



# CLO-10

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Link Optimizer  
Installation and Operation Manual  
For Firmware Version 1.2.1 or higher  
(see *New in this Release* - Section 1.7)

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



Part Number MN/CLO-10.IOM  
Revision 1

**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.





# Errata A

## *Comtech EF Data Documentation Update*

**Subject:** Changes to Appendix A. REDUNDANT SYSTEM OPERATION  
**Date:** June 26, 2008  
**Original Manual :** MN/CLO-10.IOM  
**Part Number/Rev:** Rev 1  
**Agile Document ID:** ER-MN-CLO-10\_EA1      **Agile CO Number:** CO4012

### **Change Specifics:**

This information will be incorporated into the next revision.

Update Figures A-8 and A-9 in Appendix A. REDUNDANT SYSTEM OPERATION per redlines attached on following pages.

**Action:** Replace pages A-9 through A-12 in manual with pages A-9 through A-12 provided in this Errata to facilitate update.

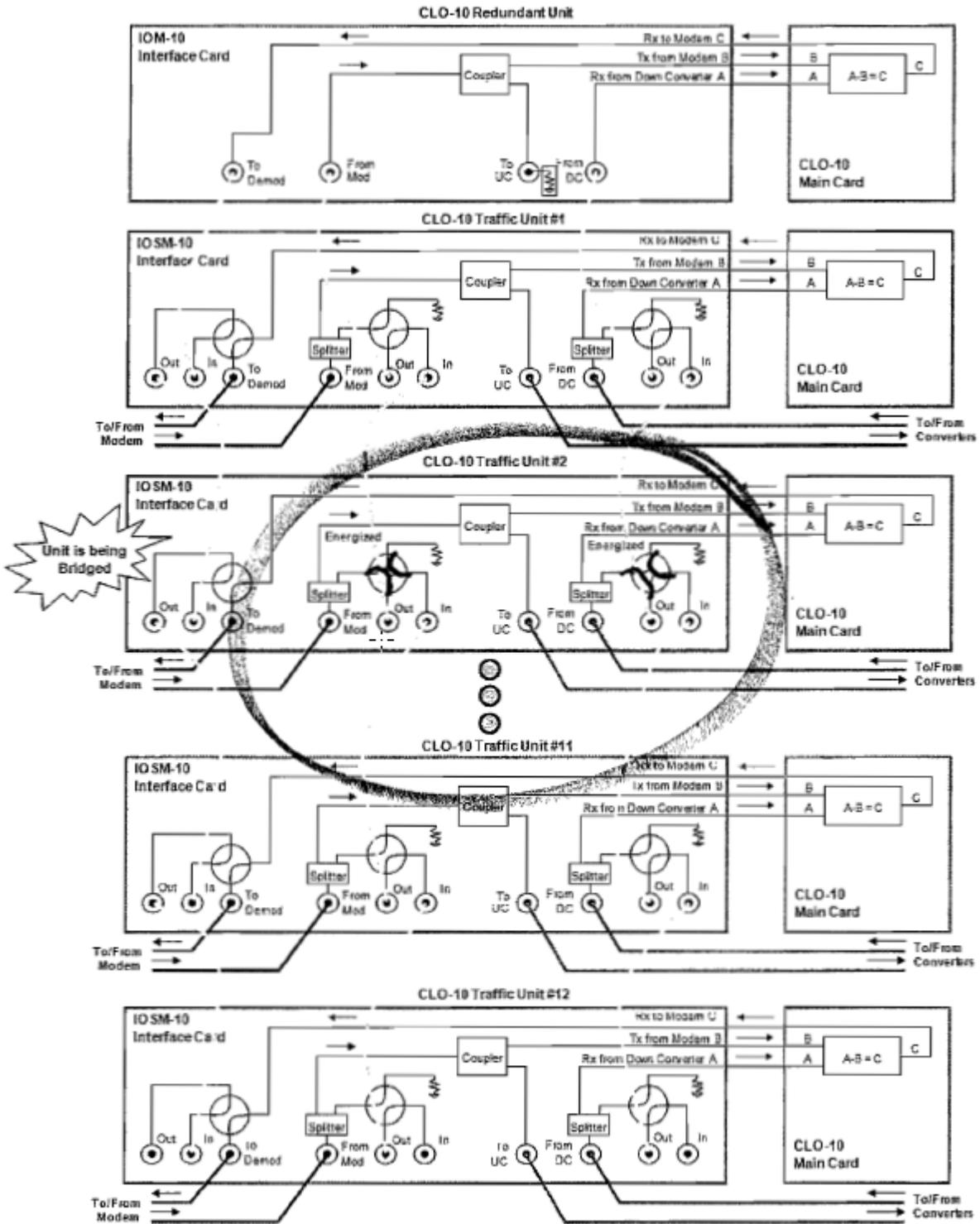
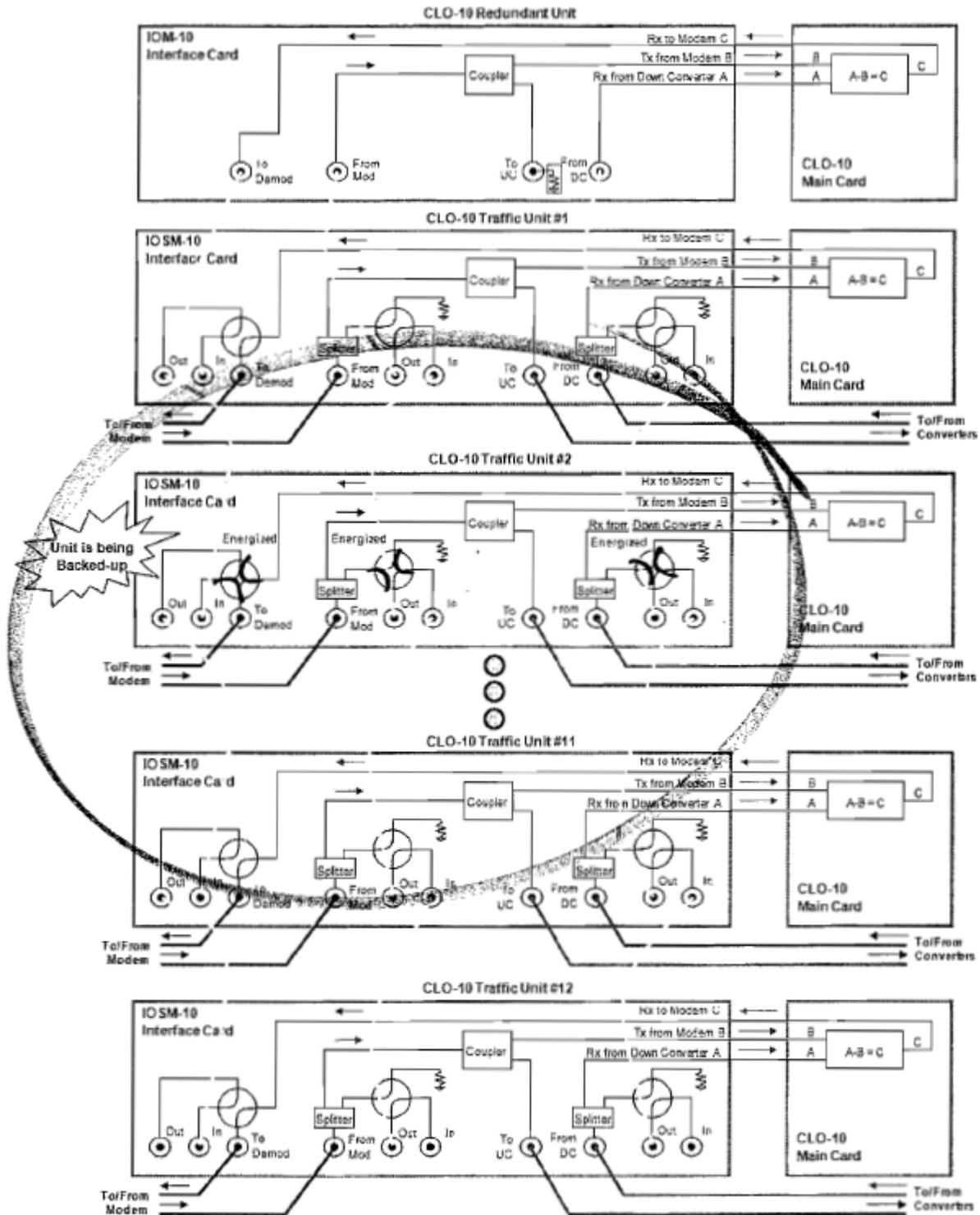


Figure A-8. CLO-10 Daisy Chain Redundancy – Bridge Mode



**Figure A-9. CLO-10 Daisy Chain Configuration – Backup Mode**



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**Figure A-8** shows the functional block diagram of Bridge Mode. In this example, Traffic Unit #2 is being bridged and, as the figure shows, the only energized “baseball” switches are on Traffic Unit #2.

#### A.4.2 Backup Mode Operation

Backup Mode is similar to Bridge Mode, with an added function: In Backup Mode, the Redundant Unit completely replaces the Traffic Unit. More specifically, the Redundant Unit will now be online, and the failed Traffic Unit will go offline. The output IF signal directed to the demodulator is subsequently taken from the Redundant Unit.

**Figure A-9** shows the functional block diagram of Backup Mode. In this example, Traffic Unit #2 is being backed up and, as the figure shows, all of the “baseball” switches are energized on the IOSM on Traffic Unit #2.

Backup Mode can be done manually or automatically. In automatic mode, the Redundant Unit will monitor all of the Traffic Units continuously. When a fault is detected on any of these active Traffic Units, the Redundant Unit will first bridge the faulted unit, then back it up. When a faulted Traffic Unit needs to be replaced, its IOSM can be separated from the Traffic Unit chassis, leaving the active online Redundant Unit HSB Daisy Chain intact through the IOSM switch module. The chain can be extended without affecting the online unit’s operation.

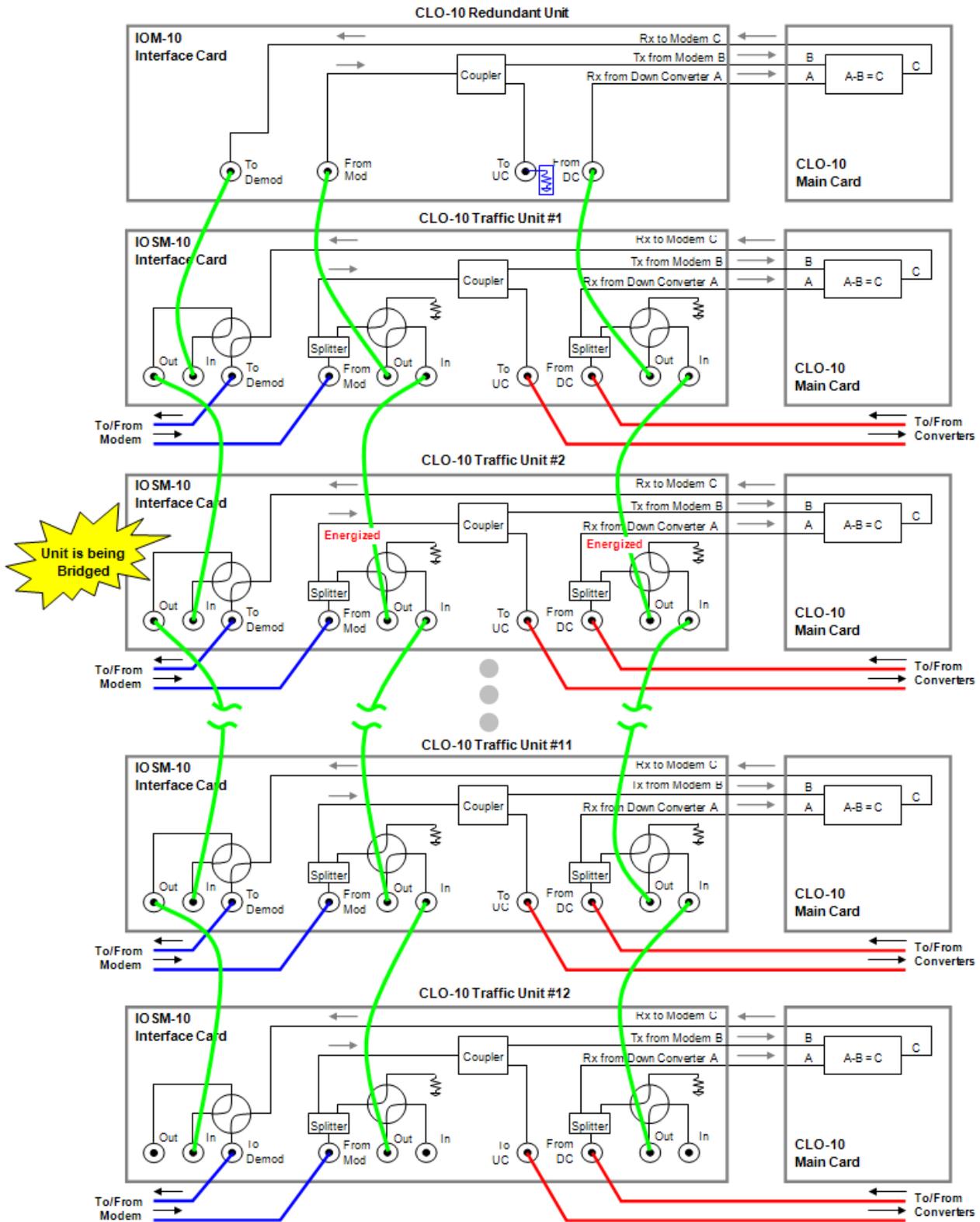


Figure A-8. CLO-10 Daisy Chain Redundancy – Bridge Mode

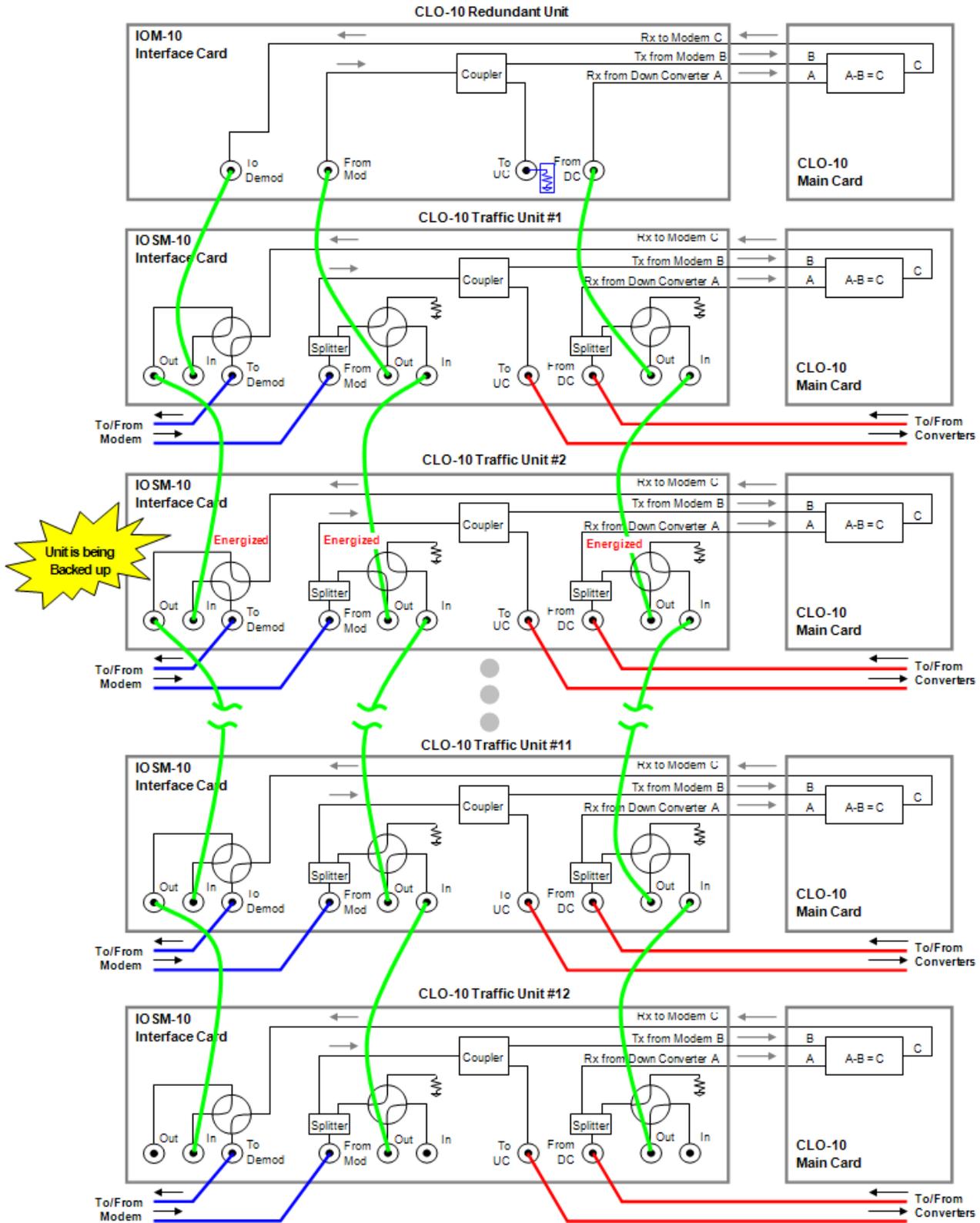


Figure A-9. CLO-10 Daisy Chain Configuration – Backup Mode

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## A.5 Cables and Connections

Once the CLO-10s and the accompanying equipment have been mounted, the user must properly attach all required cabling. Referring to **Figure A-10** and **Figure A-11**, interconnection between all equipment in the Daisy Chain Redundancy System is accomplished as follows:

- Connect Redundancy and Traffic Unit(s) using the High Speed Bus Cable, fabricated and supplied by CEFD. This cable connects to the DB-25F J2 Redundancy connector on each unit, and consists of as few as (2X) DB-25M connectors (for the CEFD P/N **CA/RB0014-1-U2** 1:1 Cable, shown in **Figure A-10**) to as many as (13X) connectors (for the CEFD P/N **CA/RB0014-12-U2** 1:12 Cable, shown in **Figure A-11**). *There will be only as many DB-25M connectors as is required for the specific 1:N Redundancy system.*



IMPORTANT

***The unit's assignment number must match that of the numbered DB-25 connector on the High Speed Bus cable (CEFD P/N CA/RB0014-XX-U2).***

- Using CEFD-supplied BNC patch cable **CA/BNC75OHM**, first connect the inputs and outputs between the Redundant Unit and Traffic Unit #1; then, connect the inputs and outputs between each Traffic Unit subsequent in the redundancy chain.
- For the interfaces between the CLO-10, modem, and the up and down converters, use standard off-the-shelf 75Ω BNC male-to-BNC male patch cables, supplied by the user.

As an alternative to using off-the-shelf patch cables, the user may purchase IF Cable **PL/0813-4** (75Ω BNC male-to-BNC male, 4') from Comtech EF Data; this cable can be ordered at the same time the order is placed for the CLO-10 Daisy Chain Redundancy System.

### A.5.1 75Ω Load in Redundant Unit

As shown in **Figure A-10** and **Figure A-11**, a 75Ω load (CEFD P/N **CN/CXLBNCTM01**) must be installed in the J5 ("To U/C") port on the Redundant Unit's IOM. This load is needed to terminate the splitter on the IOM.



