baseband Statistics

Click **[Clear Baseband Statistics]** to clear/reset this page's statistics buffers.

6.5.4.5 Interfaces pages



Be sure to read Sect. 5.2.2.1.1 Single Stream Mode vs. MultiStream Mode Operation in Chapter 5. FRONT PANEL OPERATION before you attempt to use either of the Interfaces pages.

Take care to refer back to the Chapter 5. FRONT PANEL OPERATION content sections additionally specified in the subsections that follow.

The **Interfaces** pages provide you with the means to configure and monitor the available standard and optional Ethernet and traffic data interfaces. These pages refer to the connectors and optional data interface modules that are available at the CDM-750 rear panel:

- The **GBEI 1 (J5 | DATA)** port;
- The **GBEI 2 (J6 | DATA)** port;
- The **J7 | OPTICAL** port, used with the optional **Optical Ethernet** SFP (Small Form Factor Pluggable) Module;
- **PIIC** (Plug-In Interface Card) **Slot 1** (PIIC1) and **Slot 2** (PIIC2), which accept the optional G.703 E3/T3/STS-1, OC-3 Single / Multi Mode, and STM-1 Copper PIIC modules.

Click the **Interfaces** navigation tab, and then select the **Ethernet** or **PIIC** page tab to continue.

6.5.4.5.1 Interfaces | Ethernet

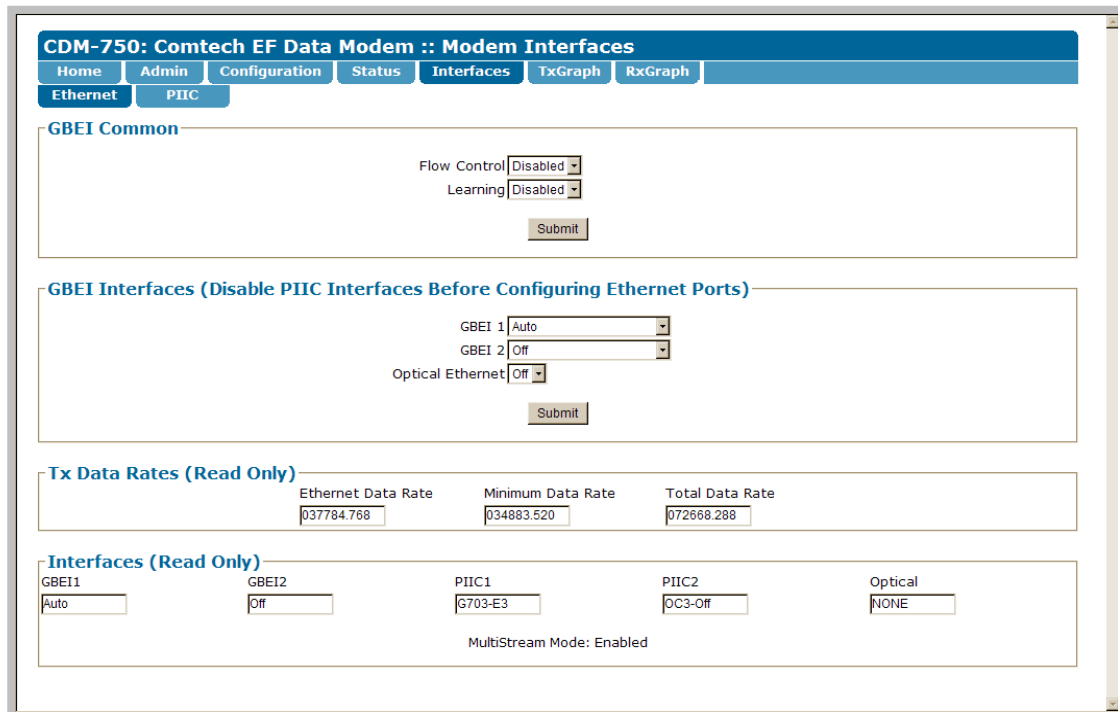


Figure 6-16. Interfaces | Ethernet page

GBEI Common



Sect. 5.2.2.1.4 (CONFIG:) INTF: GBEIX → Flow Control or Learning

Use the drop-down lists to select **Flow Control** or **Learning** as **Enabled** or **Disabled**.

Click **[Submit]** to save these settings.

GBEI Interfaces (Disable PIIC Interfaces Before Configuring Ethernet Ports)



Sect. 5.2.2.1.1 Single Stream Mode vs. MultiStream Mode Operation

Use the drop-down lists to select the appropriate mode of operation or the **GBEI 1**, **GBEI 2**, or when installed, the optional **Optical Ethernet** SFP Module.

Click **[Submit]** to save these settings.

Tx Data Rates (Read Only)



Sect. 5.2.2.2.6 (CONFIG:) Tx: Data → Tx Data Rate

Interfaces (Read Only)



- Chapter 3. REAR PANEL CONNECTIONS
- Sect. 5.2.2.1.1 Single Stream Mode vs. MultiStream Mode Operation

This section identifies the operating status for all Gigabit Ethernet and PIIC interfaces. Multi-stream Mode operation is also identified here as **Enabled** or **Disabled**.

6.5.4.5.2 Interfaces | PIIC (Plug-In Interface Card)

Use this page to configure the optional G.703 E3/T3/STS-1, OC-3 Single / Multi Mode, and STM-1 Copper PIIC modules, if installed, in PIIC slots 1 and/or 2.

Figure 6-17. Interfaces page

Typical for the **Slot1** and **Slot2** page sections, when a PIIC module is present in either or both slots:

G.703 Configuration

- **Interface Type** – Use the drop-down list to select **None**, **E3**, **T3**, or **STS1**.
- **Tx Clock Source** – Use the 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.

- **Rx Clock Source** – Use the 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.

- **External Clock** – Use the drop-down list to set the expected clock rate for the External Clock source (via the CDM-750 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**.
- **Rx Buffer Size (ms)** – Enter a buffer size, in 0.5 ms steps, ranging from 2 ms to 75 ms.

Click **[Configure PIIC]** to save these settings.

OC3 Configuration

- **Interface Type** – Use the drop-down list to select **None** or **OC3**.
- **Tx Clock Source** – Use the 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.

- **Rx Clock Source** – Use the 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.

- **Rx Buffer Size (ms)** – Enter a buffer size, in 0.5 ms steps, ranging from 2 ms to 75 ms.

Alarm Settings

- **Tx Symbol Clock PLL** – Use the drop-down list to select **Alarm**, **Fault**, **Mask**, or **Fault (Tx On)**.
- **Input Signal Loss** – Use the drop-down list to select **Alarm**, **Fault**, **Mask**, or **Fault (Tx On)**.
- **Rx Buffer Clock PLL** – Use the drop-down list to select **Alarm**, **Fault**, or **Mask**.
- **Rx Buffer Overflow / Underflow** – Use the drop-down list to select **Alarm**, **Fault**, or **Mask**.
- **Ext Clock Activity (G.703 PIIC only)** – (Indicates that the External Clock is selected by either the TxClock or RxClock but no clock is present on **J8 | EXT REF**.) Use the drop-down list to select **Alarm**, **Fault**, **Mask** or **Fault (Tx On)**.
- **Ext Clock In Range (G.703 PIIC only)** – (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 expected rate by the CDM-750.) Use the drop-down list to select **Alarm**, **Fault**, **Mask** or **Fault (Tx On)**.

6.5.4.6 TxGraph pages (Minutes / Hours / Days)

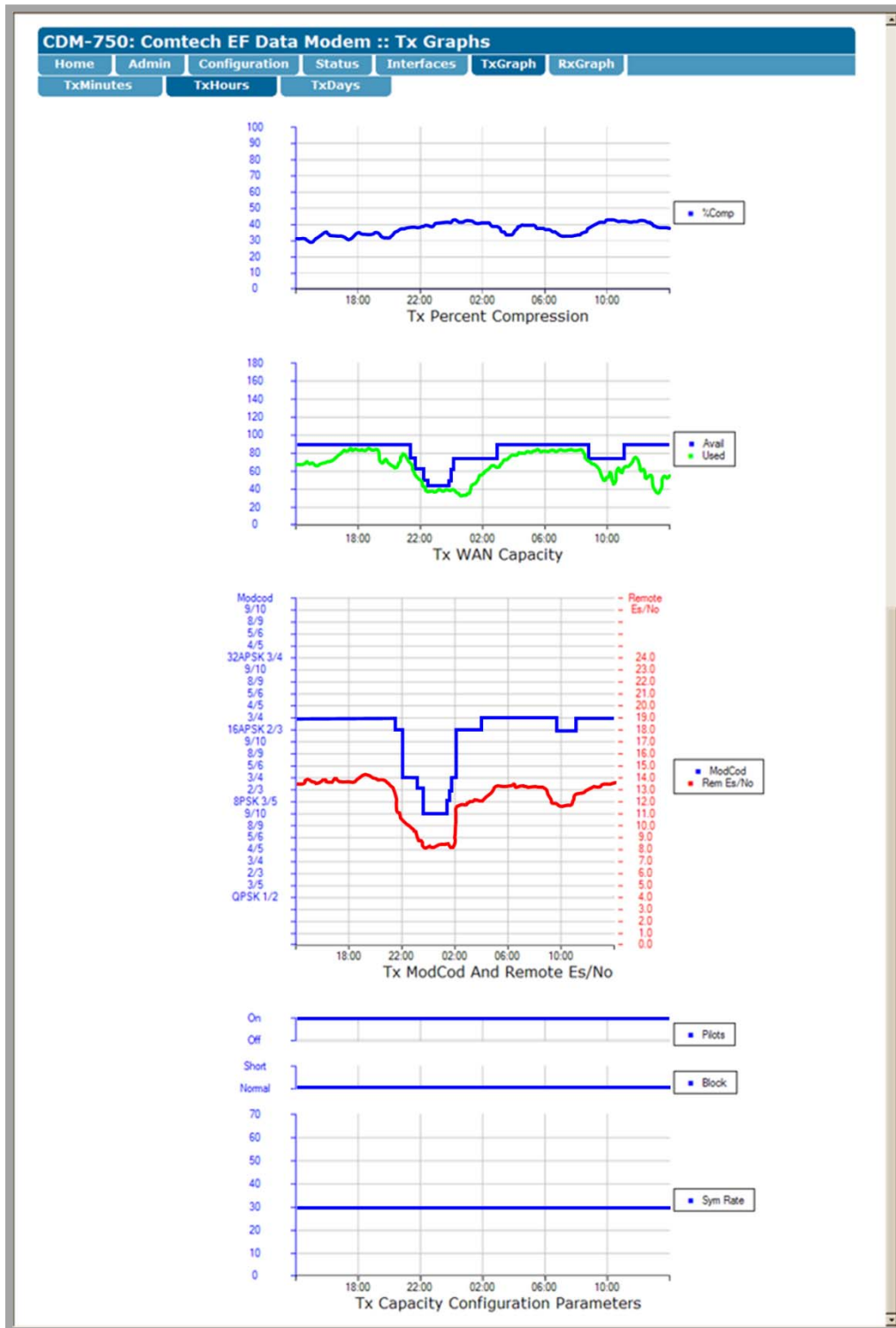


Figure 6-18. TxGraph pages (TxHours page shown)

When the presence of the optional K4 GZip Compression is detected, the **'TxGraph'** pages provide a live graphical representation of the trending characteristics that are available while using this feature.

Click the appropriate time interval page tab – **TxMinutes**, **TxHours**, or **TxDays** – to view the pertinent performance graph sets. **Figure 6-18** shows, for the purpose of example, the nested TxHours page.

The time interval afforded each nested page is self-explanatory. When the top-level **TxGraph** menu tab is selected, the page view defaults to the **TxMinutes** page. Click the desired tab to view any other nested graphing page to continue.



Once any graph page is selected, allow some time for the performance statistics to be compiled, then graphed. If the browser window is resized, allow approximately 5 to 10 seconds for the graph set to regenerate, then re-center in the browser window.

On each page, a set of four graphs is provided. The function of each graph on each page is identical. Note the following:

- **Tx Percent Compression (% Comp)** – This graph represents the LAN to WAN compression statistic as described in **Sect. 5.2.2.3.6.3 Monitor: Stats → Compression → LanToWan**. Tx Percent Compression is calculated using the following formula:

$$100 * (1 - (\text{Bytes Out} / \text{Bytes In}))$$

- **Tx WAN Capacity (Avail/Used)** – The following information is logged into the Tx WAN Capacity graph:
 - **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:

$$(\text{Tx Symbol Rate})(\text{Tx Spectral Efficiency})$$

Spectral Efficiency is a function of ModCod, Pilots On or Off, and Normal or Short Block being used. Refer to **Appendix E. 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 appropriately graphed time period (i.e., TxMinutes, TxHours, or TxDays). 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 (ModCod / Rem Es/No)** – This graph is particularly useful when the modem is running in ACM mode as it maps the remote Es/No of the far end modem synchronously along with the near side (local) Tx ModCod used. Note that 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** – This is a graphical representation of 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
 - Symbol Rate

These parameters are shown to provide you with a more complete representation of user capacity, when looked at in conjunction with the other graphs provided on these pages.

6.5.4.7 RxGraph pages (Minutes / Hours / Days)

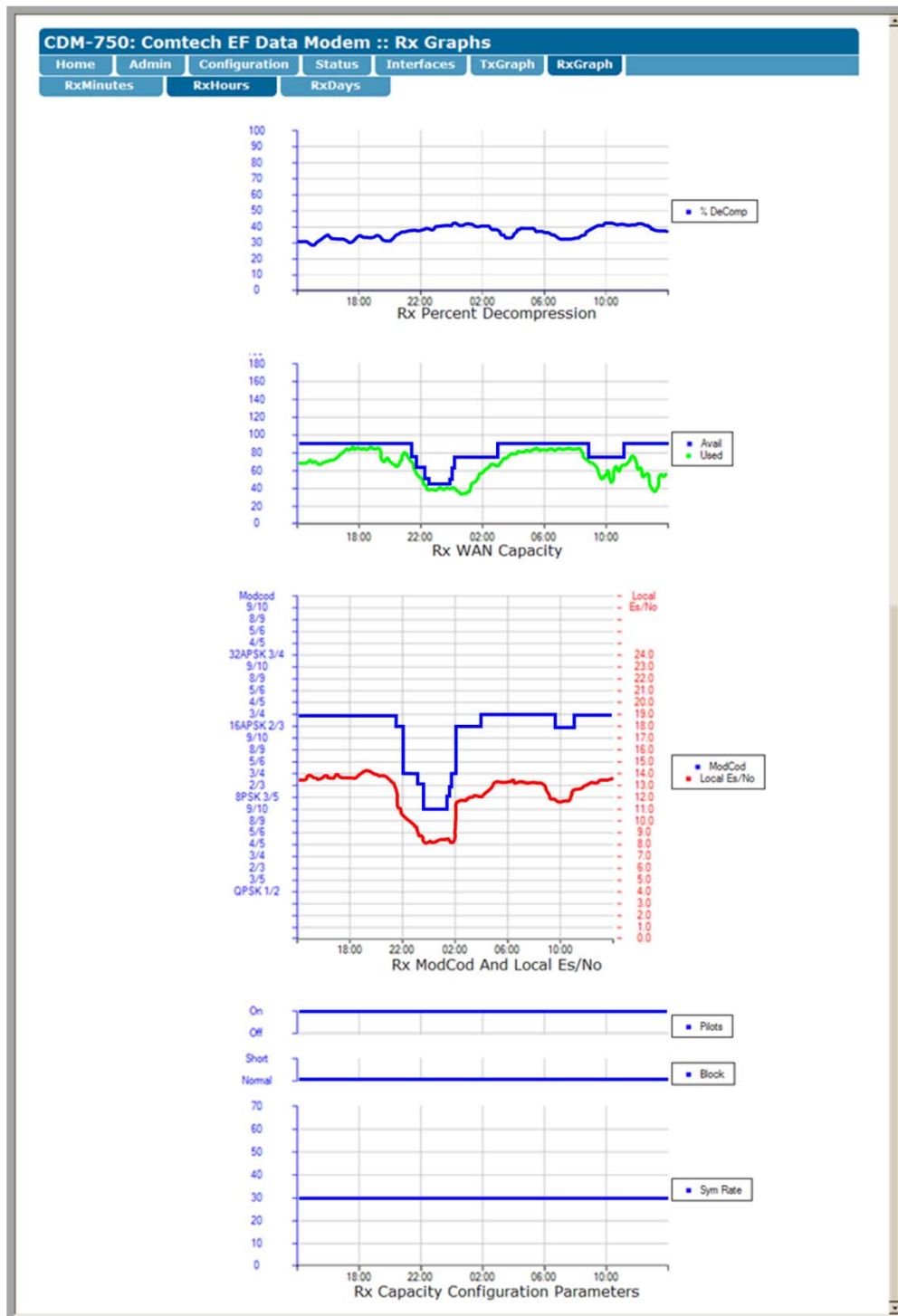


Figure 6-19. RxGraph pages (RxHours page shown)

When the presence of the optional K4 GZip Compression is detected, the 'RxGraph' pages provide a live graphical representation of the trending characteristics that are available while using this feature.

Click the appropriate time interval page tab – **RxMinutes**, **RxHours**, or **RxDays** – to view the pertinent performance graph sets. **Figure 6-19** shows, for the purpose of example, the nested **RxHours** page.

The time interval afforded each nested page is self-explanatory. When the top-level **RxGraph** menu tab is selected, the page view defaults to the **RxMinutes** page. Click the desired tab to view any other nested graphing page to continue.



Once any graph page is selected, allow some time for the performance statistics to be compiled, then graphed. If the browser window is resized, allow approximately 5 to 10 seconds for the graph set to regenerate, then re-center in the browser window.

On each page, a set of four graphs is provided. The function of each graph on each page is identical. Note the following:

- **Rx Percent Decompression (% DeComp)** – This graph represents the WAN to LAN decompression statistic as described in **Sect. 5.2.2.3.6.3 Monitor: Stats→ Compression→ WanToLan**. Rx Percent Decompression is calculated using the following formula:

$$100 * (1 - (\text{Bytes Out} / \text{Bytes In}))$$

- **Rx WAN Capacity – (Avail/Used)** – The following information is logged into the Rx WAN Capacity graph:
 - **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:

$$(\text{Rx Symbol Rate})(\text{Rx Spectral Efficiency})$$

Spectral Efficiency is a function of ModCod, Pilots On or Off, and Normal or Short Block being used. Refer to **Appendix E. 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 appropriately graphed time period (i.e., RxMinutes, RxHours, or RxDays). 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 (ModCod / Local Es/No)** – Two pieces of data are graphed 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** – This is a graphical representation of 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
 - Symbol Rate

These parameters are shown to provide you with a more complete representation of user capacity, when looked at in conjunction with the other graphs provided on these pages.

Chapter 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT

7.1 Introduction



1. *To proceed with Serial-based Remote Product Management, assumptions are made that:*

- *The CDM-750 is operating with the latest version firmware files.*
- *The CDM-750 is connected to a user-supplied, Windows-based PC, and:*
 - *The PC serial port is connected to the CDM-750 rear panel 'REMOTE' port using a user-supplied serial cable.*
 - *The PC Ethernet port is connected to the CDM-750 rear panel 'J4 | MGMT' 10/100 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-750 Serial or Telnet Interface), and a compatible Web browser (for operation of the CDM-750 Web Server Interface).*
- *The CDM-750 Management IP Address has been noted using the CDM-750 Serial Interface.*

2. 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-750 FRONT PANEL OR CDM-750 WEB SERVER INTERFACE FOR MONITOR AND CONTROL (M&C) OF THE CDM-750. SEE CHAPTER 5. FRONT PANEL OPERATION OR CHAPTER 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT.

The CDM-750 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.

7.2 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.

7.3 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.

7.4 Remote Commands and Queries Overview

7.4.1 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.

7.4.2 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).

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 Example: <0000/TMC=10[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)	= or? ASCII codes 61 or 63 (1 character)	 (n characters)	Carriage Return ASCII code 13 (1 character)

Packet Example: >0000/TMC=[cr][lf]

Detailed description of the packet components follow.

7.4.2.1 Start of Packet

- **Controller-to-Target:** This is the character ‘<’ (ASCII code 60).
- **Target-to-Controller:** This is the character ‘>’ (ASCII code 62).

The ‘<’ and ‘>’ characters indicate the start of packet. They may not appear anywhere else within the body of the message.

7.4.2.2 Target Address

- In EIA-232 applications, this value is set to **0000**.
- In EIA-485 applications, the permissible range of values is **0001** to **9999**.



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.

7.4.2.3 Address Delimiter

This is the “forward slash” character '/' (ASCII code 47).

7.4.2.4 Instruction Code

This is a three-character alphabetic sequence that identifies the message subject. Only uppercase alphabetic characters may be used ('A' to 'Z', ASCII codes 65 - 90). Wherever possible, each instruction code is named to serve as a mnemonic for its intended operation – e.g., **TFQ** for Transmit Frequency, **RMD** for Receive Modulation Type, etc. This aids in the readability of the message, should it be displayed in its raw ASCII form.

7.4.2.5 Instruction Code Qualifier

This is a single character that further qualifies the preceding instruction code. Code Qualifiers obey the following rules:

Controller-to-Target, the only permitted characters are:

Character	Definition
= (ASCII code 61)	This character is used as the Assignment Operator (AO). It establishes that the Instruction Code that precedes it is to be used as a <i>command</i> to assign or configure operation. The instruction set that follows serves to assign the Target's new parameter setting or operational value. For example: In a message from Controller-to-Target, 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 to be used as a <i>query</i> that returns the Target's current configured parameter setting or operational value. For example: <i>From Controller-to-Target</i> , TFQ? means “what is the current value of the transmit frequency?”.

Target-to-Controller, the only permitted characters are:

Character	Definition
= (ASCII code 61)	This character is used in two ways: <ol style="list-style-type: none"> If the Controller sends a query to the Target. For example: TFQ? (meaning “what is the current value of the transmit frequency?”) – the Target responds with TFQ=xxxx.xxxx, the value for that queried parameter. 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 TFQ= (with no message arguments).

Character	Definition
? (ASCII code 63)	If the Controller sends an instruction to set a parameter to a particular value, and the value sent is not valid, the Target then acknowledges the message and responds with, for example , TFO? (with no message arguments). This indicates that there was an error in the message sent by the Controller.
! (ASCII code 33)	If the Controller sends an instruction code that the Target does not recognize, the Target responds by echoing the invalid instruction, followed by ! For example : ABC!
* (ASCII code 42)	If the Controller sends the 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 acknowledges the message and responds with, for example , TFO* (with message arguments).
# (ASCII code 35)	If the Controller sends a correctly formatted command, BUT the unit is not in Remote Mode, it does not allow reconfiguration and responds, for example , with TFO#.
~ (ASCII Code 126)	If a message was sent via a local modem to a distant end device or ODU, the message was transmitted transparently through the local modem. In the event of the distant-end device not responding, the local modem would generate a response. For example : 0001/RET~ indicates that it has finished waiting for a response and is now ready for further communications.

7.4.2.6 Optional Message Arguments

Arguments are not required for all messages. Arguments are ASCII codes for the characters '0' to '9' (ASCII codes 48 to 57), 'A' to 'Z' (ASCII codes 65 to 90) period '.' (ASCII code 46), and comma ',' (ASCII code 44).

7.4.2.7 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.

7.5 Remote Commands and Queries

7.5.1 Table Indexes

Notes:

- 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*.
- In the tables that follow, the following codes are used in the ‘Response to Command’ column (per Sect. 7.4.2.5):**
 - = Message ok
 - ? Received ok, but invalid arguments were found.
 - ^ Message ok, but unit is in **Ethernet** mode.
 - # Message ok, but unit is not in **Remote** mode.
 - ~ Time out of a pass-through message to a local ODU

Sect. 7.5.2 Tx Parameters

CODE	C	Q	PAGE
TAR	X	X	7-11
TDR	X	X	7-11
TFM	X	X	7-10

CODE	C	Q	PAGE
TFQ	X	X	7-10
TGS	X	X	7-11
TLP		X	7-12

CODE	C	Q	PAGE
TMC	X	X	7-10
TPI	X	X	7-12
TPL	X	X	7-12

CODE	C	Q	PAGE
TSI	X	X	7-11
TSR	X	X	7-11
TXO	X	X	7-12

CODE	C	Q	PAGE

Sect. 7.5.3 Rx Parameters

CODE	C	Q	PAGE
EBA	X	X	7-14
EDR		X	7-15
MDR		X	7-14

CODE	C	Q	PAGE
RAR		X	7-14
RDR		X	7-14
RFM		X	7-13

CODE	C	Q	PAGE
RFQ	X	X	7-13
RGS	X	X	7-14
RMC		X	7-13

CODE	C	Q	PAGE
RPI		X	7-14
RSI		X	7-14
RSR	X	X	7-13

CODE	C	Q	PAGE

Sect. 7.5.4 IP Packet Parameters

CODE	C	Q	PAGE
CCS	X		7-16
CDS	X		7-16

CODE	C	Q	PAGE
CSA		X	7-16
DSA		X	7-16

CODE	C	Q	PAGE
EPC	X	X	7-16
ST1		X	7-17

CODE	C	Q	PAGE
WBL	X	X	7-17

CODE	C	Q	PAGE

Sect. 7.5.5 Unit Parameters

CODE	C	Q	PAGE
ADJ	X	X	7-19
CAE	X		7-21
CID	X	X	7-18
CNM	X	X	7-24
CSD	X	X	7-25
DAY	X	X	7-18
EFR	X	X	7-19

CODE	C	Q	PAGE
FRB	X		7-24
GFC	X	X	7-23
IEP	X		7-21
IMG		X	7-18
IPA	X	X	7-21
IPG	X	X	7-22
LC1	X	X	7-22

CODE	C	Q	PAGE
LC2	X	X	7-22
LC3	X	X	7-22
LRN	X	X	7-23
LRS	X	X	7-18
MAC		X	7-22
MSK	X	X	7-20

CODE	C	Q	PAGE
RFD	X		7-24
RNE		X	7-21
SBS	X	X	7-18
SLC	X	X	7-22
SRC	X	X	7-23
SSC	X	X	7-23
SSL	X	X	7-24

CODE	C	Q	PAGE
SSN	X	X	7-23
STA	X	X	7-23
STB	X	X	7-23
STV	X	X	7-24
SWC	X	X	7-23
TIM	X	X	7-18
TST	X	X	7-19

Sect. 7.5.6 ACM Parameters

CODE	C	Q	PAGE
ACM	X	X	7-26
ADC	X	X	7-26

CODE	C	Q	PAGE
ESN		X	7-26

CODE	C	Q	PAGE
LES		X	7-26
RES		X	7-26

CODE	C	Q	PAGE
RSN		X	7-26
SNR		X	7-26

CODE	C	Q	PAGE

Sect. 7.5.7 PIIC Interface

CODE	C	Q	PAGE
EFI	X	X	7-27
ETS	X	X	7-28

CODE	C	Q	PAGE
RBS	X	X	7-29
RCB	X		7-29

CODE	C	Q	PAGE
RCK	X	X	7-27
TCK	X	X	7-27

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 7.5.8 Bulk Configuration Strings

CODE	C	Q	PAGE
CLD	X		7-31

CODE	C	Q	PAGE
CST	X		7-31

CODE	C	Q	PAGE
MGC	X	X	7-30

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 7.5.9 ODU Parameters

CODE	C	Q	PAGE
LNC		X	7-32
LNH	X	X	7-32

CODE	C	Q	PAGE
LNL	X	X	7-32
LNR	X	X	7-32

CODE	C	Q	PAGE
LPS	X	X	7-32
LVO		X	7-32

CODE	C	Q	PAGE

CODE	C	Q	PAGE

Sect. 7.5.10 Modem Information

CODE	C	Q	PAGE
DMT		X	7-33
EID		X	7-34

CODE	C	Q	PAGE
FCC		X	7-36
FCF		X	7-36

CODE	C	Q	PAGE
FRW		X	7-33
HRV		X	7-36

CODE	C	Q	PAGE
SNO		X	7-33
SWR		X	7-33

CODE	C	Q	PAGE

Sect. 7.5.11 Modem Performance Information

CODE	C	Q	PAGE
BKE	X		7-40
BRA		X	7-40
BRM	X		7-40
BTX	X	X	7-40

CODE	C	Q	PAGE
CDM		X	7-39
CFM		X	7-39
CRM		X	7-39
FLT		X	7-38

CODE	C	Q	PAGE
RBP	X	X	7-40
RFO		X	7-37
RPS		X	7-41
RSL		X	7-37

CODE	C	Q	PAGE
ST2		X	7-41
ST3		X	7-41
ST4		X	7-41
ST5		X	7-41

CODE	C	Q	PAGE
TBP	X	X	7-40
TMP		X	7-37

Sect. 7.5.12 Redundancy Control

CODE	C	Q	PAGE
ASW	X	X	7-42
FSW	X		7-42

CODE	C	Q	PAGE
RED		X	7-42
R1N	X	X	7-42

CODE	C	Q	PAGE
R11		X	7-42

CODE	C	Q	PAGE

CODE	C	Q	PAGE

7.5.2 Tx Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query																																										
Tx Frequency	TFQ=	9 bytes	<p>Command or Query. Set or return Tx Frequency in MHz, Resolution=100Hz, in the form xxxx.xxxx where the range is: 50 MHz to 180 MHz, and 950 MHz to 1950 MHz (L-Band – FAST option)</p> <p>NOTE: The CDM-750 supports 70,140 MHz bands and L-Band.</p> <p>Example: TFQ=0950.9872</p>	TFQ= TFQ? TFQ* TFQ#	TFQ?	TFQ=xxxx.xxxx																																										
Tx Framing Mode	TFM=	1 byte, 0 or 1	<p>Command or Query. Set or return Tx Framing mode in the form x, where: 0 = DVB-S2 Normal 1 = DVB-S2 Short Block</p> <p>Example: TFM=1 (selects DVB-S2 Short Block mode)</p>	TFM= TFM? TFM* TFM#	TFM?	TFM=x (see Description of Arguments)																																										
Tx MODCOD	TMC=	2 bytes, value of 1 to 36	<p>Command or Query. Set or return Tx Modulation, in the form xx, where:</p> <table style="width: 100%; border: none;"> <tr> <td>0 = reserved</td> <td>14 = 8PSK 3/4</td> <td>28 = 32-APSK 9/10 *</td> </tr> <tr> <td>1 = reserved (QPSK 1/4)</td> <td>15 = 8PSK 5/6</td> <td>29 = reserved</td> </tr> <tr> <td>2 = reserved (QPSK 1/3)</td> <td>16 = 8PSK 8/9</td> <td>30 = reserved</td> </tr> <tr> <td>3 = reserved (QPSK 2/5)</td> <td>17 = 8PSK 9/10 *</td> <td>31 = reserved</td> </tr> <tr> <td>4 = QPSK 1/2</td> <td>18 = 16-APSK 2/3</td> <td>32 = auto</td> </tr> <tr> <td>5 = QPSK 3/5</td> <td>19 = 16-APSK 3/4</td> <td>33 = reserved (DVB-S QPSK 1/2)</td> </tr> <tr> <td>6 = QPSK 2/3</td> <td>20 = 16-APSK 4/5</td> <td>34 = reserved (DVB-S QPSK 2/3)</td> </tr> <tr> <td>7 = QPSK 3/4</td> <td>21 = 16-APSK 5/6</td> <td>35 = reserved (DVB-S QPSK 3/4)</td> </tr> <tr> <td>8 = QPSK 4/5</td> <td>22 = 16-APSK 8/9</td> <td>36 = reserved (DVB-S QPSK 5/6)</td> </tr> <tr> <td>9 = QPSK 5/6</td> <td>23 = 16-APSK 9/10 *</td> <td>37 = reserved (DVB-S QPSK 7/8)</td> </tr> <tr> <td>10 = QPSK 8/9</td> <td>24 = 32-APSK 3/4</td> <td></td> </tr> <tr> <td>11 = QPSK 9/10 *</td> <td>25 = 32-APSK 4/5</td> <td></td> </tr> <tr> <td>12 = 8PSK 3/5</td> <td>26 = 32-APSK 5/6</td> <td></td> </tr> <tr> <td>13 = 8PSK 2/3</td> <td>27 = 32-APSK 8/9</td> <td></td> </tr> </table> <p>All other codes are invalid.</p> <p>Example: TMC = 4</p>	0 = reserved	14 = 8PSK 3/4	28 = 32-APSK 9/10 *	1 = reserved (QPSK 1/4)	15 = 8PSK 5/6	29 = reserved	2 = reserved (QPSK 1/3)	16 = 8PSK 8/9	30 = reserved	3 = reserved (QPSK 2/5)	17 = 8PSK 9/10 *	31 = reserved	4 = QPSK 1/2	18 = 16-APSK 2/3	32 = auto	5 = QPSK 3/5	19 = 16-APSK 3/4	33 = reserved (DVB-S QPSK 1/2)	6 = QPSK 2/3	20 = 16-APSK 4/5	34 = reserved (DVB-S QPSK 2/3)	7 = QPSK 3/4	21 = 16-APSK 5/6	35 = reserved (DVB-S QPSK 3/4)	8 = QPSK 4/5	22 = 16-APSK 8/9	36 = reserved (DVB-S QPSK 5/6)	9 = QPSK 5/6	23 = 16-APSK 9/10 *	37 = reserved (DVB-S QPSK 7/8)	10 = QPSK 8/9	24 = 32-APSK 3/4		11 = QPSK 9/10 *	25 = 32-APSK 4/5		12 = 8PSK 3/5	26 = 32-APSK 5/6		13 = 8PSK 2/3	27 = 32-APSK 8/9		TMC= TMC? TMC* TMC#	TMC?	TMC=xx (see Description of Arguments)
0 = reserved	14 = 8PSK 3/4	28 = 32-APSK 9/10 *																																														
1 = reserved (QPSK 1/4)	15 = 8PSK 5/6	29 = reserved																																														
2 = reserved (QPSK 1/3)	16 = 8PSK 8/9	30 = reserved																																														
3 = reserved (QPSK 2/5)	17 = 8PSK 9/10 *	31 = reserved																																														
4 = QPSK 1/2	18 = 16-APSK 2/3	32 = auto																																														
5 = QPSK 3/5	19 = 16-APSK 3/4	33 = reserved (DVB-S QPSK 1/2)																																														
6 = QPSK 2/3	20 = 16-APSK 4/5	34 = reserved (DVB-S QPSK 2/3)																																														
7 = QPSK 3/4	21 = 16-APSK 5/6	35 = reserved (DVB-S QPSK 3/4)																																														
8 = QPSK 4/5	22 = 16-APSK 8/9	36 = reserved (DVB-S QPSK 5/6)																																														
9 = QPSK 5/6	23 = 16-APSK 9/10 *	37 = reserved (DVB-S QPSK 7/8)																																														
10 = QPSK 8/9	24 = 32-APSK 3/4																																															
11 = QPSK 9/10 *	25 = 32-APSK 4/5																																															
12 = 8PSK 3/5	26 = 32-APSK 5/6																																															
13 = 8PSK 2/3	27 = 32-APSK 8/9																																															

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Tx Symbol Rate	TSR=	10 bytes, numeric	<p>Command or Query. Set or return Tx Symbol Rate, in Ksps, in the form dddddd.ddd where the valid range is: QPSK/8PSK: 1000 to 63000Ksps 16APSK: 1000 to 47000Ksps 32APSK: 1000 to 38000Ksps</p> <p>* All 9/10 MODCODs are not valid in Short Block operation</p> <p>NOTE: If the Symbol Rate is set, then the Data Rate rate will be automatically calculated and updated.</p>	TSR? TSR= TSR* TSR#	TSR?	TSR=xxxxxx.xxx (see Description of Arguments)
Tx Data Rate	TDR=	10 bytes	<p>Command or Query. Set or return Tx Data rate in Ksps, Resolution=1 bps in the form xxxxxx.xxx.</p> <p>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.</p> <p>The Data Rate can only be changed in Non-MultiStream Mode and only with the Ethernet interface selected.</p> <p>Example: TDR=002047.999 (2047.999 kbps)</p>	TDR= TDR? TDR* TDR#	TDR?	TDR=xxxxxx.xxx (see Description of Arguments)
Tx Spectrum Invert	TSI=	1 byte, value of 0 or 1	<p>Command or Query. Set or return Tx Spectrum Invert in the form x, where: 0 = Normal 1 = Tx Spectrum Inverted</p> <p>Example: TSI=0 (selects Normal)</p>	TSI= TSI? TSI* TSI#	TSI?	TSI=x (see Description of Arguments)
Tx Alpha Rolloff	TAR=	1 byte, value of 0 thru 2	<p>Command or Query. Set or return Tx Alpha Rolloff, where: 0 = 20% 1 = 25% 2 = 35%</p> <p>Example: TAR=0 (selects a Tx Alpha Rolloff of 20%)</p>	TAR= TAR? TAR* TAR#	TAR?	TAR=x
Tx Gold Code Sequence Index	TGS=	6 bytes	<p>Command or Query. Set or return Tx Gold Code Sequence Index in the form xxxxxx, where: Gold Code Sequence index = 000000 to 262141</p> <p>Example: TGS=189063</p>	TGS= TGS? TGS* TGS#	TGS?	TGS=xxxxxx

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Tx Pilot	TPI=	1 byte, value of 0 or 1	<p>Command or Query. Set or return Tx Pilot in the form x, where: 0 = Off 1 = On</p> <p>Example: TPI=0 (selects Pilot Off)</p> <p>NOTE: CEFD recommends that you use Pilots when running any 16-APSK or 32-APSK MODCOD. Additionally, Pilots are recommended when the symbol rate is below 5000 Ksps.</p>	TPI= TPI? TPI* TPI#	TPI?	TPI=x
Tx Pilot Location	N/A	1 byte, value of 0	<p>Query only. Returns Tx Pilot location in the form 0, where: 0 = Average Power</p> <p>Example: TLP=0 (which returns Average Power)</p>	N/A	TLP?	TLP=0
Tx Power Level	TPL=	4 bytes	<p>Command or Query. Set or return Tx Output power level (dBm) in the form sxx.x, where: s = sign (+ or -) xx.x = power level (dBm) in 0.1 db steps: L-Band: 0 to -40 dBm 70/140 MHz: 0 to -25 dBm</p> <p>Example: TPL=-13.4</p>	TPL= TPL? TPL* TPL#	TPL?	TPL=sxx.x (see Description of Arguments)
Tx Carrier State	TXO=	1 byte, value of 0 or 1	<p>Command or Query. Set or return Tx Carrier State in the form x, where: 0 = OFF due to front panel or remote control command 1 = ON</p> <p>Example: TXO=1 (Tx Carrier ON)</p>	TXO= TXO? TXO* TXO#	TXO?	TXO=x (see Description of Arguments)

7.5.3 Rx Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query																																										
Rx Frequency	RFQ=	9 bytes	Command or Query. Set or return Rx Frequency ranges in MHz, Resolution=100Hz, in the form xxxx.xxxx where the range is: 50 MHz to 180 MHz, and 950 MHz to 2150 MHz NOTE: The CDM-750 supports 70,140 MHz bands and L-Band. Example: RFQ=0950.9872	RFQ= RFQ? RFQ* RFQ#	RFQ?	RFQ=xxxx.xxxx (see Description of Arguments)																																										
Rx Framing Mode	N/A	1 byte, value of 0 or 1	Query only. Returns Rx Framing mode in the form x, where: 0 = DVB-S2 Normal 1 = DVB-S2 Short Block Example: RFM=1 (selects DVB-S2 Short Block mode)	N/A	RFM?	RFM=x (see Description of Arguments)																																										
Rx MODCOD	N/A	2 bytes	Query only. Returns Rx Demodulation in the form xx, where: <table style="width: 100%; border: none;"> <tr> <td>0 = reserved</td> <td>14 = 8PSK 3/4</td> <td>28 = 32-APSK 9/10 *</td> </tr> <tr> <td>1 = reserved (QPSK 1/4)</td> <td>15 = 8PSK 5/6</td> <td>29 = reserved</td> </tr> <tr> <td>2 = reserved (QPSK 1/3)</td> <td>16 = 8PSK 8/9</td> <td>30 = reserved</td> </tr> <tr> <td>3 = reserved (QPSK 2/5)</td> <td>17 = 8PSK 9/10 *</td> <td>31 = reserved</td> </tr> <tr> <td>4 = QPSK 1/2</td> <td>18 = 16-APSK 2/3</td> <td>32 = reserved</td> </tr> <tr> <td>5 = QPSK 3/5</td> <td>19 = 16-APSK 3/4</td> <td>33 = reserved (DVB-S QPSK 1/2)</td> </tr> <tr> <td>6 = QPSK 2/3</td> <td>20 = 16-APSK 4/5</td> <td>34 = reserved (DVB-S QPSK 2/3)</td> </tr> <tr> <td>7 = QPSK 3/4</td> <td>21 = 16-APSK 5/6</td> <td>35 = reserved (DVB-S QPSK 3/4)</td> </tr> <tr> <td>8 = QPSK 4/5</td> <td>22 = 16-APSK 8/9</td> <td>36 = reserved (DVB-S QPSK 5/6)</td> </tr> <tr> <td>9 = QPSK 5/6</td> <td>23 = 16-APSK 9/10 *</td> <td>37 = reserved (DVB-S QPSK 7/8)</td> </tr> <tr> <td>10 = QPSK 8/9</td> <td>24 = 32-APSK 3/4</td> <td></td> </tr> <tr> <td>11 = QPSK 9/10 *</td> <td>25 = 32-APSK 4/5</td> <td></td> </tr> <tr> <td>12 = 8PSK 3/5</td> <td>26 = 32-APSK 5/6</td> <td></td> </tr> <tr> <td>13 = 8PSK 2/3</td> <td>27 = 32-APSK 8/9</td> <td></td> </tr> </table> All other codes are invalid. Example: RMC=4	0 = reserved	14 = 8PSK 3/4	28 = 32-APSK 9/10 *	1 = reserved (QPSK 1/4)	15 = 8PSK 5/6	29 = reserved	2 = reserved (QPSK 1/3)	16 = 8PSK 8/9	30 = reserved	3 = reserved (QPSK 2/5)	17 = 8PSK 9/10 *	31 = reserved	4 = QPSK 1/2	18 = 16-APSK 2/3	32 = reserved	5 = QPSK 3/5	19 = 16-APSK 3/4	33 = reserved (DVB-S QPSK 1/2)	6 = QPSK 2/3	20 = 16-APSK 4/5	34 = reserved (DVB-S QPSK 2/3)	7 = QPSK 3/4	21 = 16-APSK 5/6	35 = reserved (DVB-S QPSK 3/4)	8 = QPSK 4/5	22 = 16-APSK 8/9	36 = reserved (DVB-S QPSK 5/6)	9 = QPSK 5/6	23 = 16-APSK 9/10 *	37 = reserved (DVB-S QPSK 7/8)	10 = QPSK 8/9	24 = 32-APSK 3/4		11 = QPSK 9/10 *	25 = 32-APSK 4/5		12 = 8PSK 3/5	26 = 32-APSK 5/6		13 = 8PSK 2/3	27 = 32-APSK 8/9		N/A	RMC?	RMC=xx (see Description of Arguments)
0 = reserved	14 = 8PSK 3/4	28 = 32-APSK 9/10 *																																														
1 = reserved (QPSK 1/4)	15 = 8PSK 5/6	29 = reserved																																														
2 = reserved (QPSK 1/3)	16 = 8PSK 8/9	30 = reserved																																														
3 = reserved (QPSK 2/5)	17 = 8PSK 9/10 *	31 = reserved																																														
4 = QPSK 1/2	18 = 16-APSK 2/3	32 = reserved																																														
5 = QPSK 3/5	19 = 16-APSK 3/4	33 = reserved (DVB-S QPSK 1/2)																																														
6 = QPSK 2/3	20 = 16-APSK 4/5	34 = reserved (DVB-S QPSK 2/3)																																														
7 = QPSK 3/4	21 = 16-APSK 5/6	35 = reserved (DVB-S QPSK 3/4)																																														
8 = QPSK 4/5	22 = 16-APSK 8/9	36 = reserved (DVB-S QPSK 5/6)																																														
9 = QPSK 5/6	23 = 16-APSK 9/10 *	37 = reserved (DVB-S QPSK 7/8)																																														
10 = QPSK 8/9	24 = 32-APSK 3/4																																															
11 = QPSK 9/10 *	25 = 32-APSK 4/5																																															
12 = 8PSK 3/5	26 = 32-APSK 5/6																																															
13 = 8PSK 2/3	27 = 32-APSK 8/9																																															
Rx Symbol Rate	RSR=	10 bytes, numeric	Command or Query. Set or return Rx Symbol Rate, in Ksps, in the form ddddd.ddd where the valid range is: QPSK/8PSK: 1000 to 63000Ksps 16APSK: 1000 to 47000Ksps 32APSK: 1000 to 38000Ksps * All 9/10 MODCODs are not valid in Short Block operation NOTE: If the Symbol Rate is set, then the Data Rate rate will be automatically calculated and updated.	RSR= RSR? RSR* RSR#	RSR?	RSR=dddd.ddd (see Description of Arguments)																																										

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Rx Data Rate	N/A	10 bytes	Query only. Returns Rx Data Rate, in Kbps, in the form xxxxxx.xxx Example: RDR=002047.999 (In Kbps)	N/A	RDR?	RDR=xxxxx.xxx (see Description of Arguments)
Rx Spectrum Invert	N/A	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: RSI=0 (selects Normal)	N/A	RSI?	RSI=x (see Description of Arguments)
Rx Alpha Rolloff	N/A	1 byte, value of 0 thru 2	Query only. Returns Rx Alpha Rolloff in the form x, where: 0 = 20% 1 = 25% 2 = 35% Example: RAR=0 (reports Rx Alpha Rolloff of 20%)	N/A	RAR?	RAR=x
Rx Gold Code Sequence Index	RGS=	6 bytes	Command or Query. Set or return Rx Gold Code Sequence Index in the form xxxxxx, where: Gold Code Sequence index = 000000 to 262141 Example: RGS=189063	RGS= RGS? RGS* RGS#	RGS?	RGS=xxxxxx
Rx Pilot	N/A	1 byte, value of 0 or 1	Query only. Returns Rx Pilot status in the form x, where: 0 = Off 1 = On Example: RPI=0 (selects Pilots Off) NOTE: This is automatically detected on demod acquisition, but if the unit is not locked, the query returns 'x'.	N/A	RPI?	RPI=x
Es/No Alarm Point	EBA=	4 bytes	Command or Query. Set or return Es/No alarm point in dB, Resolution=0.1 dB, in the form xx.x, where: xx.x = range between 0.1 and 25 dB. Example: EBA=12.3	EBA= EBA? EBA* EBA#	EBA?	EBA=xx.x (see Description of Arguments)
Minimum Data Rate (MultiStream Mode)	N/A	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 = TDR where: MDR = (PIIC1 + PIIC2) * 1.015 for Normal Frames MDR = (PIIC1 + PIIC2) * 1.05 for Short Frames In non-MultiStream mode (Ethernet Only): MDR = TDR In non-MultiStream mode (Assume PIIC 1 G703-E3): MDR = TDR	N/A	MDR?	MDR=xxxxx.xxx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Ethernet Data Rate (Multi-Stream Mode)	N/A	10 bytes	<p>Query only. Applies to MultiStream Mode. Returns the Ethernet data rate of the modem in the form xxxxxx.xxx.</p> <p>In MultiStream mode, the Ethernet data rate calc is EDR = TDR - MDR In non-Multistream mode (Ethernet only): EDR = TDR. In non-MultiStream mode (G703-E3): EDR=00000.000 Kbps</p>	N/A	EDR?	EDR=xxxxxx.xxx (see Description of Arguments)

7.5.4 IP Packet Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Payload Compression	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: EPC=1 (selects decompression off and compression on)	EPC= EPC? EPC* EPC#	EPC?	EPC=x (see Description of Arguments)
Compression Stats All	N/A	21 byte	Query only. Returns all compression statistics 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 = 00-99 The percent savings or compression efficiency xx = 00-99 The last 10 seconds percent savings or compression efficiency Each parameter is separated by a colon. Example: CSA=2.0E+03:1.0E+03:50:50 NOTE: If the Compression Option Card is not present then all numeric fields display "X" Example: CSA=X.XE+XX:X.XE+XX:XX:XX (Indicates card not present)	N/A	CSA?	CSA= x.xE+xx:x.xE+xx:xx:x x
DeComp Stats All	N/A	21 byte	Query only. Returns all decompression statistics 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 = 00-99 The percent savings or decompression efficiency xx = 00-99 The last 10 second percent savings or decompression efficiency Each parameter is separated by a colon. Example: DSA=2.0E+03:1.0E+03:50:50 If the Decompression Option Card is not present then all numeric fields display "X" Example: DSA=X.XE+XX:X.XE+XX:XX:XX (Indicates card not present)	N/A	DSA?	DSA= x.xE+xx:x.xE+xx:xx:x x
Clear Compression Statistics	CCS=	None	Command only. Clear Compression Statistics. Example: CCS=	CCS= CCS? CCS* CCS#	N/A	N/A
Clear De-compression Statistics	CDS=	None	Command Only. Clear Decompression Statistics. Example: CDS=	CDS= CDS? CDS* CDS#	N/A	N/A

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
WAN Buffer Length	WBL	3 bytes	<p>Command or Query. Set or return WAN Buffer Length in the form xxx, where: xxx = 20 to 400ms, in 20ms steps.</p> <p>Example: WBL=100</p>	<p>WBL= WBL? WBL* WBL#</p>	WBL?	WBL=xxx (see Description of Arguments)
IP Statistics	N/A	143 bytes	<p>Query only. Returns all IP Statistics. Return format for each parameter is x.xE+xx with each parameter separated by a colon:</p> <p>GigE 1 Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN</p> <p>GigE 2 Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN</p> <p>WAN Parameters Packets to WAN Bytes to WAN Packets from WAN Bytes from WAN</p> <p>M&C Parameters Packets from M&C Packets to M&C</p> <p>Optical Parameters Packets from LAN Packets to LAN Bytes from LAN Bytes to LAN</p>	N/A	ST1?	ST1=(see Description of Arguments)