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Part Number MN/CLO-10.IOM  
Revision 1  
June 18, 2008

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# Table of Contents

<b>TABLE OF CONTENTS</b> .....	<b>III</b>
<b>TABLES</b> .....	<b>VIII</b>
<b>FIGURES</b> .....	<b>IX</b>
<b>PREFACE</b> .....	<b>XI</b>
<b>Customer Support</b> .....	<b>xi</b>
<b>About this Manual</b> .....	<b>xii</b>
Reporting Comments or Suggestions Concerning this Manual.....	xii
<b>Conventions and References</b> .....	<b>xii</b>
Cautions and Warnings .....	xii
Metric Conversion .....	xii
Recommended Standard Designations .....	xii
Trademarks .....	xiii
<b>Electromagnetic Compatibility (EMC) Compliance</b> .....	<b>xiii</b>
EN55022 - 1997 Compliance.....	xiii
EN50082-1 Compliance.....	xiii
Federal Communications Commission (FCC).....	xiii
<b>Safety Compliance</b> .....	<b>xiv</b>
EN 60950 .....	xiv
Low Voltage Directive (LVD).....	xiv
<b>Warranty Policy</b> .....	<b>xv</b>
Limitations of Warranty.....	xv
Exclusive Remedies .....	xvi
<b>CHAPTER 1. INTRODUCTION</b> .....	<b>1-1</b>
<b>1.1 Overview</b> .....	<b>1-1</b>
<b>1.2 Features</b> .....	<b>1-2</b>
1.2.1 DoubleTalk™ Carrier-in-Carrier® .....	1-2
1.2.2 Software – Flash Upgrading .....	1-2
1.2.3 Verification .....	1-2
1.2.4 Remote Control.....	1-3

<b>1.3</b>	<b>Description of CLO-10 Features.....</b>	<b>1-3</b>
1.3.1	Front Panel.....	1-3
1.3.2	Rear Panel.....	1-3
<b>1.4</b>	<b>Major Assemblies.....</b>	<b>1-3</b>
<b>1.5</b>	<b>FAST Options and Hardware Options .....</b>	<b>1-4</b>
1.5.1	FAST System.....	1-4
1.5.1.1	FAST Options.....	1-4
1.5.1.2	FAST Implementation .....	1-4
1.5.2	Hardware Options.....	1-5
<b>1.6</b>	<b>Functional Description .....</b>	<b>1-5</b>
1.6.1	What is DoubleTalk™Carrier-in-Carrier®?.....	1-5
1.6.2	Application Requirements .....	1-7
1.6.3	System Functionality .....	1-8
<b>1.7</b>	<b>New in this Release.....</b>	<b>1-9</b>
<b>1.8</b>	<b>Summary of Specifications.....</b>	<b>1-10</b>
1.8.1	System Specifications.....	1-10
1.8.2	Environmental and Physical Specifications.....	1-11
<b>1.9</b>	<b>Dimensional Envelope .....</b>	<b>1-12</b>
<b>CHAPTER 2. INSTALLATION.....</b>		<b>2-1</b>
<b>2.1</b>	<b>Unpacking and Inspection.....</b>	<b>2-1</b>
<b>2.2</b>	<b>Mounting.....</b>	<b>2-2</b>
2.2.1	Optional Rear-Mounting Support Brackets .....	2-2
<b>CHAPTER 3. REAR PANEL CONNECTORS .....</b>		<b>3-1</b>
<b>3.1</b>	<b>Connector Overview .....</b>	<b>3-1</b>
<b>3.2</b>	<b>External Reference Connector, J1 (BNC-F).....</b>	<b>3-2</b>
<b>3.3</b>	<b>Alarms Connector, P1A (DB-9F).....</b>	<b>3-2</b>
<b>3.4</b>	<b>Remote Control Interface Connector, P1B (DB-9M) .....</b>	<b>3-2</b>
<b>3.5</b>	<b>M&amp;C 10/100 BaseT Ethernet Management Port (RJ-45).....</b>	<b>3-3</b>
<b>3.6</b>	<b>IOM/IOSM Connectors (BNC-F).....</b>	<b>3-4</b>
<b>3.7</b>	<b>IEC Line Input (AC Power) Connector.....</b>	<b>3-5</b>

<b>3.8</b>	<b>DC Power Connector</b> .....	<b>3-5</b>
<b>3.9</b>	<b>Ground Connector</b> .....	<b>3-6</b>
<b>CHAPTER 4. CABLES AND CONNECTIONS</b> .....		<b>4-1</b>
<b>4.1</b>	<b>Overview</b> .....	<b>4-1</b>
<b>4.2</b>	<b>External Cable Connections</b> .....	<b>4-1</b>
<b>4.3</b>	<b>Redundancy Cable Connections</b> .....	<b>4-1</b>
<b>CHAPTER 5. MODEM AND OPTIMIZER CONFIGURATION</b> .....		<b>5-1</b>
<b>5.1</b>	<b>Modem Configuration</b> .....	<b>5-1</b>
5.1.1	Verify Link without Carrier-in-Carrier® .....	5-1
<b>5.2</b>	<b>CLO-10 Configuration</b> .....	<b>5-1</b>
5.2.1	CLO-10 Power .....	5-1
5.2.2	Flash Updating.....	5-2
5.2.2.1	Flash Update Help.....	5-2
5.2.3	CLO-10 FTP Upload Procedure .....	5-3
5.2.4	CLO-10 Tuning.....	5-5
5.2.4.1	Initial Link Access Procedures .....	5-5
5.2.4.2	Link Access Setup.....	5-6
<b>5.3</b>	<b>Other Useful Information</b> .....	<b>5-6</b>
<b>CHAPTER 6. FRONT PANEL OPERATION</b> .....		<b>6-1</b>
<b>6.1</b>	<b>Introduction</b> .....	<b>6-1</b>
6.1.1	LED Indicators.....	6-2
6.1.2	Keypad .....	6-3
6.1.3	Vacuum Fluorescent Display (VFD) .....	6-4
<b>6.2</b>	<b>CLO-10 Menu Structure</b> .....	<b>6-5</b>
<b>6.3</b>	<b>Main (Top-level Select) Menu</b> .....	<b>6-6</b>
<b>6.4</b>	<b>CONFIG (Configuration)</b> .....	<b>6-7</b>
6.4.1	CONFIG: Remote .....	6-8
	CONFIG: Remote → Serial.....	6-8
	CONFIG: Remote → Serial → Interface.....	6-8
	CONFIG: Remote → Serial → Interface → RS485-2W or RS485-4W .....	6-8
	CONFIG: Remote → Serial → Baudrate .....	6-9
	CONFIG: Remote → Ethernet.....	6-9

	CONFIG: Remote → Ethernet → Gateway .....	6-9
	CONFIG: Remote → Ethernet → Address.....	6-9
	CONFIG: Remote → Ethernet → MAC.....	6-9
6.4.2	CONFIG: BW (Bandwidth).....	6-10
6.4.3	CONFIG: Uplink (Uplink Frequency).....	6-10
6.4.4	CONFIG: Downlink (Downlink Frequency).....	6-10
6.4.5	CONFIG: Remod (Remodulation Parameters).....	6-11
	CONFIG: Remod → Frequency .....	6-11
	CONFIG: Remod → On/Off .....	6-11
	CONFIG: Remod → Attenuation .....	6-11
6.4.6	CONFIG: CnC (Carrier-in-Carrier <sup>®</sup> Parameters) .....	6-12
	CONFIG: CnC → SearchDelay.....	6-12
	CONFIG: CnC → FrequencyOffset .....	6-12
6.4.7	CONFIG: Misc: (Miscellaneous Configurations).....	6-12
	CONFIG: Misc: → Mask.....	6-12
	CONFIG: Misc: → Alarm Mask: → Unit .....	6-13
	CONFIG: Misc: → Alarm Mask: → Unit Alarm Mask: → ERC .....	6-13
	CONFIG: Misc: → Alarm Mask: → Unit Alarm Mask: → ACQ_FAIL.....	6-13
	CONFIG: Misc: → Alarm Mask: → Uplink .....	6-13
	CONFIG: Misc: → Alarm Mask: → Downlink .....	6-13
	CONFIG: Misc: → Reference (Reference Oscillator).....	6-14
	CONFIG: Misc: → Redundancy .....	6-14
<b>6.5</b>	<b>Monitor .....</b>	<b>6-15</b>
6.5.1	Monitor: Alarms (Live Alarms).....	6-15
	Monitor: Alarms → (Live Alarms:) Unit (Unit Alarms).....	6-15
	Monitor: Alarms → (Live Alarms:) Uplink (Uplink Alarms).....	6-16
	Monitor: Alarms →( Live Alarms:) Downlink (Downlink Alarms) .....	6-16
	Monitor: Alarms →( Live Alarms:) Remod (Remod Alarms) .....	6-17
6.5.2	Monitor: Event Log (Stored Events).....	6-17
6.5.3	Monitor: CnC (Carrier-in-Carrier <sup>®</sup> ).....	6-18
6.5.4	Monitor: Temp.....	6-18
6.5.5	Monitor: RSL (Receive Signal Level) .....	6-18
<b>6.6</b>	<b>TEST .....</b>	<b>6-19</b>
<b>6.7</b>	<b>INFO (Information).....</b>	<b>6-20</b>
	INFO: Remote (Remote Control Information) .....	6-20
	INFO: Bw (Bandwidth Information) .....	6-20
	INFO: Uplink (Uplink Information).....	6-20
	INFO: Downlink (Downlink Information) .....	6-21
	INFO: Remod (Remodulation Information).....	6-21
	INFO: CnC (Carrier-in-Carrier <sup>®</sup> Information) .....	6-21
	INFO: Ref (Frequency Reference).....	6-21

<b>6.8</b>	<b>SAVE/LOAD .....</b>	<b>6-22</b>
	Save/Load: Save (Save Configuration).....	6-22
	Save/Load: Load (Load Configuration).....	6-23
<b>6.9</b>	<b>UTILITY.....</b>	<b>6-24</b>
	Utility: Clock (Real-time Clock) .....	6-24
	Utility: Ref (Reference Adjustment).....	6-24
	Utility: ID (Circuit Identification) .....	6-25
	Utility: Display (Display Brightness) .....	6-25
	Utility: Firmware .....	6-25
	Utility: FAST (FAST Code Options).....	6-27
<b>APPENDIX A. REDUNDANT SYSTEM OPERATION .....</b>		<b>A-1</b>
<b>A.1</b>	<b>Introduction.....</b>	<b>A-1</b>
	A.1.1 Overview.....	A-1
	A.1.2 Redundancy System Operational Rules.....	A-3
<b>A.2</b>	<b>Installation.....</b>	<b>A-4</b>
<b>A.3</b>	<b>Description of Modules.....</b>	<b>A-5</b>
	A.3.1.1 Overview: CLO-10 with Input/Output Module (IOM).....	A-5
	A.3.1.2 Overview: CLO-10 With Input/Output Switch Module (IOSM) .....	A-6
	A.3.2 Connector Pinouts.....	A-6
	A.3.2.1 IOM / IOSM Redundancy Connector, J2 (DB-25F).....	A-6
	A.3.2.2 IOM / IOSM BNC Connectors .....	A-7
<b>A.4</b>	<b>Description of Operation.....</b>	<b>A-8</b>
	A.4.1 Bridge Mode Operation .....	A-8
	A.4.2 Backup Mode Operation .....	A-9
<b>A.5</b>	<b>Cables and Connections .....</b>	<b>A-12</b>
	A.5.1 75Ω Load in Redundant Unit.....	A-12
	A.5.2 1:1 Redundancy Configuration Cabling .....	A-13
	A.5.3 1:N Redundancy Configuration Cabling .....	A-14
	A.5.4 Adding and Removing CLO-10s and/or Modules .....	A-15
<b>A.6</b>	<b>Front Panel Operation.....</b>	<b>A-17</b>
	A.6.1 Redundancy Menu Access.....	A-17
	A.6.2 Traffic Unit Redundancy Configuration.....	A-18
	A.6.3 Redundant Unit Redundancy Configuration.....	A-18
	A.6.3.1 Redundancy Enable /Disable .....	A-19
	A.6.3.2 Redundancy Holdoffs .....	A-19
	A.6.3.3 Active Unit Selection.....	A-19
	A.6.3.4 Establish the Operating Mode.....	A-20
	A.6.3.4.1 Switch Auto Off/On .....	A-20
	A.6.3.4.2 Redundancy Unit – Manual Select.....	A-20

A.6.3.5	Set the Redundant Unit Address via the Main Menu .....	A-22
A.6.4	Set Operation Mode .....	A-24
A.6.4.1.1	Set Holdoff Period.....	A-24
A.6.4.1.2	Set Backup Holdoff Period.....	A-24
A.6.4.1.3	Set Restore Holdoff Period.....	A-25
<b>A.7</b>	<b>Daisy Chain Remote Addressing .....</b>	<b>A-26</b>
A.7.1	Introduction to Addressing .....	A-26
A.7.2	Switching Addresses.....	A-26
A.7.3	Traffic Unit Addresses.....	A-26
<b>APPENDIX B.</b>	<b>REMOTE CONTROL .....</b>	<b>B-1</b>
<b>B.1</b>	<b>Overview .....</b>	<b>B-1</b>
<b>B.2</b>	<b>RS-485 .....</b>	<b>B-1</b>
<b>B.3</b>	<b>RS-232 .....</b>	<b>B-2</b>
<b>B.4</b>	<b>Basic Protocol .....</b>	<b>B-2</b>
<b>B.5</b>	<b>Packet Structure.....</b>	<b>B-2</b>
B.5.1	Start of Packet.....	B-3
B.5.2	Address .....	B-3
B.5.3	Instruction Code.....	B-3
B.5.4	Instruction Code Qualifier .....	B-4
B.5.5	Message Arguments.....	B-5
B.5.6	End Of Packet .....	B-5
<b>B.6</b>	<b>Remote Commands and Queries .....</b>	<b>B-6</b>
B.6.1	Switch Remote Commands and Queries for the CLO-10 Link Optimizer.....	B-7
B.6.2	Remote Commands and Queries For the CLO-10 Link Optimizer .....	B-9
B.6.3	Commands and Queries .....	B-15
B.6.4	Bulk Commands and Queries .....	B-19

## Tables

Table 3-1.	External Connections.....	3-1
Table 3-2.	Alarm Interface Connector Pin Assignments .....	3-2
Table 3-3.	Remote Control Interface Connector Pin Assignments.....	3-2
Table 3-4.	M&C Interface Connector Pin Assignments.....	3-3
Table 3-5.	CLO-10 IOM BNC Connectors Reference .....	3-4
Table A-1.	IOM (CEFD P/N PL/12833-1) BNC Connectors Reference.....	A-7
Table A-2.	IOSM (CEFD P/N PL/12834-1) BNC Connectors Reference .....	A-7

## Figures

Figure 1-1. CLO-10 Link Optimizer.....	1-1
Figure 1-2. CLO-10 Front Panel.....	1-3
Figure 1-3. CLO-10 Rear Panel (CLO-10-1 shown) .....	1-3
Figure 1-4. Conventional FDMA Link.....	1-6
Figure 1-5. Link with Carrier-in-Carrier®.....	1-6
Figure 1-6. Conceptual Block Diagram.....	1-8
Figure 1-7. CLO-10 Dimensional Envelope.....	1-12
Figure 2-1. Typical CLO-10 Rack Installation (Side View).....	2-3
Figure 2-2. Installation of the Optional Rear-Mounting Support Brackets .....	2-4
Figure 3-1. CLO-10 Rear Panel (CLO-10-1 Shown).....	3-1
Figure 4-1. CLO-10 External Cable Connections – Standalone Configuration .....	4-2
Figure 5-1. Flash Update via Internet .....	5-2
Figure 6-1. CLO-10 Front Panel.....	6-1
Figure 6-2. CLO-10 Menu Tree.....	6-5
Figure A-1. CLO-10 1:1 Daisy Chain Redundancy.....	A-2
Figure A-2. CLO-10 1:N Daisy Chain Redundancy (1:12 shown) .....	A-2
Figure A-3. Typical Rack-mounted Redundancy Configuration.....	A-4
Figure A-4. IOM (CEFD P/N PL/12833-1).....	A-5
Figure A-5. CLO-10 With IOM – Block Diagram .....	A-5
Figure A-6. IOSM (CEFD P/N PL/12834-1).....	A-6
Figure A-7. CLO-10 With IOSM – Block Diagram .....	A-6
Figure A-8. CLO-10 Daisy Chain Redundancy – Bridge Mode .....	A-10
Figure A-9. CLO-10 Daisy Chain Configuration – Backup Mode.....	A-11
Figure A-10. CLO-10 1:1 Daisy Chain Redundancy Cabling.....	A-13
Figure A-11. CLO-10 1:N Daisy Chain Redundancy Cabling (1:12 shown).....	A-14
Figure A-15. Module Removal/Installation.....	A-15
Figure A-16. Operating Configuration .....	A-16
Figure A-12. Redundancy Menu Tree .....	A-17
Figure A-13. Unit Bridging in AUTO-OFF ( <i>manual operating</i> ) Mode .....	A-21
Figure A-14. Unit Backup in AUTO-ON ( <i>automatic operating</i> ) Mode.....	A-21
Figure A-17. CLO-10 Daisy Chain Addressing Scheme Example: User Remote M&C RS-232 ....	A-27
Figure A-18. CLO-10 Daisy Chain Addressing Scheme Example: User Remote M&C RS-485 ....	A-27
Figure A-19. CLO-10 Base Addressing Scheme Example for Daisy Chained Multiple Redundant Systems: User Remote M&C RS-485.....	A-28

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# Preface

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## Customer Support

### Contact the Comtech EF Data Customer Support Department for:

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

### A Customer Support representative may be reached at:

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

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

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

### For Online Customer Support:

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

- **Click “Return Material Authorization Instructions”** from the **Service** page for detailed information on our return procedures.
- **Click** the “**RMA Request** form” hyperlink, then fill out the form completely before sending.
- **Send e-mail** to the Customer Support Department at [service@comtechefdata.com](mailto:service@comtechefdata.com).

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

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## About this Manual

This manual provides installation and operation information for the Comtech EF Data CLO-10 Link Optimizer. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CLO-10.

Comtech EF Data reserves the right to change specifications of products described in this document at any time without notice and without obligation to notify any person of such changes. Information in this document may differ from information published in other Comtech EF Data documents. Refer to the company website or contact Customer Service for the latest released product information.

## Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual are appreciated. To submit comments, please contact the Comtech EF Data Technical Publications department: [TechnicalPublications@comtechefdata.com](mailto:TechnicalPublications@comtechefdata.com)

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## Conventions and References

### Cautions and Warnings



**IMPORTANT** or **NOTE** indicates a statement that is associated with the task being performed or information critical for proper equipment function.



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



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

### Metric Conversion

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

### Recommended Standard Designations

Recommended Standard (RS) Designations are interchangeable with the designation of the Electronic Industries Association (EIA).

## Trademarks

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

---

## Electromagnetic Compatibility (EMC) Compliance

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

### EN55022 - 1997 Compliance

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

### EN50082-1 Compliance

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

## Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.



***To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.***

## Safety Compliance

### EN 60950

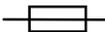
Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950. This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

### Low Voltage Directive (LVD)

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

<b>&lt;HAR&gt;</b>	Type of power cord required for use in the European Community.
	<b>CAUTION:</b> Double-pole/Neutral Fusing <b>ACHTUNG:</b> Zweipolige bzw. Neutralleiter-Sicherung

International Symbols:

Symbol	Definition
	Alternating Current
	Fuse

Symbol	Definition
	Protective Earth / Safety Ground
	Chassis Ground



***For additional symbols, refer to Cautions and Warnings listed earlier in this Preface. Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.***

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## Warranty Policy

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

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

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

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

## Limitations of Warranty

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

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

The warranty does not cover damage or loss incurred in transportation of the product.

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

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

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

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

## **Exclusive Remedies**

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

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

# Chapter 1. INTRODUCTION

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## 1.1 Overview

The CLO-10 is Comtech EF Data's Link Optimizer incorporating DoubleTalk™ Carrier-in-Carrier® technology. The CLO-10 allows transmit (Tx) and receive (Rx) carriers in a full-duplex link to use the same transponder segment via advanced signal processing techniques. The result is a reduction in bandwidth required for the duplex link by as much as 50%.

The CLO-10 operates on the 70/140 MHz IF band, which facilitates retrofitting into existing systems. The unit is installed in the IF path between the modem and the up/down converters. The CLO-10 does not require prior knowledge of the signals to be processed (i.e., modulation type, FEC, etc) other than the bandwidth and center frequency of the desired signal.

**Figure 1-1** shows the CLO-10 Link Optimizer. The Link Optimizer can be configured for two versions – the standard CLO-10-1 (shown), and the CLO-10-2, which features the optional redundancy hardware upgrade.



**Figure 1-1. CLO-10 Link Optimizer**

For the purpose of brevity, the Link Optimizer is referred to throughout this manual as the CLO-10. With the exception of redundancy operations, all content in this manual is applicable to both the CLO-10-1 and CLO-10-2 models; the CLO-10-2's added functionality is explained in detail in **Appendix A. REDUNDANT SYSTEM OPERATION.**

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## 1.2 Features

The CLO-10 includes the following features:

- DoubleTalk™ Carrier-in-Carrier® allowing Tx and Rx carriers of a full-duplex link to use the same transponder segment
- 50- 90 and 100-180 MHz frequency range
- Signal Bandwidth up to 10MHz (bandwidth typically refers to usable bandwidth of signal of interest)
- 10/100 BaseT Ethernet (Telnet), RS-232 or RS-485 for M&C remote control
- Fully Accessible System Topology (FAST)
- Optional User-configurable Redundancy — 1:1 up to 1:12 (CLO-10-2 unit only)
- *Future / planned upgrade:* HTTP, SNMP Remote Management

### 1.2.1 DoubleTalk™ Carrier-in-Carrier®

Designed for bandwidth compression, DoubleTalk™ Carrier-in-Carrier® (CnC) uses a patented technology that allows full duplex satellite links to transmit concurrently in the same segment of transponder bandwidth.

CnC is complementary to all advances in modem technology, including advanced FEC and modulations techniques. As these technologies approach theoretical limits of power and bandwidth efficiencies, CnC utilizes advanced signal processing techniques to achieve a new dimension in bandwidth efficiency.

CnC can be successfully deployed in bandwidth-limited as well as power-limited scenarios. Combining CnC with advanced FEC techniques such as Turbo Product Codes (TPC) or Low Density Parity Check Codes (LDPC) [also used by DVB-S2] can recover enough power that can then be traded for bandwidth.

Refer to **Chapter 1.6 Functional Description** for detailed information on DoubleTalk™ Carrier-in-Carrier®.

### 1.2.2 Software – Flash Upgrading

The internal software is both powerful and flexible, permitting storage and retrieval of up to 10 different unit configurations. The CLO-10 uses ‘flash memory’ technology internally, and new firmware can be uploaded to the unit from an external PC. This simplifies software upgrading, and updates can now be sent via the Internet, e-mail, or on disk. The upgrade can be performed without opening the unit by simply connecting the modem to the Ethernet port of a computer.

### 1.2.3 Verification

The CLO-10 includes test modes for rapid verification of the correct functioning of the unit. Test modes that exercises various signal paths within the CLO-10, as well as carrier test modes, allow an operator to quickly perform simple diagnostics without having to remove/connect cables from the unit.

## 1.2.4 Remote Control

The operator may configure and monitor the modem from the front panel, or through the remote M&C port. M&C is via RS-232, RS-485 (2/4 wire) or 10/100 BaseT Ethernet.

## 1.3 Description of CLO-10 Features

### 1.3.1 Front Panel

The CLO-10 is constructed as a 1RU-high, rack-mounting chassis that can be freestanding if desired. It is provided with rack handles at the front for easy removal from and placement into a rack.

**Figure 1-2** shows the CLO-10 front panel. The front panel features a Vacuum Fluorescent Display (VFD), six-button keypad, and eight LED indicators. The user enters data via the keypad, and messages are displayed on the VFD. The LEDs indicate, in a summary fashion, the status of the unit. See **Chapter 6. Front Panel Operation** for detailed information pertaining to this functionality.



Figure 1-2. CLO-10 Front Panel

### 1.3.2 Rear Panel

**Figure 1-3** shows the rear panel of the standard CLO-10-1 chassis configuration. Refer to **Chapter 3. REAR PANEL CONNECTORS** for detailed information about these connectors and their functionality.