7.5.5 Unit Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Local/Remote Status	LRS=	1 byte, value of 0 thru 4	Command or Query. Set or return 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 LRS defaults to Ethernet plus Serial (LRS=4) Example: LRS=0 (selects Local)	LRS= LRS? LRS* LRS#	LRS?	LRS=x (see Description of Arguments)
Software Boot From Image	SBS=	1 byte, value of 1 or 2	Command or Query. Select or return which bulk firmware image to boot from, in the form x, where: 1 = Firmware is Image #1 2 = Firmware is Image #2 Example: SBS=1 (selects Image 1 Firmware)	SBS= SBS? SBS* SBS#	SBS?	SBS=x (see Description of Arguments)
Current Software Image	N/A	1 byte, value of 0 or 1	Query only. Return the active software image in the form x, where: 0 = Bulk Image #1 currently active 1 = Bulk Image #2 currently active	N/A	IMG?	IMG=x (see Description of Arguments)
Circuit ID String	CID=	4 to 24 bytes	Command or Query. Set or return the user-defined Circuit ID string, selects 4 to 24 characters in length. Valid characters include: [Space] () * + - . / 0 thru 9 and A thru Z	CID= CID? CID* CID#	CID?	CID=x (see Description of Arguments)
Date	DAY=	6 bytes	Command or Query. Set or return a date in the form ddmmyy (European format), where dd = day of the month (01 to 31) mm = month (01 to 12) yy = year (00 to 38) Example: DAY=240457 (April 24, 2057)	DAY= DAY? DAY* DAY#	DAY?	DAY=ddmmyy (see Description of Arguments)
Time	TIM=	6 bytes	Command or Query. Set or return the time in the form hhmmss, indicating the time from midnight, where: hh = hours (00 to 23) mm = minutes (00 to 59) ss = seconds (00 to 59) Example: TIM=231259 (23 hours:12 minutes:59 seconds)	TIM= TIM? TIM* TIM#	TIM?	TIM=hhmmss (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
External Frequency Reference	EFR=	1 byte, value of 0 thru 5	<p>Command or Query. Set or return 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 "Ext Ref" rear connector (small rear-panel LED indicates when ON)).</p> <p>Example: EFR=1 (selects External 1MHz)</p>	<p>EFR= EFR? EFR* EFR#</p>	EFR?	EFR=x (see Description of Arguments)
Adjustment for the Internal 10MHz High-Stability Reference	ADJ=	4 bytes, numeric	<p>Command or Query. Set or return fine adjustment of the Internal 10MHz Reference on the High-Stability Frequency Reference module in the form sddd, where: s = sign (+ or -) ddd = value, 0-999.</p>	<p>ADJ= ADJ? ADJ* ADJ#</p>	ADJ?	ADJ=sddd (see Description of Arguments)
Unit Test Mode	TST=	1 byte, value of 0 thru 8	<p>Command or Query. Set or return Unit Test Mode in the form x, where: 0 = Normal Mode (no test) 1 = Tx CW 2 = Dual Side Band (Tx Alternating 1,0 Pattern) 3 = Single Side Band 4 = IQ PN Sequence 5 = RF Loopback (auto configures Rx to match Tx) 6 = IF Loopback 7 = Digital Loopback 8 = I/O Loopback</p> <p>Example: TST=5 (RF Loopback)</p>	<p>TST= TST? TST* TST#</p>	TST?	TST=x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Unit Alarm Mask	MSK=	36 bytes	<p>Command or Query. Set or return unit alarm masks in the form abcdefgxxxxxxxxhijklmxxxxnopqrsxxxx, where:</p> <p>Unit Alarm mask conditions, in form abcdefg, where: a = Rx AGC Alarm*** b = Es/No Alarm*** c = d = LNB e = Reference alarm f = Reserved g = Rx decompression mismatch alarm*** xxxxxxxx (9 spares)</p> <p>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 xxx (3 spares)</p> <p>PIIC2 Alarm mask conditions, in form nopqrs, where: n = Rx Buf PLL Alarm*** o = Rx Buf Overflow Alarm*** p = rx Buf UnderFlow Alarm*** q = Ext Clk Act Alarm r = Ext Clk In Range Alarm s = input signal loss Alarm t = Tx Symbol Clock PLL Alarm xxx (3 spares)</p> <p>For PIIC1 And PIIC2 U = Uninstalled X = Installed/Spare</p> <p>Value of each mask: *** indicates a 3 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)</p> <p>All other masks are 4 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)</p> <p>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 affect on operation.</p> <p>Example: MSK=11001010000000000000000000000000</p>	MSK= MSK? MSK* MSK#	MSK?	MSK= abcdefgxxxxxxxx hijklmxxxx nopqrsxxxx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Retrieve next 5 unread Stored Events	N/A	80 bytes	<p>Query only. Return the oldest 5 Stored Events which have not yet been read over the remote control in the form [CR]sub-body[CR]sub-body[CR]sub-body[CR]sub-body[CR]sub-body, where Sub-body=ABCCddmmyyhhmss:</p> <p>A is fault/clear indicator where: F=Fault C = Clear I = Info</p> <p>B is the fault type where: 1 = Unit 2 = Rx Traffic 3 = Tx Traffic 4 = Info (Power on/off, or log cleared)</p> <p>CC is Fault Code number, as in FLT? or Info Code, which may be: 0 = Power Off 1 = Power On 2 = Log Cleared 3 = Global Config Change 4 = Redundancy Config Change</p> <p>ddmmyy = date stamp. hhmss = time stamp.</p> <p>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*.</p>	N/A	RNE?	<p>RNE=[CR]ABCCddmmyyhhmss[CR]ABCCddmmyyhhmss[CR]ABCCddmmyyhhmss[CR]ABCCddmmyyhhmss[CR]ABCCddmmyyhhmss[CR]ABCCddmmyyhhmss</p> <p>(see description for details of arguments)</p>
Clear All Stored Events	CAE=	None	<p>Command only. Forces the software to clear the events log.</p> <p>Example: CAE=</p>	CAE= CAE? CAE* CAE#	N/A	N/A
Initialize the Stored Events Pointer	IEP=	None	<p>Command only. Resets internal pointer to allow RNE? queries to start at the beginning of the stored events log.</p>	IEP= IEP#	N/A	N/A
Management IP Address	IPA=	18 bytes numerical	<p>Command or Query. Set or return the IP Address and network prefix for the 10/100 Base-T Ethernet management port, in the format: aaa.bbb.ccc.ddd.yy, where: aaa = 000-223 bbb = 000-255 ccc = 000-255 ddd = 000-255 yy = network prefix (range: 8 to 31)</p> <p>Example: IPA=010.006.030.001.24</p>	IPA= IPA? IPA* IPA#	IPA?	IPA=xxx.xxx.xxx.xxx.yy (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Management Default IP Gateway	IPG=	15 bytes numerical	Command or Query. Set or return 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: IPG=010.006.030.001.24	IPG= IPG? IPG* IPG#	IPG?	IPG=xxx.xxx.xxx.xxx (see Description of Arguments)
Management MAC Address	N/A	12 bytes, alpha-numerical	Query only. Return the unique MAC Address for the modem in the form aabbccddeeff. Example: MAC=0006B00001C2	N/A	MAC?	MAC=aabbccddeeff (see Description of Arguments)
GE1 Link Configuration	LC1=	1 byte, value of 0 thru 6	Command or Query. Set or return 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?	LC1=x (see Description of Arguments)
GE2 Link Configuration	LC2=	1 byte, value of 0 thru 6	Command or Query. Set or return 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?	LC2=x (see Description of Arguments)
Gig Optical Ethernet Interface	LC3=	1 byte, value of 0 or 1	Command or Query. GigE Optical Ethernet Interface mode, where x may be: 0 = Off 1 = On NOTE: Option must be purchased and SFP module installed!	LC3= LC3? LC3* LC3#	LC3?	LC3=x (see descriptor arguments)
Inband Communications	SLC=	1 byte, value of 0 or 1	Command or Query. Set or return 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?	SLC=x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
GBEI Flow Control	GFC=	1 byte, value of 0 or 1	Command or Query. Enable or disable flow control (applies to all ports) in the form x, where: 0 = Disable GBEI Flow Control 1 = Enable GBEI Flow Control	GFC= GFC* GFC#	GFC?	GFC=x (see Description of Arguments)
GBEI MAC Learning	LRN=	1 byte, value of 0 or 1	Command or Query. Enable or disable MAC address learning (applies to all ports) in the form x, where: 0 = Disable MAC learning 1 = Enable MAC learning	LRN= LRN?	LRN?	LRN=x (see Description of Arguments)
SNMP Read Community	SRC=	16 bytes, characters, no spaces	Command or Query. Set or return SNMP read community string. Empty string is not allowed Example: <1/SRC=public	SRC = SRC!	SRC?	SRC =x (see description of arguments)
SNMP Write Community	SWC=	16bytes, characters, no spaces	Command or Query. Set or return SNMP write community string. Empty string is not allowed Example: <1/SWC=private	SWC = SWC!	SWC?	SWC =x (see description of arguments)
SNMP Trap Destination IP Address 1	STA=	15 bytes, Numerical	Command or Query. Set or return the IP address of the first SNMP Trap destination IP Address 1 where traps will be sent, in the form xxx.xxx.xxx.xxx (the IP address). Example: <1/STA=010.006.030.001 <i>Returns >0001/STA=0.0.0.0 when not configured.</i>	STA = STA!	STA?	STA = xxx.xxx.xxx.xxx (see description of arguments)
SNMP Trap Destination IP Address 2	STB=	15 bytes, Numerical	Command or Query. Set or return the IP address of the SNMP Trap destination IP Address 2 where traps will be sent, in the form xxx.xxx.xxx.xxx (the IP address). Example: <1/STB=010.006.030.001 <i>Returns >0001/STB=0.0.0.0 When not configured.</i>	STB = STB!	STB?	STB = xxx.xxx.xxx.xxx (see description of arguments)
SNMP System Contact	SSC=	255 bytes, characters,	Command or Query. Set or return SNMP System Contact string. Example: <1/SSC=Joe Net Admin If not configured it returns empty string: <1/SSC=	SSC = SSC!	SSC?	SSC =x [1..128] (see description of arguments)
SNMP Unit Name	SSN=	16 bytes, characters,	Command or Query. Set or return SNMP System Name string. Example: <1/SSN=Remote1 If not configured it returns empty string: <1/SSC=	SSN = SSN!	SSN?	SSN =x [1..128] (see description of arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
SNMP System Location	SSL=	255 bytes	Command or Query. Set or return SNMP System Location string. Example: <1/SSL=Upstairs back right If not configured it returns empty string: <1/SSL=	SSL = SSL!	SSL?	SSL =x [1..128] (see description of arguments)
SNMP Trap Version	STV=	1 byte, value of 1 or 2	Command or Query. Set or return 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: <1/STV=0	STV = STV!	STV?	STV =x (see description of arguments)
Force Reboot	FRB=	None	Command only. Force unit to perform a reboot. NOTE: LRS must be set to Serial Remote (LRS=1) or Ethernet plus Serial (LRS=4) before executing this command. Example: FRB= (force reboot)	FRB = FRB? FRB #	N/A	N/A
Reset Factory Defaults	RFD=	None	Command only. Clears the NVRAM in the unit to force a re-initialization at the next boot-up. Also forces a reboot. NOTE: LRS must be set to Serial Remote (LRS=1) Or Ethernet plus Serial (LRS=4) before executing this command. Example: RFD= (will reset to factory defaults)	RFD = RFD? RFD #	N/A	N/A
DoubleTalk® Carrier-in-Carrier® (CnC) Mode	CNM=	1 byte, value of 0 or 1	Command or Query. Enable or Disable 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?	CNM=x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
CnC Min/Max Search Delay	CSD=	6 bytes	Command or Query. (CnC parameter) Set or return CnC min/max delay value, in ms, in the form xxxyyy where: xxx = minimum delay yyy = maximum delay Maximum allowable value is 300ms. Example: CSD=010300	CSD= CSD? CSD* CSD#	CSD?	CSD=xxxxyy (see Description of Arguments)

7.5.6 ACM Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
ACM Operating Parameters	ACM=	7 bytes	<p>Command or Query. Set or return ACM operating parameters in the form mmMMATT, where: mm = Minimum ModCod, range is 1 to 28 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).</p> <p>Example: 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.)</p>	ACM ACM? ACM* ACM#	ACM?	ACM=mmMMATT (see Description of Arguments)
ACM Degradation Configuration	ADC=	8 bytes	<p>Command or Query. Set or return 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 = 16APSK degradation in dB from 0.0 to 9.9 tt = 32APSK degradation in dB from 0.0 to 9.9</p> <p>Example: ADC=03050717 (Sets QPSK degradation to 0.3 dB, 8PSK degradation to 0.5 dB, 16APSK degradation to 0.7 dB, 32APSK degradation to 1.7 dB – these are the factory default parameters)</p>	ADC= ADC? ADC* ACC#	ADC?	<u>ADC</u> =qqeesstt (see Description of Arguments)
Remote Es/No	N/A	4 bytes	<p>Query only. Returns the value of the remote demod Es/No, in dB, resolution 0.1 dB, in the form xx.x. Responds 99.9 = demod is unlocked.</p> <p>Example: RES=12.4 (selects Es/No = 12.4 dB)</p>	N/A	RES?	RES=xx.x (see Description of Arguments)
Remote Signal to Noise Ratio	N/A	4 bytes	<p>Query only.</p> <p>NOTE: Same as RES? RSN remains for backwards compatibility</p>	N/A	RSN?	RSN=xx.x (see Description of Arguments)
Local Es/No	N/A	4 bytes	<p>Query only. Returns the value of Local Es/No, resolution 0.1 dB, in the form xx.x. Returns 99.9 if demod is unlocked.</p> <p>Example: LES=12.3 (selects Es/No = 12.3 dB)</p>	N/A	LES?	LES=xx.x (see Description of Arguments)
Local Signal to Noise Ratio	N/A	4 bytes	<p>Query only.</p> <p>NOTE: Same as LES? SNR remains for backwards compatibility</p>	N/A	SNR?	SNR=xx.x (see Description of Arguments)
ACM Local Es/No Ratio	N/A	4 bytes	<p>Query only.</p> <p>NOTE: Same as LES? ESN remains for backwards compatibility</p>	N/A	ESN?	ESN=xx.x (see Description of Arguments)

7.5.7 PIIC Interface Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Rx Interface Clock source	RCK=	2 bytes	<p>Command or Query. Set or return Rx Clock Source (For Data Rate Accuracy) in the form sx, where: s = Defines which Interface Slot (1 or 2) x = Rx Clock Source, where: 0 = Tx Clock 1 = External Clock (not valid for OC3 interface) 2 = Rx Sat 3 = Internal Clock</p> <p>NOTE: In MultiStream Mode, RCK is forced to internal clock.</p> <p>Example: RCK=12 (Slot 1, Rx Sat Clock is selected)</p>	RCK = RCK? RCK * RCK #	RCK?s	RCK=sx (see Description of Arguments)
Tx Interface Clock source	TCK=	2 bytes	<p>Command or Query. Set or return Tx Clock Source (For Data Rate Accuracy), where: s = Defines which Interface Slot (1 or 2) x = Rx Clock Source, where: 0 =Tx Clock 1 = External Clock (not valid for OC3 interface) 2 = Rx Sat</p> <p>Example: TCK=10 (Slot 1, Tx Clock is selected)</p>	TCK = TCK? TCK * TCK #	TCK?s	TCK=sx (see Description of Arguments)
Interface Reference Clock	EFI=	2 bytes	<p>Command or Query. (G.703 interface only) Set or return External Clock (Interface) in the form sx, where: s = Defines which Interface Slot (1 or 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</p> <p>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.</p> <p>Example: EFI=14 (Selects 10MHz on Slot 1)</p>	EFI = EFI? EFI * EFI #	EFI?s	EFI=sx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
PIIC Mode Select	ETS=	2 bytes	<p>Command or Query. Set or return the PIIC interface card mode in the form sm, where: s = Interface Slot, where: 1 = Slot 1 2 = Slot 2 m = Mode, where:</p> <p>For G.703 PIIC module: 0 = NONE 1 = E3 2 = T3 3 = STS1</p> <p>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</p> <p>For OC3 PIIC module: 0 = NONE 1 = OC3/STM-1</p> <p>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.</p> <p>NOTE: Commands are valid only with the appropriate PIIC interface as indicated above. In addition, the following is true for various cards.</p> <p>Example: 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</p> <p><u>MultiStream and Single Stream Modes:</u> 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.</p> <p>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.</p> <p>GBEI 1, GBEI 2 and Optical Ethernet must all be disabled before a PIIC can operate in a synchronous mode.</p>	ETS = ETS? ETS * ETS #	ETS?s	ETS=sm (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
PIIC Rx Buffer Size	RBS=	6 bytes	<p>Command or Query. Set or return 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</p> <p>Example: RBS=1032.5 (selects 32.5 ms for Slot 1)</p>	RBS = RBS? RBS * RBS #	RBS?s	RBS = (see Description of Arguments)
Re Center Buffer	RCB=	None	<p>Command only. Force the software to recenter the receive buffer in the form x, where: s = Interface Slot, where: 1 = Slot 1 2 = Slot 2</p> <p>Example: RCB=2 (re-centers the buffer on the Slot 2 interface card)</p>	RCBs= RCB? RCB# RCB*	N/A	N/A

7.5.8 Bulk Configuration Strings

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Global Configuration	MGC=	245 bytes, numerical entries, fixed values and delimiters	<p>Command or Query. Set or return Global Configuration of CDM-750, in the form shown in the 'Response to Query' column, where:</p> <p>FFFF.FFFF=Tx Frequency same as TFQ SSSSS.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 GGGGG=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.fff=Rx Frequency same as RFQ sssss.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 ggggg=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 - p=LNB DC Power Supply Control - 3=Opt Eth Port Control - x=(spare) - w=CnC mode same as CNM BBBCCC=CnC search delays same as CSD CCC=LNB High Current Limit Value same as LNH xx=(spare) - DDddEee=ACM Operating Parameters same as ACM HHhhJjj=ACM Degradation Configuration same as ADC III=LNB Low Current Limit Value same as LNL</p>	<p>MGC= MGC? MGC* MGC#</p>	MGC?	<p>MGC=FFFF.FFFFSS SSSS.SSSMMBVAG GGGGGTLsPP.PXfff f.ffffsssss.sssmbv aggggggee.ebbrcdf 12ixxxxwBBCCcx xxxDDddEeeHHhhJJ jjxxxxTeeeeeeee eeeeeeeeeeeee eeeeeeeeeexxxxx xxxuuu.uuu.uuu. uuuu.vv.vv.vvG Hxxxx1111111111 11111111222222 222222222222</p> <p>(see Description of Arguments for details)</p>

Global Configuration (cont.)			<p>xx=(spare) – T=Unit Test Mode same as TST eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee=Unit Alarm Mask same as MSK xxxxxxxxxx=(spare) – 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 xxxxx (spares) – 11111111111111111111=PIIC Card 1 Configuration Notes 1-3 22222222222222222222=PIIC Card 2 Configuration Notes 1-3 END OF MGC COMMAND/QUERY STRING</p> <p>Notes:</p> <ol style="list-style-type: none"> 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. If no interface is present, then the following bits will be returned: 0UUUUUUUUUUUUUUUUUUUU If an interface is detected but the interface type is set to NONE, then the following bits will be returned: 20xxxxxxxxxxxxxxxxxxxx, where: 2 means G.703 interface detected 0 means NONE selected so i is disabled. <p>Description Of PIIC Interface Types: ABCDEFGHIJ ssssssssss A=type of interface detected 0 = no interface detected 1 = reserved 2 = G.703 interface detected 3 = QC3 interface detected B=PIIC Mode C=Tx Intf Clock Source D=Rx Intf Clock Source E=Intf Reference Clock FGHIJ=Rx Buffer Size sssssssss = spares</p>			
Configuration Save	CST=	1 byte, value of 0 thru 9	Command only. Store the current modem configuration in Configuration Memory location defined by the one-byte argument (0 to 9). Example: CST=4 (store the current configuration in location 4)	CST= CST? CST* CST#	N/A	N/A
Configuration Load	CLD=	1 byte, value of 0 thru 9	Command only. Retrieve a previously stored modem configuration from Configuration Memory location defined by the one-byte argument (0 to 9). Example: CLD=4 (load modem configuration from location 4 to be the active configuration)	CLD= CLD? CLD* CLD#	N/A	N/A

7.5.9 ODU Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
LNB 10MHz Reference Enable	LNR=	1 byte, value of 0 or 1	Command or Query. Enable or disable LNB 10MHz Reference Enable in the form x, where: 0 = Disable LNB Reference 1 = Enable LNB Reference	LNR = LNR? LNR * LNR #	LNR?	LNR =x (see Description of Arguments)
LNB DC Power Control	LPS=	1 byte, value of 0 thru 3	Command or Query. Set or return 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?	LPS =x (see Description of Arguments)
LNB Low Current Limit	LNL=	3 byte	Command or Query. Set or return Low Current Limit in the form x, where: xxx = value between 0 and 500 mA.	LNL = LNL? LNL * LNL #	LNL?	LNL =xxx (see Description of Arguments)
LNB High Current Limit	LNH=	3 byte	Command or Query. Set or return High Current Limit in the form x, where: xxx = value between 0 and 500 mA.	LNH = LNH? LNH * LNH #	LNH?	LNH =x (see Description of Arguments)
LNB Current	N/A	4 byte	Query only. Return LNB Current Limit in the form xxxx, where: xxxx = value in mA. Example: LNC=0500	N/A	LNC?	LNC =xxxx (see Description of Arguments)
LNB Voltage	N/A	4 byte	Query only. Return LNB Voltage in the form xx.x, where: xx.x = value in volts. Example: LVO=12.0	N/A	LVO?	LVO =xx.x (see Description of Arguments)

7.5.10 Modem Information

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Hardware Revision	N/A	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.	N/A	HRV?	HRV=xx.yy (see Description of Arguments)
Software Revision	N/A	8 bytes	Query only. Returns the value of the internal software revision installed in the unit, in the form of xx.xx.xx. Example: SWR? SWR=Boot:1.0.3 Bulk1: 1.1.2 Bulk2:1.4.3	N/A	SWR?	SWR=xx.xx.xx (see description of arguments)
Firmware information	N/A	100 bytes	Query only. Returns firmware information for image 1 or 2 or the boot loader in the form xxxxxx, where: Example: FRW?1 FRW=1: FW-XXXXXXA 1.1.1 10/27/09 12 part numbers will be displayed: M&C Application Glue Terrestrial Framer Mod Demod Modem App CnC Compression DeCompression G.703 OC3 Example: FRW?B FRW=B: Boot:FW-XXXXXXA 1.1.1 10/27/09	N/A	FRW?1 FRW?2 FRW?B	FRW=xxxxxx (see Description of Arguments)
Serial Number	N/A	9 bytes	Query only. Returns the modem 9 digit serial number. Example: SNO=176500143	N/A	SNO?	SNO=xxxxxxxx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Equipment ID	N/A	33 bytes	<p>Query only</p> <p>Returns the equipment ID and installed options in the form shown in the 'Response to Query' column, where:</p> <p>AAAA=0750 , the modem model number</p> <p>Installed hardware: B=Modulator 0 = not present, 1=present C=Demodulator 0 = not present, 1=present D=Gzip 0 = not present, 1=present E=Reserved (Transec 0 = not present, 1=present) F=CnC 0 = not present, 1=present G=PIIC1¹ H=PIIC2¹ I=Optical Present 0 = not present, 1=present J=Reserved</p> <p>¹PIIC cards will be reported as: 0=not present 1=reserved 2=G.703 3=OC3 4+=reserved</p> <p>Software FAST options: K=CnC Data Rate 0 = None/Off 4 = 5M 5 = 10M 6 = 15M 7 = 20M 8 = 25M 9 = 30M A = 40M B = 52M C = 75M D = 100M E = 125M F = 155M L=Fractional CnC 0 = Not Installed, 1 = Installed</p>	N/A	EID?	EID=AAAABCDEFGH IJKLMNOPQRSTU VWXYZ (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Equipment ID (cont.)			<p>M=ACM 0=None 1=ACM Point to Point N=Tx Symbol Rate² O=Rx Symbol Rate² ²0 = None 1 = 5M 2 = 15M 3 = 34M 4 = 47M 5 = 63M P=Tx Modulation (Bitwise Representation)³ Q=Rx Modulation (Bitwise Representation)³ ³0x00 = None 0x08 = QPSK 0x04 = 8PSK 0x02 = 16APSK 0x01 = 32APSK R=Modulator 0 = not installed, 1=installed S=Demodulator 0 = not installed, 1=installed T=Gzip 0 = not installed, 1 = installed U=Reserved (Transec 0 = not installed, 1=installed) V=Optical 0= not installed, 1=installed W=GZIP Tx Symbol Rate ²0 = None 1 = 5M 2 = 15M 3 = 34M 4 = 47M 5 = 63M X=Reserved Y-Z=Spares (reserved and indicted with an X)</p> <p>Example: EID=xxxx indicates all software options and FAST codes</p>			

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
CnC Fractional Time Remaining	N/A	11 byte	<p>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</p> <p>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.</p>	N/A	FCC?	FCC=DD:HH:MM:SS (see Description of Arguments)
Time remaining in 365 day period	N/A	12 bytes	<p>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</p> <p>NOTE: When the timer hits zero, it will automatically reset to and begin counting down again.</p>	N/A	FCF?	FCF=DD:HH:MM:SS (see Description of Arguments)
Demo Time remaining	N/A	11 byte	<p>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</p> <p>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.</p>	N/A	DMT?	DMT=DD:HH:MM:SS (see Description of Arguments)

7.5.11 Modem Performance Indication

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Rx Signal Level	N/A	5 bytes	<p>Query only. Returns value of Rx signal level in the form xxxxx, where: xxxxx = value, in dBm, between -20 and -90 dBm.</p> <p>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') If in the range of -20 to -90dBm, returns RSL=YY-xx</p> <p>Example: RSL=EQ-45 (indicating -45 dBm)</p>	N/A	RSL?	RSL=xxxxx (see description of arguments)
Rx Frequency Offset	N/A	6 bytes	<p>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 ranging from 0 to 200 kHz, in 100 Hz resolution. Returns 999999 if the demodulator is unlocked.</p> <p>Example: RFO=+002.3 (selects + 2.3 kHz)</p>	N/A	RFO?	RFO=sxxx.x (see description of arguments)
Temperature	N/A	3 bytes	<p>Query only. Returns the highest of 4 temperature sensors. Value of the internal temperature sensor, in the form xxx, where: xxx = degrees C</p> <p>Example: TMP=+26</p>	N/A	TMP?	TMP=xxx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Faults and Status	N/A	9 bytes	<p>Query only. Returns the current <i>highest-priority</i> fault and status codes for the Unit (hardware), TX Traffic, RX Traffic, and ODUs in the form aabccdexx, where: aa = Unit status: 00=No faults 01=Main Board Power Supply 3.3V 02=Main Board Power Supply 1.5V 03=Main Board Power Supply 1.2V 04=Main Board Power Supply 1.8V 05=Main Board Power Supply 1.9V 06=Main Board Power Supply 2.5V 07=Main Board Power Supply 1.25V 08=Modem Board Power Supply 5.5V 09=Modem Board Power Supply 3.8V 10=Modem Board Power Supply 2.3V 11=Modem Board Power Supply 3.3V 12=Modem Board Power Supply 1.8V 13=Modem Board Power Supply 1.2V 14=Tx Power Cal 15=FPGA Load Fail 16=Reference Unlocked 17=Temperature Exceeded 18=General Fault 19=General Test Fault 20=PIIC1 External Clock Activity 21=PIIC1 External Clock In Range 22=PIIC2 External Clock Activity 23=PIIC2 External Clock In Range NOTE: External clocks are not valid with OC3 interface 24 =General Test - Unit forced Good b = Tx status: 0=No Faults 1=Input Data 2=PLL 3=General Test Fault 4=PIIC1 Symbol Clock PLL 5=PIIC2 Symbol Clock PLL 6=PIIC1 Input Signal Loss 7=PIIC2 Input Signal Loss 8 =General Test - Tx forced Good cc = Rx status: 00=No Fault 01=Demodulator unlocked 02=AGC Signal Level</p>	N/A	FLT?	FLT=aabccdexx (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Faults and Status (cont.)			03=CnC Lock 04=Output Data 05=Es/No 06=PLL 07=General Test Fault 08= PIIC1 Buffer Overflow 09= PIIC1 Buffer Underflow 10= PIIC1 Buffer PLL 11= PIIC2 Buffer Overflow 12= PIIC2 Buffer Underflow 13= PIIC2 Buffer PLL 14= DeComp Inv 15 =General Test - Rx forced Good 16=LNB Current 17=LNB Voltage 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=sparcs			
CnC Ratio Monitor	N/A	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 1: CRM==+02 (interferer > desired) (format: =sdd) Example 2: CRM=LT11 (less than -11 dB) Example 3: CRM=GT11 (greater than +11 dB) Example 4: CRM=99.9 (not locked or CnC not enabled)	N/A	CRM?	CRM=xxxx (see Description of Arguments)
CnC Delay Monitor	N/A	6 bytes	Query only. When CnC is enabled and the modem is locked, it monitors the delay, in microseconds (μ s), of the interferer. Delay is returned in the form xxxxxx. Example 1: CDM=229500 (returns 229,500 μ s or 229.5 ms) Example 2: CDM=999999 (not locked or CnC not enabled)	N/A	CDM?	CDM=xxxxxx (see Description of Arguments)
CnC Freq Offset Monitor	N/A	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 1: CFM=+001.0 (1 kHz) Example 2: CFM=9999.9 (not locked or CnC not enabled)	N/A	CFM?	CFM=xxxx.x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Rx BERT Pattern	RBP=	1 byte, value of 0 thru 6	Command or Query. Set or return the PN loopback 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: RBP=0 (default 2 ²³ -1)	RBP = RBP? RBP * RBP #	RBP?	RBP = (see Description of Arguments)
Tx BERT Pattern	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: TBP=0 (default 2 ²³ -1)	TBP = TBP? TBP * TBP #	TBP?	TBP = (see Description of Arguments)
BERT Error Insert	BKE=	None	Command only. Inserts a single error.	BKE = BKE? BKE #	N/A	N/A
BERT Clear BER Counters	BRM=	None	Command only Clears the BER counters.	BRM = BRM? BRM * BRM #	N/A	N/A
BERT Results All: Total Bit Errors, Total Number Of Bits and average BER	N/A	22 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 y.yEy = total number of bits z.zEz = value of the average BER or "No Sync" if no demod lock. Example 1: BRA=1.0E+03:2.2E+06:1.0E+03 (No Demod Lock) Example 2: BRA=1.0E+03:2.2E+06 (No Sync)	N/A	BRA?	BRA=x.xEx:y.yEy:z.zEz (see Description of Arguments)
Tx BERT State	BTX=	1 byte, value of 0 or 1	Command or Query. Set or return Tx BERT state in the form of x, where: 0 = off 1 = on Example: BTX=1 (BERT On)	BTX = BTX? BTX * BTX #	BTX?	BTX =x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
BERT Pattern Sync	N/A	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?	RPS=X
Tx Baseband Frames per Modcod	N/A		Query only. Return format for each modcod entry is x.xE+xx with each entry separated by a colon. There are 25 total entries beginning with modcod 4 (QPSK 1/2) and ending with modcod 28 (32APSK 9/10).	N/A	ST2?	ST2=(see Description of Arguments)
Rx Baseband Frames per Modcod	N/A		Query only. Return format for each modcod entry is x.xE+xx with each entry separated by a colon. There are 25 total entries beginning with modcod 4 (QPSK 1/2) and ending with modcod 28 (32APSK 9/10).	N/A	ST3?	ST3=(see Description of Arguments)
Rx Baseband Frames received with errors per Modcod	N/A		Query only. Return format for each modcod entry is x.xE+xx with each entry separated by a colon. There are 25 total entries beginning with modcod 4 (QPSK 1/2) and ending with modcod 28 (32APSK 9/10).	N/A	ST4?	ST4=(see Description of Arguments)
Rx Baseband Frames discarded	N/A		Query only. These are baseband frames that are received without errors but are discarded due to the required feature code not having been purchased. Currently there are two entries separated by a colon. The first entry is for 16 APSK frames discarded and the second is for 32 APSK frames discarded.	N/A	ST5?	ST5=(see Description of Arguments)

7.5.12 Redundancy Control

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
1:1 Operational Mode	ASW	1 byte, value of 0 or 1	<p>Command or Query. Set or return 1:1 operational mode in the form x, where: 0 = Unit is in Manual mode 1 = Unit is in Auto mode.</p> <p>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).</p>	ASW= ASW? ASW * ASW #	ASW?	ASW=x (see description of arguments)
1:1 Force Unit Offline	FSW=	1	<p>Command only. There are no parameters associated with this command. In a 1:1 switch environment, this command forces an online unit offline. If the unit is offline, then no action is taken.</p> <p>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?</p> <p>Example: FSW=</p>	FSW= FSW?	FSW?	FSW=
1:1 Redundancy Unit online or offline	N/A	0	<p>Query only. Return 1:1 online/offline status in the form x, where: 0 = Unit is offline 1 = Unit is online</p> <p>Example: RED?1 (indicating the unit is online)</p>	N/A	RED?	RED=x
1:N Redundancy Enable	R1N=	1 byte, value of 0 or 1	<p>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.</p> <p>Example: R1N=1 (indicating the unit is enabled for 1:N)</p>	R1N= R1N? R1N * R1N #	R1N?	R1N=x (see description of arguments)
1:1 Redundancy Switch Available	N/A	1 byte, value of 0 or 1	<p>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</p> <p>Example: R11?0 (indicating the unit is not connected to a 1:1 switch)</p>	N/A	R11?	R11=x

Appendix A. FAST OPTIONS AND ACTIVATION PROCEDURE

A.1 FAST System Overview

The CDM-750 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 **Fully Accessible System Topology (FAST)**, which permits the purchase and installation of options through special authorization codes. You may purchase these unique Fast Access Codes from Comtech EF Data during normal business hours, and then load these codes into the unit using the CDM-750 Front Panel.

FAST System Theory: FAST facilitates on-location 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 can be accomplished because of FAST's extensive use of the programmable logic devices incorporated into Comtech EF Data products.

FAST Implementation: Comtech EF Data's FAST system is factory-implemented in the unit. All FAST options are available through the basic platform unit at the time of order – FAST allows immediate activation of available options, after confirmation by Comtech EF Data, through the Web Server Interface.

FAST Accessible Options: Hardware options can be ordered and installed either at the factory or in the field. Depending on the current hardware configuration of the unit, you can select options that can be easily activated on-site. The FAST Access Code that is purchased from Comtech EF Data enables configuration of the available hardware.



See Table 1-1 in Chapter 1. INTRODUCTION or Sect. 5.2.9.1 FAST: Options in Chapter 5. FRONT PANEL OPERATION for listings of the FAST and FAST-accessible hardware options available for the CDM-750.

A.2 FAST Activation Procedure

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, and Interface options.
- Register 3 is for the K4 GZip lossless compression and decompression option.

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.

A.2.1 FAST Activation via the CDM-750 Front Panel



See Chapter 5. FRONT PANEL OPERATION for detailed information about using the CDM-750 Front Panel FAST menus or Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT for detailed information about using the CDM-750 Web Server interface.

Step	Task																																																																	
1	<p>Before contacting Comtech EF Data to order FAST feature upgrades, obtain and record the modem's baseboard serial number:</p> <ol style="list-style-type: none"> Use the front panel ◀▶ arrows keys to navigate to the SELECT: FAST menu, and then press ENTER. The modem's 9-digit "Baseboard S/N" is displayed on the left hand side of the bottom line, as shown in this example: <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"> FAST: Options Demo-Mode CnC (◀ ▶) Baseboard S/N 123456789 Hw Rev##.## </div> Record Serial Number: _____ <p>Alternately, the serial number may be obtained using the CDM-750 Web Server Interface. Log in to the Web Server Interface, and open the Status Info page. The serial number is provided in the General Information section of this page:</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">CDM-750: Comtech EF Data Modem :: Modem Information</th> </tr> <tr> <th>Home</th> <th>Admin</th> <th>Configuration</th> <th>Status</th> <th>Interfaces</th> <th>TxGraph</th> <th>RxGraph</th> </tr> <tr> <th>Status</th> <th>Logs</th> <th>Info</th> <th>Firmware</th> <th>ACM</th> <th>IP Statistics</th> <th>BB Statistics</th> </tr> </thead> <tbody> <tr> <td colspan="7">General Information</td> </tr> <tr> <td>Circuit ID:</td> <td colspan="6">-----</td> </tr> <tr> <td>Serial Number:</td> <td colspan="6">101091682</td> </tr> <tr> <td>Software Revision:</td> <td colspan="6">1.6.4</td> </tr> <tr> <td>Active Software Image:</td> <td colspan="6">Image2</td> </tr> <tr> <td>Local/Remote:</td> <td colspan="6">Ethernet Plus Serial</td> </tr> <tr> <td>Optical Card Installed:</td> <td colspan="6">No</td> </tr> </tbody> </table> </div>	CDM-750: Comtech EF Data Modem :: Modem Information		Home	Admin	Configuration	Status	Interfaces	TxGraph	RxGraph	Status	Logs	Info	Firmware	ACM	IP Statistics	BB Statistics	General Information							Circuit ID:	-----						Serial Number:	101091682						Software Revision:	1.6.4						Active Software Image:	Image2						Local/Remote:	Ethernet Plus Serial						Optical Card Installed:	No					
CDM-750: Comtech EF Data Modem :: Modem Information																																																																		
Home	Admin	Configuration	Status	Interfaces	TxGraph	RxGraph																																																												
Status	Logs	Info	Firmware	ACM	IP Statistics	BB Statistics																																																												
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Serial Number:	101091682																																																																	
Software Revision:	1.6.4																																																																	
Active Software Image:	Image2																																																																	
Local/Remote:	Ethernet Plus Serial																																																																	
Optical Card Installed:	No																																																																	

Step	Task														
2	<p>To view currently installed FAST features, proceed as follows from the top-level SELECT: FAST menu:</p> <p>b) Use the ◀▶ arrows keys to select OPTIONS, and then press ENTER:</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> FAST options: 1: Set View 2: Set View 3: Set View (◀▶▶▼) </div> <p>a) Use the ◀▶ arrows keys to select View for the <i>desired register #</i>, and then then press ENTER.</p> <p>b) Use the ▲▼ arrow keys to scroll through the list of available FAST options. Options are identified as 'Installed' or 'Not Installed'. Any that are 'Not Installed' may be purchased as a FAST upgrade.</p> <p>Alternately, the roster of installed vs. uninstalled FAST Options may be obtained using the CDM-750 Web Server Interface. Log in to the Web Server Interface, and open the Status Info page. The FAST information is provided in the Installed Options and Uninstalled Options sections of this page:</p> <div style="display: flex; justify-content: space-around;"> <table border="1" style="width: 45%;"> <thead> <tr> <th>Installed Options</th> </tr> </thead> <tbody> <tr><td>Installed Hardware Items</td></tr> <tr><td>Modulator</td></tr> <tr><td>Demodulator</td></tr> <tr><td>SDIP</td></tr> <tr><td>CnC</td></tr> <tr><td>FIIC1 G.703</td></tr> <tr><td>FIIC2 OC3</td></tr> <tr><td>FAST Options Installed</td></tr> <tr><td>CnC Data Rate = 155 Mbps</td></tr> </tbody> </table> <table border="1" style="width: 45%;"> <thead> <tr> <th>Uninstalled Options</th> </tr> </thead> <tbody> <tr><td>Uninstalled Hardware Items</td></tr> <tr><td>FAST Options Uninstalled</td></tr> <tr><td>Fractional CnC</td></tr> </tbody> </table> </div>	Installed Options	Installed Hardware Items	Modulator	Demodulator	SDIP	CnC	FIIC1 G.703	FIIC2 OC3	FAST Options Installed	CnC Data Rate = 155 Mbps	Uninstalled Options	Uninstalled Hardware Items	FAST Options Uninstalled	Fractional CnC
Installed Options															
Installed Hardware Items															
Modulator															
Demodulator															
SDIP															
CnC															
FIIC1 G.703															
FIIC2 OC3															
FAST Options Installed															
CnC Data Rate = 155 Mbps															
Uninstalled Options															
Uninstalled Hardware Items															
FAST Options Uninstalled															
Fractional CnC															
3	<p>Contact a Comtech EF Data sales representative during normal business hours to order features:</p> <ul style="list-style-type: none"> • Provide the modem's 9-digit Baseboard Serial Number to the representative. • Identify and purchase the desired FAST option(s). • Obtain the invoice, the <i>register-specific</i> 20-digit FAST Access Code(s), and the FAST option activation instructions. <div style="display: flex; align-items: center; margin-top: 10px;"> <p><i>When a FAST access code is obtained 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. A.2.</i></p> </div>														
4	<p>Enter the FAST access code(s):</p> <p>c) Press CLEAR to return to the SELECT: FAST → Options → (Register #) Set menu.</p> <p>d) Use the arrow keys (◀▶▲▼) to <i>carefully</i> enter each register-specific 20-character FAST access code.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"> FAST: Set register1: Enter code below 88888888888888888888 then [ENTER] (◀▶▶▼) </div> <p>e) Press ENTER to execute the FAST upgrade.</p> <p>The modem responds with "Configured Successfully" if the FAST upgrade is accepted; the modem then resets to its newly-incorporated default configuration.</p> <p>However, if an invalid code is entered, the following message displays:</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"> Failure to configure. Re-enter code. 88888888888888888888 then [ENTER] (◀▶▶▼) </div> <p>Repeat the FAST access code entry procedure. Should the code entry error persist, contact Comtech EF Data Customer Support for further assistance.</p>														

Appendix B. PIIC (PLUG-IN INTERFACE CARD) MODULES

B.1 Introduction

The CDM-750 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-750 chassis (**Figure B-1**).

By convention, a modem is **Data Communications Equipment (DCE)** where Tx data enters the data interface and Rx data exits. Via the chassis' PIIC module connections, the CDM-750 provides physical and electrical connection between the external terrestrial device and the internal circuitry of the modulator or demodulator.

While the CDM-750'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 B Sect.
PL-0000795	G.703 'BNC' E3/T3/STS-1 PIIC Module	B.2.1
KT-0000255	SFP STM-1 Copper 'BNC' PIIC Module	B.2.2
KT-0000256	SFP OC-3 Single Mode PIIC Module	B.2.3
KT-0000257	SFP OC-3 Multi Mode PIIC Module	



Additional PIIC module data options (ASI, HSSI, etc.) will become available upon request.

Any PIIC module supported by the CDM-750 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-750 acts as a multiplexor/demultiplexor in MultiStream Mode.

B.1.1 Typical PIIC Module Installation

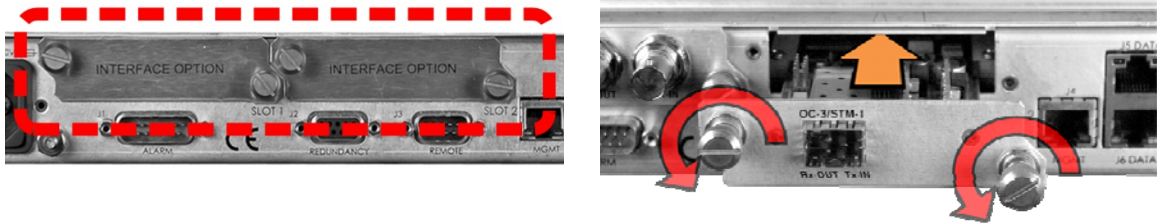


Figure B-1. Typical PIIC Module Installation

Follow these steps to install the optional PIIC module(s) (Figure B-1):

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).

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B.2 Optional PIIC Modules

B.2.1 G.703 E3/T3/STS-1 PIIC Module (CEFD P/N PL-0000795)



Figure B-2. G.703 E3/T3/STS-1 PIIC Module

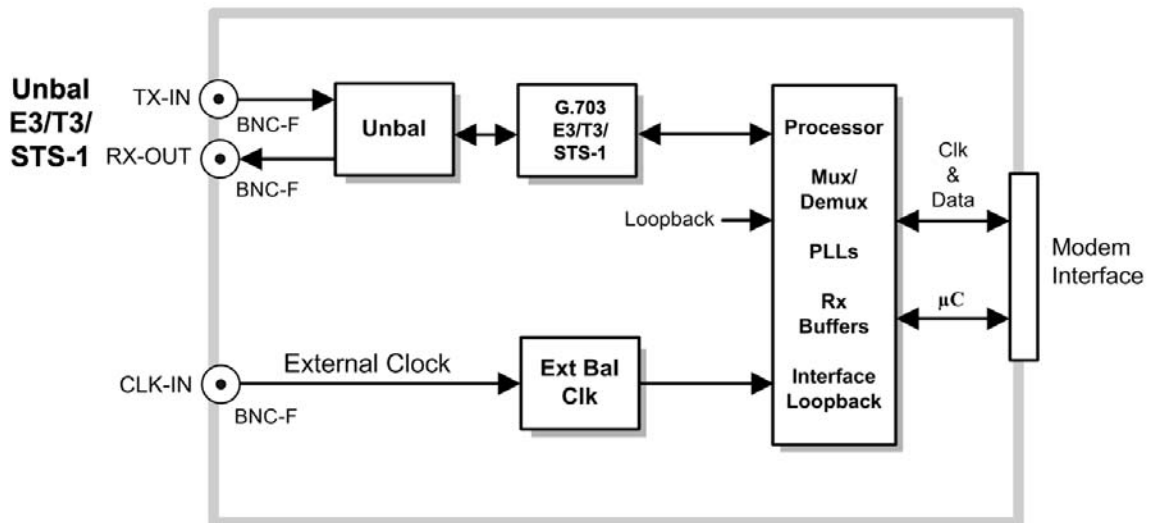


Figure B-3. G.703 E3/T3/STS-1 PIIC Module Block Diagram

	Name	Connector Type	Description	Direction (I/O)
	TX-IN	BNC	Data In	I
	TX-OUT	BNC	Data Out	O
	CLK-IN	BNC	External Clock Input	I

Figure B-4. G.703 E3/T3/STS-1 PIIC Module Panel Connectors

B.2.1.1 G.703 E3/T3/STS-1 PIIC Module Summary of Specifications

B.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 \pm 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 \pm 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

B.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

B.2.2 STM-1 Copper PIIC Module Kit (CEFD P/N KT-000255)



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 B-5. STM-1 Copper PIIC Module Kit (CEFD P/N KT-000255)

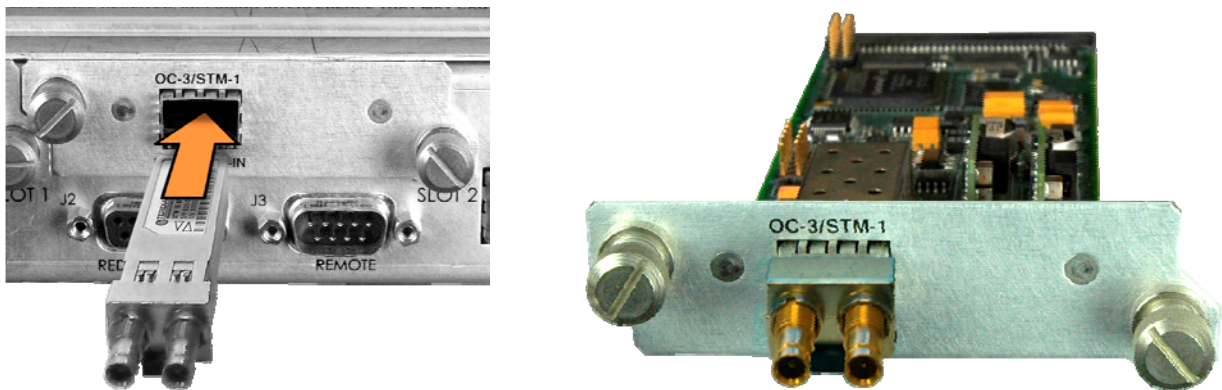


Figure B-6. STM-1 Copper PIIC Module – SFP Installation

Use the STM-1 Copper PIIC module in either of the CDM-750 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 B-6**).



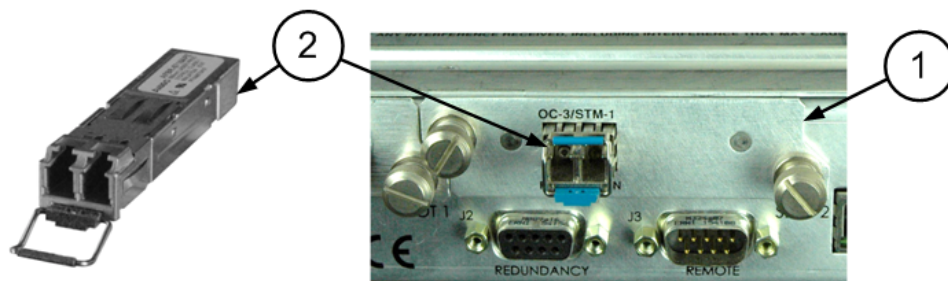
User-supplied standard modules (SFP Multi-Source Agreement (MSA) SFF-8074i and SFF-8472 Rev. 9.3) may be used, but Comtech EF Data does not guarantee interoperability.

See **Figure B-1** for installation of a PIIC module into an available PIIC interface slot.

B.2.2.1 STM-1 Copper PIIC Module Summary of Specifications

Item	Description
Data Rate	155.52 Mbps \pm 20 ppm
Framing and Signaling	G.703/GR-253, CMI
Jitter	G.825
Direction	Full duplex, allowing Tx/Rx only operation
Connectors	BNC-F, 75 Ω
Output Level	1 Vpp Typical
Input Level	0.5 Vpp to 1.1 Vpp
Diagnostics	<ul style="list-style-type: none">• Baseband Loopback (at interface)• Interface Loopback (through interface module)
Rx Buffer	0.5 to 75 ms in 0.1 ms steps

B.2.3 OC-3 Single/Multi Mode PIIC Module Kits (CEFD P/N KT-00025X)



KT-00025X 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 B-7. OC-3 Single Mode or Multi Mode PIIC Module Kit (CEFD P/N KT-000025X)

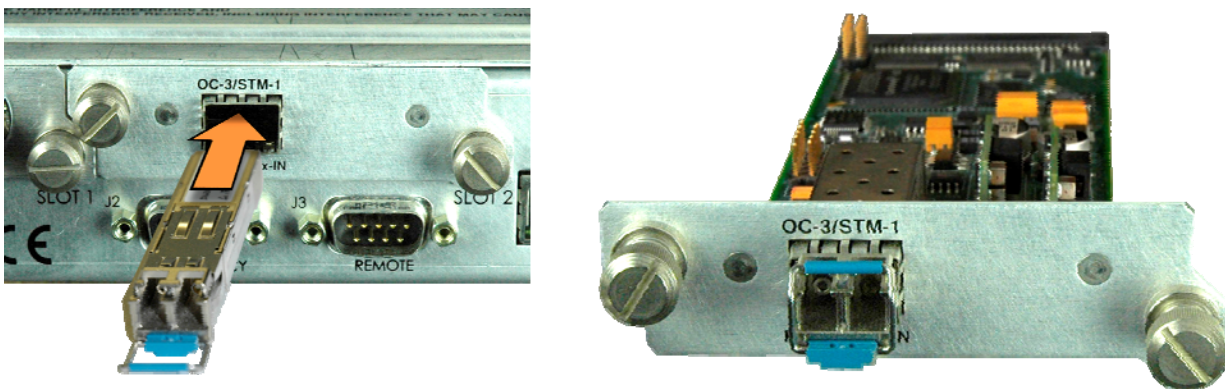


Figure B-8. OC-3 Single Mode or Multi Mode PIIC Module – SFP Installation

Use the OC-3 Single or Multi Mode PIIC module in either of the CDM-750 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 B-8**).



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 B-1** for installation of a PIIC module into an available PIIC interface slot.

B.2.3.1 OC-3 Single/Multi Mode PIIC Module Summary of Specifications

Item	Description
Interfaces	<ul style="list-style-type: none"> OC-3 Single Mode (CEFD Kit KT-0000256) OC-3 Multi Mode (CEFD Kit KT-0000257)
Data Rate	155.52 Mbps \pm 20 ppm
Framing and Signaling	SONET OC-3 SDH STM-1
Direction	Full Duplex, allowing Tx/Rx only operation
Connectors	Duplex LC
Fiber	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Single Mode: Up to 15 Km Multi Mode: Up to 500 m
Output Power	<ul style="list-style-type: none"> Single Mode: -12 dBm Typical Multi Mode: -14 dBm Typical
Input Power	<ul style="list-style-type: none"> Single Mode: -31 dBm to -8 dBm Multi Mode: -35 dBm to -30 dBm
Jitter	G.825
Diagnostics	<ul style="list-style-type: none"> Baseband Loopback (at interface) Interface Loopback (through interface module)
Rx Buffer	0.5 to 75 ms in 0.1 ms steps

Appendix C. ADAPTIVE CODING AND MODULATION (ACM) OPTION

C.1 Introduction

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-750 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-750 Advanced High-Speed Trunking Modem. When enabled with ACM, the CDM-750 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-750, the benefits of CnC and ACM are available simultaneously.

C.2 Background

The CDM-750 system is based on DVB-S2 standards. The DVB standardized a suite of 28 ModCods that work over an Es/No range of -2.3 dB to 16.0 dB (ideal). They have also defined much of the system for both ACM and a related feature called Variable Coding and Modulation (VCM)¹. DVB-S2 did not specify the means of passing necessary information between system components, so the ACM schemes adopted by different manufacturers are generally not interoperable.

During ACM operation, control parameters between modems are transferred over the satellite link along with user traffic in what is usually referred to as *Inband Signaling*. DVB-S2 also describes an ACM method using “out-of-band” ACM controllers (per EN 302 307 Annex D.1) that is not supported with the CDM-750.

The CDM-750 supports duplex ACM operation between a pair of modems in a point-to-point link. While point-to-multipoint operation is not currently supported, the modem’s physical layer, software, and overall architecture are designed to allow future expansion.

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 C-1** shows the several ModCods, the Spectral Efficiency (SE), and Es/No for the CDM-750 assuming Normal FEC Frame (64,800 bits).

Table C-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
4	QPSK 1/2	0.9653	1.4	19.31
5	QPSK 3/5	1.1600	3.7	23.20
6	QPSK 2/3	1.2908	3.4	25.82
7	QPSK 3/4	1.4521	4.6	29.04
8	QPSK 4/5	1.5494	5.1	30.99
9	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

Example: If a link is designed to operate at an Es/No of 3.7 dB during a 3.0 dB fade, the 3.0 dB fade is commonly referred to as link margin . When fade conditions are not present, the link

¹ VCM operation does not provide any advantage in a point to point link and therefore is not supported

margin is directly converted into a higher link Es/No: 3.7 dB + 3.0 dB margin = new Es/No of 6.7dB. This non faded Es/No of 6.7 dB 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 (DR) and Symbol Rate are related by the symbol rate as follows:

$$DR \text{ (Data Rate)} = SR \text{ (Symbol Rate)} \times SE \text{ (Spectral Efficiency)}$$

For a 20 Msps link, this corresponds to the data rates listed in **Table C-1**. **Table C-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 C-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.

C.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 C-1** plots the amount of downlink fade margin versus availability for this link.

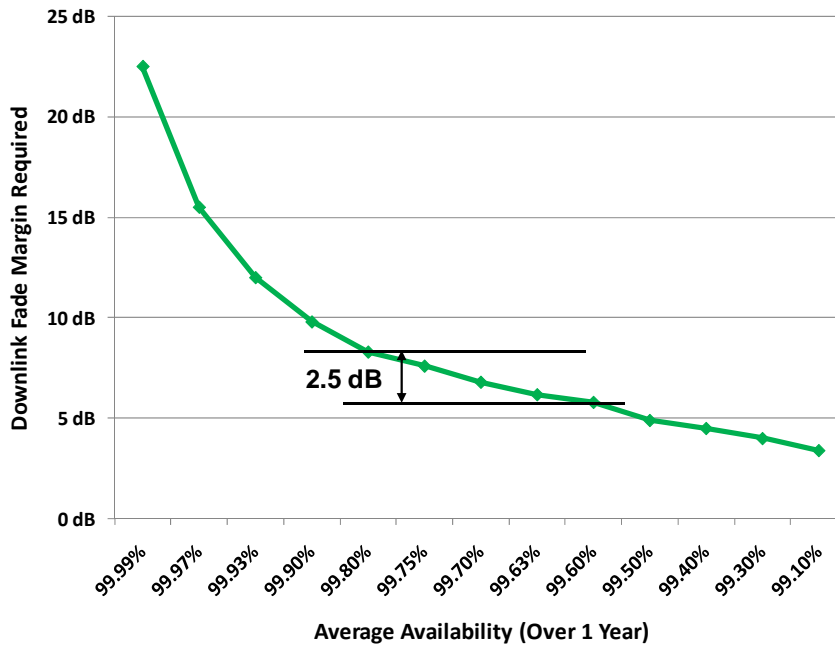


Figure C-1. Downlink Margin vs. Average Link Availability

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 C-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 2.2 dB 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 6.9 dB that throttles throughput down to 31 Mbps. **Table C-3** summarizes the capacity.