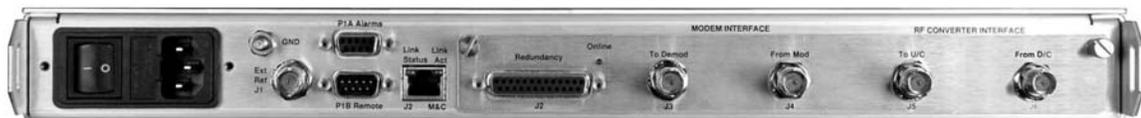


Figure 1-3. CLO-10 Rear Panel (CLO-10-1 shown)

## 1.4 Major Assemblies

Unit	Part No.	Description
CLO-10-1	PL/12833-1	Input Output Module (IOM)
CLO-10-2	PL/12834-1	Input Output Switch Module (IOSM) – 1:N

## 1.5 FAST Options and Hardware Options

The CLO-10 incorporates several optional features. These include redundancy and cancellation bandwidth. In order to permit a lower initial cost, the unit may be purchased with only the desired features enabled. The base configuration is 1.024 MHz of bandwidth, and standalone (no redundancy) operation.

Bandwidth Options	Description and Comments	Installation Method
1.024 MHz	Capable of suppressing signals with 1.024MHz bandwidth	Base Unit (CLO-10-1)
2.046 MHz	Capable of suppressing signals with 2.048 MHz of bandwidth	FAST
4.096 MHz	Capable of suppressing signals with 4.096 MHz of bandwidth	FAST
8.192 MHz	Capable of suppressing signals with 8.192 MHz of bandwidth	FAST
10 MHz	Capable of suppressing signals with up to 10 MHz of bandwidth	FAST
1:N Redundancy	Each traffic unit requires installation of IOSM	HARDWARE (CLO-10-2)

### 1.5.1 FAST System

Comtech EF Data provides FAST (**F**ully **A**ccessible **S**ystem **T**opology) as an enhancement feature available in CEFD products, enabling on-location upgrade of the most operating feature sets - in the rack - without removing a unit from the setup.

When service requirements change, the operator can upgrade the topology of the product to meet those requirements within minutes after confirmation by Comtech EF Data. This accelerated upgrade can be accomplished only because of FAST's extensive use of programmable devices incorporating Comtech EF Data-proprietary signal processing techniques. These techniques allow the use of a unique access code to enable configuration of the available hardware. The access code can be purchased at any time from Comtech EF Data. Once obtained, the access code is loaded into the unit via the front panel user interface keypad or the rear remote port.

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

#### 1.5.1.1 FAST Options

FAST permits the purchase and installation of options through special authorization codes entered remotely, or via the front panel user interface keypad where immediate implementation of the different options is facilitated. All FAST options are available through the basic platform unit.

#### 1.5.1.2 FAST Implementation

FAST is factory-implemented in the modem at the time of order. Options for basic modems can be ordered and installed either at the factory or in the field. The operator can select Bandwidth options that can be activated easily in the field.

## 1.5.2 Hardware Options

Redundancy is the only available hardware option for the CLO-10. See **Appendix A. REDUNDANT SYSTEM OPERATION** for more information.

If the user wishes to add redundancy to an existing single-thread system, the existing standalone setup may be converted by purchasing and installing an IOSM interface in place of the original IOM interface. More specifically, the CLO-10 designated as the system's Redundant Unit must be equipped with an IOM, while each CLO-10 within the redundant system designated as a Traffic Unit will require the IOSM interface.

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## 1.6 Functional Description

### 1.6.1 What is DoubleTalk™ Carrier-in-Carrier®?

The CLO-10 utilizes Carrier-in-Carrier® (CnC): Comtech EF Data's implementation of Applied Signal Technology, Inc.'s patented (United States #6,859,641) DoubleTalk™ signal processing algorithm technology, which allows both the forward and reverse carriers of a full duplex link to share the same segment of transponder bandwidth..

CnC allows satellite users to achieve spectral efficiency (i.e., bps/Hz) that cannot be achieved with traditional links. For example, CnC used with a pair of 16-QAM carriers achieves the bandwidth efficiency of 256-QAM (8bps/Hz when using uncoded operation as a baseline for both modulation types) with the power efficiency that is closer to that of 16-QAM. This allows CnC to not only provide significant operating expenditure (OPEX) savings, but also reduce capital expenditure (CAPEX) by allowing a smaller BUC/HPA and/or antenna.

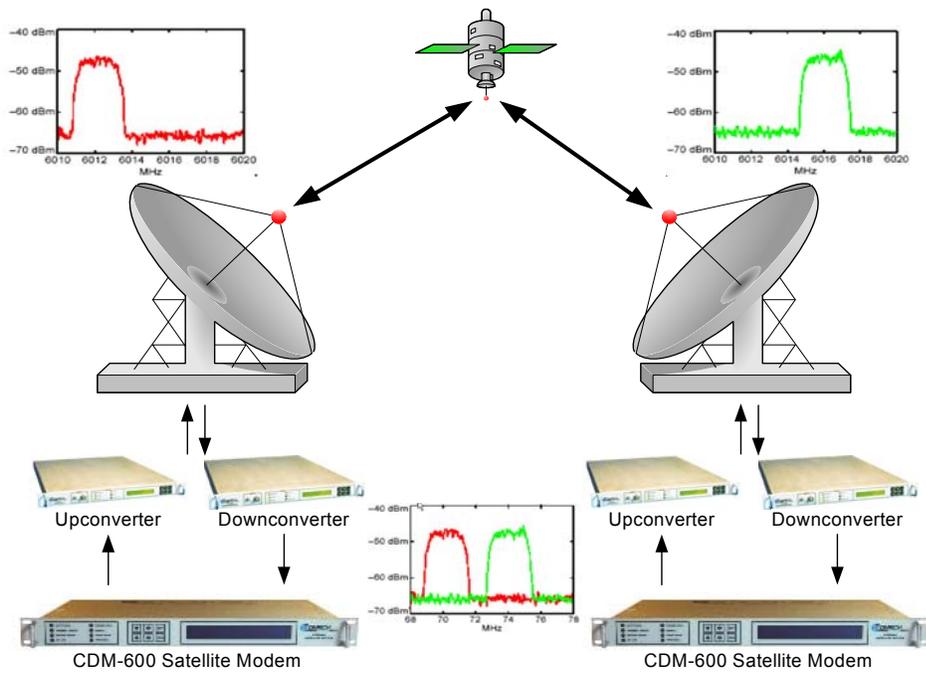
A CLO-10 at each end of the link suppresses the uplink carrier (at the near end) and allows the distant end carrier to be received by the (near end) demodulator. The CLO-10 operates on the standard IF band of 50-90 MHz and 100-180 MHz and allows users to upgrade existing systems while preserving their initial investment in modems and up/down converters. By placing the CLO-10 in the signal path between the modem and the up/down converters, **up to 50% savings in bandwidth can be immediately realized.**

**Figure 1-4** illustrates a conventional, full duplex satellite link where two carriers are placed in non-overlapping channels.

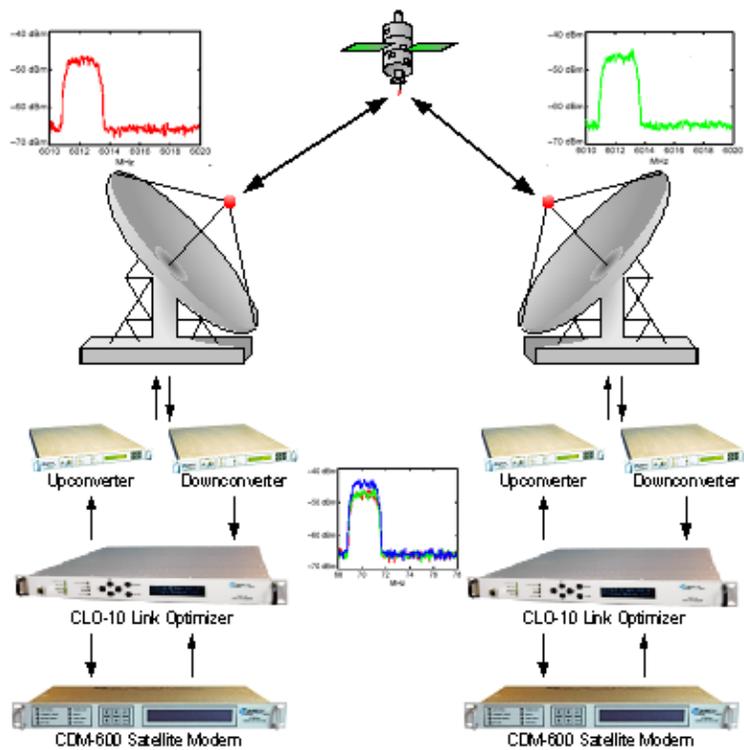
**Figure 1-5** shows operation of the same link but utilizing the CLO-10 on both ends of the link. The two carriers now overlap and occupy half the bandwidth of the scenario in **Figure 1-4**.

The transponder downlinks the composite signal containing both carriers on the same band to the CLO-10 which then translates the signal to near baseband where it can be filtered (decimated) and then processed as a complex envelope signal. The CLO-10 next suppresses the version of the near end carrier on the downlink side and then remodulates the desired carrier to the modem for demodulation.

The CLO-10 operates on the IF signal between the modem and the up/down converters 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 suppression operation. The only caveat to this is that the waveform must be "sufficiently random".



**Figure 1-4. Conventional FDMA Link**



**Figure 1-5. Link with Carrier-in-Carrier®**

Because acquiring the delay and frequency offset of the interfering carrier is fundamentally a correlation operation, anything deterministic in the interfering carrier (within the correlation window of the algorithm) will potentially produce false correlation peaks, and result in incorrect delays and/or frequency. Normally, this is not a problem, since energy dispersal techniques are utilized in the vast majority of commercial and military modems; however, this is something the user must keep in mind when troubleshooting a system that utilizes the DoubleTalk™ Carrier-in-Carrier® technique for signal suppression.

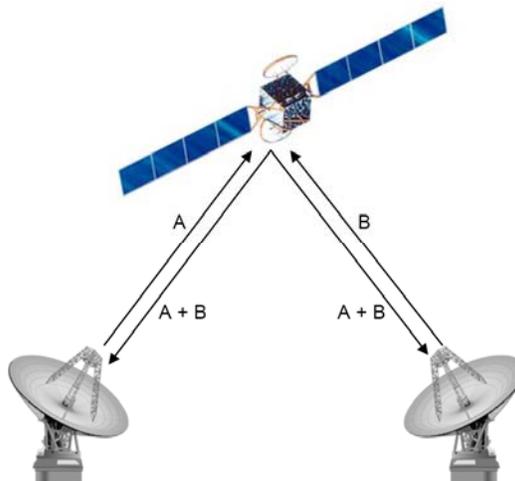
One possible way to mitigate false peaks is to narrow the correlation window. For example, if you know the delay to be around 240ms, set the minimum search delay to 230ms and the maximum search delay to 250ms.

A typical CnC system does require a 3dB increase within the band (for symmetric links). This is usually compensated for by using a more powerful FEC like TPC or LDPC, by use of a larger antenna, or carefully managing the link budget. Many links operate with excessive margins which can be allocated to CnC without having to resort to changing out the equipment.

## 1.6.2 Application Requirements

The following conditions are necessary in order to operate Carrier-in-Carrier®:

- Link must be full duplex
- A CLO-10 must be used at each end 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 return (downlink) path from the satellite. The looped back signal is then subtracted which leaves the signal from the distant end of the link. CnC cannot be used in spot beam systems.

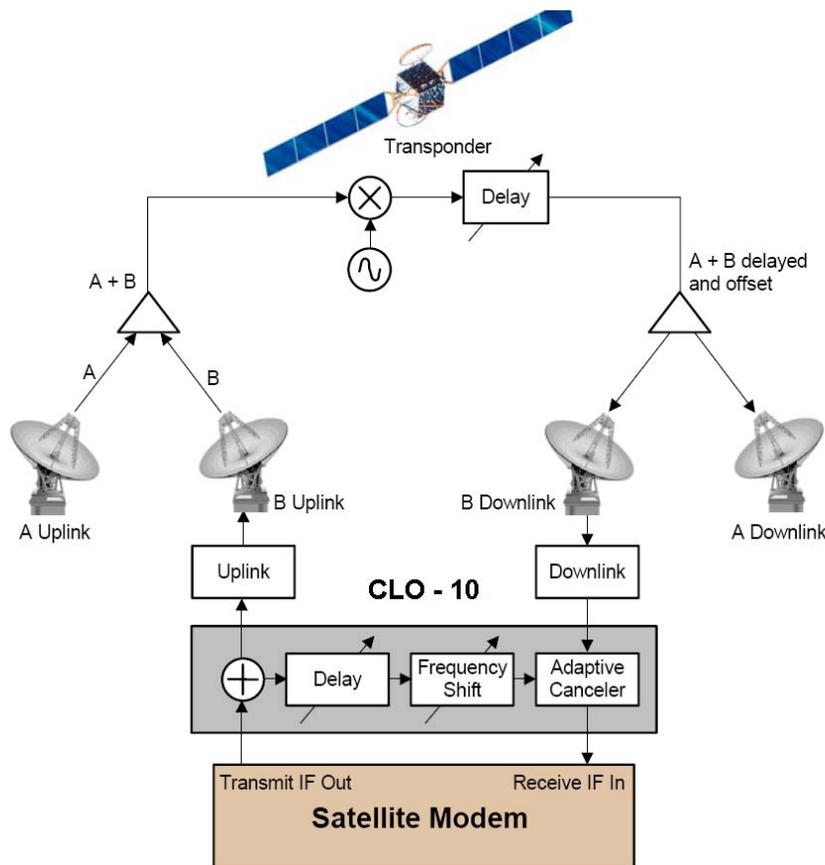


- The transponder is “bent-pipe”, meaning no on-board processing, demodulation, or regeneration can be employed. Demodulating/remodulating does not preserve the linear combination of the forward and return signals and the resulting reconstituted waveform prevents recovery of the original constituent signals.

### 1.6.3 System Functionality

Carrier-in-Carrier<sup>®</sup> achieves its cancellation performance due to its ability to automatically adapt to dynamic system impairments.

**Figure 1-6** 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. As depicted here, a variety of *dynamic* system impairments must be considered for CnC application. Their effects must be minimized in order to realize sufficient cancellation of the user's own uplink signal. The cancellation process adds a small amount of degradation to the existing link (tenths of a dB) under various signal conditions.



**Figure 1-6. Conceptual Block Diagram**

This performance is achieved through advanced signal processing algorithms that provide superior cancellation while tracking and compensating for the following common link impairments:

- **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. CnC tracks and compensates for this variation.
- **Frequency offset and drift.** Common sources are satellite Doppler shift, up/down converter frequency uncertainties, and other drift associated with the electronics in the

modem and the CLO-10 itself. The CLO-10 tracks and compensates for this frequency offset and drift.

- **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. CnC tracks and compensates for these atmospheric related impairments.
- **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 impairments, but these differences drain CnC's cancellation ability.

---

## 1.7 New in this Release

Version 1.2.1 firmware adds the following new features:

- 1:N Redundancy

## 1.8 Summary of Specifications

### 1.8.1 System Specifications

Characteristic	Requirement
Eb/No Degradation	<0.5dB for QPSK at 1E-6BER and 0dB C/I (desired carrier to interferer)
Delay/Doppler range	0 to 330 ms, +/-32kHz
Latency	<10ms
Cancellation Bandwidth	Up to 10MHz
Input Frequency	50MHz - 90MHz, 100MHz -180MHz, 1kHz steps
Input level, Uplink	0 to -40dBm Reference Carrier +10dBc Maximum Composite
Input level, Downlink	-105dbm + 10*log(BW) BW is input signal processing bandwidth, usually set to the symbol bandwidth of the desired or signal of interest  Maximum 35 dB above minimum 94 – 10log(BW) dBc maximum composite +20 dBm absolute maximum composite
Output Frequency	50MHz - 90MHz, 100MHz-180MHz, 1kHz steps
Uplink output level	Tx Input level -1 +/-0.5dB
Uplink output spurs, stability, spectrum	Set by uplink modem
Output level to modem (RX OUT port)	-20 to -30dBm for C/I of ±10dB
Reflash	FTP Ethernet (rear panel)
Frequency Reference: Internal Reference External Ref (BNC Female*)	Selectable 10 MHz for data and IF, stability ±1.5 ppm None (off), 1, 2, 5, or 10MHz for IF, internally phase locked. Input is 50 / 75 Ω compatible with 0.5 to 4.0 V pp sine or square wave. Requires high stability source.
Input/Output impedance	75 Ω, 17 Return Loss
Form C	Unit Fault
1:N Redundancy (optional)	Daisy Chain via High Speed Bus (HSB) cable
Agency Approval	Safety, conducted and radiated emissions (Class B) and Immunity sufficient for CE certification
M&C/ Remote Port	Telnet (10/100 Base-T Ethernet with HTTP, SNMP at a later release)
Eb/No Degradation	<0.5dB for QPSK at 1E-6BER and 0dB C/I (desired carrier to interferer)

## 1.8.2 Environmental and Physical Specifications

Characteristic	Requirement
Operating Temp	0 to 50°C (32 to 122°F)
Humidity	95% maximum, non-condensing
Power Supply Input	100 - 240AC 50/60Hz (standard)
	48 VDC (optional)
Power Consumption	< 70W
Weight	10lbs (4.5 kg) maximum
Dimensional Envelope, 1RU	1.75H x 19.0W x 18.65D inch (4.4H x 48W x 46.8D cm) approximate
Rack Slides	Not recommended — use rack shelf or rack mounting kit KT/6228-2 (see <b>Chapter 2. INSTALLATION</b> ).
AC Receptacle	Retainer to prevent plug from disconnecting due to vibration
Keypad and Display	Per CEFD “style”. See <b>Figure1-2</b> and <b>Chapter 6. FRONT PANEL OPERATION</b> .

## 1.9 Dimensional Envelope

Figure 1-7 shows the dimensional envelope for the CLO-10 Link Optimizer.

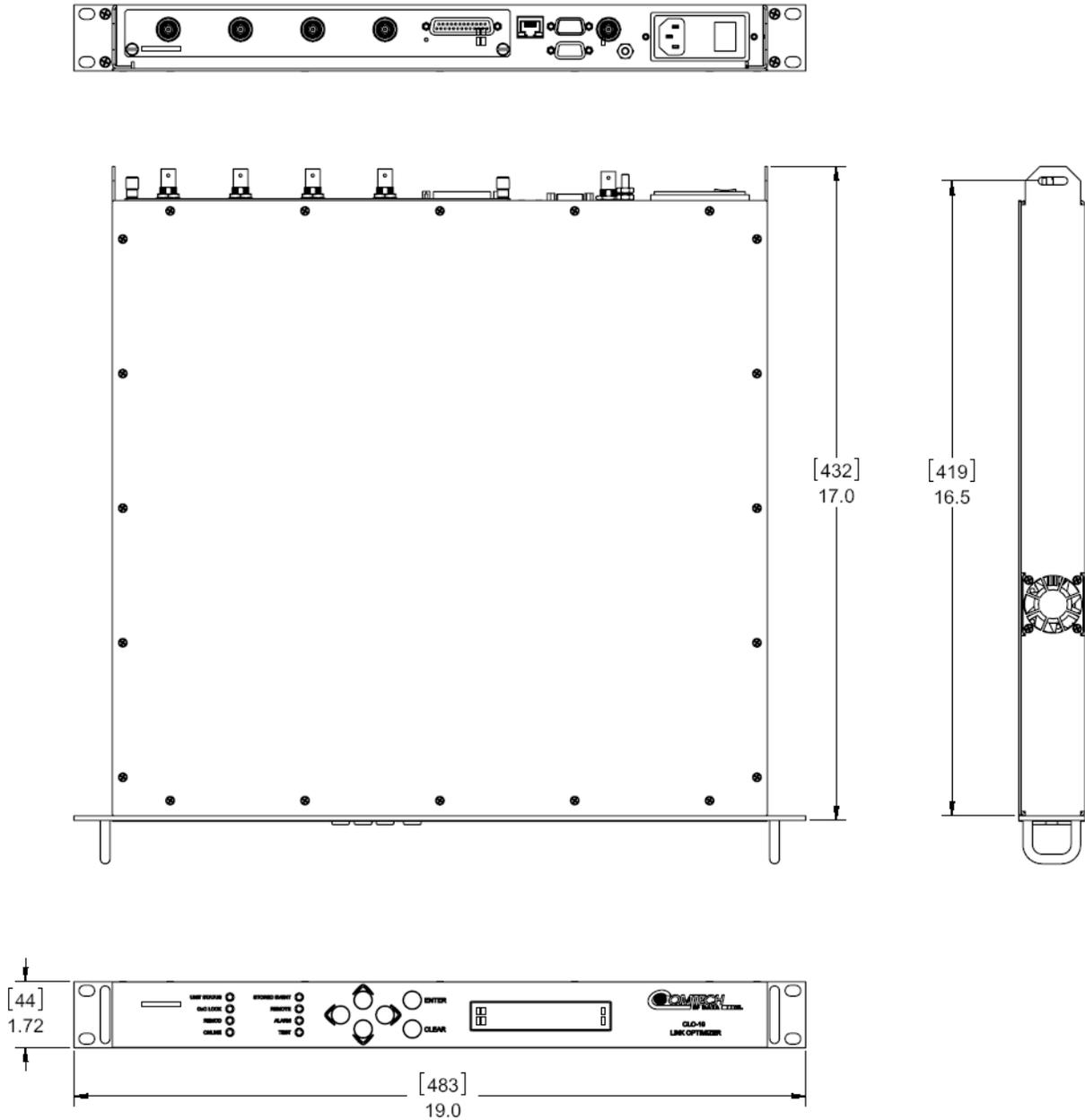


Figure 1-7. CLO-10 Dimensional Envelope

# Chapter 2. INSTALLATION

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## 2.1 Unpacking and Inspection

The CLO-10 Link Optimizer and its Installation and Operation Manual are packaged and shipped in a pre-formed, reusable cardboard carton containing foam spacing for maximum shipping protection.



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



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

Unpack and inspect the CLO-10 as follows:

Step	Procedure
1	Inspect shipping containers for damage. If shipping containers are damaged, keep them until the contents of the shipment have been carefully inspected and checked for normal operation.
2	Remove the packing list from the outside of the shipping carton.
3	Open the carton by cutting the tape at the top of the carton (indicated by OPEN THIS END).
4	Remove the cardboard/foam space covering the CLO-10. Remove the CLO-10, manual and power cord from the carton.
5	Check the contents against the packing list to verify completeness of the shipment.
6	Inspect the equipment for any possible damage incurred during shipment. If damage is evident, contact the carrier and Comtech EF Data immediately and submit a damage report.
7	Refer to the following sections for further installation instructions.

## 2.2 Mounting

**Figure 2-1** provides a “cut-away” side view of a typical CLO-10 rack configuration, combining use of CLO-10s and – as furnished by Comtech EF Data or others – modems, up converters, and down converters. Mount all equipment in the rack(s) as required for efficient arrangement and operation.

(**Note:** For depiction of the CLO-10 in optional redundancy configuration, refer to **Appendix A. REDUNDANCY SYSTEM OPERATION** for details and illustrations pertaining to this setup.)

If the CLO-10 is to be mounted in a rack, ensure that there is adequate clearance for ventilation, particularly at the sides. In rack systems where there is high heat dissipation, forced air cooling must be provided by top or bottom mounted fans or blowers. Under no circumstance should the highest internal rack temperature be allowed to exceed 50°C (122°F).



***Because a cooling fan is installed in the right-hand side of the unit, the CLO-10 CAN NOT have rack slides mounted to the side of the chassis. Comtech EF Data therefore recommends that an alternate method of support, such as rack shelves, is employed within the rack. If there is any doubt, please consult the Comtech EF Data Customer Support department.***

### 2.2.1 Optional Rear-Mounting Support Brackets

Install optional rear-mounting support brackets using mounting kit KT/6228-2 or KT/6228-3:

Quantity		Part Number	Description
KT/6228-2	KT/6228-3		
2	2	HW/10-32SHLDR	Screw, #10 Shoulder
4	4	HW/10-32FLT	Washer, #10 Flat
2	2	HW/10-32SPLIT	Washer, #10 Split
2	2	HW/10-32HEXNUT	Nut, #10 Hex
2	—	FP/6138-1	Bracket, 4”, Rear Support
—	2	FP/6138-3	Bracket, 10”, Rear Support
4	4	HW/10-32x1/2RK	Bolt, #10 Rack Bracket

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

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

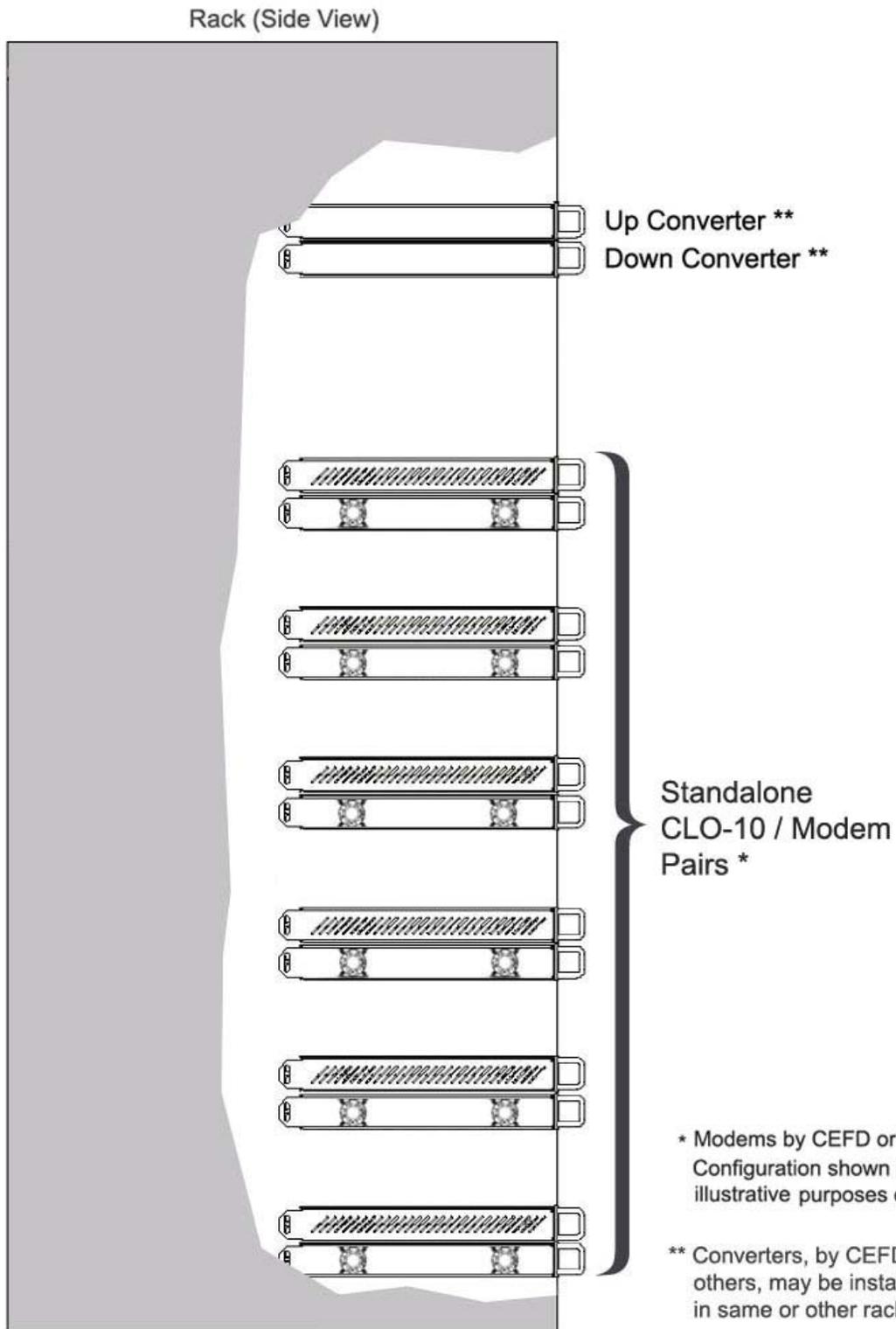
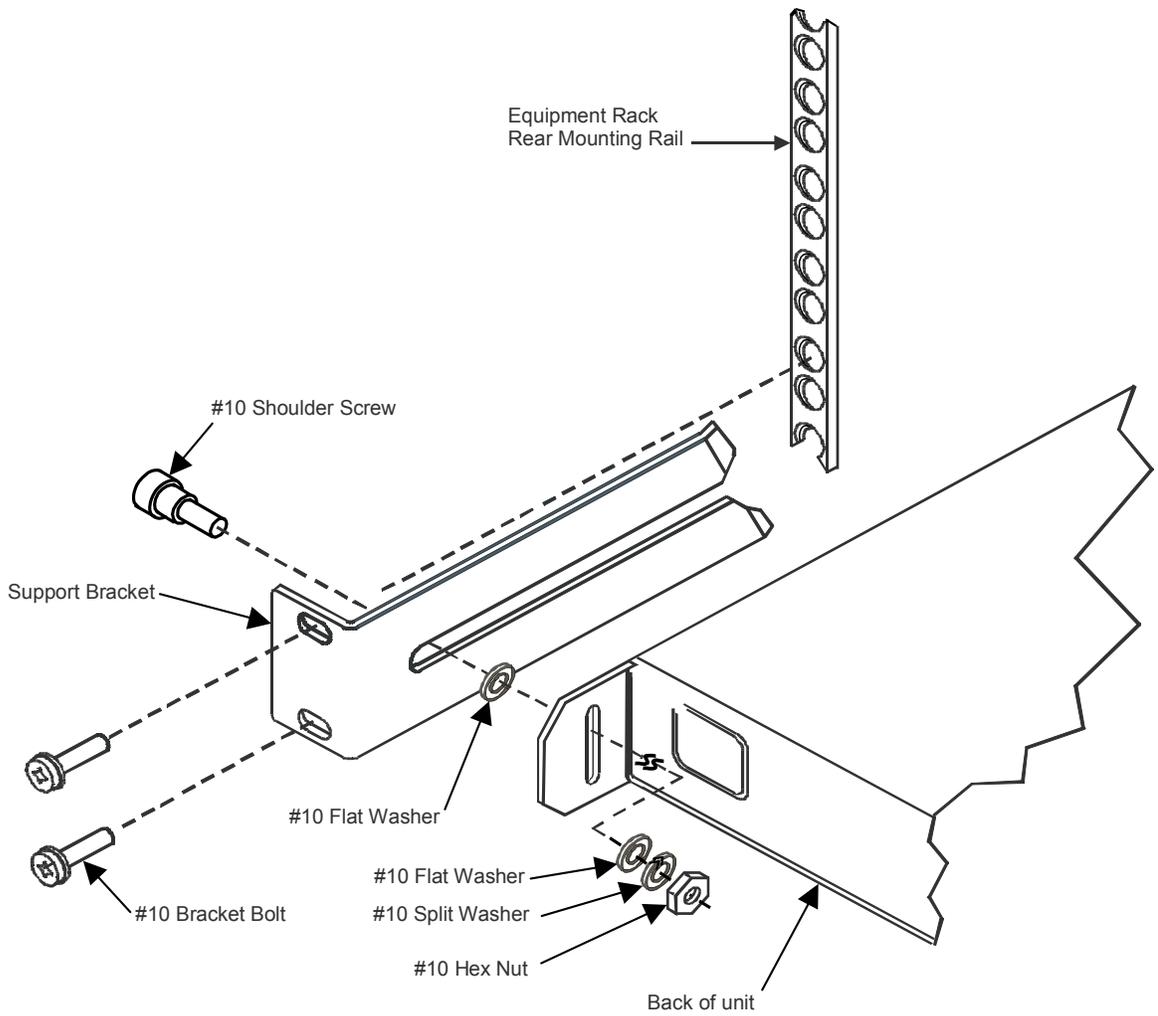


Figure 2-1. Typical CLO-10 Rack Installation (Side View)



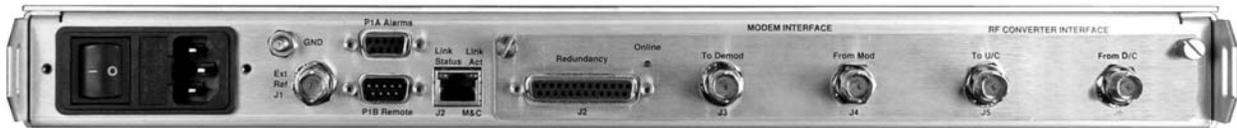
**Figure 2-2. Installation of the Optional Rear-Mounting Support Brackets**

# Chapter 3. REAR PANEL CONNECTORS

## 3.1 Connector Overview

The connectors located on the CLO-10 rear panel (**Figure 3-1**) provide all necessary external connections between the modem and other equipment.

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



**Figure 3-1. CLO-10 Rear Panel (CLO-10-1 Shown)**

**Table 3-1. External Connections**

Name	Sect	Connector Type	Function
Ext Ref	3.2	BNC (female)	External 1,5, 10 MHz Reference input
Alarms	3.3	9-Pin Type 'D' (female)	Form C Unit Alarm
Remote	3.4	9-Pin Type 'D' (male)	Serial Remote Control Interface
M&C	3.5	RJ-45	10/100 Ethernet M&C
IOM / IOSM Interface	To Demod	BNC (female)	Output to Demod
	From Mod		Input from Uplink Modulator
	To U/C		Output to Upconverter
	From D/C		Input from Downconverter
(AC Plug)	3.7	IEC	Modem Power
(DC Connector – not shown)	3.8	Terminal Block	Modem Power
GND	3.9	#10-32 Stud	Grounding

### 3.2 External Reference Connector, J1 (BNC-F)



The **J1 External Reference Input** is used to supply a master reference to entire chassis. Use of an external reference is not required. The input/output signal supplied here by the user is used for phase-locking the internal 10MHz reference oscillator, and can be 1, 2, 5, or 10 MHz. The impedance is matched for 50/75Ω, and requires a level in the range 0.5V-4.0Vpp square or sine wave.

### 3.3 Alarms Connector, P1A (DB-9F)



The **P1A Alarms** connector is a Type 'D' 9-pin female connector (DB-9F), providing the user with access to the Form-C relay contacts that indicate the fault status of the unit. P1A is typically connected to an external fault monitoring system, often found in satellite earth stations.

**Table 3-2. Alarm Interface Connector Pin Assignments**

Pin #	Signal Function	Name
8	Unit is faulted	NO
3	Unit is not faulted	NC
7	Unit Alarm common	COM
1,2,4,5,6,9	NOT USED	--

### 3.4 Remote Control Interface Connector, P1B (DB-9M)



The **P1B Remote** Control connector is a Type 'D' 9-pin male connector (DB-9M), providing the user with access to both EIA-232 and EIA-485 remote control ports of the modem.

**Table 3-3. Remote Control Interface Connector Pin Assignments**

Pin #	Description	Direction
1	Ground	
2	EIA-232 Transmit Data	Out
3	EIA-232 Receive Data	In
4	Reserved—NO CONNECT	
5	Ground	
6	EIA-485 Receive Data B *	In
7	EIA-485 Receive Data A *	In
8	EIA-485 Transmit Data B	Out
9	EIA-485 Transmit Data A	Out

**\*NOTE:** Use for 2-wire EIA-485 operation.

---

### 3.5 M&C 10/100 BaseT Ethernet Management Port (RJ-45)

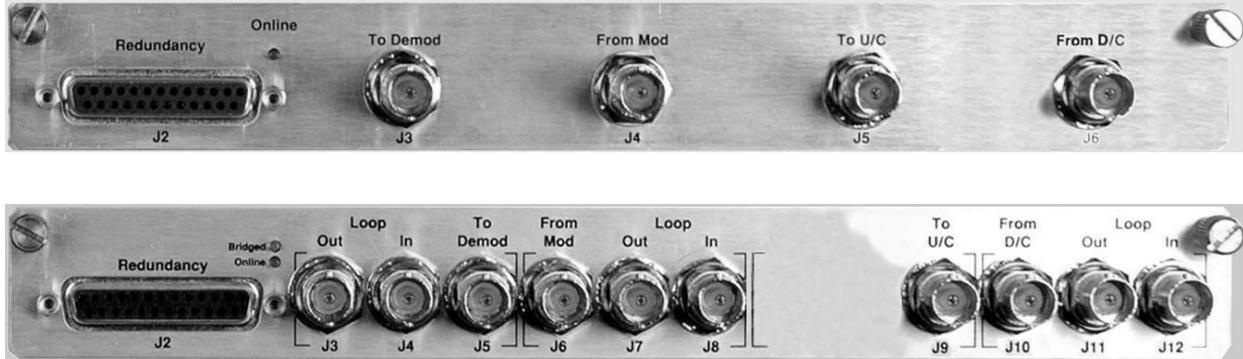


This is a standard RJ-45 female connector used for management via Telnet, HTTP (future), and SNMP (future). It is also used for upgrading CLO-10 firmware. This receptacle uses a UTP cable to connect to an Ethernet hub, router, switch, PC, etc.

**Table 3-4. M&C Interface Connector Pin Assignments**

Pin #	Description	Direction
1	Tx+	Out
2	TX-	Out
3	Rx+	In
4	N/A	
5	N/A	
6	Rx-	In

### 3.6 IOM/IOSM Connectors (BNC-F)



The CLO-10 may be used in Standalone configuration with either the Input/Output Module (IOM) or Input/Output Switch Module (IOSM) installed. **Table 3-5** defines use of the BNC connectors (in Standalone and in Daisy Chain Redundancy configurations) for both modules.

Note that the J2 DB-25F Redundancy connector is not used in a Standalone configuration. For detailed information pertaining to the IOM/IOSM connectors used in Daisy Chain Redundancy configuration, refer to **Appendix A. REDUNDANCY SYSTEM OPERATION**.

**Table 3-5. CLO-10 IOM BNC Connectors Reference**

BNC Connector	Ref. Des.		Description / Function	Direction
	IOM	IOSM		
To Demod	J3	J5	<b>Output to Demod</b> – signal from the downconverter with the near-end carrier suppressed.	Out
From Mod	J4	J6	<b>Input from near-end Modulator</b> – used as reference copy for cancellation processing.	In
To U/C	J5	J9	<b>Output to Upconverter</b> – same signal as J4/J6 with up to 5 dB $\pm$ 0.2 dB loss.	Out
From D/C	J6	J10	<b>Composite signal from Downconverter</b> – far-end carrier signal summed with the near-end carrier.	In

### 3.7 IEC Line Input (AC Power) Connector



The IEC line input connector contains the ON/OFF switch for the unit. It is also fitted with two fuses, one each for line and neutral connections (or L1, L2, where appropriate). These are contained within the body of the connector, behind a small plastic flap.

A standard, detachable, non-locking, 3-prong power cord (IEC plug) supplies the Alternating Current (AC) power to the CLO-10. Observe the following:

AC Power Specifications	
Input Power	75W maximum, less than 65W typical
Input Voltage	100 - 240 volts AC, +6/-10% - autosensing (total absolute max. range is 90 to 254 VAC)
Connector Type	IEC
Fuse Protection	<ul style="list-style-type: none"> <li>For 230 volt AC operation, use T2.5A, (slow-blow) 20mm fuses.</li> <li>For 115 volt AC operation, use T5.0A, (slow-blow) 20mm fuses.</li> </ul>



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

### 3.8 DC Power Connector



A standard 3-screw terminal block supplies the Direct Current (DC) power to the CLO-10. Observe the following:

DC Power Specifications	
Input Power	200W maximum, less than 50W typical
Input Voltage	36 to 72 VDC; 6.25 amps
Connector Type	Terminal Block
Fuse Protection	3.15A Slow-blow 20mm type fuses



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

---

### 3.9 Ground Connector



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

**Note:** The AC power connector provides the safety ground.

# Chapter 4.

## CABLES AND CONNECTIONS

---

### 4.1 Overview



*Leave the CLO-10, up and down converters, and modem powered OFF until all connections are ready.*

Once the CLO-10(s) and accompanying modem(s) have been mounted, the user must properly attach all required cabling. These interfaces between the CLO-10, modem, and the up and down converters utilize standard off-the-shelf 75Ω BNC male-to-BNC male patch cables, supplied by the user.

Alternately, the user may purchase IF Cable **PL/0813-4** (75Ω BNC male -to- BNC male, 4') from Comtech EF Data; this cable can be ordered at the same time the order is placed for the CLO-10.

---

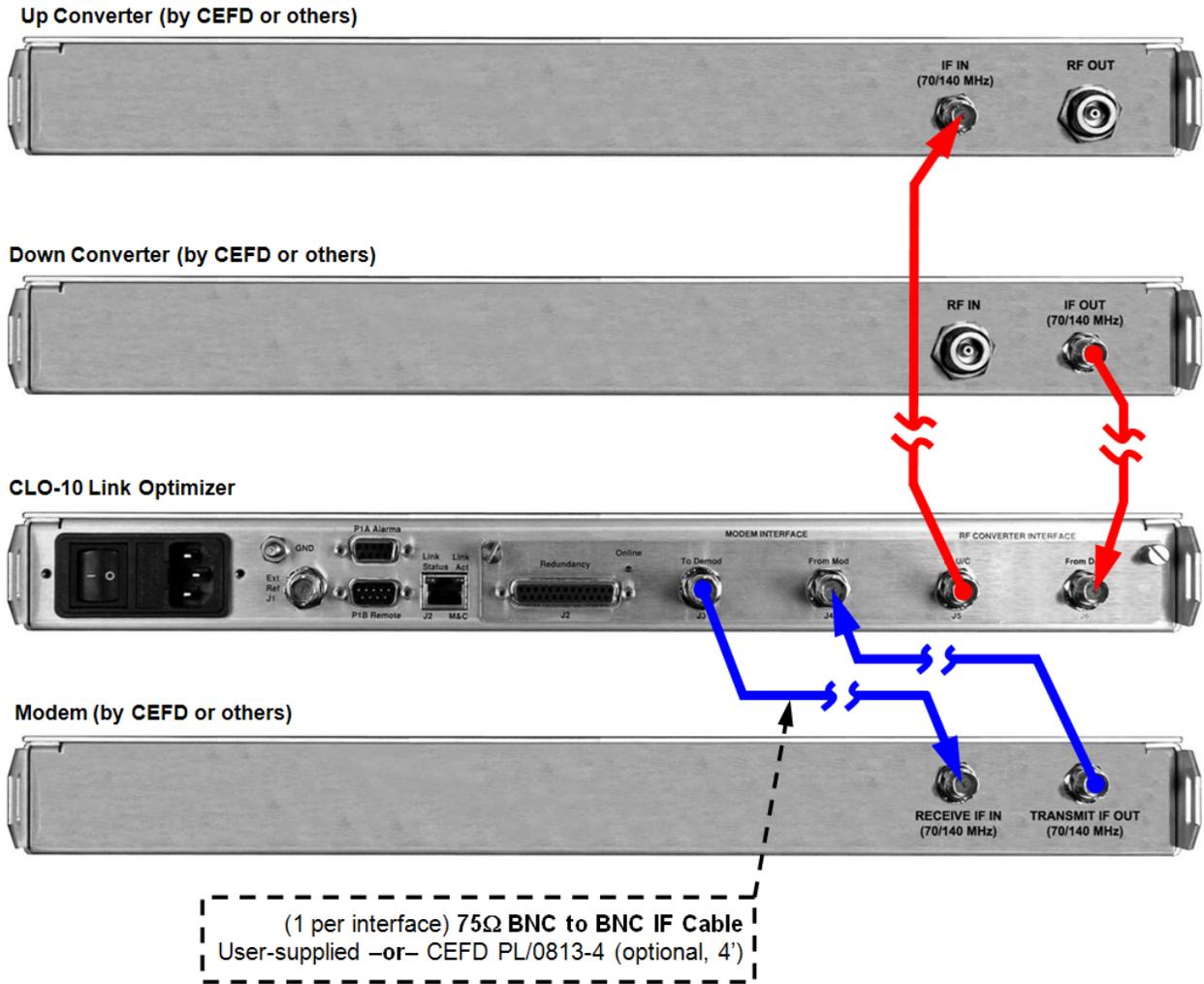
### 4.2 External Cable Connections

Using cables as provided by the user (or, optionally, PL/0813-4 cables available from Comtech EF Data): Connect the CLO-10 to the modem and the up and down converters as shown in **Figure 4-1**. Note that the CLO-10 has up to 1.5 dB insertion loss on the uplink side. On the downlink side, the CLO-10 provides a nominal output range to the demodulator from -20 dBm to -30dBm. Also note that this output can also be attenuated by configuring the Remodulator attenuation from the front panel menu (**CONFIG: REMOD → ATTENUATION**). Refer to **Chapter 6. FRONT PANEL OPERATION** for further information.