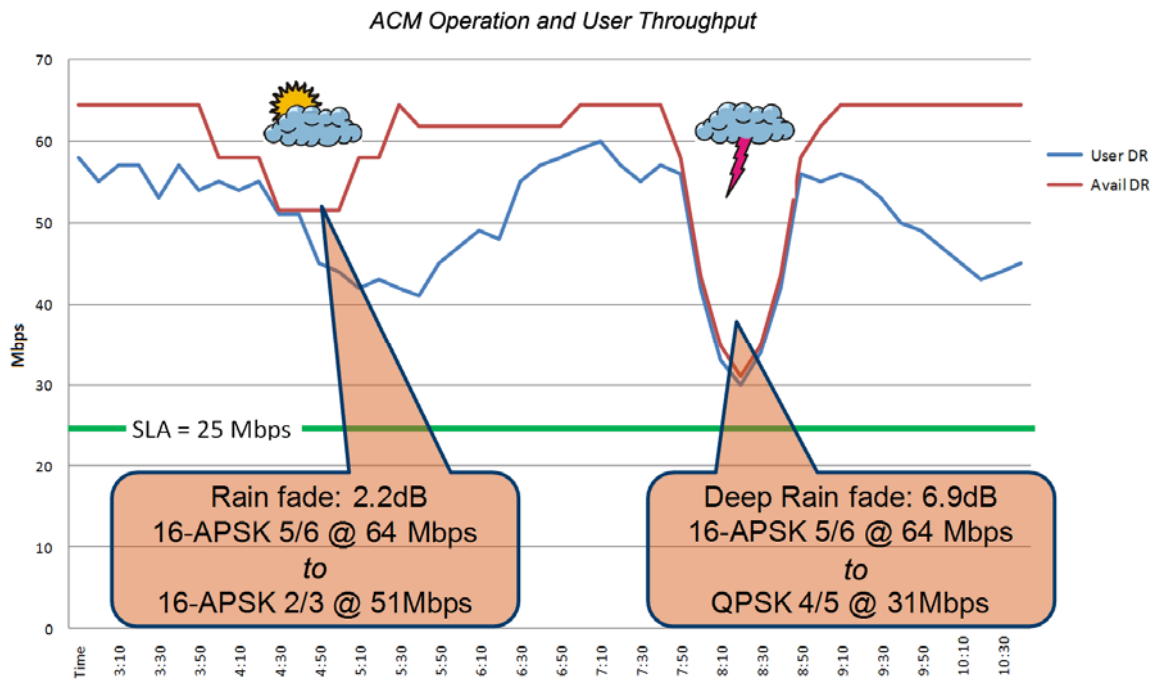


Figure C-2. User Throughput vs. Time and Fades

Table C-3. Turning Margin into Additional Capacity

Parameter	SLA	Clear	2.2 dB Fade	6.9 dB 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

C.3 ACM System Description

A generic example of ACM-over-Satellite is shown in **Figure C-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 E_s/N_0 , 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.

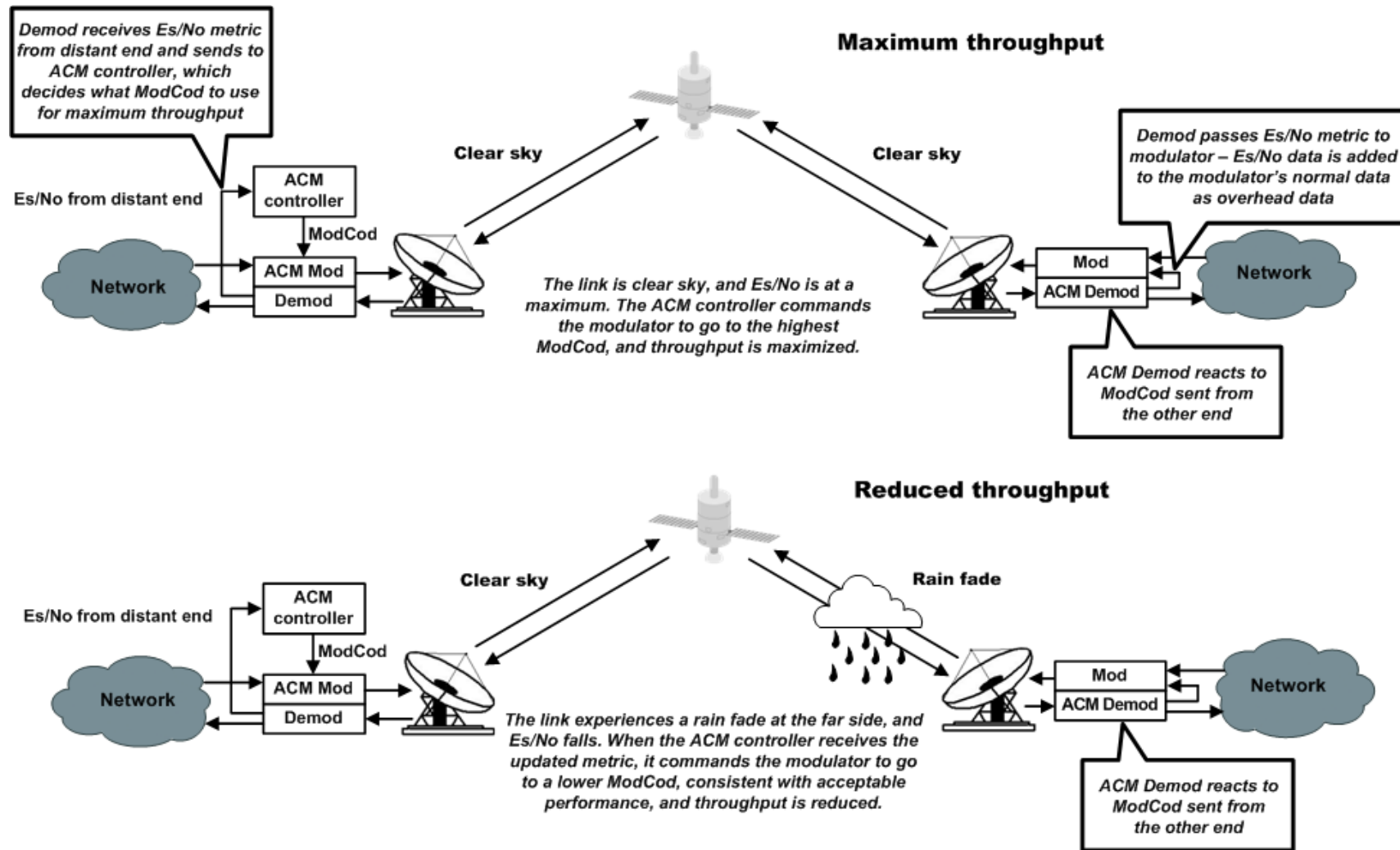


Figure C-3. ACM-over-Satellite – Generic Example

C.4 CDM-750 ACM Scheme

The description of ACM operation in this section serves as the prelude to configuring the CDM-750 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

C.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 ($PER \approx 10^{-7}$); 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.

Example: An Es/No Margin of 1.0 dB 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 300-400 ms of path delay AND a 250 ms (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/s it would be 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 C-4** depicts a graph of ACM messaging delay (including satellite delay).

Example: A 10 Msps link is run and has a maximum rain fade of 1 dB per second. At 10 Msps there will be a single hop latency of 300ms and an additional maximum ACM message gap of 250 ms. So, if a 1.0 dB rain fade began just after an ACM message was sent it would be $300+250=550\text{ms}$ before an updated ACM message with the reduced Es/No is received and

acted upon by the near side modulator. In this example, the Target Es/No should not be less than $(1.0 \text{ dB/s}) * (550\text{ms}) = 0.55 \text{ dB}$.

The default Target Es/No Margin is 1.0 dB.

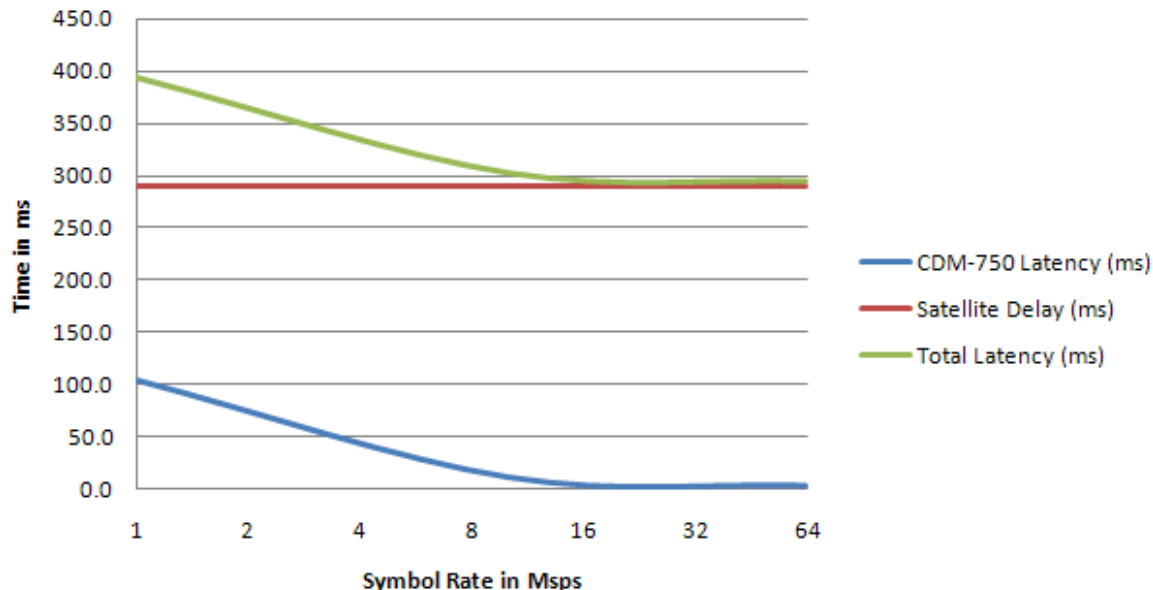


Figure C-4. Single Hop Latency

C.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 0.0 dB – when operating in the linear portion of the ground amplifier and satellite amplifier segment, degradation should be minimal and can be left at 0.0 dB 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-750 specified Es/No for a given constellation. **Table C-4** describes the impairment entry.

Table C-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

C.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-750 modem always enables Pilots ON for all ModCods whenever ACM mode is selected.***

C.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-750 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.

C.4.5 Monotonic Operation

Table C-5 shows the ideal E_s/N_0 at QEF for each DVB-S2 ModCod along with spectral efficiency and ModCod #. The QEF or Quasi Error Free point corresponds to a Packet Error Rate (PER) = 10^{-7} , based on 188 byte packets. Scanning down the table, there are two entries, ModCods #12 and #18, where the Spectral Efficiency does not change monotonically. In ACM mode, the table is resorted by Spectral Efficiency to assure monotonic behavior and system stability.

Table C-5. Spectral Efficiency and Ideal Es/No by ModCod

ModCod #	ModCod	Spectral Efficiency Normal FECFrame Pilots ON	DVB-S2 Ideal Es/No (dB) @ QEF
1	QPSK 1/4	0.478577	-2.35
2	QPSK 1/3	0.640827	-1.24
3	QPSK 2/5	0.770627	-0.30
4	QPSK 1/2	0.965327	1.00
5	QPSK 3/5	1.160026	2.23
6	QPSK 2/3	1.290788	3.10
7	QPSK 3/4	1.452076	4.03
8	QPSK 4/5	1.549426	4.68
9	QPSK 5/6	1.615288	5.18
10	QPSK 8/9	1.724416	6.20
11	QPSK 9/10	1.746049	6.42
12	8PSK 3/5	1.739569	5.50
13	8PSK 2/3	1.935658	6.62
14	8PSK 3/4	2.177525	7.91
15	8PSK 5/6	2.422276	9.35
16	8PSK 8/9	2.585924	10.69
17	8PSK 9/10	2.618365	10.98
18	16APSK 2/3	2.574613	8.97
19	16APSK 3/4	2.896320	10.21
20	16APSK 4/5	3.090495	11.03
21	16APSK 5/6	3.221863	11.61
22	16APSK 8/9	3.439530	12.89
23	16APSK 9/10	3.482680	13.13
24	32APSK 3/4	3.623332	12.73
25	32APSK 4/5	3.866247	13.64
26	32APSK 5/6	4.030589	14.28
27	32APSK 8/9	4.302894	15.69
28	32APSK 9/10	4.356875	16.05

C.4.6 ModCod Selection

Figure C-5 shows considerable overlap of ModCod combinations. The overlap depicted in this figure implies omitting some of the ModCods; therefore, without dropping some of the 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 table resolves this.

Also, a practical system needs some hysteresis to provide orderly transition to adjacent ModCods and avoid dithering. The minimum distance between adjacent ModCods must be at least the amount of hysteresis – the figure used for hysteresis is fixed in the CDM-750 at 0.5 dB. The actual Es/No values used are based on the guaranteed Es/No values + Target Es/No Margin + 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.

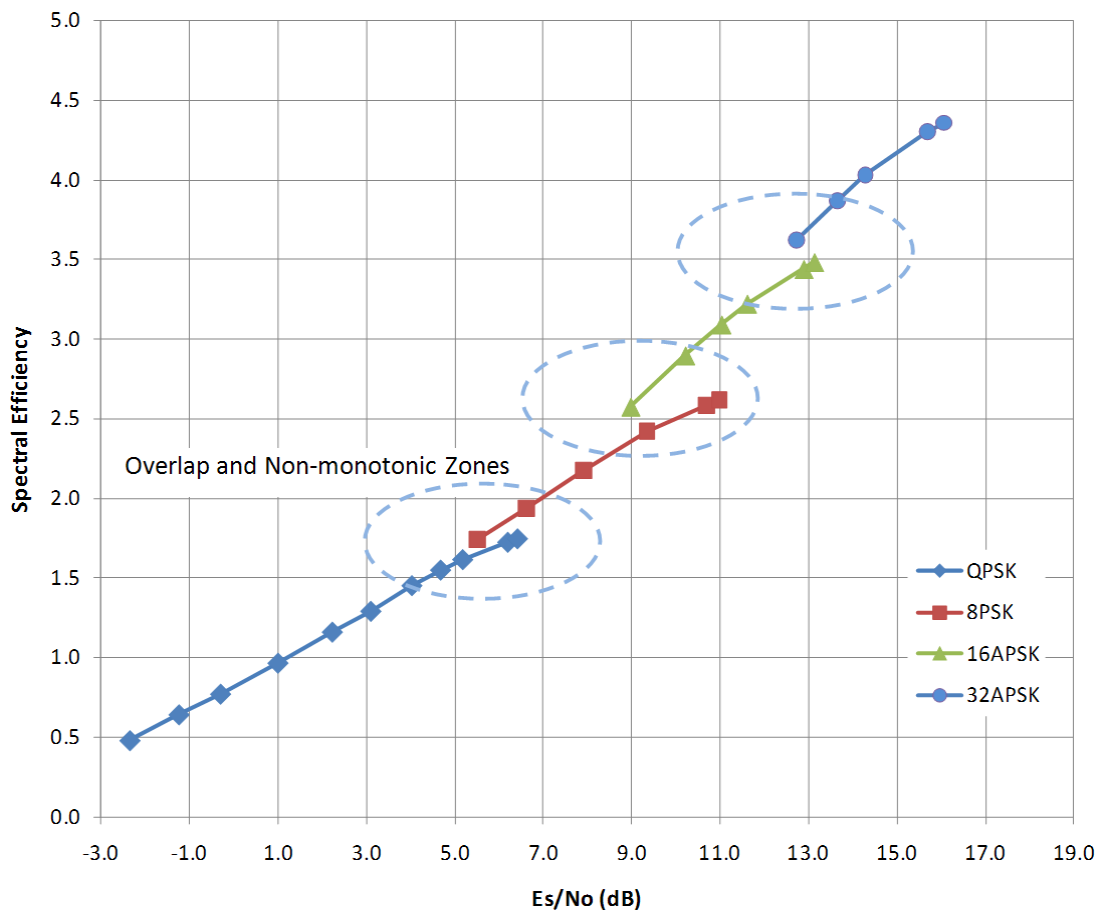


Figure C-5. Spectral Efficiency vs. Ideal Es/No @ QEF

Figure C-6 presents a practical set of ModCods based on ModCod selection. The pruned or inactive ModCods are shown along the baseline of the plot. The transition to the next higher ModCod is the E_s/N_0 (spec) + E_s/N_0 Target Margin (user selected) + hysteresis (0.5 dB) + modulation impairment (user selected), while a step down is the E_s/N_0 (spec) + E_s/N_0 Target Margin + modulation impairment. In the example, the Target E_s/N_0 Margin and Modulation Impairment are zero.

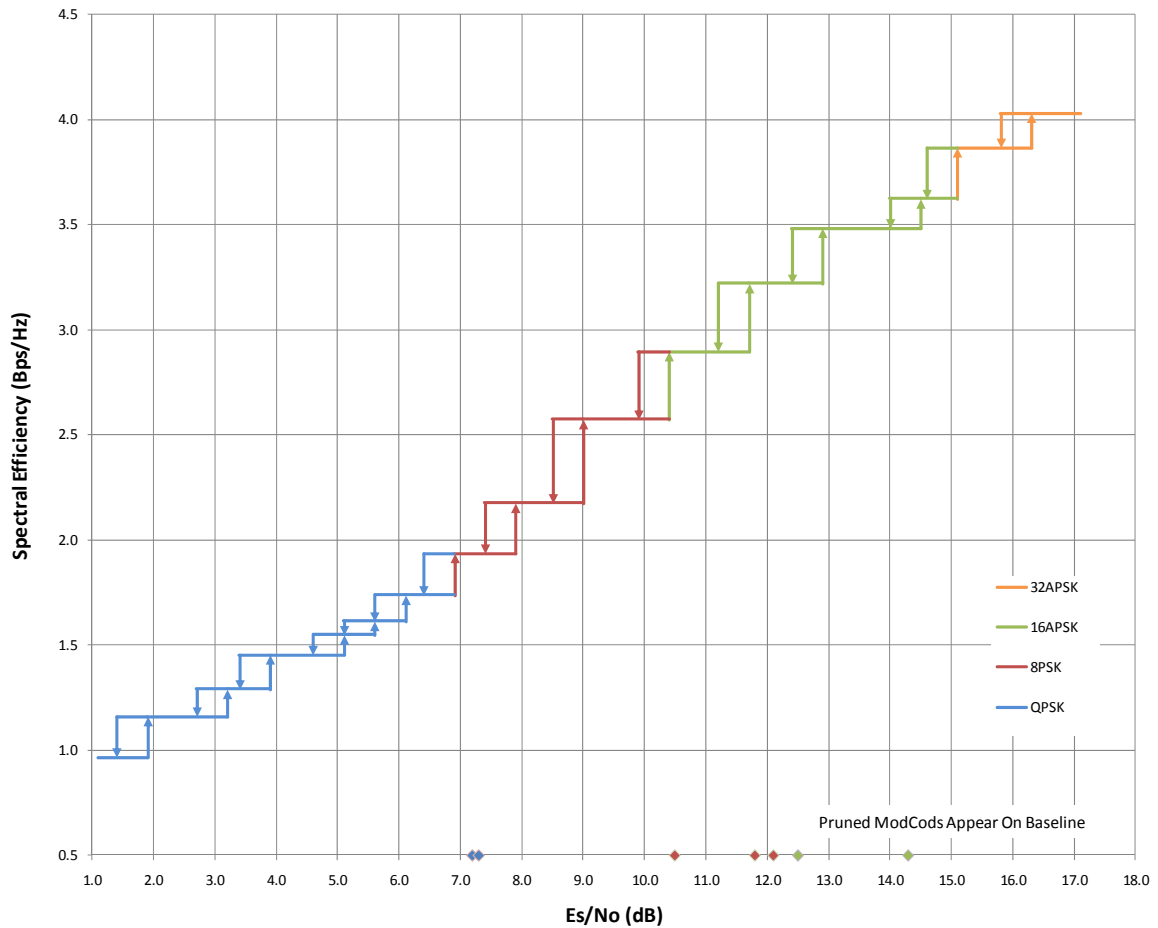


Figure C-6. Spectral Efficiency vs. Modem Es/No @ QEF (Pruned ModCods)

C.5 Configuring ACM in the CDM-750



ACM operation is a FAST option that must first be ordered, and then activated in the CDM-750 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.

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:

- Symbol rate options are: 5 Msps (standard), 18, 36, 54, and 63 Msps;
- QPSK and 8PSK operate to 63 Msps;
- 16APSK to 47 Msps;
- 32APSK to 38 Msps.

Additionally, the following modulation types are available:

- QPSK / 8PSK (standard);
- QPSK / 8PSK /16APSK (FAST-enabled option);
- QPSK / 8PSK /16APSK 32APSK (FAST-enabled option).

Table C-6 shows the maximum satellite data rate capacity for the symbol rate option when used in ACM mode. 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 only suggested to run in Normal (64,800 bit) frames with pilots ON.

Table C-6. Data Rate by Option Symbol Rate

ModCod #	ModCod	Spectral Efficiency 64,800 FECFrame Pilots ON	Maximum Data Rate at 5 Msps	Maximum Data Rate at 15 Msps	Maximum Data Rate at 34 Msps	Maximum Data Rate at 47 Msps	Maximum Data Rate at 63 Msps
1	QPSK 1/4	0.478577	-	-	-	-	-
2	QPSK 1/3	0.640827	-	-	-	-	-
3	QPSK 2/5	0.770627	-	-	-	-	-
4	QPSK 1/2	0.965327	4.83	14.48	32.82	45.37	60.82
5	QPSK 3/5	1.160026	5.80	17.40	39.44	54.52	73.08
6	QPSK 2/3	1.290788	6.45	19.36	43.89	60.67	81.32
7	QPSK 3/4	1.452076	7.26	21.78	49.37	68.25	91.48
8	QPSK 4/5	1.549426	7.75	23.24	52.68	72.82	97.61
9	QPSK 5/6	1.615288	8.08	24.23	54.92	75.92	101.76
10	QPSK 8/9	1.724416	8.62	25.87	58.63	81.05	108.64
11	QPSK 9/10	1.746049	8.73	26.19	59.37	82.06	110.00
12	8PSK 3/5	1.739569	8.70	26.09	59.15	81.76	109.59
13	8PSK 2/3	1.935658	9.68	29.03	65.81	90.98	121.95
14	8PSK 3/4	2.177525	10.89	32.66	74.04	102.34	137.18
15	8PSK 5/6	2.422276	12.11	36.33	82.36	113.85	152.60
16	8PSK 8/9	2.585924	12.93	38.79	87.92	121.54	162.91
17	8PSK 9/10	2.618365	13.09	39.28	89.02	123.06	164.96
18	16APSK 2/3	2.574613	12.87	38.62	87.54	121.01	121.01
19	16APSK 3/4	2.896320	14.48	43.44	98.47	136.13	136.13
20	16APSK 4/5	3.090495	15.45	46.36	105.08	145.25	145.25
21	16APSK 5/6	3.221863	16.11	48.33	109.54	151.43	151.43
22	16APSK 8/9	3.439530	17.20	51.59	116.94	161.66	161.66
23	16APSK 9/10	3.482680	17.41	52.24	118.41	163.69	163.69
24	32APSK 3/4	3.623332	18.12	54.35	123.19	137.69	137.69
25	32APSK 4/5	3.866247	19.33	57.99	131.45	146.92	146.92
26	32APSK 5/6	4.030589	20.15	60.46	137.04	153.16	153.16
27	32APSK 8/9	4.302894	21.51	64.54	146.30	163.51	163.51
28	32APSK 9/10	4.356875	21.78	65.35	148.13	165.56	165.56

C.5.1 ACM Configuration via the Front Panel



Chapter 5. FRONT PANEL OPERATION

To configure the CDM-750 for ACM operation, proceed as follows:

Step	Task				
1	Make sure the Gigabit Ethernet interface is selected and enabled. See Sect. 5.2.2.1.4.				
2	Select the Tx and Rx modulation types. See Sects. 5.2.2.2.5 and 5.2.2.3.4.				
3	Program the Tx and Rx symbol rates. See Sects. 5.2.2.2.6 and 5.2.2.3.5.				
4	Enter the operating Tx Power (Sect. 5.2.2.2.3), Tx frequency (Sect. 5.2.2.2.2), and Rx frequency (Sect. 5.2.2.3.2).				
5	Before engaging ACM, conduct a test to verify both modems are interoperable.				
6	<p>Configuration via the ACM menus – see Sect. 5.2.2.5:</p> <ol style="list-style-type: none"> <i>Min/Max-ModCod</i>: 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). <i>Unlock Action</i>: 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. <i>Es/No Target Margin</i>: 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 4.5 dB (the default value is 0.0 dB). <i>Modulation Impairment</i>: The amount of degradation for each modulation type is selected (0 dB is the default). This selection recognizes that impairments rise as modulation order increases. It provides some help combating compression: <table> <tr> <td>QPSK: 0.2 dB</td> <td>16APSK: 0.4 dB</td> </tr> <tr> <td>8PSK: 0.3 dB</td> <td>32APSK: 0.6 dB</td> </tr> </table> <p>Note: The impairment for QPSK ≤ 8PSK ≤ 16APSK ≤ 32APSK</p> 	QPSK: 0.2 dB	16APSK: 0.4 dB	8PSK: 0.3 dB	32APSK: 0.6 dB
QPSK: 0.2 dB	16APSK: 0.4 dB				
8PSK: 0.3 dB	32APSK: 0.6 dB				
7	Upon completion of Steps 1 through 6, the modem then determines the optimal set of ModCods and prunes non-optimal ModCods.				

C.5.2 ACM Configuration via the CDM-750 Web Server Interface



Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT

Use the **Configuration | Modem** page to carry out the tasks explained in **Sect. C.5.1.**

CDM-750: Comtech EF Data Modem :: Modem Configuration

Home
Admin
Configuration
Status
Interfaces
TxGraph
RxGraph

Modem
Utilities
Test
Lnb

Transmit

DVB-S2 Frame

ModCod

Data Rate kbps

Symbol Rate ksps

Frequency MHz

Spectrum

Goldcode

Pilots

Alpha Rolloff

Pilot Location

Power Level dBm

Carrier

Compression

Receive

DVB-S2 Frame

ModCod

Data Rate kbps

Symbol Rate ksps

Frequency MHz

Spectrum

Goldcode

Pilots

Alpha Rolloff

Es/No Alarm Pt dB

Decompression

Carrier-in-Carrier (CnC)

Search Delay Range Min

Search Delay Range Max

ACM

Minimum ModCod

Maximum ModCod

When distant-end demod loses lock

Target EsNo Margin

Degradation QPSK

Degradation 8PSK

Degradation 16APSK

Degradation 32APSK

Figure C-7. CDM-750 Web Server Interface – Configuration | Modem page

C.6 Monitoring ACM Performance and Statistics



- **Chapter 3. REAR PANEL CONNECTORS**
- **Chapter 5. FRONT PANEL OPERATION**
- **Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT**
- **Chapter 7. SERIAL-BASED REMOTE PRODUCT MANAGEMENT**

The CDM-750 provides a number of ways to monitor the ACM system:

- **Via the CDM-750 Front Panel:** Use the **MONITOR: ACM** front panel menu to view the current Tx and Rx ModCod , as well as the Local and Remote Es/No.

The Es/No displays values between -3.0 dB 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.

- **Via the CDM-750 Remote Control and Ethernet Management Interfaces:** As described for the CDM-750 Front Panel, this information is available via remote queries issued over the Remote Control Interface (Serial or Telnet), and by using the Ethernet Remote Product Management Interfaces – SNMP, or the CDM-750 Web Server interface via the **Status | Status** and **Status | ACM** pages.
- **Via Oscilloscope:** If you have access to an Oscilloscope in X-Y mode, Pins #3 and #11 on the CDM-750 rear panel **J1 | ALARMS** connector provide analog voltages to monitor the constellation. The advantage here is that ModCod changes may be viewed instantaneously.
- **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. 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.

C.6.1 ACM Congestion Control



See Sect. 5.2.2.1.4 (CONFIG) INTF: GBEIX in Chapter 5. FRONT PANEL OPERATION for detailed information on Flow 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.

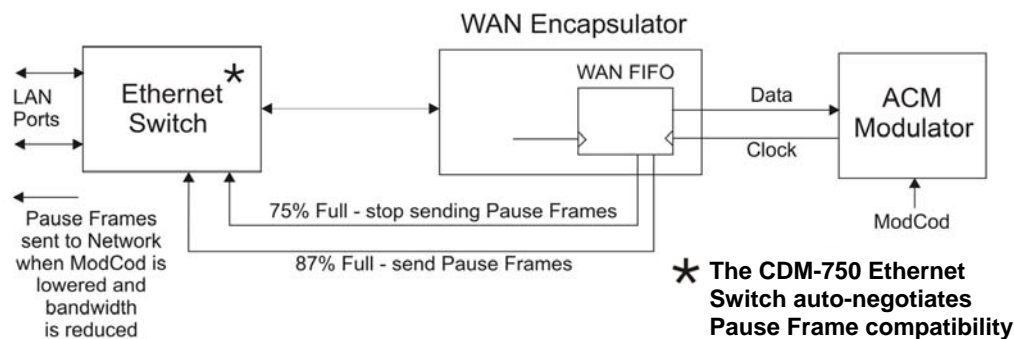


Figure C-8. CDM-750 – ACM Congestion Control

As shown in **Figure C-8**, in order to mitigate packet loss when bandwidth is reduced, the CDM-750 incorporates a WAN buffer. When this WAN buffer cannot accommodate the amount of Ethernet traffic due to the WAN bandwidth, the CDM-750 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 C-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 is 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.

C.6.2 Notes and Recommendations

- CDM-750 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 E_s/N_0 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-750 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 E_s/N_0 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 E_s/N_0 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 E_s/N_0 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-750.

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.

- E_s/N_0 is the preferred metric for driving the adaptation – this is the value displayed on the monitor screens. If you want to convert this to E_b/N_0 then remember that the relationship is simply **$E_b/N_0 = E_s/N_0 - 10\log(\text{Spectral Efficiency})$** .
- 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).
- ACM maximizes throughput not only when E_s/N_0 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 E_s/N_0 Margin.
- ACM modes are **not** compatible with CCM modes, due to differences in frame preambles.

C.6.3 ACM – Summary of Specifications



See Sect. 1.4.7 Adaptive Coding and Modulation (ACM) in Chapter 1. INTRODUCTION for the complete table of ACM specifications.

Appendix D. Doubletalk Carrier-in-Carrier (CnC) OPTION



BEFORE ATTEMPTING TO COMMISSION A SATELLITE LINK USING CARRIER-IN-CARRIER (CnC), THE USER **MUST** ENSURE THAT THE LINK IS ROBUST ENOUGH FOR NORMAL OPERATION. ONLY WHEN THIS HAS BEEN DONE – AND ALL SYSTEM ISSUES (E.G., ANTENNA-POINTING, CABLING, TERRESTRIAL INTERFERENCE, SATELLITE INTERFERENCE, ETC.) HAVE BEEN RESOLVED – SHOULD THE USER ATTEMPT THE USE OF CARRIER-IN-CARRIER.

D.1 Introduction

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.

D.1.1 What is DoubleTalk Carrier-in-Carrier?

The CDM-750'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-750 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.

D.2 Application Requirements

The following conditions are necessary in order to operate DoubleTalk Carrier-in-Carrier:

- Link must be full duplex.
- A CDM-750 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 D-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 the following 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-750 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.

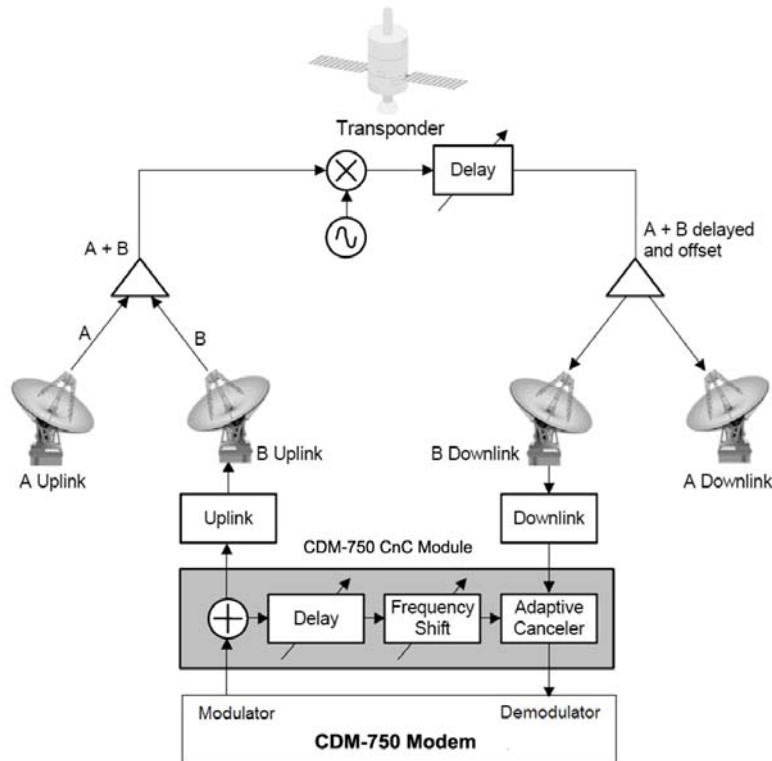


Figure D-1. Conceptual Block Diagram

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.

D.3 Operational Details

The rules for CnC operation can be 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, observe the following:

- 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 0-400 ms, where 0 ms is used when doing loop-back or bench testing.
- Use the CDM-750's Internal BERT Tester when evaluating CnC performance.

D.4 System Functionality and Operational Considerations

Figure D-2 illustrates a conventional, full duplex satellite link where two carriers are placed in non-overlapping channels. **Figure D-3** shows the same link using CDM-750s 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-750 which then translates the signal to near baseband where it can be filtered (decimated) and then processed as a complex envelope signal. The CDM-750 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 D-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.

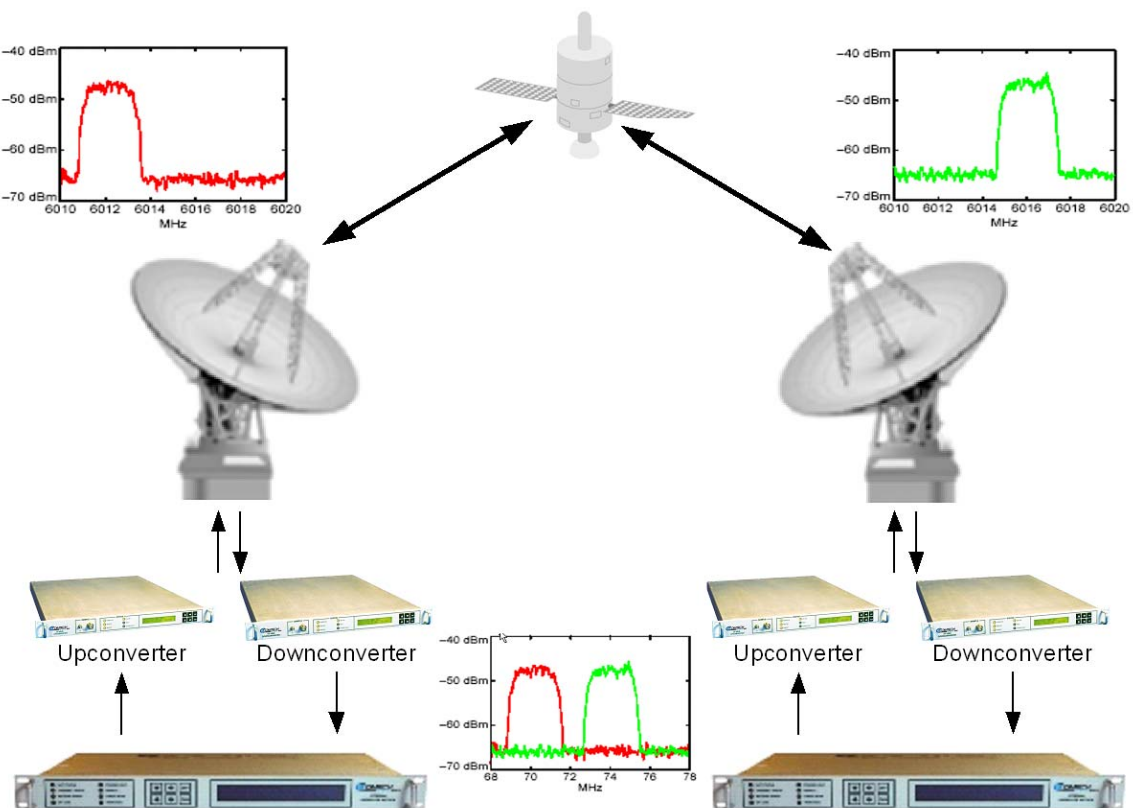


Figure D-2. Conventional FDMA Link

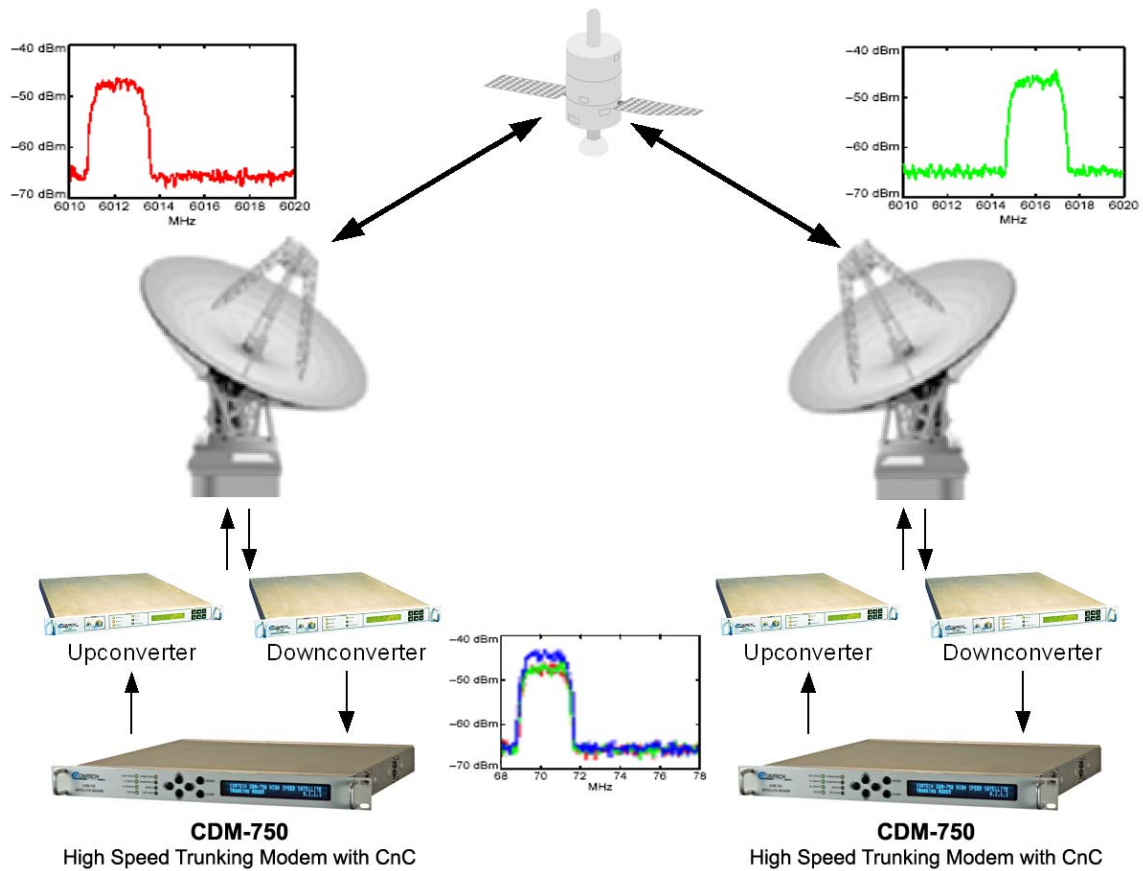
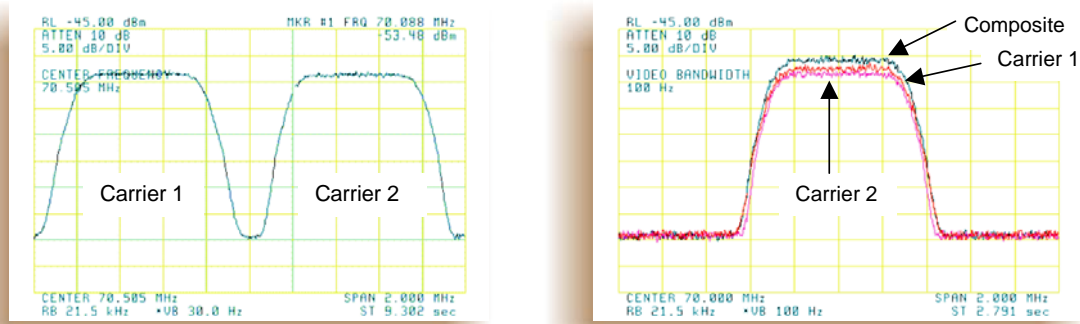


Figure D-3. Same Link Using CDM-750 and DoubleTalk Carrier-in-Carrier



Traditional Full Duplex Link

Duplex Link with DoubleTalk Carrier-in-Carrier

Figure D-4. Duplex Link Optimization

The CDM-750 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-750 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 D-1** illustrates how QPSK, when used with CnC, approaches the bandwidth efficiency of 16APSK.

Table D-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.

D.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.

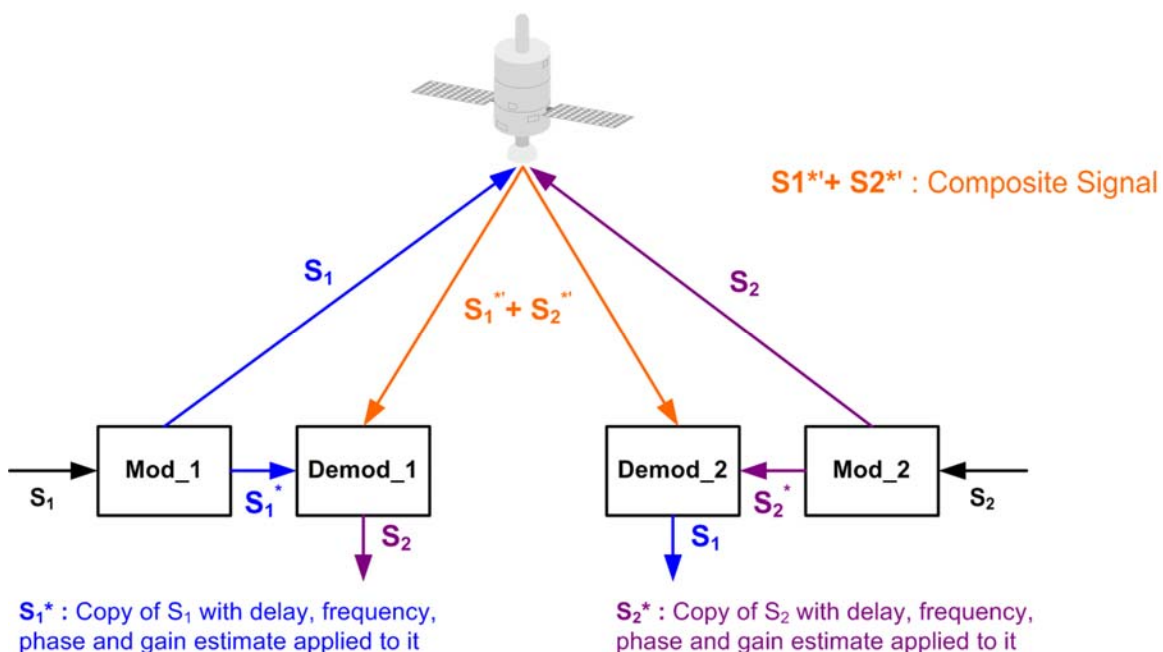


Figure D-5. DoubleTalk Carrier-in-Carrier Signals

Referring to Figure D-5: Modem 1 and Modem 2 transmit signals S_1 and S_2 respectively. The satellite receives, translates, and retransmits the composite signal. The composite downlink signal $S_1^* + S_2^*$ 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 D-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 S_1 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.

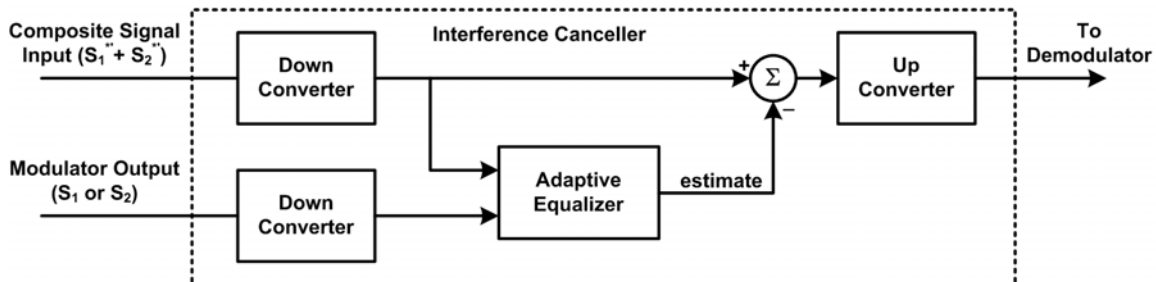


Figure D-6. Carrier-in-Carrier Signal Processing Block Diagram

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.

D.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 E_s/N_0 . To compensate for the residual noise, a small amount of additional link margin is required to improve the E_s/N_0 and maintain the QEF performance. Margin requirements depend on the product, modulation and power ratios; for the CDM-750, these additional margin requirements are as follows:

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.

D.4.3 Carrier-in-Carrier Latency

DoubleTalk Carrier-in-Carrier has no measurable impact on circuit latency.

D.4.4 Carrier-in-Carrier and Adaptive Coding and Modulation (ACM)



Appendix C. ADAPTIVE CODING AND MODULATION (ACM) OPTION

DoubleTalk Carrier-in-Carrier is fully compatible with the Adaptive Coding and Modulation (ACM) mode of operation in the CDM-750.

CnC combined with ACM can provide 100 – 200% increase in average throughput.

D.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 sections that follow in this chapter.



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.

D.4.6 Symmetric Data Rate Link

Consider the following example:

Satellite & Transponder	Galaxy 18 @ 123° 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. The LST² summary for the traditional link is as follows:

Link Analysis Description:			
MultiCarrier Txpdr Lease	Link 1	Link 2	
Number of links: <input type="text" value="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			
(MultiCarrier Txpdr Lease)			
Total EIRP utilized	36.5 dBW		Total BW allocated
Total EIRP available	36.5 dBW		Total BW PEB
Margin (available-utilized)	.0 dB		Total BW utilized
			Total BW available
			Margin (available-utilized)



Allocated BW = 35.1245 MHz
PEB = 35.9610 MHz
Leased BW = 35.9610 MHz

² LST is Intelsat’s Lease Transmission Plan Program.

Link parameters and LST summary for 16APSK 2/3 with Carrier-in-Carrier is as follows:

Digital Carrier Definition

Select From Available Products & Modems...

Carrier Type: DIGITAL

Performance (BER):

FEC Code Rate: .6437

R-S Code Rate: n= N/A, k= N/A

Overhead: .0 %

Modulation: 16-Phase

Eb/No Threshold: 6.4 dB

C/N Threshold: 10.5 dB

U/L Carrier Center Freq.: 14242.00000 MHz

Car/Link: 1 Act. Fact.: 100 %

Information Rate: 34368.0 kbits/s

Alloc. BW: .30 17.3522 MHz

Noise BW: 13.3478 MHz

Min Uplink Rain Margin: 1.00 dB

Min Dnlink Degrad. Margin: 1.00 dB

Total Availability: % yr

Transmit ES Code: 8_1M

Receive ES Code: 8_1M

Buttons: Return, Accept, Copy, Cancel

Link: 1 1 2

- User Specified
- LST Calculated

Include IF and RF Margin and CnC Margin

Link Analysis Description:			
	Link 1	Link 2	
MultiCarrier Txpr Lease			
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 Txpr 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 as follows:

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%.

D.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 the following example:

Satellite & Transponder	IS-901 @ 342° 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 as follows (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%

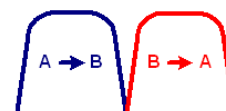
If the CnC link was designed using S2-8PSK 3/4 in both directions, it would have required:

- **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).

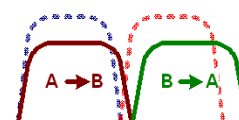
D.4.6.2 Power Limited Links

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 the following examples:

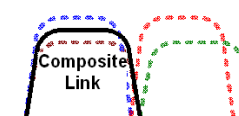
The conventional link is using 8PSK, TPC 3/4:



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 @ 342° 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 used DVB-S2 8PSK 3/4. The savings summary is as follows – using CnC and DVB-S2 reduced the leased bandwidth by almost 50% and HPA power by almost 60%:

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.

D.4.7 Commissioning and Deploying Carrier-in-Carrier



Prior to commissioning a Carrier-in-Carrier link, it is critical that the link is fully tested in non-CnC mode and all system issues – including external interference, antenna pointing, cabling, and SSPA backoff – are resolved. Only after the link is robust should the user attempt turning on CnC.

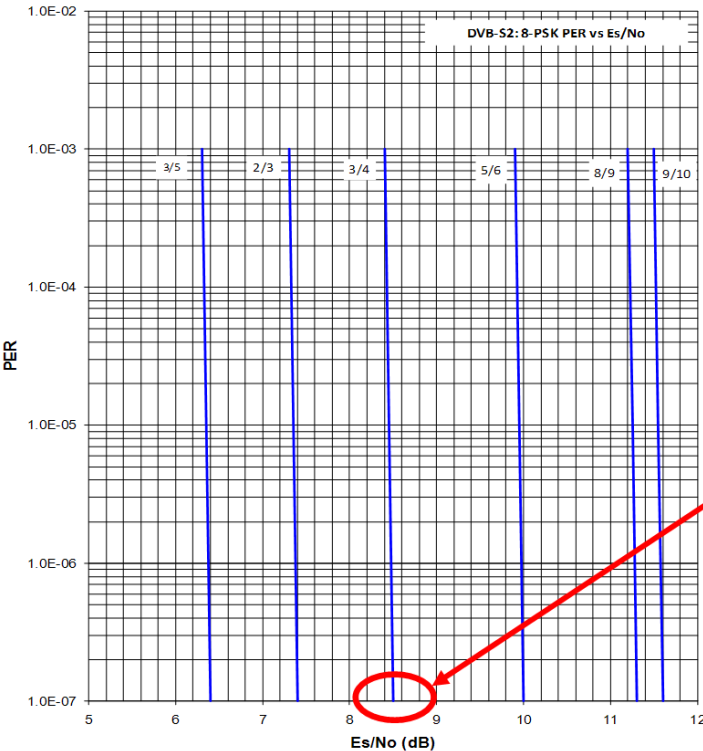
Comtech EF Data recommends that you follow these steps to commission and deploy CnC:

Step	Task
1	<p>Turn ON the carrier at <i>Site A</i>. Carrier from <i>Site B</i> is OFF. CnC function is OFF at <i>both sites</i>.</p> <ul style="list-style-type: none"> ➤ Using a spectrum analyzer, measure Co+No/No at the input to the modem at <i>Site A</i>. ➤ Using a spectrum analyzer, measure Co+No/No at the input to the modem at <i>Site B</i>. ➤ Measure/record Es/No at <i>Site B</i>. Make sure there is sufficient margin to account for CnC. ➤ Measure/record Receive Signal Level (RSL) at <i>Site B</i>, usually midrange.
2	<p>Turn OFF the carrier at <i>Site A</i>. Turn ON the carrier at <i>Site B</i>. CnC function is OFF at <i>both sites</i>.</p> <ul style="list-style-type: none"> ➤ Using a spectrum analyzer, measure Co+No/No at the input to the modem at <i>Site A</i>. ➤ Using a spectrum analyzer, measure Co+No/No at the input to the modem at <i>Site B</i>. ➤ Measure/record Es/No at <i>Site A</i>. Make sure there is sufficient margin to account for CnC. ➤ Measure/record RSL at <i>Site B</i>.
3	<p>Using Co+No/No readings, calculate CnC ratio at <i>Sites A</i> and <i>B</i>. If it is not within specification, make necessary adjustments to bring it within specification and repeat measurements in Steps 1 and 2.</p> <ul style="list-style-type: none"> ➤ Also verify that the RSL is within spec.
4	<p>Now, without changing the transmit power levels, turn ON both the carriers (on the same frequency) and turn CnC ON.</p> <ul style="list-style-type: none"> ➤ Measure/record Es/No at <i>Sites A</i> and <i>B</i>. ➤ Measure/record RSL at <i>Sites A</i> and <i>B</i>. ➤ 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	<p>You may repeat the test for different SR ratios and modulation types.</p>

D.5 Operational References

D.5.1 Calculating a Carrier-in-Carrier Link Budget

Follow these steps to calculate the link budget for a CnC Link:

Step	Task
1	<p>Calculate the link budget for both carriers in the duplex link, with required CnC margin:</p>  <div style="border: 1px solid red; padding: 5px;"> <ul style="list-style-type: none"> • Find the <i>Es/No</i> corresponding to the desired <i>BER</i>, usually <i>QEF</i> • Add <i>CnC Margin</i> • Add any other margin • Use this compiled value as the <i>Threshold Es/No</i> for the link budget </div>
2	Verify that the CnC ratio is within spec for the CDM-750.
3	<p>Calculate the Allocated Bandwidth (BW) and Power Equivalent Bandwidth (PEB) for the duplex link:</p> <ul style="list-style-type: none"> • $BW_{\text{Duplex Link}} = \text{Greater of } (BW_{\text{Carrier 1}}, BW_{\text{Carrier 2}})$ • $PEB_{\text{Duplex Link}} = PEB_{\text{Carrier 1}} + PEB_{\text{Carrier 2}}$ • $\text{Leased } BW_{\text{Duplex Link}} = \text{Greater of } (BW_{\text{Duplex Link}}, PEB_{\text{Duplex Link}})$
4	For an optimal link, the Leased Bandwidth and the Power Equivalent Bandwidth are equal or nearly equal.
5	Repeat the link budget process by selecting different Modulation and FEC until the BW and PEB is nearly balanced.