---

### 4.3 Redundancy Cable Connections

The CLO-10 can be utilized, as an optional hardware configuration, from 1:1 to up to 1:12 redundancy configurations. Refer to **Appendix A. REDUNDANT SYSTEM OPERATION** for detailed configuration and cabling information for these optional hardware configurations.



**Figure 4-1. CLO-10 External Cable Connections – Standalone Configuration**

# Chapter 5. MODEM AND OPTIMIZER CONFIGURATION

---

## 5.1 Modem Configuration

Tune the modem to the desired operating frequency within the 50-90 MHz or 100-180 MHz range. Refer to the modem manufacturer's documentation if necessary.

### 5.1.1 Verify Link without Carrier-in-Carrier®

Prior to installing the CLO-10, it is suggested that the tuning changes from the previous step be verified on the link. This will require coordination from both the transmit and receive stations.

The link should be verified using your standard link setup and verification process. This step ensures that the modem, up converter and downconverter are correctly configured. Once this step is completed and the link established, the CLO-10 can then be inserted in the signal path.

---

## 5.2 CLO-10 Configuration

The unit should first be configured locally, using the front panel keypad and display. Refer to Chapter 6. **FRONT PANEL OPERATION** for details on how to fully configure the unit for the desired operating parameters.

### 5.2.1 CLO-10 Power

Turn on the power to the CLO-10 using the ON/OFF switch located on the back of the unit (on DC versions, connect DC power to terminal block).

**Note:** The auto-sensing AC power supply requires no adjustments. Simply plug in the supplied line cord, and turn the unit ON using the ON/OFF switch on the rear panel.

The unit is ready for configuration when the front panel display shows the Comtech EF Data 'welcome screen':



## 5.2.2 Flash Updating

The CLO-10 eliminates the need for updating firmware by physically replacing EPROMs. Instead, the CLO-10 uses 'flash memory' technology internally. This makes software upgrading very simple, and updates can now be sent via the Internet (Figure 5-1), e-mail, or on disk. The upgrade can be performed without opening the unit by simply connecting the CLO-10 to the serial port of a computer.

New firmware can be uploaded to the unit from an external PC via the Internet as follows:

1. Go online to: [www.comtechefdata.com](http://www.comtechefdata.com)
2. Click on: **Support**
3. Click on: **Software Downloads**
4. Click on: **Flash Update Files**
5. Click on: **<dir> CLO-10**
6. Select: **F13167 V113 012108\***

(\*Note: Choices shown are representative of upgrades available via the Web as of 3/2008. These selections are updated periodically. Contact Comtech EF Data Customer Support for questions regarding the availability of support files for your specific product.)

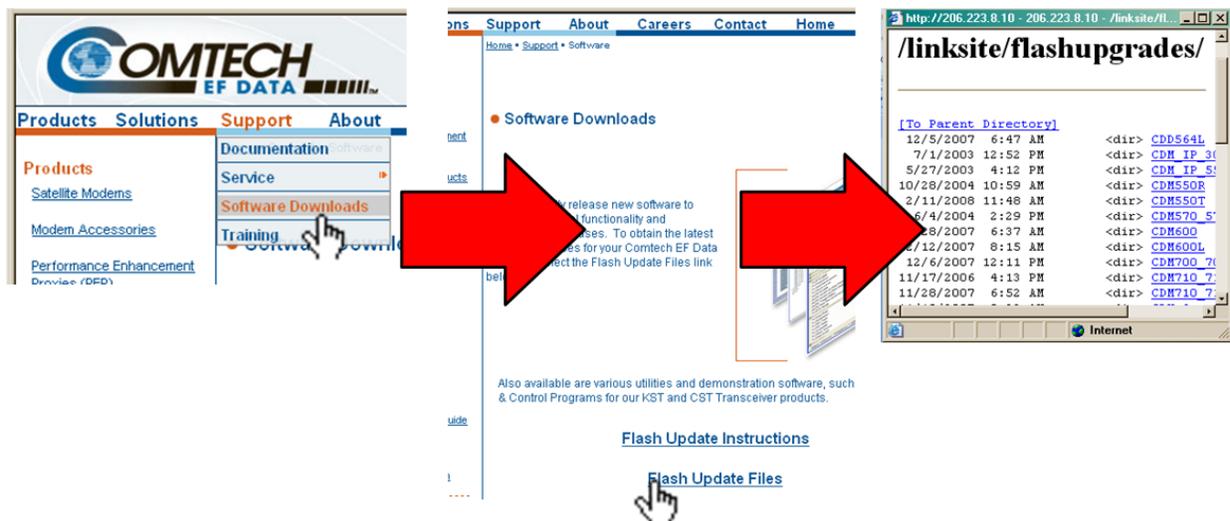


Figure 5-1. Flash Update via Internet

### 5.2.2.1 Flash Update Help

Full on-line help is provided with CCCFLASH.EXE. Additionally, a reference guide is available by selecting the **Flash Update Instructions** link on the *Software Upgrade* Web page (Figure 5-1). Please contact Comtech EF Data Customer Support if you have questions or need additional assistance.

### 5.2.3 CLO-10 FTP Upload Procedure

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

The current base Optimizer M&C version can be viewed at the top-level menu of the front panel display (press CLR button several times to view). Also, you can find the firmware information within the **Util → Firmware → Info → Image#1, Image#2** menu tree.

Using serial remote control, you can query the firmware revision levels with the following commands:

<0/SWR? (Abbreviated), or:

<0/FRW?x (Detailed), where x = B (Boot), 1 (Image 1) or 2 (Image 2)

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

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

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

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

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

Access the download server with the flash firmware data files link, **<http://206.223.8.10/linksite/flashupgrades/CLO-10/>**

**About Firmware Numbers, File Versions, and Formats:** All CEFD products are shipped configured with the current version firmware release. The most recent firmware versions are also available for download. If applicable, one version prior to the current release is also available for download. Be sure to properly identify and download the desired version of firmware.

The flashable files on the download server are organized by product prefix, firmware number (to verify the correct firmware number, see **Step 1** in this section), revision letter if applicable, version, and release date.

The base firmware for the CLO-10 is **FW13167\*\_\*\_\*** (where **FW** means firmware, and the asterisks signify, in order, firmware revision, firmware version, and release date).

The downloadable files are stored in two formats: \*.exe (self extracting) and \*.zip (compressed). Some firewalls will not allow the downloading of \*.exe files. In this case, download the \*.zip file instead.

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

**4. Unzip** the files in the temporary folder on your PC.

At least 3 files should be extracted:

- a. **FW13167x.bin**, where "x" is the version (bulk image file).
  - b. **FW13167x.txt**, where "x" is the version (history notes).
  - c. **README.TXT** installation notes.
5. **Connect** the client PC to the CLO-10 Optimizer 10/100 Ethernet M&C via a hub or a switch, or directly to a PC with a crossover cable.
6. Verify the communication and connection by issuing a "ping" command to the CLO-10. Determine the IP address of the unit remotely or using the front panel:
- Remotely - use the **<0/IPA?** command
  - Front panel – use the **Config: Remote → Remote → Ethernet** menu.
  - **Using DOS to PING (and FTP):** Click **"Start"** on the Windows toolbar, then select the **"Run..."** option. (Alternatively, use the **"DOS Prompt"** or **"Command Prompt"** icons in the **Start Menu**.)
  - **Using Win95 or Win98:** Type **"command"**.
  - **Using WinNT, Win2K or WinXP:** Type **"cmd"**.

Once in DOS, use **"cd c:\temp"** to change to the temporary directory created earlier. Use the **"dir"** command to list the downloaded files.

**7. Initiate** an FTP session with the CLO-10. The example uses a DOS window.

- a. From the PC, type "ftp xxx.xxx.xxx.xxx" where "xxx.xxx.xxx.xxx" is the IP address of the CLO-10.
- b. Enter your admin user name and password to complete login:  

<b>Factory</b>	<b>Default</b>	<b>user</b>	<b>is:</b>	COMTECH
<b>Password is: COMTECH</b>				
- c. Verify your FTP transfer is binary by typing "bin".
- d. Type "prompt" then type "hash" to facilitate the file transfers.

**8. Transfer** the files.

Type "put **FW13167\*.bin** bulk:" to begin the file transfers. The destination "bulk:" must be all lower-case. Approximately **one minute** is required to transfer the file.

**9. Verify** the file transfer.

- a. The PC should report that the file transfer has occurred, and the display on the CLO-10 will start reporting **"PROGRAMMING FLASH SECTOR#xx – PLEASE WAIT"**.



**Stopping the FTP before the "PROGRAMMING FLASH SECTOR#xx- PLEASE WAIT" screen has finished could lead to an incomplete download and a repeat of Step 8a.**

- b. Terminate the FTP session by typing "bye" and closing the DOS window.
  - c. Verify that the new file loaded using the procedure in **Step 1**.
10. **Change** the desired image to boot using the **Util: Firmware → Select** (use ◀ ▶ arrows to change to the other image), then cycle power to reboot the CLO-10.
11. **Verify** the new software versions are booting by observing the following messages on the CLO-10 display (unit model number and firmware version number will vary):



## 5.2.4 CLO-10 Tuning

Tune the CLO-10 to the desired downlink frequency. This is the same frequency to which the demodulator is programmed and is the output frequency from the downconverter.

1. Using the front panel keypad, from the top level menu select **Config: DOWNLINK** and enter in the desired downlink frequency.
2. The remodulated signal also needs to be tuned. This is the frequency that the demodulator is tuned to. From the top level menu, select **Config: REMOD** and enter the remod frequency.
3. The CLO-10 needs to know the frequency of the near-end modulator. Select **Config: UPLINK**, then enter the uplink frequency.

### 5.2.4.1 Initial Link Access Procedures

Before attempting an initial link access, an understanding of the operating modes of the CLO-10 is useful. Specifically, the operating modes are as follows:

- **Normal Mode** – This mode provides the characteristic Carrier-in-Carrier processing function of initial acquisition, cancellation, and re-acquisition. Switching to **NORMAL** mode forces initial acquisition.
- **Bypass Mode** – Signal from the Downlink port is downconverted, decimated (decimation bandwidth is set using BW setting) and then re-modulated out the **REMOD** port. This capability is typically used for troubleshooting, or for bringing up a CnC link. Each of the two links can initially be brought up in **BYPASS** mode and tested before bringing both up in CnC **NORMAL** mode.
- **UPLINK Mode** – Uplink mode is similar in functionality to **BYPASS** mode. The input from the uplink is downconverted, decimated (decimation bandwidth is set using BW setting) and then re-modulated out the **REMOD** port.

Note that the CLO-10 is configured from the factory in **NORMAL** mode. Note also that, for the CLO-10 to process a link in **NORMAL** mode, a CLO-10 is required at each end of the link. This requires coordination on each side of the link.

### 5.2.4.2 Link Access Setup

For establishing a link when using Carrier-in-Carrier<sup>®</sup>, follow these suggested procedures:

1. **Uplink and Downlink Setup** – Set up the uplinks and downlinks for the appropriate IF and RF frequencies. The CLO-10s on both ends of the link should now be tuned to the same IF transmit and receive frequencies.
2. **Link Access and Testing** – The standard link access procedures that are normally performed to verify non-CnC links over the satellite should be used with the CLO-10 configured in **BYPASS** mode. The link access procedures need to be performed in a single direction; that is, one end of the link at a time transmits, and the other end listens (transmit is muted). This will verify link performance in each direction.
3. **Link Power Balancing** – At this point, it is appropriate to *balance* the link power. This means that both carriers should be presented to the CLO-10 at about the same power from the downconverter output. This can be done by using a spectrum analyzer and monitoring the spectrum at the output of the downconverter.
4. **CnC Full-Duplex Link Access and Testing** – The link access procedure from the previous step should be repeated with the CLO-10 configured in **NORMAL** mode *EXCEPT* both transmitters should be transmitting. Ensure that the CnC search delay range encompasses the expected delay through the satellite. Typical delays are on the order of 220-250ms. Also ensure that the frequency offset between the two carriers are within the CnC Frequency Offset setting. Both of these can be found under **Config: CnC** → **CnC Parameters**.

---

## 5.3 Other Useful Information

The CLO-10 acquisition is fundamentally a correlation operation. As such, it assumes *sufficiently* random data on the carrier to prevent false correlation peaks from occurring and causing false delay results. This is usually not a problem provided the data is randomized with a good scrambler; however, there are some rare cases in which a PN test pattern can “beat” with a modulator’s scrambler such that the resulting data can produce false correlation peaks.

One way to mitigate such non-randomness is to narrow the CnC delay range. For example, if the expected delay is 230ms, set the Min delay to 210ms and Max delay to 250ms to mask out the false peaks – the narrower the better, the faster the acquisition.

Synchronous scramblers often display artifacts which can cause false correlations. Selecting an asynchronous scrambler can help. Synchronous scramblers usually have better performance, so narrowing the range should be tried first.

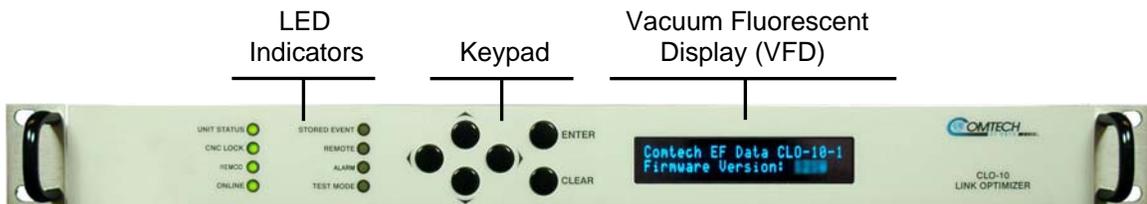
Optimum link performance is achieved if the link is “balanced” – that is, the two carriers are of equal power. This gives allowance for normal fades to occur on either side of the link. As the link becomes unbalanced, there will be some slight degradation in link performance but it is no more than a few tenths of a dB for a typical link.

The bandwidth (BW) setting should be chosen to minimize the processing bandwidth. This bandwidth sets the decimation bandwidth in the CLO-10. As such, minimizing this bandwidth also minimizes signal processing ingress noise. For example, if the carrier’s 3dB bandwidth is 364kHz, set the bandwidth to 512kHz.

# Chapter 6. FRONT PANEL OPERATION

---

## 6.1 Introduction

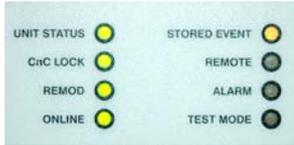


**Figure 6-1. CLO-10 Front Panel**

The user can fully control and monitor the operation of the CLO-10 from the front panel using the keypad and display. Nested menus are used, which display all available options, and prompt the user to carry out a required action.

**Figure 6-1** identifies the key features of the front panel, which are explained in greater detail in this section.

### 6.1.1 LED Indicators



The eight LEDs positioned to the left side of the front panel reflect the operating condition of the CLO-10 Link Optimizer.

The function of these LEDs is as follows:

LED	Color	Condition
UNIT STATUS	Red	A Unit Fault exists (Unit Fault includes Uplink, Downlink, and Remod faults). <b>Example: PSU fault</b>
	Green	No Unit Faults exist.
CnC LOCK	Green	CnC has acquired the delay and frequency offset of the uplink and is suppressing it on the downlink side.
	Off	CnC is not locked.
REMOD	Green	The output to the demod (remodulator) is ON.
	Off	The remodulation transmitter is currently OFF.
ONLINE	Green	The Unit is Online and carrying traffic. This LED should always be on in single-thread (non-redundancy) systems.
	Green (flashing)	The Traffic Unit is bridged or in "Hot Standby" – verifies that the Redundant Unit is configured identically to this unit.
	Off	The Unit is Offline (standby) - forced by externally connected 1:1 or 1:N redundancy system.
STORED EVENT	Orange	There is a Stored Event in the log, which can be viewed from the front panel or retrieved via the remote control interface.
	Orange (flashing)	<b>CAUTION: The Redundant Unit is in Manual mode.</b>
	Off	There are no Stored Events.
REMOTE	Orange	The Unit is in Remote Mode - Local <i>monitoring</i> is possible, but Local <i>control</i> is not.
	Off	The Unit is in Local Mode - Remote <i>monitoring</i> is possible, but Remote <i>control</i> is not.
ALARM	Orange	An Alarm exists (includes Unit, Uplink, Downlink and Remod Alarms).
	Off	No Alarms exist.
TEST MODE	Orange	One of the Test Modes is enabled.
	Off	Unit operating in Normal mode.

## 6.1.2 Keypad



The keypad on the front panel contains six individual key switches with a positive “click” action for tactile feedback.

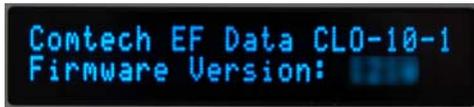
The function of these keys is as follows:

<b>ENTER</b>	This key is used to display a selected function or to execute a modem configuration change.
<b>CLEAR</b>	This key is used to back out of a selection or to cancel a configuration change which has not been executed using <b>ENTER</b> . Pressing <b>CLEAR</b> generally returns the display to the previous selection.
 <b>(Left, Right)</b>	These arrows are used to move to the next selection or to move the cursor position. Space permitting, most of the menus include arrow key hints to guide the user.
 <b>(Up, Down)</b>	These arrows are used primarily to change configuration data (numbers), at the current cursor position. Occasionally they may be used to scroll through a number of choices at the current cursor position. Space permitting, most of the menus include arrow key hints to guide the user.



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

### 6.1.3 Vacuum Fluorescent Display (VFD)



This 'welcome screen' is displayed whenever power is first applied to the unit.

The display has two lines each of 24 characters. As shown, the first line identifies the unit model (CLO-10-1 or CLO-10-2); the second line displays the CLO-10's installed firmware version (this number will vary).

Pressing any key takes the user to the top-level Select menu.

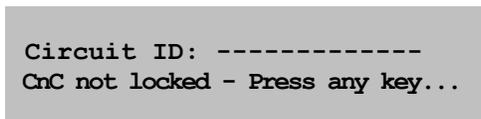
On most menu screens, users will see a flashing, solid-block cursor. This indicates the currently selected item, digit, or field:



Where this solid block cursor would obscure the item being edited (for example, a numeric field), the cursor will automatically change to an underline cursor:



To prevent the display from becoming burnt by a constant image, the unit employs a screen saver feature, which activates after one hour and constantly scrolls and wraps a message across the screen. The top line of the screen saver display shows the Circuit ID (which can be entered by the user); the bottom line shows the Carrier-in-Carrier<sup>®</sup> (CnC) lock status followed by the message 'Press any key...'



Press any key to restore the previously active screen.

## 6.2 CLO-10 Menu Structure

Figure 6-2 shows the menu structure of the CLO-10. The menu, branches, and applicable submenus are described in detail in the chapter sections that follow.

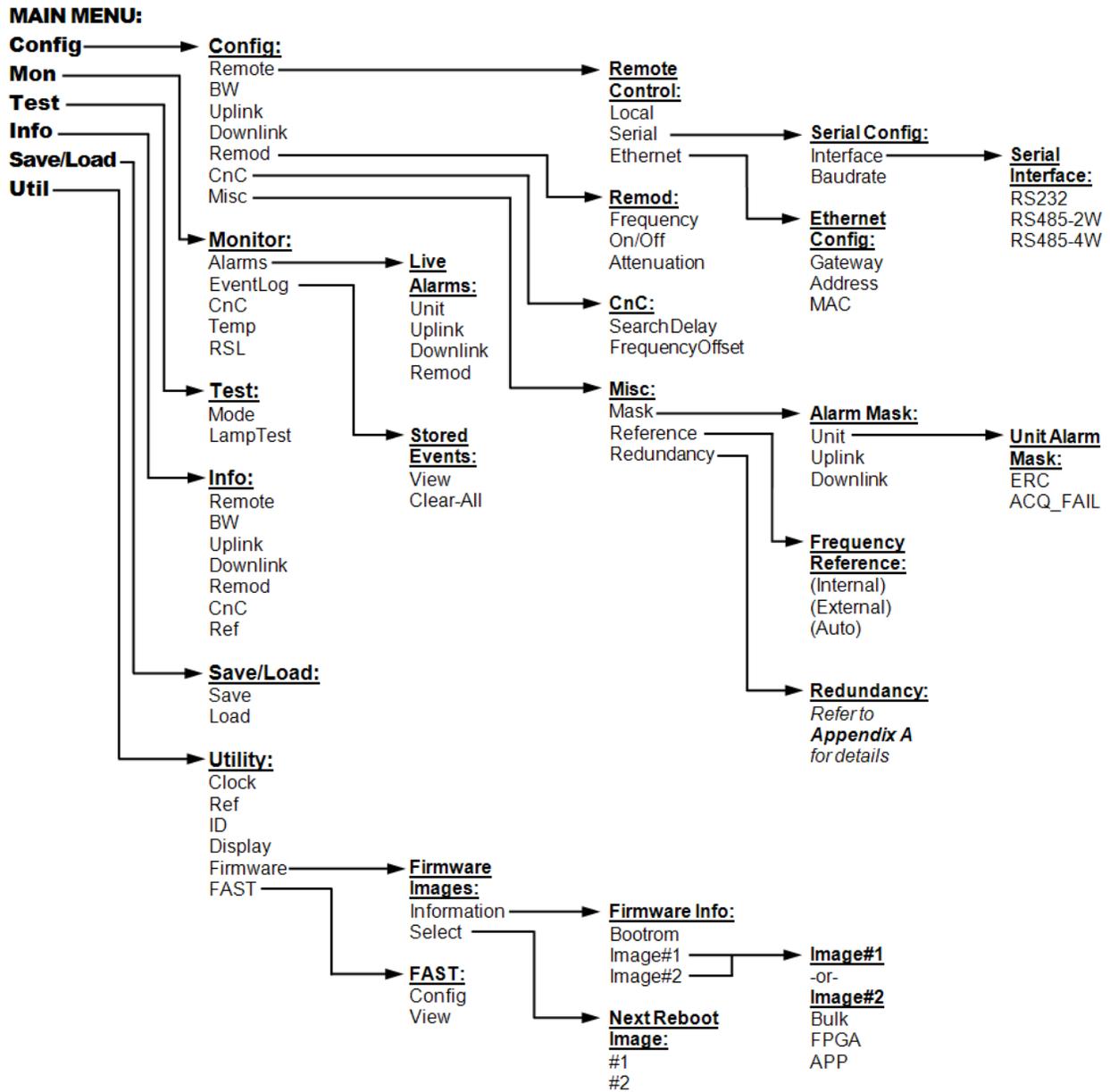


Figure 6-2. CLO-10 Menu Tree

### 6.3 Main (Top-level Select) Menu

```
MAIN MENU: Config Mon
           Test Info Save/Load Util
```

Move the cursor to the desired menu branch choice using the ◀ ▶ arrow keys, then press **ENTER**. The following table describes the function of each menu branch (along with the section in this chapter that provides detailed information on that branch and its accompanying submenus).