D.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).

D.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**

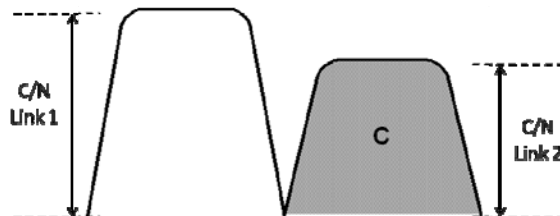
Per Carrier UL & DL eirp (Clr-Sky)	Link 1	Link 2	
Transmit ES elevation angle	48.8	48.6	deg.
Uplink EIRP per carrier	57.7	58.6	dBW
Pathloss at uplink frequency	206.9	206.9	dB
Gain of 1 m ² antenna	44.3	44.3	dBi
Per carrier FD @SC	-104.8	-104.0	dBW/m ²
SC pattern advantage @ES	5.0	3.3	dB
Per carrier BE FD arriving @ SC	-99.8	-100.6	dBW/m ²
Transponder BE SFD	-83.6	-83.6	dBW/m ²
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

D.5.2.2 Calculating CnC Ratio from Carrier to Noise Ratio (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):



- $\text{CnC Ratio} = \text{C/N Interferer} - \text{C/N Desired} + 10\log(\text{SR Interferer} / \text{SR}_{\text{Desired}})$
- $\text{CnC Ratio at Site A} = \text{C/N Link 1} - \text{C/N Link 2} + 10\log(\text{SR Link 1} / \text{SR Link 2})$
- $\text{CnC Ratio at Site B} = \text{C/N Link 2} - \text{C/N Link 1} + 10\log(\text{SR Link 2} / \text{SR Link 1})$

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*:
 $\text{CnC Ratio} = 9.5 - 7.5 + 10\log(5.0 / 6.5) = +0.86$
- From the standpoint of *Site B*:
 $\text{CnC Ratio} = 7.5 - 9.5 + 10\log(6.5 / 5.0) = -0.86$

D.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]

PSD Carrier A to B

$$28.41 - 10\log(10.326 \times 1E6) = -41.7 \text{ dBW/Hz}$$

CnC Ratio

$$\pm(28.41 - 27.59) \pm 0.8 \text{ dB}$$

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]

PSD Carrier B to A

$$27.59 - 10\log(10.326 \times 1E6) = -42.5 \text{ dBW/Hz}$$

$$\text{PSD Ratio} = \pm 0.8 \text{ dB}$$

D.6 DoubleTalk Carrier-in-Carrier Specifications



See Sect. 1.4.8 DoubleTalk Carrier-in-Carrier (CnC) in Chapter 1. INTRODUCTION for the complete table of CnC specifications.

D.7 Carrier-in-Carrier Summary

Comtech EF Data's DoubleTalk Carrier-in-Carrier can provide significant savings in operational expenses. The following considerations must be taken 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.

D.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:

$$\text{CnC Ratio (in dB)} = \text{PowerC1 (in dBm)} - \text{PowerC2 (in dBm)}$$

E_b/N_o

Ratio of Energy per bit (*E_b*) to Noise density (*N_o*) (unit in dB):

$$E_b/N_o = C/N_o - 10\log(\text{DR}) \text{ (where DR is the Data Rate)}$$

$$E_b/N_o = E_s/N_o - 10\log(\text{SE}) \text{ (where SE is Spectral Efficiency)}$$

E_s/N_o

Ratio of Energy per symbol (*E_s*) to Noise density (*N_o*) (unit in dB):

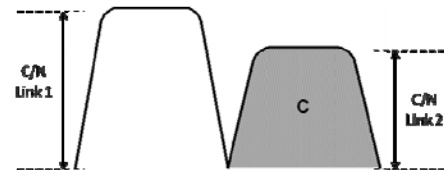
$$E_s/N_o = C/N_o - 10\log(\text{SR}) \text{ (where SR is the Symbol Rate)}$$

$$E_s/N_o = E_b/N_o + 10\log(\text{SE}) \text{ (where SE is Spectral Efficiency)}$$

C/N

Ratio of Carrier Power (*C*) to Noise (*N*) (unit in dB):

Equivalent to *E_s/N_o* when calculated in the Symbol Rate bandwidth.



C/N_o

Ratio of Carrier Power (*C*) to Noise Density (*N_o*) (unit in dBHz)

C_o+N_o/N_o

Ratio of Carrier Density (*C_o*) + Noise (*N_o*) to Noise Density (*N_o*) (unit in dB):

$$C/N = C/N_o - 10\log(B) \text{ [where B is bandwidth in Hz]}$$

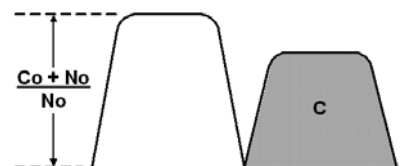
$$E_b/N_o = C/N_o - 10\log(\text{DR}) \text{ [where DR is data rate in bits/sec]}$$

$$= C/N + 10\log(B) - 10\log(\text{DR})$$

$$= C/N - 10\log(\text{SE}) \text{ (where SE is Spectral Efficiency)}$$

$$E_b/N_o = 10\log(10^{((C_o+N_o/N_o)/10)} - 1) - 10\log(\text{SE}) \text{ (where SE is Spectral Efficiency)}$$

[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

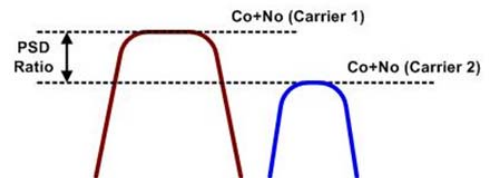
Signal bandwidth = 5 MHz

$$\begin{aligned} \text{PSD} &= 20 - 10 * \log (5,000,000) \\ &= -46.99 \text{ dBm / Hz} \end{aligned}$$

PSD Ratio

Ratio of Power Spectral Density (PSD) of the interfering carrier to the desired carrier.

If looking at the 2 carriers side-by-side on a spectrum analyzer:



Quasi Error Free (QEF)

Quasi Error Free (QEF) corresponds to PER $\sim 10^{-7}$

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:

$$\text{DR} = \text{SR} * \text{SE} \text{ (Data Rate = Symbol Rate * Spectral Efficiency)}$$

$$\text{SR} = \text{DR} / \text{SE} \text{ (Symbol Rate = Data Rate / Spectral Efficiency)}$$

Appendix E. Es/No MEASUREMENT

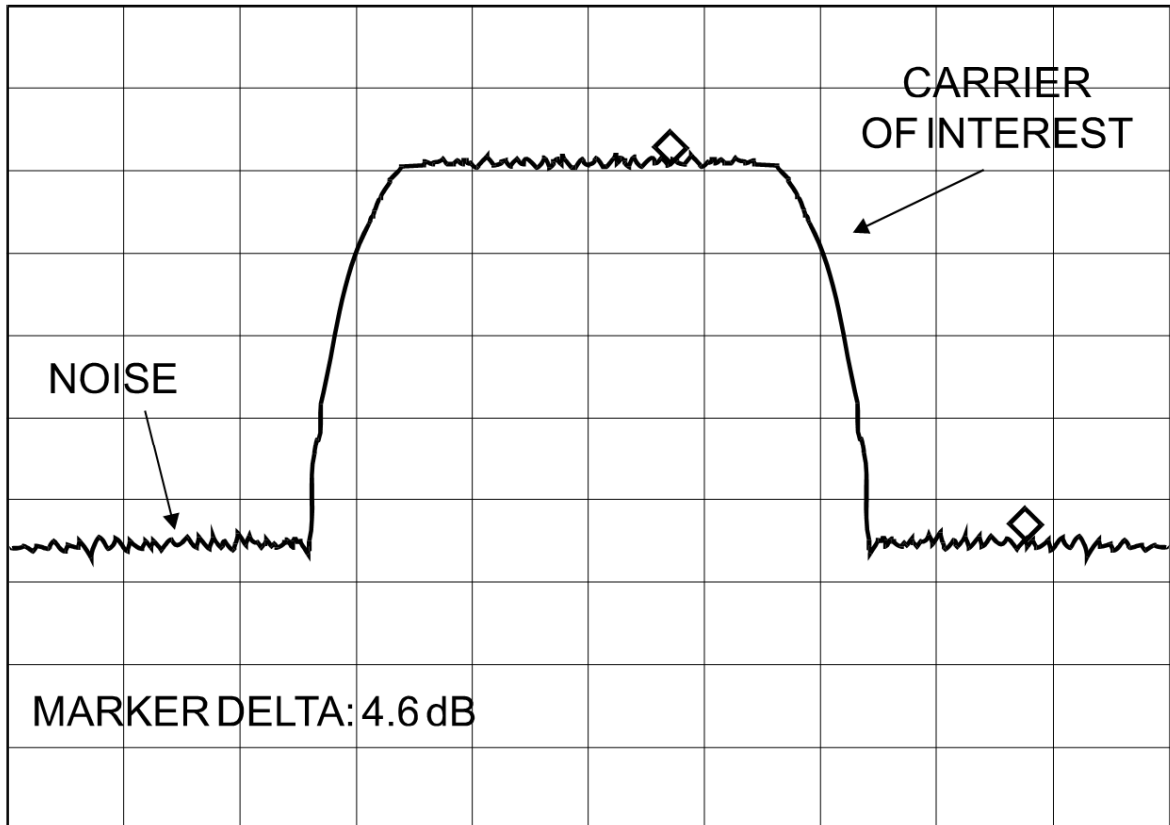
Although the CDM-750 Advanced High-Speed Trunking Modem calculates and displays the value of receive Es/No on the front panel of the unit, it is sometimes useful to measure the value using a spectrum analyzer, if one is available.

The idea is to accurately measure the value of $(C_0+N_0)/N_0$ (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 $(C_0+N_0)/N_0$, in dB.
- Use this value of $(C_0+N_0)/N_0$ in the table on the following page to determine the E_b/N_0 . You will need to know the operating mode to read from the appropriate column.
- If the $(C_0+N_0)/N_0$ 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 $(C_0+N_0)/N_0$ (approximately less than 6 dB).

Example: In the diagram that follows, the $(C_o+N_o)/N_o$ measured is 4.6 dB. If Rate 1/2 QPSK is used, this corresponds to an E_s/N_o of approximately 2.8 dB (DVB-S2).



VIDEO AVERAGING ON

VERT SCALE: 1 dB/DIV

The relationship used to derive the table values (the only simple way for DVB-S2) is as follows:

$$E_s/N_o = C/N = 10\log_{10}(10^{((C_o + N_o)/10)} - 1) - 10\log_{10}(\text{Spectral Efficiency})$$

where:

- E_s/N_o and $(C_o+N_o)/N_o$ are expressed in dB,

and

- **Spectral Efficiency** includes the modulation type, code rate, overhead and framing and is shown in **Table E-1** and
- **Table E-2.**

Table E-1. CDM-750 Co+No/No to C/N (Es/No) and Eb/No (dB) for DVB-S2 QPSK and 8PSK
(DVB-S2 uses C/N (Es/No), and Eb/No is shown for information)

Spectral Efficiency Normal Block Mode Pilots ON ▶		QPSK											8PSK					
		0.478577	0.640827	0.770627	0.965327	1.160026	1.290788	1.452076	1.549426	1.615288	1.724416	1.746049	1.739569	1.935658	2.177525	2.422276	2.585924	2.618365
Code Rate ▶		1/4	1/3	2/5	1/2	3/5	2/3	3/4	4/5	5/6	8/9	9/10	3/5	2/3	3/4	5/6	8/9	9/10
(Co+No)/No	C/N = Es/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No
2.6	-0.9	2.3	1.1	0.3	-0.7	-1.5	-2.0	-2.5	-2.8	-2.9	-3.2	-3.3	-3.3	-3.7	-4.2	-4.7	-5.0	-5.0
2.9	-0.2	3.0	1.7	0.9	-0.1	-0.9	-1.3	-1.8	-2.1	-2.3	-2.6	-2.6	-2.6	-3.1	-3.6	-4.1	-4.3	-4.4
3.2	0.4	3.6	2.3	1.5	0.5	-0.3	-0.7	-1.2	-1.5	-1.7	-2.0	-2.0	-2.0	-2.5	-3.0	-3.5	-3.8	-3.8
3.5	0.9	4.1	2.9	2.1	1.1	0.3	-0.2	-0.7	-1.0	-1.2	-1.4	-1.5	-1.5	-1.9	-2.4	-2.9	-3.2	-3.3
3.8	1.5	4.7	3.4	2.6	1.6	0.8	0.3	-0.2	-0.4	-0.6	-0.9	-1.0	-0.9	-1.4	-1.9	-2.4	-2.7	-2.7
4.1	2.0	5.2	3.9	3.1	2.1	1.3	0.9	0.3	0.1	-0.1	-0.4	-0.5	-0.4	-0.9	-1.4	-1.9	-2.2	-2.2
4.4	2.4	5.6	4.4	3.6	2.6	1.8	1.3	0.8	0.5	0.4	0.1	0.0	0.0	-0.4	-0.9	-1.4	-1.7	-1.7
4.7	2.9	6.1	4.8	4.0	3.1	2.3	1.8	1.3	1.0	0.8	0.5	0.5	0.5	0.0	-0.5	-0.9	-1.2	-1.3
5.0	3.3	6.5	5.3	4.5	3.5	2.7	2.2	1.7	1.4	1.3	1.0	0.9	0.9	0.5	0.0	-0.5	-0.8	-0.8
5.3	3.8	7.0	5.7	4.9	3.9	3.1	2.7	2.2	1.9	1.7	1.4	1.4	1.4	0.9	0.4	-0.1	-0.3	-0.4
5.6	4.2	7.4	6.1	5.3	4.4	3.6	3.1	2.6	2.3	2.1	1.8	1.8	1.8	1.3	0.8	0.4	0.1	0.0
5.9	4.6	7.8	6.5	5.7	4.8	4.0	3.5	3.0	2.7	2.5	2.2	2.2	2.2	1.7	1.2	0.8	0.5	0.4
6.2	5.0	8.2	6.9	6.1	5.2	4.4	3.9	3.4	3.1	2.9	2.6	2.6	2.6	2.1	1.6	1.2	0.9	0.8
6.5	5.4	8.6	7.3	6.5	5.6	4.8	4.3	3.8	3.5	3.3	3.0	3.0	3.0	2.5	2.0	1.6	1.3	1.2
6.8	5.8	9.0	7.7	6.9	5.9	5.1	4.7	4.2	3.9	3.7	3.4	3.4	3.4	2.9	2.4	1.9	1.7	1.6
7.1	6.2	9.4	8.1	7.3	6.3	5.5	5.0	4.5	4.3	4.1	3.8	3.7	3.8	3.3	2.8	2.3	2.0	2.0
7.4	6.5	9.7	8.5	7.7	6.7	5.9	5.4	4.9	4.6	4.4	4.2	4.1	4.1	3.7	3.1	2.7	2.4	2.3
7.7	6.9	10.1	8.8	8.0	7.0	6.2	5.8	5.3	5.0	4.8	4.5	4.5	4.5	4.0	3.5	3.0	2.8	2.7
8.0	7.3	10.5	9.2	8.4	7.4	6.6	6.1	5.6	5.3	5.2	4.9	4.8	4.8	4.4	3.9	3.4	3.1	3.1
8.3	7.6	10.8	9.5	8.7	7.8	7.0	6.5	6.0	5.7	5.5	5.2	5.2	5.2	4.7	4.2	3.8	3.5	3.4
8.6	8.0	11.2	9.9	9.1	8.1	7.3	6.8	6.3	6.1	5.9	5.6	5.5	5.6	5.1	4.6	4.1	3.8	3.8
8.9	8.3	11.5	10.2	9.4	8.5	7.7	7.2	6.7	6.4	6.2	5.9	5.9	5.9	5.4	4.9	4.5	4.2	4.1
9.2	8.6	11.8	10.6	9.8	8.8	8.0	7.5	7.0	6.7	6.6	6.3	6.2	6.2	5.8	5.3	4.8	4.5	4.5
9.5	9.0	12.2	10.9	10.1	9.1	8.3	7.9	7.4	7.1	6.9	6.6	6.6	6.6	6.1	5.6	5.1	4.9	4.8
9.8	9.3	12.5	11.3	10.5	9.5	8.7	8.2	7.7	7.4	7.2	7.0	6.9	6.9	6.5	5.9	5.5	5.2	5.1
10.1	9.7	12.9	11.6	10.8	9.8	9.0	8.5	8.0	7.8	7.6	7.3	7.2	7.2	6.8	6.3	5.8	5.5	5.5
10.4	10.0	13.2	11.9	11.1	10.1	9.3	8.9	8.4	8.1	7.9	7.6	7.6	7.6	7.1	6.6	6.1	5.9	5.8
10.7	10.3	13.5	12.2	11.4	10.5	9.7	9.2	8.7	8.4	8.2	7.9	7.9	7.9	7.4	6.9	6.5	6.2	6.1
11.0	10.6	13.8	12.6	11.8	10.8	10.0	9.5	9.0	8.7	8.6	8.3	8.2	8.2	7.8	7.3	6.8	6.5	6.5
11.3	11.0	14.2	12.9	12.1	11.1	10.3	9.9	9.3	9.1	8.9	8.6	8.5	8.6	8.1	7.6	7.1	6.8	6.8
11.6	11.3	14.5	13.2	12.4	11.4	10.6	10.2	9.7	9.4	9.2	8.9	8.9	8.9	8.4	7.9	7.4	7.2	7.1
11.9	11.6	14.8	13.5	12.7	11.8	11.0	10.5	10.0	9.7	9.5	9.2	9.2	9.2	8.7	8.2	7.8	7.5	7.4
12.2	11.9	15.1	13.9	13.1	12.1	11.3	10.8	10.3	10.0	9.8	9.6	9.5	9.5	9.1	8.6	8.1	7.8	7.7
12.5	12.2	15.4	14.2	13.4	12.4	11.6	11.1	10.6	10.3	10.2	9.9	9.8	9.8	9.4	8.9	8.4	8.1	8.1
12.8	12.6	15.8	14.5	13.7	12.7	11.9	11.5	10.9	10.7	10.5	10.2	10.1	10.2	9.7	9.2	8.7	8.4	8.4

Notes:

1. $E_b/N_o = E_s/N_o - 10_{\log}(\text{Spectral Efficiency})$.
2. The required C/N for QEF with Short Frames is typically 0.2 to 0.3 dB higher.
3. **Shaded areas** are high error rate or unstable.

Table E-2. CDM-750 Co+No/No to C/N (Es/No) and Eb/No (dB) for DVB-S2 16APSK and 32APSK
(DVB-S2 uses C/N (Es/No), and Eb/No is shown for information)

Spectral Efficiency Normal Block Mode Pilots ON ▶		16APSK						32APSK				
		2.574613	2.896320	3.090495	3.221863	3.439530	3.482680	3.623332	3.866247	4.030589	4.302894	4.356875
Code Rate ▶		2/3	3/4	4/5	5/6	8/9	9/10	3/4	4/5	5/6	8/9	9/10
(Co+No)/No	C/N = Es/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No
9.8	9.3	5.2	4.7	4.4	4.2	4.0	3.9	3.7	3.4	3.3	3.0	2.9
10.1	9.7	5.5	5.0	4.8	4.6	4.3	4.2	4.1	3.8	3.6	3.3	3.3
10.4	10.0	5.9	5.4	5.1	4.9	4.6	4.6	4.4	4.1	3.9	3.6	3.6
10.7	10.3	6.2	5.7	5.4	5.2	4.9	4.9	4.7	4.4	4.3	4.0	3.9
11.0	10.6	6.5	6.0	5.7	5.6	5.3	5.2	5.0	4.8	4.6	4.3	4.2
11.3	11.0	6.9	6.3	6.1	5.9	5.6	5.5	5.4	5.1	4.9	4.6	4.6
11.6	11.3	7.2	6.7	6.4	6.2	5.9	5.9	5.7	5.4	5.2	5.0	4.9
11.9	11.6	7.5	7.0	6.7	6.5	6.2	6.2	6.0	5.7	5.6	5.3	5.2
12.2	11.9	7.8	7.3	7.0	6.8	6.6	6.5	6.3	6.1	5.9	5.6	5.5
12.5	12.2	8.1	7.6	7.3	7.2	6.9	6.8	6.7	6.4	6.2	5.9	5.9
12.8	12.6	8.5	7.9	7.7	7.5	7.2	7.1	7.0	6.7	6.5	6.2	6.2
13.1	12.9	8.8	8.3	8.0	7.8	7.5	7.5	7.3	7.0	6.8	6.5	6.5
13.4	13.2	9.1	8.6	8.3	8.1	7.8	7.8	7.6	7.3	7.1	6.9	6.8
13.7	13.5	9.4	8.9	8.6	8.4	8.1	8.1	7.9	7.6	7.5	7.2	7.1
14.0	13.8	9.7	9.2	8.9	8.7	8.5	8.4	8.2	8.0	7.8	7.5	7.4
14.3	14.1	10.0	9.5	9.2	9.1	8.8	8.7	8.5	8.3	8.1	7.8	7.7
14.6	14.4	10.3	9.8	9.5	9.4	9.1	9.0	8.9	8.6	8.4	8.1	8.1
14.9	14.8	10.7	10.1	9.9	9.7	9.4	9.3	9.2	8.9	8.7	8.4	8.4
15.2	15.1	11.0	10.4	10.2	10.0	9.7	9.6	9.5	9.2	9.0	8.7	8.7
15.5	15.4	11.3	10.8	10.5	10.3	10.0	10.0	9.8	9.5	9.3	9.0	9.0
15.8	15.7	11.6	11.1	10.8	10.6	10.3	10.3	10.1	9.8	9.6	9.3	9.3
16.1	16.0	11.9	11.4	11.1	10.9	10.6	10.6	10.4	10.1	9.9	9.7	9.6
16.4	16.3	12.2	11.7	11.4	11.2	10.9	10.9	10.7	10.4	10.2	10.0	9.9
16.7	16.6	12.5	12.0	11.7	11.5	11.2	11.2	11.0	10.7	10.6	10.3	10.2
17.0	16.9	12.8	12.3	12.0	11.8	11.5	11.5	11.3	11.0	10.9	10.6	10.5
17.3	17.2	13.1	12.6	12.3	12.1	11.9	11.8	11.6	11.3	11.2	10.9	10.8
17.6	17.5	13.4	12.9	12.6	12.4	12.2	12.1	11.9	11.7	11.5	11.2	11.1
17.9	17.8	13.7	13.2	12.9	12.7	12.5	12.4	12.2	12.0	11.8	11.5	11.4
18.2	18.1	14.0	13.5	13.2	13.1	12.8	12.7	12.5	12.3	12.1	11.8	11.7
18.5	18.4	14.3	13.8	13.5	13.4	13.1	13.0	12.8	12.6	12.4	12.1	12.0
18.8	18.7	14.6	14.1	13.8	13.7	13.4	13.3	13.2	12.9	12.7	12.4	12.4
19.1	19.0	14.9	14.4	14.1	14.0	13.7	13.6	13.5	13.2	13.0	12.7	12.7
19.4	19.3	15.2	14.7	14.4	14.3	14.0	13.9	13.8	13.5	13.3	13.0	13.0
19.7	19.7	15.5	15.0	14.8	14.6	14.3	14.2	14.1	13.8	13.6	13.3	13.3
20.0	20.0	15.8	15.3	15.1	14.9	14.6	14.5	14.4	14.1	13.9	13.6	13.6

Notes:

1. Eb/No = Es/No - 10 Log (Spectral Efficiency).
2. The required C/N for Short Frames is typically 0.2 to 0.3 dB higher.
3. **Shaded areas** are high error rate or unstable.

Appendix F. ETHERNET NETWORK CONFIGURATION

F.1 Introduction

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-750 in redundancy. These issues are specifically addressed with a CDM-750 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-750 Advanced High-Speed Trunking Modem.

F.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 **Content Addressable Memory (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'.

F.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.

F.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.

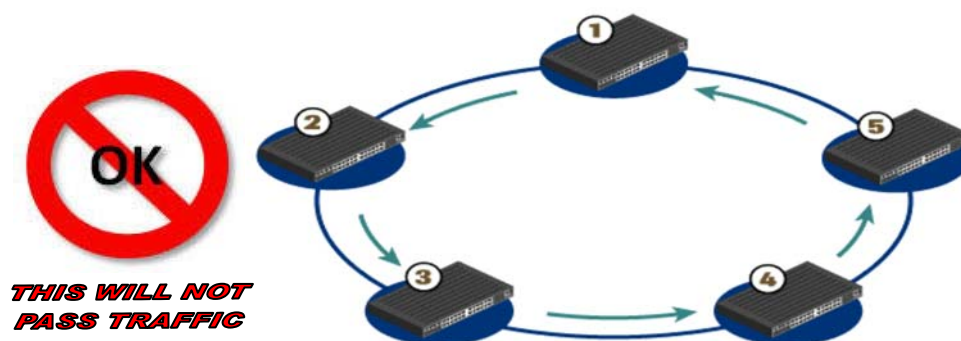


Figure F-1. Networking Loop with Switches

Figure F-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.

F.4 CDM-750 Ethernet Overview

F.4.1 Ethernet Interfaces

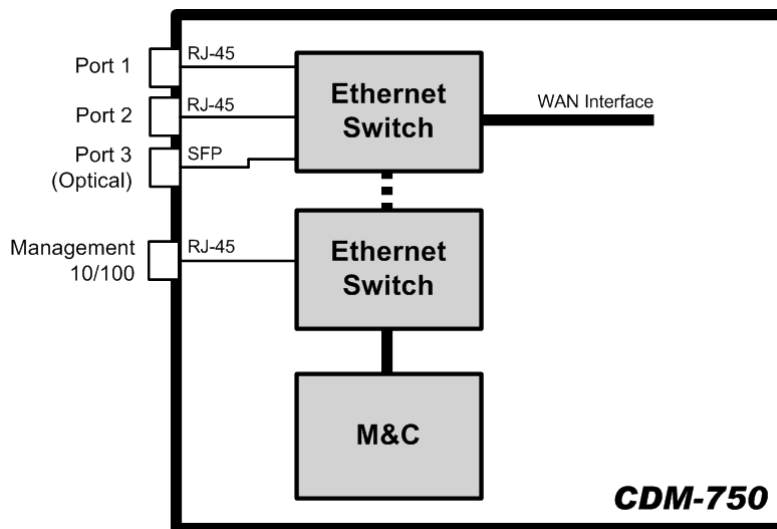


Figure F-2. CDM-750 Ethernet Architecture Design

Figure F-2 shows the internal Ethernet architecture for the CDM-750. The CDM-750 modem has two built-in 10/100/1000 BaseT Ethernet Ports and an optical Gigabit Ethernet port (for use with the optional Optical Ethernet SFP module – see **Chapter 3. REAR PANEL CONNECTIONS**) connected to a single internal Ethernet Layer 2 Switch. Port configuration and statistics are available on a per-port basis.