Selection (Chapter Sect.)	Menu Branch Description
<b>Config</b> (6.4)	<b>(Configuration)</b> Permits the user to fully configure the unit.
<b>Mon</b> (6.5)	<b>(Monitor)</b> Permits the user to monitor the alarm status of the unit, view the log of stored events, display the CnC parameters, and monitor the temperature of the base unit.
<b>Test</b> (6.6)	Permits the user to invoke one of several test modes (e.g., Loopback).
<b>Info</b> (6.7)	<b>(Information)</b> Permits the user to view information on the unit without having to go into configuration screens.
<b>Save/Load</b> (6.8)	Permits the user to save and load up to 10 different unit configurations.
<b>Util</b> (6.9)	<b>(Utility)</b> Permits the user to perform miscellaneous functions, such as setting the Real-time clock, adjusting the display brightness, etc.

## 6.4 CONFIG (Configuration)

```
CONFIG: Remote BW Uplink
        Downlink Remod CnC Misc
```

Move the cursor to the desired choice using the ◀ ▶ arrow keys, then press **ENTER**.

The submenus available under the Configuration menu branch are as follows:

Selection (Chapter Sect.)	Submenu Description
<b>Remote</b> (6.4.1)	Permits the user to define whether the unit is being controlled locally or remotely.  <b>NOTE:</b> The unit may be monitored over the remote control bus at any time. When in Local mode, however, configuration parameters may only be changed through the front panel. Conversely, when in Remote mode, the unit may be monitored from the front panel, but configuration parameters may only be changed via the remote control bus.
<b>BW</b> (6.4.2)	Permits the user to define the bandwidth parameter for the link optimizer.
<b>Uplink</b> (6.4.3)	Permits the user to define, on a parameter-by-parameter basis, the uplink configuration of the unit.
<b>Downlink</b> (6.4.4)	Permits the user to define, on a parameter-by-parameter basis, the downlink configuration of the unit.
<b>Remod</b> (6.4.5)	Permits the user to define, on a parameter-by-parameter basis, the remodulator (CLO-10 output to the demod) configuration of the unit.
<b>CnC</b> (6.4.6)	Permits the user to define the minimum and maximum search delays, and the frequency offset parameters.
<b>Misc</b> (6.4.7)	Permits the user to set alarm masks, choose between the 10MHZ internal reference or phase lock to an externally applied reference, and enable/disable redundant operations for units equipped for this optional functionality (refer to <b>Appendix A. REDUNDANCY SYSTEM OPERATION</b> for detailed information on this option).

## 6.4.1 CONFIG: Remote

```
Remote Control:      Local
Serial Ethernet     (< ▶ ENT)
```

Select **Local**, **Serial**, or **Ethernet** using the ◀ ▶ arrow keys, then press **ENTER**. If **Local** is selected, then remote control is disabled. Remote monitoring is still possible.

### CONFIG: Remote → Serial

If **Serial** is selected:

```
Serial Config: Interface
Baudrate          (< ▶ ENT)
```

### CONFIG: Remote → Serial → Interface

If **Interface** is selected:

```
Serial Interface:    RS232
RS485-2W RS485-4W   (ENT)
```

Select **RS232**, **RS485-2W** (2-wire) or **RS485-4W** (4-wire) using the ◀ ▶ arrow keys, then press **ENTER**. Here, the user is further prompted to enter the bus address.

If **RS232** is selected, the following menu is displayed:

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

### CONFIG: Remote → Serial → Interface → RS485-2W or RS485-4W



*If the unit is configured as a Redundant Unit and the Redundant feature has been enabled, refer to Appendix A. REDUNDANCY SYSTEM OPERATION for detailed information on the front panel operations associated with redundancy.*

If either RS-485 mode is selected, and this unit is *not configured as a Redundant Unit* and the Redundant feature *has not been enabled*, the user is further prompted:

```
RS-485 Bus Address:  0245
                    (< ▶ ▲ ▼ ENT)
```

Edit the RS-485 bus address of this unit by selecting the digit to be edited using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▼ ▲ arrow keys. The valid range of addresses is from 1 to 9996.

Once the bus address is edited, the user should press **ENTER**.

## CONFIG: Remote → Serial → Baudrate

If **Baudrate** is selected:

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

Edit the baud rate of the remote control bus, connected locally to the M&C computer. The value is changed using the ▲ ▼ arrow keys. Values of 2400, 4800, 9600, 19200, 38400, and 57600 baud are possible. Note that the asynchronous character format is **FIXED** at 8 data bits, 1 stop bit, no parity (8-N-1).

Once the baud rate is edited, the user should press **ENTER**.

## CONFIG: Remote → Ethernet

If **Ethernet** is selected:

```
Ethernet Config: Gateway
Address MAC      (◀ ▶ ENT)
```

## CONFIG: Remote → Ethernet → Gateway

If **Gateway** is selected:

```
Ethernet IP Gateway:
192.128.001.001  (ENT)
```

Edit the IP Gateway Address for the Ethernet M&C port for this unit by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The user should then press **ENTER**.

## CONFIG: Remote → Ethernet → Address

If **Address** is selected:

```
Ether IP Address/Range:
192.168.001.001/24  (ENT)
```

Edit the IP Address and Range for the Ethernet M&C port for this unit by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The user should then press **ENTER**.

## CONFIG: Remote → Ethernet → MAC

If **MAC** is selected, a read-only window displays , for the user's reference, the factory program MAC address for the Ethernet management interface:

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

## 6.4.2 CONFIG: BW (Bandwidth)

```
Bandwidth:  
00256 kHz      (< > ▲ ▼ ENT)
```

Edit the bandwidth (decimation bandwidth) for this unit. The value of the bandwidth is changed using the ▲ ▼ arrow keys. Values of 256, 512, 1024, 2048, 4096, 8192 and 10,000 kHz are possible.

Once the bandwidth is edited, the user should press **ENTER**.

## 6.4.3 CONFIG: Uplink (Uplink Frequency)

```
Uplink Frequency:  
0070.0000 MHz  (< > ▲ ▼ ENT)
```

Edit the IF Uplink Frequency by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The range of frequencies is 50-90 MHz and 100-180 MHz with a resolution of 100 Hz.

Once the uplink frequency is edited, the user should press **ENTER**.

## 6.4.4 CONFIG: Downlink (Downlink Frequency)

```
Downlink Frequency:  
0070.0000 MHz  (< > ▲ ▼ ENT)
```

Edit the IF Downlink Frequency by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The range of frequencies is 50-90 MHz and 100-180 MHz with a resolution of 100 Hz.

Once the downlink frequency is edited, the user should press **ENTER**.

### 6.4.5 CONFIG: Remod (Remodulation Parameters)

```
Remod:  Frequency      On/Off
        Attenuation    (< ▶ ENT)
```

Select **Frequency**, **On/Off**, or **Attenuation** using the ◀ ▶ arrow keys, then press **ENTER**.

#### CONFIG: Remod → Frequency

If **Frequency** is selected:

```
Remod:  Frequency
        0070.0000 MHz (< ▶ ▲ ▼ ENT)
```

Edit the IF Remod Frequency by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The range of frequencies is 50-90 MHz and 100-180 MHz with 100 Hz resolution.

Once the IF Remod Frequency is edited, the user should press **ENTER**.

#### CONFIG: Remod → On/Off

If **On/Off** is selected:

```
Output State:  Off   On
                (< ▶ ENT)
```

Edit the Output State for this unit. Select either **On** or **Off** using the ◀ ▶ arrow keys, then press **ENTER**.

#### CONFIG: Remod → Attenuation

If **Attenuation** is selected:

```
Attenuation:
        00.0 dB      (< ▶ ▲ ▼ ENT)
```

Edit the Attenuation for this unit. Editing the value is accomplished by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The range varies 0-31.5 dB in 0.5 dB steps.

Once the Attenuation is edited, the user should press **ENTER**.

## 6.4.6 CONFIG: CnC (Carrier-in-Carrier<sup>®</sup> Parameters)

```
CnC: SearchDelay
FrequencyOffset (< ▶ ENT)
```

Select **SearchDelay** or **Frequency Offset** using the ◀ ▶ arrow keys, then press **ENTER**.

### CONFIG: CnC → SearchDelay

```
LinkDelay 100 (ms)
DelayRange 025 (ms) (< ▶ ▲ ▼)
```

The Search Delay actually represents a minimum and maximum delay value, and consists of two parameters: Link Delay and Delay Range. The Link Delay is an estimate of the round trip delay of the earth station to the Satellite. The Delay Range extends on either side of the Link Delay.

**For example:** if the user enters a Link Delay of 100 ms and a Delay Range of 10 ms, then the actual Search Delay Range will be a minimum value of 90 ms and a maximum value of 110 ms.

Edit the Link Delay in milliseconds by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys.

Edit the Delay Range in milliseconds by selecting the digit to be edited, using the ◀ ▶ arrow keys. The value of the digit is then changed using the ▲ ▼ arrow keys. The user should then press **ENTER**.

### CONFIG: CnC → FrequencyOffset

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

Edit the CnC Frequency Offset. The value of the digit is changed using the ▲ ▼ arrow keys. The user should then press **ENTER**.

## 6.4.7 CONFIG: Misc: (Miscellaneous Configurations)

```
Misc: Mask Reference
Redundancy (< ▶ ENT)
```

Select **Mask**, **Reference**, or **Redundancy** using the ◀ ▶ arrow keys, then press **ENTER**.

### CONFIG: Misc: → Mask

```
Alarm Mask: Unit
Uplink Downlink (< ▶ ENT)
```

Select **Unit**, **Uplink**, or **Downlink** using the ◀ ▶ arrow keys, then press **ENTER**.

### CONFIG: Misc: → Alarm Mask: → Unit

```
Unit Alarm Mask:      ◀ ▶  
ERC  ACQ_FAIL        (ENT)
```

Select **ERC** or **ACQ\_FAIL** using the ◀ ▶ arrow keys, then press **ENTER**.

### CONFIG: Misc: → Alarm Mask: → Unit Alarm Mask: → ERC

```
Unit Ext Ref Clk Alarm:  
Active Masked      (◀ ▶ ENT)
```

### CONFIG: Misc: → Alarm Mask: → Unit Alarm Mask: → ACQ\_FAIL

```
Unit Acq Failure Alarm:  
Active Masked      (◀ ▶ ENT)
```

For the Unit Alarm Mask **ERC** (Unit External Reference Clock) or **ACQ\_FAIL** (Unit Acquisition Failure) selections (as shown above), the user is prompted to select **Active**, whereas the External Reference Clock alarm or Acquisition Failure alarm activates the fault relay, or **Mask**, whereas the respective fault relay will not be activated.

Once **Active** or **Masked** is selected using the ◀ ▶ arrow keys, the user should then press **ENTER**.

### CONFIG: Misc: → Alarm Mask: → Uplink

```
Uplink AGC Alarm Mask:  
Active Masked      (◀ ▶ ENT)
```

The user is prompted to select **Active**, whereas the Uplink AGC alarm activates the fault relay, or **Mask**, whereas the fault relay will not be activated.

Once **Active** or **Masked** is selected using the ◀ ▶ arrow keys, the user should then press **ENTER**.

### CONFIG: Misc: → Alarm Mask: → Downlink

```
Downlink AGC Alarm Mask:  
Active Masked      (◀ ▶ ENT)
```

The user is prompted to select **Active**, whereas the Downlink AGC alarm activates the fault relay, or **Mask**, which deactivates the fault relay.

Once **Active** or **Masked** is selected using the ◀ ▶ arrow keys, the user should then press **ENTER**.

## CONFIG: Misc: → Reference (Reference Oscillator)

The CLO-10 can accept an externally supplied frequency reference, using the BNC connector on the rear panel. However, rather than bypassing the internal reference and substituting the external signal, the internal reference is used in a low-bandwidth (~ 2Hz) phase-locked loop (PLL); for this reason, the CLO-10 actually phase locks to the external reference signal.

Edit the configuration and value of the frequency reference. The value is changed using the ▲▼ arrow keys. Values of **Internal 10 MHz**, **External 01 MHz**, **External 02 MHz**, **External 05 MHz**, **External 10 MHz** and **Auto** are possible.

Once the configuration has been edited, the user should press **ENTER**.

**Auto** will detect the following external frequency references: 01 MHz, 02 MHz, 05 MHz and 10 MHz. If the external reference frequency is invalid or no external reference frequency is connected, then **Auto - XX** will be displayed.

Four examples are shown below:

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

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

```
Ext Reference Auto Det  
Auto - 05 MHz
```

```
Ext Reference Auto Det  
Auto - XX
```

## CONFIG: Misc: → Redundancy

The CLO-10 can be optionally configured to operate within 1:1 through 1:12 redundancy configurations. Refer to **Appendix A. REDUNDANCY SYSTEM OPERATION** for detailed information on the front panel operations associated with redundancy.

## 6.5 Monitor

```
Monitor: Alarms  Event Log
CnC   Temp   RSL   (< ▶ ENT)
```

Select **Alarms**, **Event Log**, **CnC**, **Temp**, or **RSL** using the ◀ ▶ arrow keys, then press **ENTER**.

### 6.5.1 Monitor: Alarms (Live Alarms)

```
Live Alarms: Unit   Uplink
Downlink  Remod  (< ▶ ENT)
```

Select **Unit**, **Uplink**, **Downlink**, or **Remod** using the ◀ ▶ arrow keys, then press **ENTER**.



*The CLO-10 uses a system of Fault Prioritization. In each category of fault, only the highest priority fault is displayed. This also holds true for the faults reported via the remote control.*

*The ▲▼ arrow keys will display each fault and its current status. This will also allow the user to display all of the possible alarms as OK or FAULT.*

*A comprehensive list of faults is shown at the end of this section.*

#### Monitor: Alarms → (Live Alarms:) Unit (Unit Alarms)

If **Unit** is selected:

```
Unit: Fault           ▲ ▼
+5V under voltage
```

The screen indicates if there are any Unit Faults and displays the highest priority fault. If there are no faults, the screen displays **None**.

Press **ENTER** to return to the previous menu. In the case where multiple faults have occurred, each of the possible faults can be viewed using the ▲▼ arrow keys. The display also indicates the status of each fault (**Fault** or **None**).

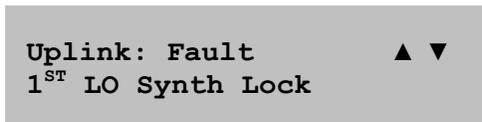
The comprehensive list of Unit faults is as follows:

- +5V PSU (+5 Volt PSU is under voltage)
- +12V PSU (+12 Volt PSU is under voltage)
- -12V PSU (-12 Volt PSU is under voltage)
- Ext Ref PLL (External Reference PLL)
- SW MGC RU (Switch Redundant Unit Configuration)

- CnC lock (Loss of lock)
- Ext Ref Clock (External Reference Clock)
- SW Comm TU (Traffic Unit Communications)
- SW FLT TU (Traffic Unit Fault)
- SW INV CFG (Invalid Configuration, Traffic Unit Fault)

## Monitor: Alarms → (Live Alarms:) Uplink (Uplink Alarms)

If **Uplink** is selected:



```
Uplink: Fault      ▲ ▼
1ST LO Synth Lock
```

The screen indicates if there are any Uplink Faults and displays the highest priority fault. If there are no faults, the screen displays '**None**'.

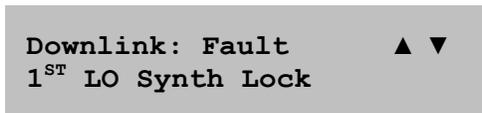
Press **ENTER** to return to the previous menu. In the case where multiple faults have occurred, each of the possible faults can be viewed using the ▲▼ arrow keys. The display also indicates the status of each fault (**Fault** or **None**).

The comprehensive list of Uplink Faults is as follows:

- 1<sup>ST</sup> LO Synthesizer not locked
- 2<sup>Nd</sup> LO Synthesizer not locked
- AGC out of range

## Monitor: Alarms → (Live Alarms:) Downlink (Downlink Alarms)

If **Downlink** is selected:



```
Downlink: Fault   ▲ ▼
1ST LO Synth Lock
```

The screen indicates if there are any Downlink Faults and displays the highest priority fault. If there are no faults, the screen displays '**None**'.

Press **ENTER** to return to the previous menu. In the case where multiple faults have occurred, each of the possible faults can be viewed using the ▲▼ arrow keys. The display also indicates the status of each fault (**Fault** or **None**).

The comprehensive list of Downlink Faults is as follows:

- 1<sup>ST</sup> LO Synthesizer not locked
- 2<sup>Nd</sup> LO Synthesizer not locked
- AGC out of range

## Monitor: Alarms →( Live Alarms:) Remod (Remod Alarms)

If **Remod** is selected:

```
Remod: Fault      ▲ ▼  
1ST LO Synth Lock
```

The screen indicates if there are any Remod Faults and displays the highest priority fault. If there are no faults, the screen displays 'None'.

Press **ENTER** to return to the previous menu. In the case where multiple faults have occurred, each of the possible faults can be viewed using the ▲▼ arrow keys. The display also indicates the status of each fault (**Fault** or **None**).

The comprehensive list of Uplink Faults is as follows:

- 1<sup>ST</sup> LO Synthesizer not locked
- 2<sup>Nd</sup> LO Synthesizer not locked

### 6.5.2 Monitor: Event Log (Stored Events)

```
Stored Events:  
View Clear-All (< ▶ ENT)
```

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

If **View** is selected:

```
Log 023: 30/11/07 10:37:32  
Fault - Remod 1ST LO (▲ ▼)
```

In this example, a Remod 1<sup>st</sup> LO fault occurred on Nov. 30, 2007 at 10:37:32 with log number 23.

The user may scroll backwards or forwards through the entries in the event log, using the ▲▼ arrow keys. Pressing **ENTER** or **CLEAR** takes the user back to the previous menu.

The event log can store up to 255 events. When a fault condition occurs, it is time-stamped and put into the log. Similarly, when the fault condition clears, this is also recorded, as shown:

```
Log 024: 30/11/07 10:37:35  
Clear - REMOD 1ST LO (▲ ▼)
```

If **Clear-All** is selected, the user is prompted to confirm that all events will be erased from the event log:

```
Clear All Stored Events?  
No  Yes
```

The user must select **No** or **Yes** using the ▲▼ arrow keys, then press **ENTER** to proceed.

Once the event log is cleared, the user is taken directly back to the previous menu. However, if there are faults present on the unit at this time, they will be re-time-stamped, and new log entries will be generated.



*Note that, in accordance with international convention, the event log shows dates in DAY/MONTH/YEAR format.*

### 6.5.3 Monitor: CnC (Carrier-in-Carrier®)

```
CnC: Delay = 100.0 ms  
Frequency = +001.0 kHz
```

**Monitor: CnC** provides the user with current Carrier-in-Carrier® parameters:

- **Delay:** CnC delay in milliseconds
- **Frequency:** CnC frequency offset in kHz

### 6.5.4 Monitor: Temp

```
Ambient Temperature  
+037 C
```

**Monitor: Temp** provides the user with current ambient temperature in degrees Celsius.

### 6.5.5 Monitor: RSL (Receive Signal Level)

```
[ ■■■■■■■■■■■■ ]  
Downlink RSL
```

**Monitor: RSL** provides the user with a virtual ‘peak meter’ that displays the approximate strength, from 0% to 100%, of the AGC signal currently being received by the CLO-10.

## 6.6 TEST

```
TEST: Mode   LampTest
          (< ▶ ENT)
```

Select **Mode** or **LampTest** using the ◀ ▶ arrow keys, then press **ENTER**.

If the user selects **Mode**:

```
TEST: Norm   Bypass
Uplink CW   1010 (< ▶ ENT)
```

The user may select **Norm**, **Bypass**, **Uplink**, **CW**, or **1010** test modes using the ◀ ▶ arrow keys, then press **ENTER**. The function of each test mode selection is as follows:

Selection	Test Description
<b>Norm</b>	Any test modes or loopbacks are cleared, and the unit is placed back into an operational state.
<b>Bypass</b>	The downlink signal is sent out to the demod with the CnC canceller disabled. This is useful for checking integrity of inbound link; however, the outbound modulator must be turned off.
<b>Uplink</b>	The uplink carrier is sent back to the near end demodulator. This test mode can be used to close an external RF loop on the near-end modem.
<b>CW</b>	A pure carrier (no modulation) is transmitted out the remodulator.
<b>1010</b>	An alternating 1010 pattern is sent to the remodulator. This test mode is used for checking the carrier suppression of the mixers.

If the user selects **LampTest**, a visual test is conducted on the front panel display and LEDs to verify that they are operational.

---

## 6.7 INFO (Information)

```
INFO: Remote  Bw  Uplink  
Downlink  Remod  CnC  Ref
```

These screens display information on the current configuration of the unit. Select **Remote**, **Bw**, **Uplink**, **Downlink**, **Remod**, **CnC** or **Ref** using the ◀ ▶ arrow keys, then press **ENTER**.

### INFO: Remote (Remote Control Information)

Select **INFO: Remote** to show if the unit is in **Local** or **Remote** mode; the display gives details of the selected electrical interface type, the unit's address, the selected baud rate, etc., as per the following examples:

```
Remote M&C: Monitor Only  
(Local Control only)
```

```
Remote M&C: RS485-4Wire  
Address: 0001 19200 Baud
```

```
Remote M&C: 100BaseTx  
IP Addr: 255.255.255.255
```

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

### INFO: Bw (Bandwidth Information)

Select **INFO: Bw** to display the unit's Bandwidth:

```
Bandwidth:  
256 kHz (ENT)
```

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

### INFO: Uplink (Uplink Information)

Select **INFO: Uplink** to display the unit's Uplink Frequency:

```
Uplink:  
0070.0000 MHz (ENT)
```

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

### **INFO: Downlink (Downlink Information)**

Select **INFO: Downlink** to display the unit's Uplink Frequency:

```
Downlink:
0070.0000 MHz      (ENT)
```

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

### **INFO: Remod (Remodulation Information)**

Select **INFO: Remod** to display the Tx Attenuation in dB, the state of the transmitter, and the remodulation frequency.:

```
Remod:      Atten 00.0 dB
On 0070.0000 MHz      (ENT)
```

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

### **INFO: CnC (Carrier-in-Carrier<sup>®</sup> Information)**

Select **INFO: CnC** to display the CnC Frequency Range and Min/Max Delays as per the following example:

```
FqRg: +/- 030 kHz
Dly: LDL=320 DRG=010 ms
```

Where **LDL** = Link Delay, and **DRG** = Delay Range in milliseconds. Press **ENTER** or **CLEAR** to return back to the previous menu.

### **INFO: Ref (Frequency Reference)**

Selecting **INFO: Ref** displays the source of the Frequency Reference for the CLO-10:

```
Frequency Reference:
Internal 10 MHz      (ENT)
```

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

---

## 6.8 SAVE/LOAD

```
Save/Load Configuration:
Save   Load   (< > ENT)
```

These sub-menus permit the user to store or load up to 10 different modem configurations in the non-volatile memory of the modem.

Select **Save** or **Load** using the < > arrow keys, then press **ENTER**.

### Save/Load: Save (Save Configuration)

If **Save** is selected and a location is empty, what displays is similar to the following example:

```
Save Config to Loc: 9
Empty                (▲▼ ENT)
```

However, if the location already contains data, what displays is similar to the next example:

```
Save Config to Loc: 9
10:37:32 30/11/07 (▲▼ENT)
```

The user is shown the time and date stamp of the previously stored configuration, for identification purposes.

Select the location to where the current configuration is to be stored, using the ▲▼ arrow keys, then press **ENTER**. Locations **1** through **10** are available.

If the selected location does not contain a previously stored configuration, the following screen is displayed:

```
Your Configuration has been
Saved to Location 9 (ENT)
```

However, if the selected location *does* contain a previously stored configuration, the following screen is displayed:

```
Location 9 Contains Data!
Overwrite? No Yes (< > ENT)
```

The user must select **No** or **Yes** using the < > arrow keys, then press **ENTER**. Selecting **Yes** overwrites the existing configuration at the selected location.

## Save/Load: Load (Load Configuration)

If **Load** is selected and there is a configuration stored at the selected location, what displays is similar to the following example:

```
Load Config from Loc: 9
10:37:32 30/11/07(▲▼ ENT)
```

Note that the stored configuration is identified with a date and time stamp.

If the selected location contains no data, what displays is similar to the next example:

```
Load Config from Loc: 9
Empty           (▲▼ ENT)
```

Select the location from where the current configuration is to be loaded using the ▲▼ arrow keys, then press **ENTER**. Locations **1** through **10** are available.

If the selected location contains *valid* data, what displays is similar to the following example:

```
New Config has been Loaded
From Location 9      (ENT)
```

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

If the selected location contains invalid data, what displays is similar to the next example:

```
Warning! Location 9
Contains No Data!   (ENT)
```

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

## 6.9 UTILITY

```
UTILITY: Clock Ref ID
Display Firmware FAST ◀ ▶
```

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

Select **Clock**, **Ref**, **ID**, **Display**, **Firmware**, or **FAST** using the (◀ ▶ ▲ ▼ ENT) arrow keys, then press **ENTER**.

### Utility: Clock (Real-time Clock)

```
Real-Time Clock:
12:00:00 24/01/08 (◀ ▶ ▲ ▼)
```

Edit the time and date setting of the Real-time Clock. This is accomplished by first selecting the digit to be edited using the ◀ ▶ arrow keys, then changing the value of the digit using the ▲ ▼ arrow keys. Press **ENTER** when done.



**Note that, in accordance with international convention, the Real-time Clock shows dates in DAY/MONTH/YEAR format.**

### Utility: Ref (Reference Adjustment)

```
Internal 10 MHz Ref Freq
Fine Adjust:+0190 (ENT)
```

Fine adjustment of the Internal 10 MHz reference oscillator is possible through this menu. Use the ▲ ▼ arrow keys to edit the value. The range of values is from -2048 to +2047. Once the value has been edited, press **ENTER**.



**The numbers displayed here do not correspond to an exact frequency increment. A user should perform this fine adjustment while using an external frequency counter, connected to either:**

- a) *the internal 10 MHz reference, or*
- b) *the Tx Output, set for CW, and an exact center frequency of (as an example) 70 MHz.*

## Utility: ID (Circuit Identification)

```
Edit Circuit ID: (< ▶ ▲ ▼ ENT)
28 CHARACTER TST MESSAGE
```

Edit the Circuit ID string. Only the bottom line is available (28 characters). The cursor edits the string by selecting the position on the bottom line using the ◀ ▶ arrow keys, then editing the character in that position using the ▲ ▼ arrow keys.

The following characters are available:

*[space] ( ) \* + - . / 0-9 and A-Z*

Once the Circuit ID string has been edited, press **ENTER**.

**Note:** Backup devices in redundant groups do not have an ID. If plug-in devices are to be grouped, naming of the group should take precedence over assigning IDs so the group, and not the individual devices, can be named.

## Utility: Display (Display Brightness)

```
Edit Display Brightness:
100% (▲ ▼ ENT)
```

Brightness levels of 25%, 50%, 75% or 100% are selectable. Edit the display brightness using the ▲ ▼ arrow keys. Once the desired brightness has been set, press **ENTER**.

## Utility: Firmware



**THESE MENUS ARE FOR DIAGNOSTIC PURPOSES ONLY. DO NOT CHANGE AN IMAGE UNLESS INSTRUCTED TO DO SO BY COMTECH EF DATA CUSTOMER SERVICE TECHNICIANS.**

The sub-menus available through **Utility: Firmware** permit the user to view information about the CLO-10 internal firmware. The modem stores two complete firmware images, and the user can select which image will be loaded the next time the unit reboots.

```
Firmware Images:
Information Select (< ▶ ENT)
```

Select either **Information** or **Select** using the ◀ ▶ arrow keys, then press **ENTER**.

If **Information** is selected:

```
Firmware Info: Bootrom
Image#1 Image#2 (< ▶ ENT)
```

The user can view information on the Bootrom and the two images. Select **Bootrom**, **Image#1**, or **Image#2** using the ◀ ▶ arrow keys, then press **ENTER**.

If **Bootrom** is selected:

```
Bootrom:          DD/MM/YY
FW/XXXXXX-X-    X.X.X
```

The user is provided information on the installed Bootrom firmware; on the top display line, the release date is provided in DAY/MONTH/YEAR format. The bottom line provides the Firmware release number and its installed version number.

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

If **Image#1** or **Image#2** are selected:

```
Image #X: Bulk
FPGA  APP
```

For **Image#1** or **Image#2**, select **Bulk**, **FPGA**, or **APP** using the ◀ ▶ arrow keys, then press **ENTER**. The information viewable on these screens is as follows:

Selection	Display Description
<b>Bulk</b>	Identifies the top-level Bulk Firmware – the overall operating system for the CLO-10 – containing the bundled FPGA and APP (Applications) firmware. The top display line identifies the bulk firmware release date in <b>DAY/MONTH/YEAR</b> format; the bottom line identifies the installed Bulk Firmware release number (FW/XXXXX-X) and its installed version (X.X.X).
<b>FPGA</b>	Identifies the FPGA Firmware bundled with the Bulk Firmware installation. The top display line identifies the firmware release date in <b>DAY/MONTH/YEAR</b> format; the bottom line identifies the firmware release number (FW/XXXXX-X) and its installed version (X.X.X).
<b>APP</b>	Identifies the Applications (microprocessor operations) Firmware bundled with the Bulk Firmware installation. The top display line identifies the firmware release date in <b>DAY/MONTH/YEAR</b> format; the bottom line identifies the firmware release number (FW/XXXXX-X) and its installed version (X.X.X).

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

## Utility: FAST (FAST Code Options)

```
FAST: Config  View
Board S/N: 123456789
```

Comtech EF Data's FAST (Fully Accessible System Topology) system permits the purchase and installation of options through special authorization codes, entered remotely or through the front panel. FAST allows immediate implementation of different options through the user interface keypad. All FAST options are available through the basic platform unit.

Select either **Config** or **View** using the ◀ ▶ arrow keys, then press **ENTER**.

If **Config** is selected:

```
Edit 20 digit FAST Code:
00000000000000000000 (ENT)
```

Enter the code *carefully* on the bottom line by using the ◀ ▶ arrow keys to move to each character position, then editing the character in that position by using the ▲ ▼ arrow keys. Once the 20-digit FAST Code has been correctly edited into place, press **ENTER**. The CLO-10 will respond with "**Configured Successfully**" if the new FAST option has been accepted:

```
Configured Successfully
(ENT or CLR)
```

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

If the FAST Code is rejected, however, the following message is displayed:

```
FAST Code Rejected!
(ENT or CLR)
```

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

If **View** is selected:

```
View Options: 01 (▲ ▼ ENT)
Bandwidth - Not Installed
```

By using the ▲ ▼ arrow keys, the user may review the Install Status for each available option. As shown in the preceding example, the option's number, description, and its Install Status are displayed either as "**Installed**" or "**Not Installed**". Press **ENTER** or **CLEAR** to return back to the previous menu.



# Appendix A. REDUNDANT SYSTEM OPERATION

---

## A.1 Introduction

The Comtech EF Data CLO-10 Link Optimizer, when operating with Firmware Version 1.2.1 or later, can be configured for redundant system operation using a distributed Daisy Chain configuration. This appendix provides detailed information for cabling, configuration and operation of the CLO-10 Daisy Chain Redundancy System.

### A.1.1 Overview

Intended for remote or hub applications, the CLO-10 Daisy Chain Redundancy System provides fully manual and automatic protection of CLO-10 Traffic Units from a simple 1:1 pair to a fully-configured 1:12 hub system.

**Figure A-1** shows a CLO-10 1:1 Daisy Chain Redundancy configuration. **Figure A-2** shows a CLO-10 1:12 Daisy Chain Redundancy configuration.

The Redundancy operation is simple. The user will assign which of the Traffic Units will be part of the redundancy system. All active Traffic Unit configurations will be “learned” by the Redundant Unit. The Redundant Unit will then continually monitor for any faulted Traffic Units. An automatic backup will occur if the Redundant detects a fault on any active Traffic Unit. In an automatic backup, the Redundant Unit will first *bridge* the Traffic Unit by configuring itself the same as the failed Traffic Unit. After remaining fault-free itself, the Redundant Unit will then force the failed Traffic Unit offline and place itself online.

A **High Speed Bus** (HSB) provides the communications interface between the Redundant Unit and Traffic Units.

For CLO-10 standalone operation, the units can have either interface card installed. The top-level menu on the unit’s front panel Vacuum Fluorescent Display (VFD) identifies which card is installed, displaying “CLO-10-1” for any unit equipped with an **Input/Output Module (IOM)**, or “CLO-10-2” for any unit equipped with an **Input/Output Switch Module (IOSM)**.

For CLO-10 Redundancy, the Redundant Unit must have the IOM installed and each Traffic Unit must have the IOSM installed.

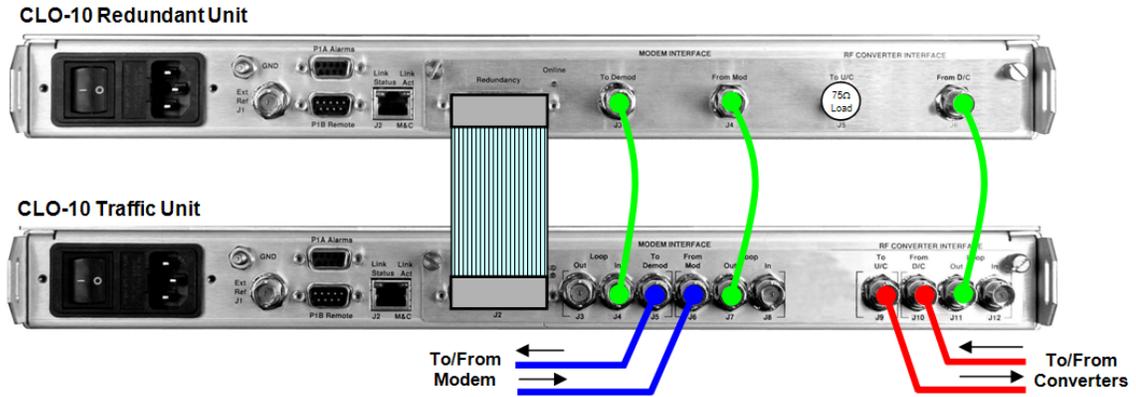


Figure A-1. CLO-10 1:1 Daisy Chain Redundancy

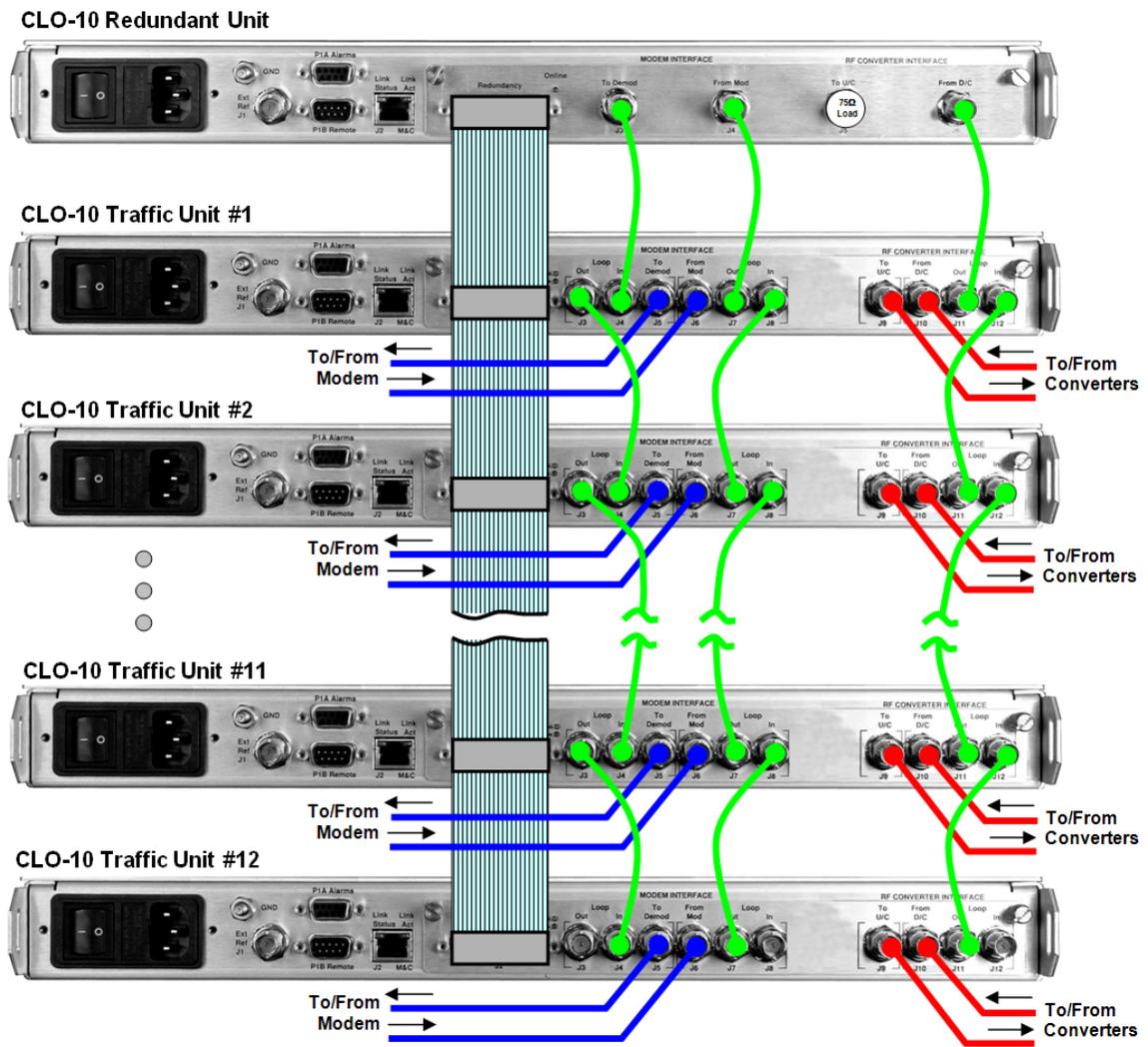


Figure A-2. CLO-10 1:N Daisy Chain Redundancy (1:12 shown)

## A.1.2 Redundancy System Operational Rules

For proper operation of the CLO-10 Daisy Chain Redundancy System, the operational rules outlined in this section should be understood by the user.

### **General Rules:**

**Rule 1: Which Traffic Unit is *Active*?** All Traffic Units are considered to be set as *Active* in the examples cited in these rules. Any Traffic Unit that is not *Active* is **not** considered part of the redundant system; it will not be polled for configuration or faults by the Redundant Unit.

**Rule 2: What to Bridge?** The Redundant Unit will *bridge* the **first** Traffic Unit set to *Active*.

**Rule 3: The Redundant Unit is not under the user's control.** Any configuration change made by the user will be overwritten on the Redundant Unit. The same is true of a Traffic Unit that is being *backed up* by the Redundant Unit.

**Rule 4: Which Traffic Unit has *Priority*?** Traffic Unit #1 has the **highest** priority. Traffic Unit #12 has the **lowest** priority.

**Rule 5: Power Recovery.** If the Redundant Unit loses power, the last known “Redundancy State” will return.

**For example:** If Traffic Unit #2 was being backed up before power is lost, it will remain backed up when power is restored.

### **For Manual Switch mode:**

**Rule 6: Just do it.** The Redundant Unit will *bridge* or *back up* any Traffic Unit selected, regardless of faults of the Traffic Unit or Redundant Unit.

### **For Automatic Switch mode:**

**Rule 7: Redundant Unit will back up highest priority failed Traffic Unit.** Any Traffic Unit that faults will first be *bridged*, then – if the Redundant Unit stays fault-free – *backed up*. If a Traffic Unit loses power, the Redundant Unit will treat the incident as a Traffic Unit fault. If a fault occurs simultaneously in two or more Traffic Units, the Redundant Unit will *bridge*, then *back up* the Traffic Unit with the **highest priority** – that is, the lowest-numbered Traffic Unit will be selected over all other Traffic Units in the redundancy system.

**Rule 8: Faulted Unit is backed up.** Once a Traffic Unit is Backed-up (offline) and no other Traffic Units show faults, the Redundant Unit will stay online unless this same Traffic Unit is now fault-free and the Redundant Unit later has faults.

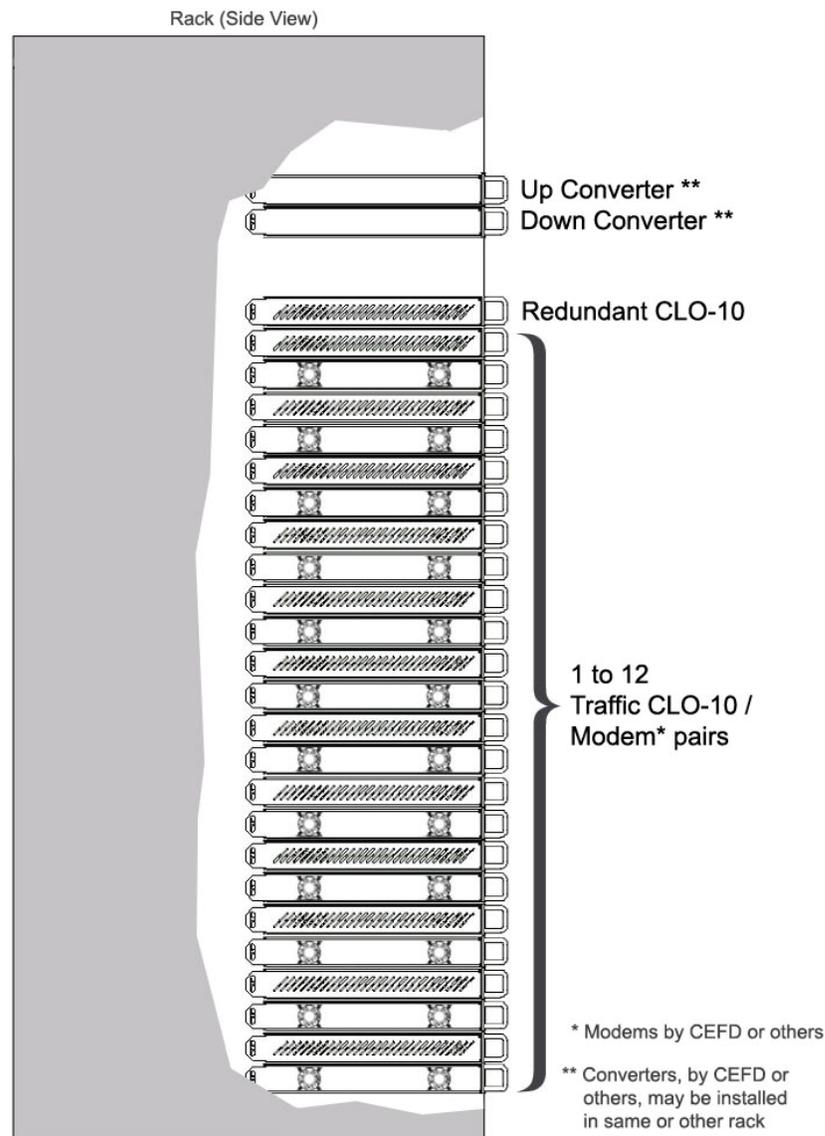
Additionally, if the Redundant Unit and Traffic Unit remains fault-free and a different Traffic Unit faults, the “restore” function will begin – the original Traffic Unit will go back online and the Redundant Unit will *bridge* and *back up* this newly failed Traffic Unit. The other option is to have the user take the Redundant Unit offline manually.