This configuration allows for multiple customer Ethernet interfaces. The 10/100BaseT management port is connected to a switch that interfaces optionally with the data traffic switch and the M&C controller. Normally, the management port is configured so that management traffic is physically separated from the data traffic ports. However, it is possible to enable operation so that management traffic may pass with the data through the data traffic ports and WAN interface.

It should also be noted that additional care must be taken to avoid **Ethernet Networking Loops** as defined in **Sect. F.3.1**. Specifically, the network operator must make sure to avoid connecting multiple ports of the CDM-750 to the same external Ethernet switch, as shown in **Figure F-3**.

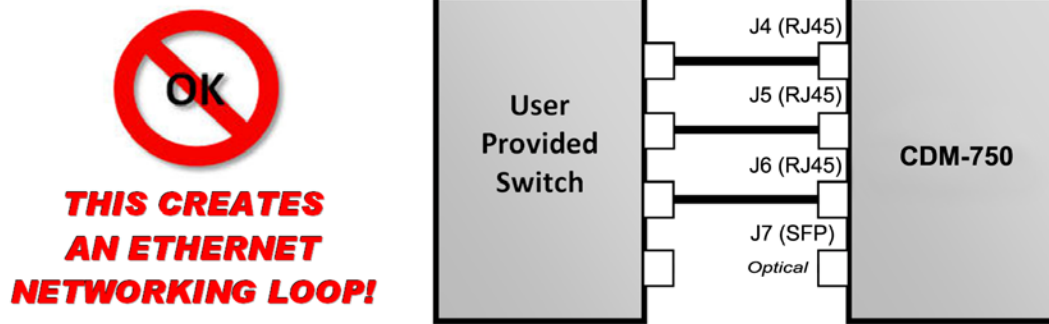


Figure F-3. Improper Use of External Switch with CDM-750

F.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%.

Appendix G. ETHERNET STATISTICS and STATUS REPORTING

G.1 Introduction

Information is available from the CDM-750 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 data traffic-related items.

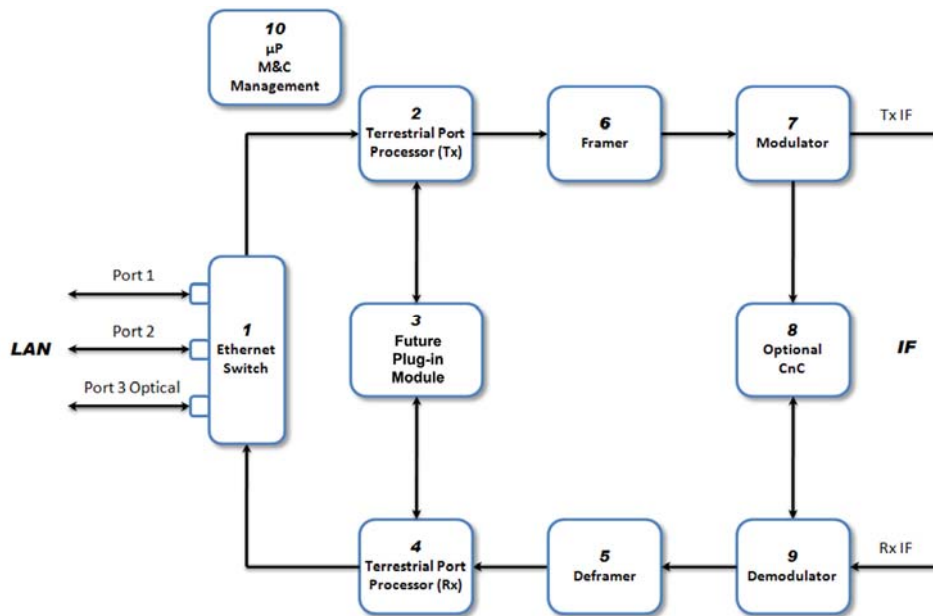
G.2 Data Flow Diagram

Figure G-1 provides a simplified way to visualize the CDM-750 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 and one optional optical Gigabit Ethernet (SFP module) port 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 G-1. CDM-750 Data Flow Diagram

G.3 Statistics Items



The tabulated content presented in the sections that follow may or may not be operational at this time.

G.3.1 Ethernet Data Statistics

Item	Fig. B-1 Block Flow		Comments
	From	To	
GigE-1 Mode	1 4	2 1	Normal, test, PHY Up, PHY Down, OFF
GigE-2 Mode	1 4	2 1	Normal, test, PHY Up, PHY Down, OFF
GigE-3 (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	LAN	1	Packets accepted to Port 1 and inclusive of M&C
Packets from LAN to PORT 2	LAN	1	Packets accepted to Port 2 and inclusive of M&C
Packets from LAN to optical Port 3	LAN	1	Packets accepted to Port 3 (optional optical 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 1	2	1	Breakout of packets from WAN to Port 1 and inclusive of M&C packets
Packets from WAN to PORT 2	1	LAN	Breakout of packets from WAN to Port 2 and inclusive of M&C packets
Packets from WAN to OPT-3	-	-	Breakout of packets from WAN to Port 3 (optional optical 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

G.3.2 Framing and Baseband Statistics

Item	Fig. B-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 16-APSK option not active
BB RX Frames received count for 32APSK	9	5	While 32-APSK option not active
Counter Reset	9	5	Resets all above counters

G.3.3 Status Items



Status items are not strictly part of the Statistics but are important items used for monitoring for current conditions.

G.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. B-1 Block 6) and recovered in the Deframer (Fig. B-1 Block 5).

G.3.5 ACM Modulator Status

Item	Comments
Current TX ModCod	Currently active Tx ModCod.
Remote Es/No Reading	Es/No from distant end.

G.3.6 ACM Demodulator Status

Item	Comments
Rx ModCod	Currently active Rx ModCod.
Local Es/No Reading	Es/No of local demodulator.

G.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. B-1 Block 8).

Appendix H. FEC (FORWARD ERROR CORRECTION)

H.1 Introduction

The CDM-750 Advanced High-Speed Trunking Modem operates with error correction based on the DVB-S2 standard for QPSK, 8PSK, 16APSK and 32APSK with concatenated Low Density Parity Code (LDPC) and Bose-Chaudhuri-Hocquenghem (BCH).

H.2 DVB-S2: LDPC and BCH

The DVB-S2 specification defines a generation of performance that boosts throughput by about 30% over DVB-S while using the same amount of bandwidth. The result is coding and modulation that surpasses the capability of concatenated Viterbi and Reed Solomon coding. LDPC and BCH is also a concatenated error correction technique; the LDPC coding scheme features significant, Near-Shannon Bound Performance.

In some cases, LDPC error correction starts flaring toward an error floor as the carrier-to-noise ratio increases. To compensate, BCH error correction follows LDPC and eliminates the flare for any practical range of error rates.

LDPC also functions differently than Viterbi decoding by using iterative decoding. In this process, the data initially corrected by the LDPC decoder is re-encoded and run through the decoder again to correct additional errors. Through soft decision output from the LDPC decoder and a high-speed processor operating at a rate much higher than the data rate, the iterative process is run as many times as possible before corrected data is finally output to make way for a new block of data entering the decoder.

LDPC also uses interleaving to spread the errors. In contrast, Viterbi error correction operates by passing data through the convolutional error correction process using a single error correction pass.

The error correcting capability of LDPC is enhanced by use of large block sizes. Although large block sizes can increase latency in low bitrate applications (typically less than 2Mbps), this is not a drawback in one-way broadcast applications. Links with LDPC normally operate at multi-

megabit data rates where latency effects are minimal. The standard block size for LDPC is 64,800 bits and, for lower data rate applications, a short frame block at 16,800 bits suffers only a small error correcting loss (0.2 to 0.5 dB) compared to the standard block.

H.2.1 Range of Data Rates



See Sect. 1.4 SUMMARY OF SPECIFICATIONS for the range of available data rates.

H.2.2 BER, QEF, Eb/No, Es/No Spectral Efficiency, and Occupied Bandwidth

Depending on the operating mode, the DVB standard uses different modes of specifying performance with a unit in IF Loop and Additive White Gaussian Noise (AWGN):

- **DVB-S (QPSK with Viterbi and Reed Solomon):** BER = 2×10^{-4} after Viterbi (before Reed Solomon) and QEF after Reed Solomon at the specified Eb/No and includes a modem implementation loss of 0.8 dB and the noise bandwidth increase due to the outer code ($10_{\log} 188/204 = 0,36$ dB).
- **DVB-S2 standard: "Quasi Error Free" (QEF)** is defined as "less than one uncorrected error-event per transmission hour at the level of a 5 Mbits/s single TV service decoder", approximately corresponding to a Transport Stream Packet Error Ratio equal to a PER 10^{-7} before demultiplexer. A packet is defined as block of 188-byte MPEG frame size data.
- **Es/No vs. Eb/No:** The DVB-S2 standard commonly refers to the use of Es/No instead of Eb/No. When links operate at a constant symbol rate this is a good method for comparing the performance of different modulation types and code rates.

The relation between the two quantities is given by:

$$E_b/N_o = E_s/N_o - 10_{\log}(\text{Spectral Efficiency})$$

- **Occupied Bandwidth:** Occupied bandwidth is defined as the bandwidth between -10 dB points of the power spectral density, which are approximately:

$$\begin{aligned} \text{Occupied Bandwidth} &= 1.19 \times \text{Symbol Rate, for 35\% Rolloff} \\ &= 1.15 \times \text{Symbol Rate, for 25\% Rolloff} \\ &= 1.12 \times \text{Symbol Rate, for 20\% Rolloff} \end{aligned}$$

* Taken at the -10 dB points on the plot of power spectral density, the occupied bandwidth is 1.19 x Symbol Rate for 35%, and 1.15 x Symbol Rate for 25%.

Figure H-1 through **Figure H-4** illustrate the guaranteed error performance characteristics of the CDM-750 while running with Normal frames (64,800 bits), Pilots ON. QPSK 1/4, 1/3, 2/5 are shown for information only and are not available in the CDM-750.

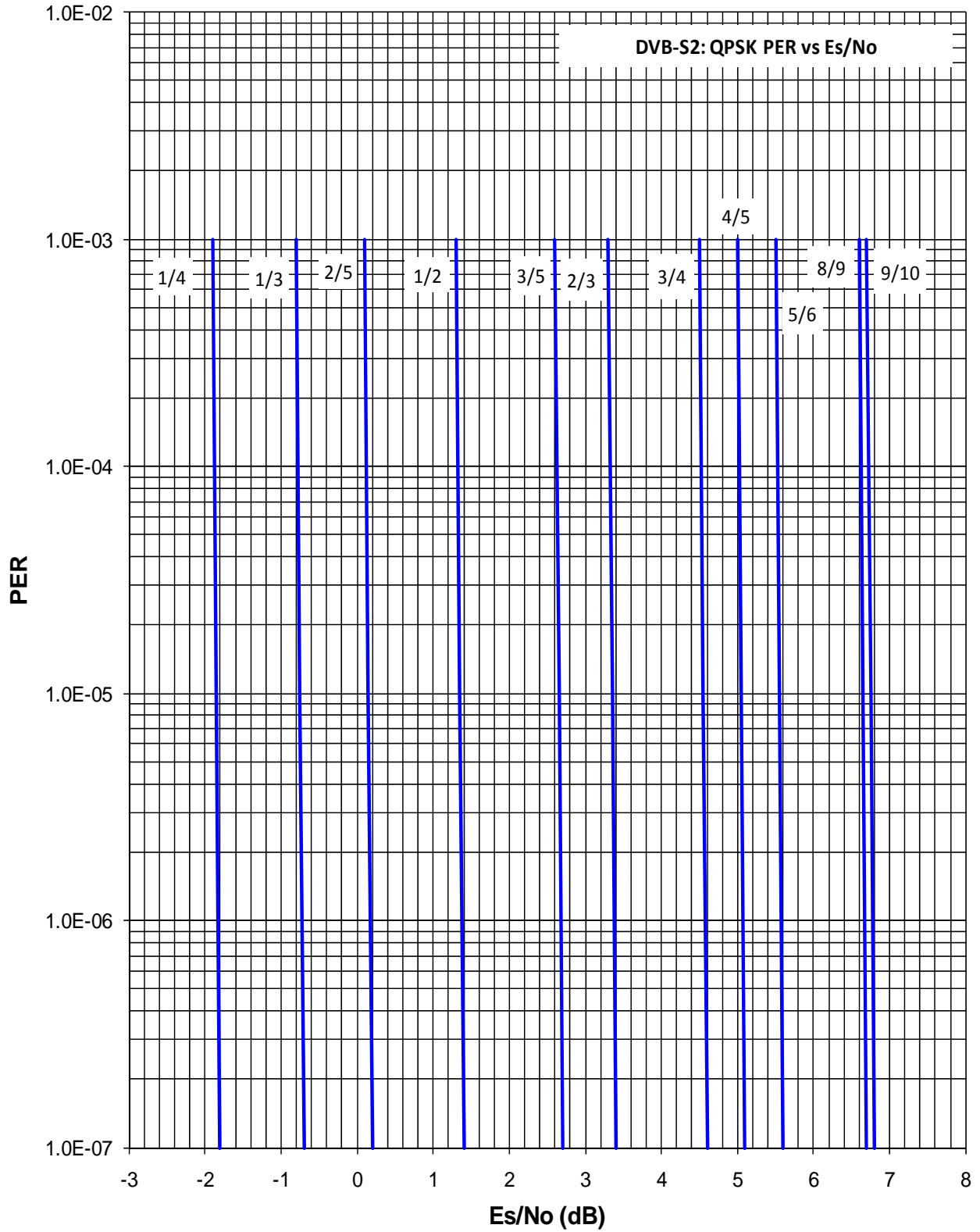


Figure H-1. DVB-S2 QPSK Packet Error Rate versus Es/No
(QPSK 1/4, 1/3, and 2/5 provided for information only)

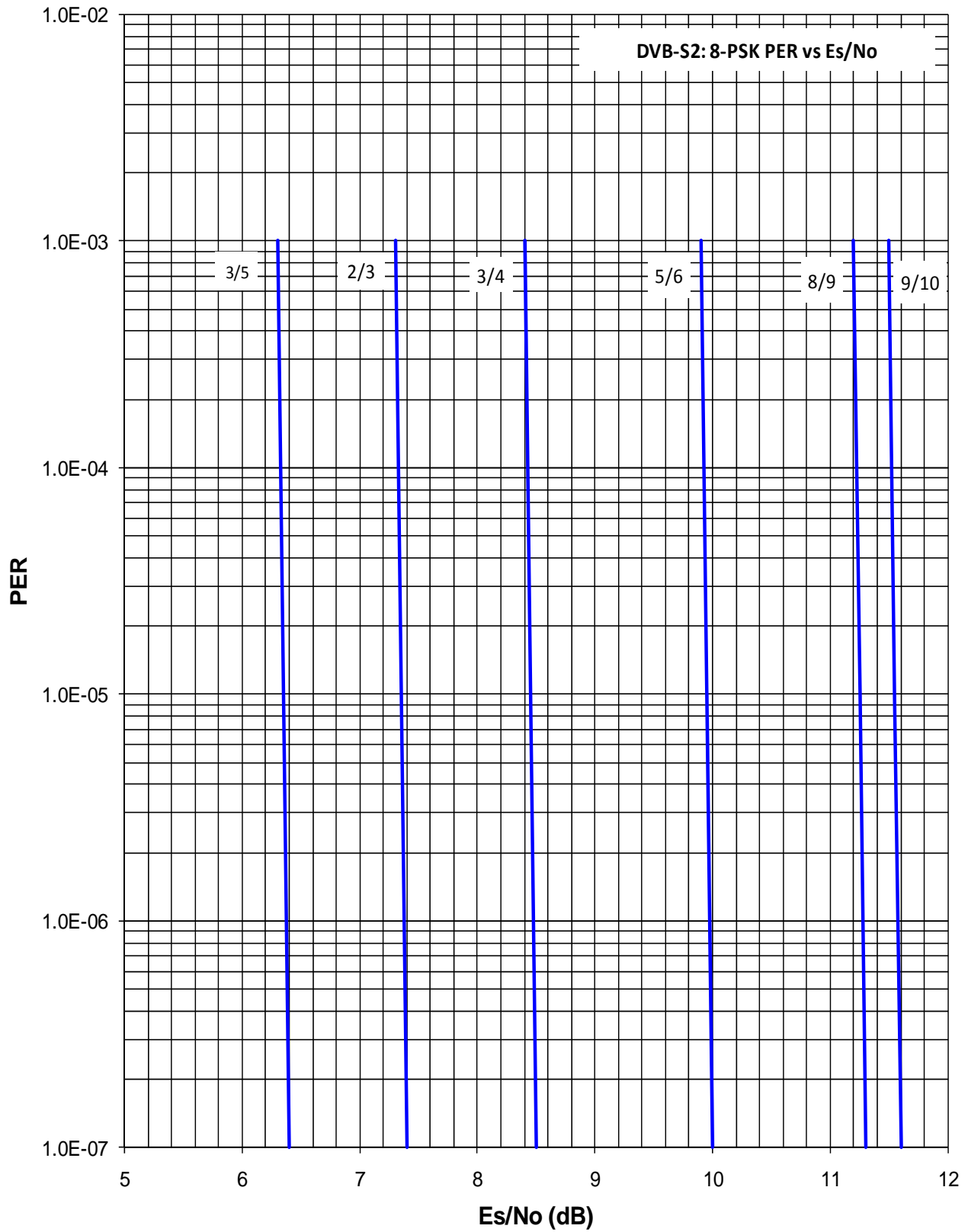


Figure H-2. DVB-S2 8PSK Packet Error Rate versus Es/No

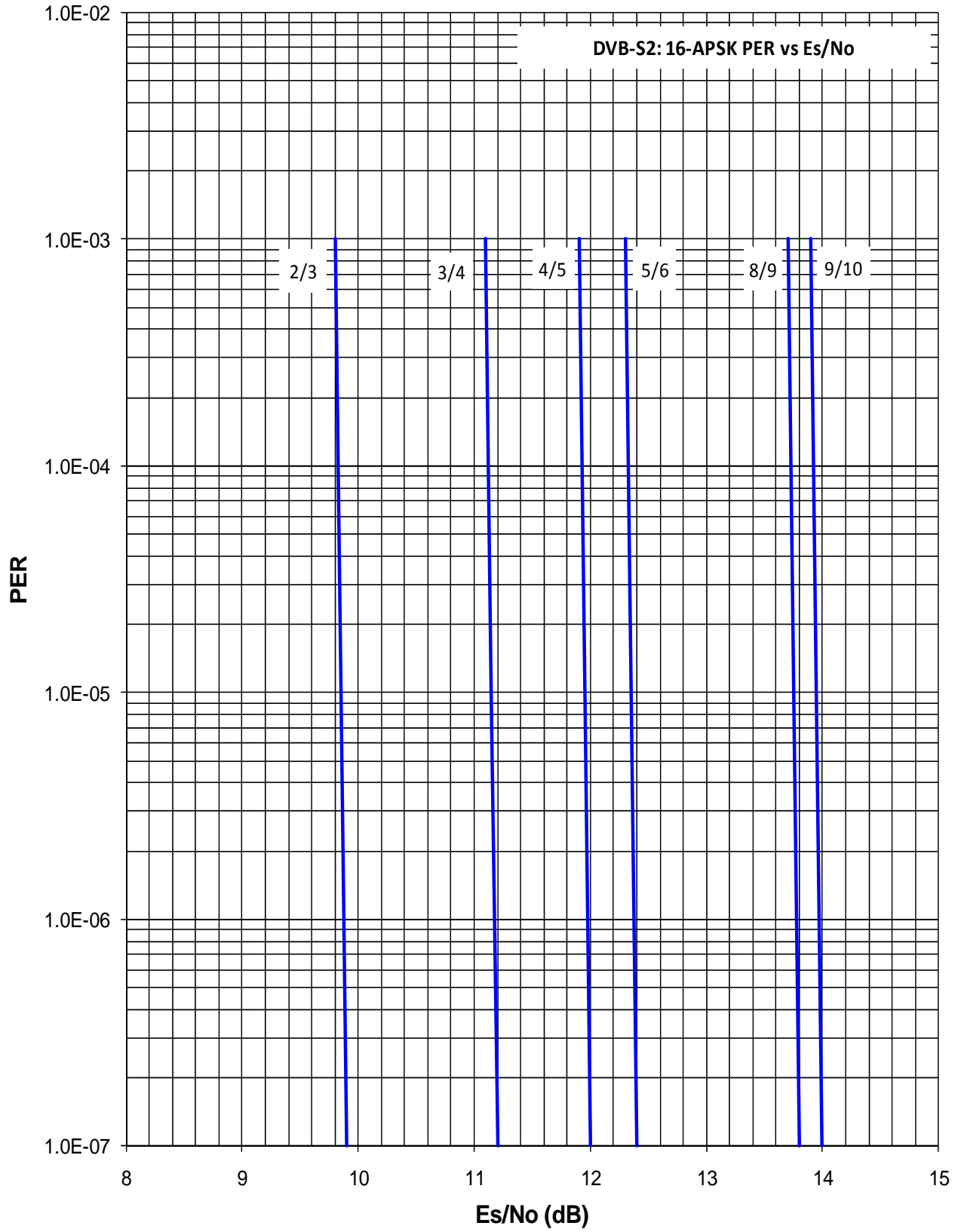


Figure H-3. DVB-S2 16APSK Packet Error Rate versus Es/No

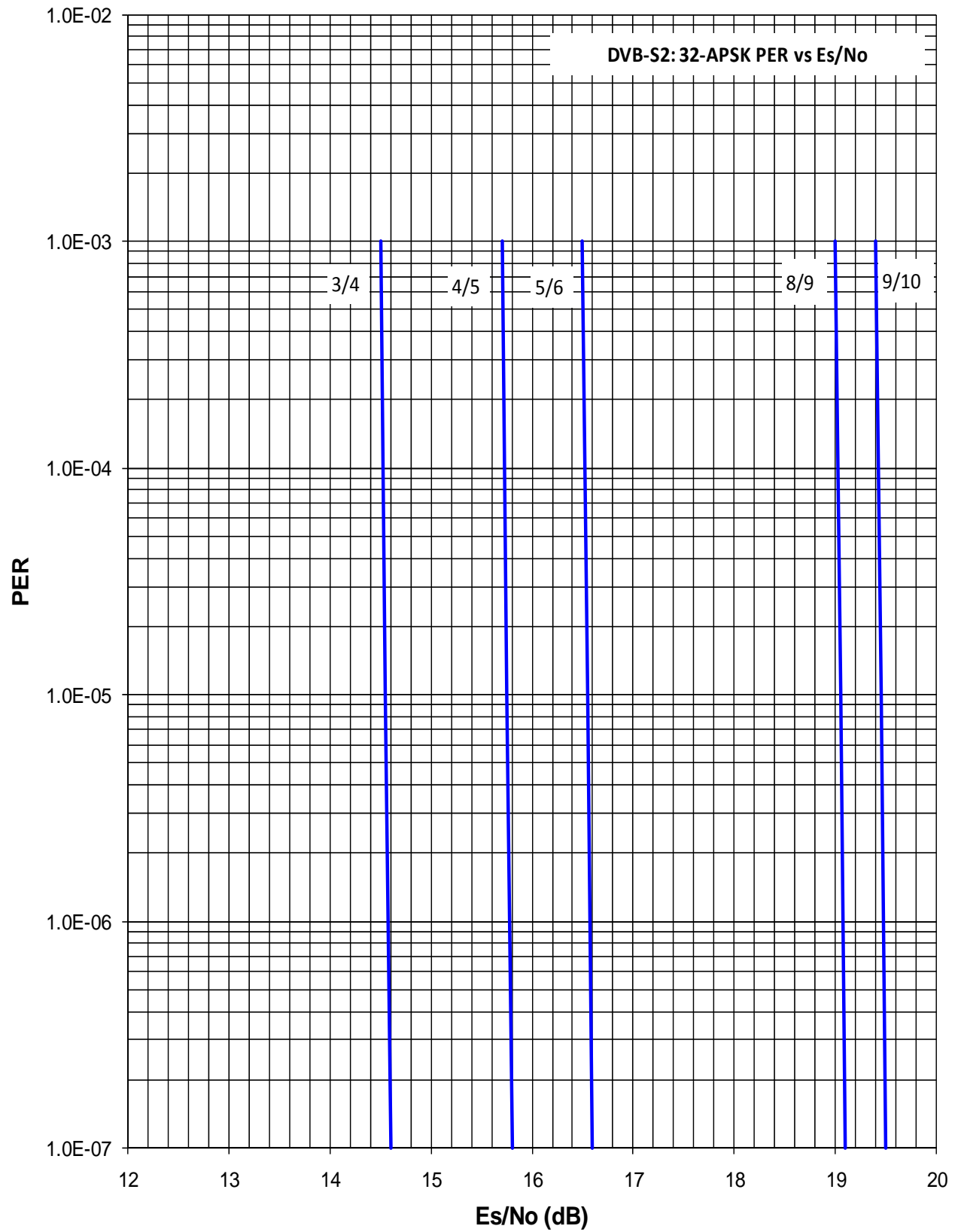


Figure H-4. DVB-S2 32APSK Packet Error Rate versus Es/No

METRIC CONVERSIONS

Units of Length

Unit	Millimeter	Centimeter	Inch	Foot	Yard	Meter	Kilometer	Mile
1 millimeter	1	0.1	0.0394	0.0033	0.0011	0.001	1×10^{-6}	6.214×10^{-7}
1 centimeter	10	1	0.3937	0.0328	0.0109	0.01	1×10^{-5}	6.214×10^{-6}
1 inch	25.4	2.54	1	0.0833	0.0278	0.0254	2.54×10^{-5}	1.578×10^{-5}
1 foot	304.8	30.48	12	1	0.3333	0.3048	3.048×10^{-4}	1.894×10^{-4}
1 yard	914.4	91.44	36	3	1	0.9144	9.144×10^{-4}	5.682×10^{-4}
1 meter	1000	100	39.37	3.2808	1.0936	1	0.001	6.214×10^{-4}
1 kilometer	1×10^6	1×10^5	3.938×10^4	3.281	1093	1000	1	0.6214
1 mile	1.609×10^6	1.609×10^5	6.336×10^4	5280	1760	1609	1.609	1

Temperature Conversions

Temperature	° Fahrenheit	° Centigrade
Water freezes	32	0
Water boils	212	100
Absolute zero	-459.69	-273.16

Formulas
$^{\circ}\text{C} = (\text{F} - 32) \times 0.555$
$^{\circ}\text{F} = (\text{C} \times 1.8) + 32$

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoirdupois	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoird.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoird.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^3	35.27	32.15	2.205	2.679	—



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