## A.2 Installation

For information pertaining to the CLO-10's unpacking, inspection, and basic rack mounting instructions, refer to **Chapter 2. INSTALLATION**.

**Figure A-3** provides a "cut-away" side view of a typical CLO-10 redundancy configuration; this example shows up to 12 CLO-10 Traffic Units with one (1) CLO-10 Redundant Unit, for use with any combination of modems and up and down converters (supplied by CEFD or others).

It is important to ensure that there is adequate clearance for ventilation in the rack. In rack systems where there is high heat dissipation, provide forced-air cooling by installing top- or bottom-mounted fans or blowers.



**Figure A-3. Typical Rack-mounted Redundancy Configuration**

## A.3 Description of Modules

The CLO-10 can be equipped with one of two possible modules: the Input/Output Module (IOM), or the Input/Output Switch Module (IOSM).

### A.3.1.1 Overview: CLO-10 with Input/Output Module (IOM)

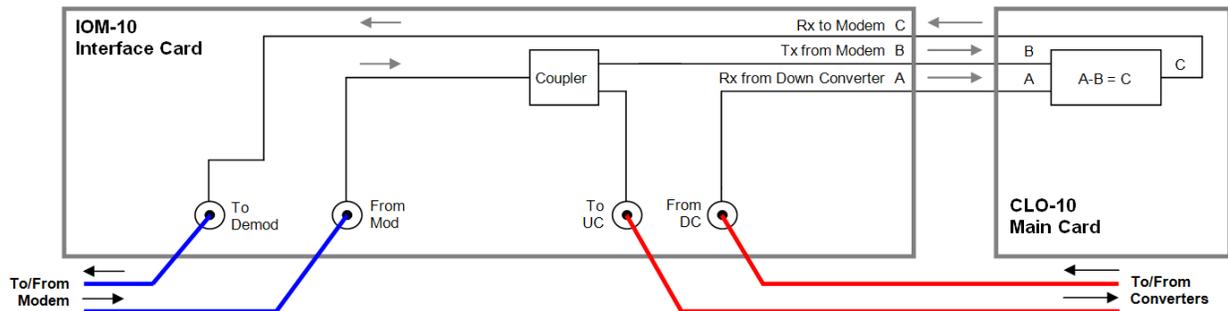
The CLO-10 with the Input/Output Module (IOM) can be used in two different configurations:

- As a **Standalone Traffic Unit** (without Daisy Chain Redundancy).
- As the **Redundant Unit** (for use within the Daisy Chain Redundancy).

**Figure A-3** shows the IOM; **Figure A-4** shows the functional block diagram of the IOM as it operates in tandem with the CLO-10 Main Card (installed in the CLO-10 chassis).



**Figure A-4. IOM (CEFD P/N PL/12833-1)**



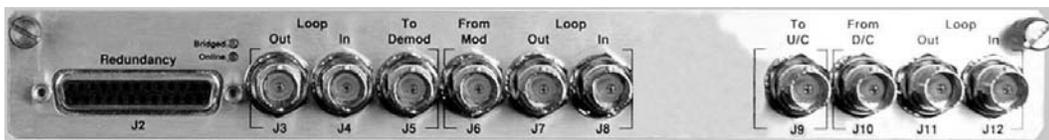
**Figure A-5. CLO-10 With IOM – Block Diagram**

### A.3.1.2 Overview: CLO-10 With Input/Output Switch Module (IOSM)

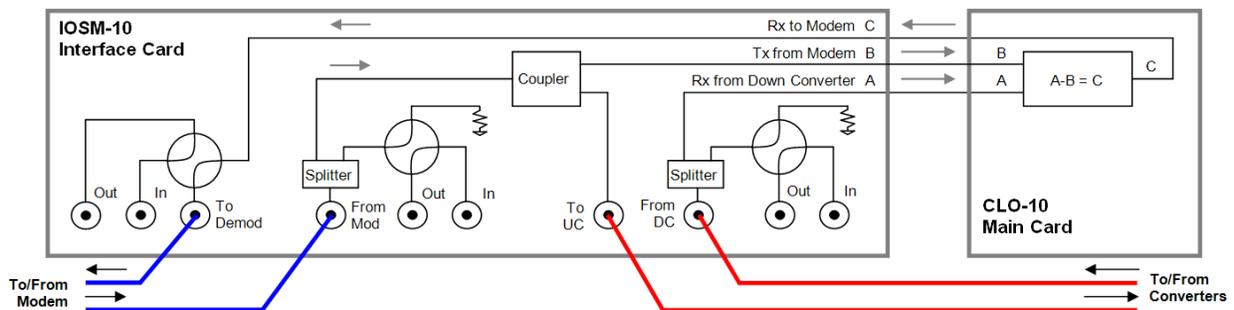
The CLO-10 with the Input/Output Switch Module (IOSM) can be used in two different configurations:

- As a **Standalone Traffic Unit** (without Daisy Chain Redundancy).  
**Note:** The J3, J4, J6, J7, J10, and J11 connectors are not used in this mode.
- As a **Traffic Unit**, from 1 up to 12 (as part of the Daisy Chain Redundancy).

**Figure A-5** shows the IOSM; **Figure A-6** shows the functional block diagram of the IOSM as it operates in tandem with the CLO-10 Main Card (installed in the CLO-10 chassis).



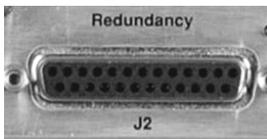
**Figure A-6. IOSM (CEFD P/N PL/12834-1)**



**Figure A-7. CLO-10 With IOSM – Block Diagram**

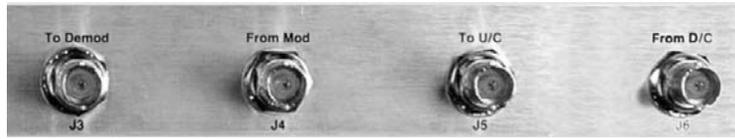
## A.3.2 Connector Pinouts

### A.3.2.1 IOM / IOSM Redundancy Connector, J2 (DB-25F)



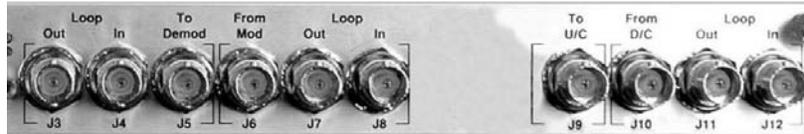
Typical for both the IOM and IOSM, the J2 Redundancy connector is a Type ‘D’ 25-pin female connector used to connect the CLO-10 to other CLO-10s in the optional Daisy Chain Redundancy system via the High Speed Bus (HSB) Cable (CEFD P/N CA/RB0014-XX-U2). This cable is used to communicate between the CLO-10-1 Redundant (controller) Unit and CLO-10-2 Traffic Unit(s).

### A.3.2.2 IOM / IOSM BNC Connectors



**Table A-1. IOM (CEFD P/N PL/12833-1) BNC Connectors Reference**

BNC Connector	Ref. Des.	Description / Function	Direction
To Demod	J3	<b>Output to Demod</b> – signal from the downconverter with the near-end carrier suppressed.	Out
From Mod	J4	<b>Input from near-end modulator</b> – used as reference copy for cancellation processing.	In
To U/C	J5	<b>Output to Upconverter</b> – same signal as J4 with up to 1.5 dB loss.	Out
From D/C	J6	<b>Composite signal from Downconverter</b> – far-end carrier signal summed with the near-end carrier.	In



**Table A-2. IOSM (CEFD P/N PL/12834-1) BNC Connectors Reference**

BNC Connector	Ref. Des.	Description / Function	Direction	
Demod Group	Loop Out	Connects the previous Traffic Unit into the Daisy Chain system.	Out	
	Loop In		In	
	To Demod	J5	<b>Output to Demod</b> – signal from the downconverter with the near-end carrier suppressed.	Out
Mod Group	From Mod	J6	<b>Input from near-end modulator</b> – used as reference copy for cancellation processing.	In
	Loop Out	J7	Connects the previous Traffic Unit into the Daisy Chain system.	Out
	Loop In	J8		In
U/C	To U/C	J9	<b>Output to Upconverter</b> – same signal as J6 with up to 5 dB loss	Out
D/C Group	From D/C	J10	<b>Composite signal from Downconverter</b> – far-end carrier signal summed with the near-end carrier.	In
	Loop Out	J11	Connects the previous Traffic Unit into the Daisy Chain system.	Out
	Loop In	J12		In

---

## A.4 Description of Operation

**Ease of Connection:** Because the redundancy switch controller resides within the CLO-10 Redundant Unit, cabling the redundancy system is remarkably simple. As shown in **Chapter 4. CABLES AND CONNECTIONS**, this is accomplished using three (3) daisy-chained IF BNC connections and a system-specific, Daisy Chain **High Speed Bus (HSB)** Cable.

The HSB interface serves several purposes:

- The Redundant Unit communicates with the Traffic Units via the HSB, along with controlling all bridge and backup functions of each Traffic Unit.
- Control of each Traffic Unit is accomplished by controlling relays in the IOSMs of the Traffic Units, via the HSB.
- The HSB does not interfere with the remote serial communication link access to any of the Units in the chain.

**Remote Operation:** For user remote serial M&C communication connection to any Traffic Unit, the user must connect only to the Redundant Unit. The Redundant Unit then passes all M&C communications through to the appropriate Traffic Unit.

**Functional Capability Requirement:** Because the Redundant Unit may back up any Traffic Unit, the Redundant Unit must be of the same or higher functional capability as the system's Traffic Units (i.e., FAST options).

**Key Reliability Features:** The CLO-10 Redundancy System incorporates the following key reliability features:

- An IOSM can be completely removed from any Traffic Unit, with cables still attached, without interrupting or affecting traffic, and
- An IOSM can be replaced without disturbing other Traffic circuits.

### A.4.1 Bridge Mode Operation

A key feature of the CLO-10 Redundancy architecture is its ability to allow the Redundant Unit to *bridge*, or mirror, a Traffic Unit. The Redundant Unit “learns” and stores each Traffic Unit's configuration, then configures itself to bridge the highest priority Traffic Unit's configuration.

The Redundant Unit is able to detect faults and reconfigure itself to replace any faulted Traffic Unit. Changes in any Traffic Unit – i.e., frequency, bandwidth, etc. – are detected by the Redundant Unit and are immediately copied. Additionally, information is obtained automatically by the Redundant Unit from newly added Traffic Units.

Bridge Mode allows incoming IF signals from the modem's Tx IF and Downconverter IF to feed, via two IF splitters on the bridged Traffic Unit's IOSM, to both the online Traffic Unit #2 and the Redundant Unit. These signals allow the Redundant Unit to operate under the exact same conditions and configuration as the Traffic Unit that is being bridged. No external test equipment is needed to determine the health of the Redundant Unit.

**Figure A-8** shows the functional block diagram of Bridge Mode. In this example, Traffic Unit #2 is being bridged and, as the figure shows, the only energized “baseball” switches are on Traffic Unit #2.

## A.4.2 Backup Mode Operation

Backup Mode is similar to Bridge Mode, with an added function: In Backup Mode, the Redundant Unit completely replaces the Traffic Unit. More specifically, the Redundant Unit will now be online, and the failed Traffic Unit will go offline. The output IF signal directed to the demodulator is subsequently taken from the Redundant Unit.

**Figure A-9** shows the functional block diagram of Backup Mode. In this example, Traffic Unit #2 is being backed up and, as the figure shows, all of the “baseball” switches are energized on the IOSM on Traffic Unit #2.

Backup Mode can be done manually or automatically. In automatic mode, the Redundant Unit will monitor all of the Traffic Units continuously. When a fault is detected on any of these active Traffic Units, the Redundant Unit will first bridge the faulted unit, then back it up. When a faulted Traffic Unit needs to be replaced, its IOSM can be separated from the Traffic Unit chassis, leaving the active online Redundant Unit HSB Daisy Chain intact through the IOSM switch module. The chain can be extended without affecting the online unit’s operation.

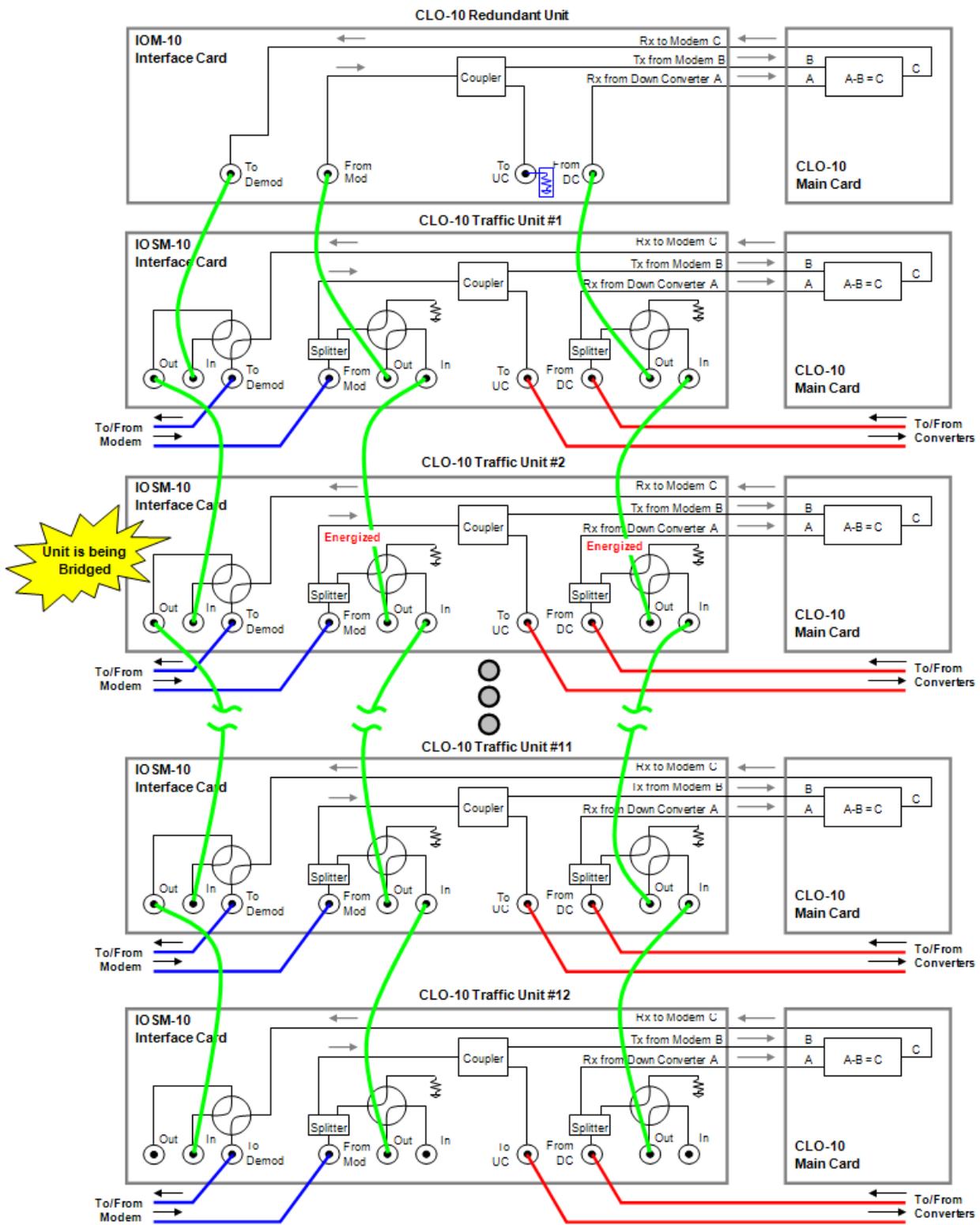


Figure A-8. CLO-10 Daisy Chain Redundancy – Bridge Mode

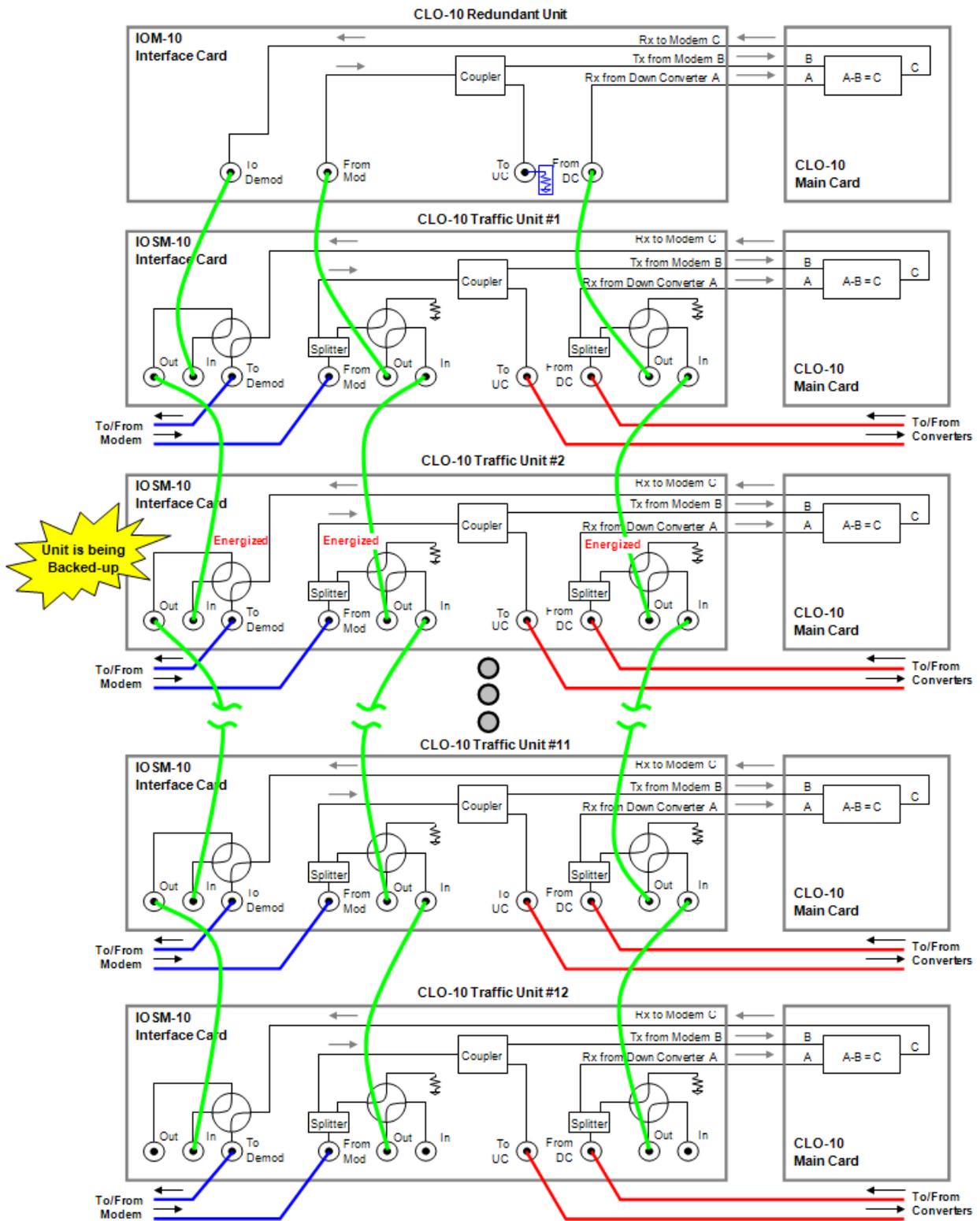


Figure A-9. CLO-10 Daisy Chain Configuration – Backup Mode

---

## A.5 Cables and Connections

Once the CLO-10s and the accompanying equipment have been mounted, the user must properly attach all required cabling. Referring to **Figure A-10** and **Figure A-11**, interconnection between all equipment in the Daisy Chain Redundancy System is accomplished as follows:

- Connect Redundancy and Traffic Unit(s) using the High Speed Bus Cable, fabricated and supplied by CEFD. This cable connects to the DB-25F J2 Redundancy connector on each unit, and consists of as few as (2X) DB-25M connectors (for the CEFD P/N **CA/RB0014-1-U2** 1:1 Cable, shown in **Figure A-10**) to as many as (13X) connectors (for the CEFD P/N **CA/RB0014-12-U2** 1:12 Cable, shown in **Figure A-11**). *There will be only as many DB-25M connectors as is required for the specific 1:N Redundancy system.*



IMPORTANT

***The unit's assignment number must match that of the numbered DB-25 connector on the High Speed Bus cable (CEFD P/N CA/RB0014-XX-U2).***

- Using CEFD-supplied BNC patch cable **CA/BNC75OHM**, first connect the inputs and outputs between the Redundant Unit and Traffic Unit #1; then, connect the inputs and outputs between each Traffic Unit subsequent in the redundancy chain.
- For the interfaces between the CLO-10, modem, and the up and down converters, use standard off-the-shelf 75Ω BNC male-to-BNC male patch cables, supplied by the user.

As an alternative to using off-the-shelf patch cables, the user may purchase IF Cable **PL/0813-4** (75Ω BNC male-to-BNC male, 4') from Comtech EF Data; this cable can be ordered at the same time the order is placed for the CLO-10 Daisy Chain Redundancy System.

### A.5.1 75Ω Load in Redundant Unit

As shown in **Figure A-10** and **Figure A-11**, a 75Ω load (CEFD P/N **CN/CXLBNCTM01**) must be installed in the J5 ("To U/C") port on the Redundant Unit's IOM. This load is needed to terminate the splitter on the IOM.

### A.5.2 1:1 Redundancy Configuration Cabling

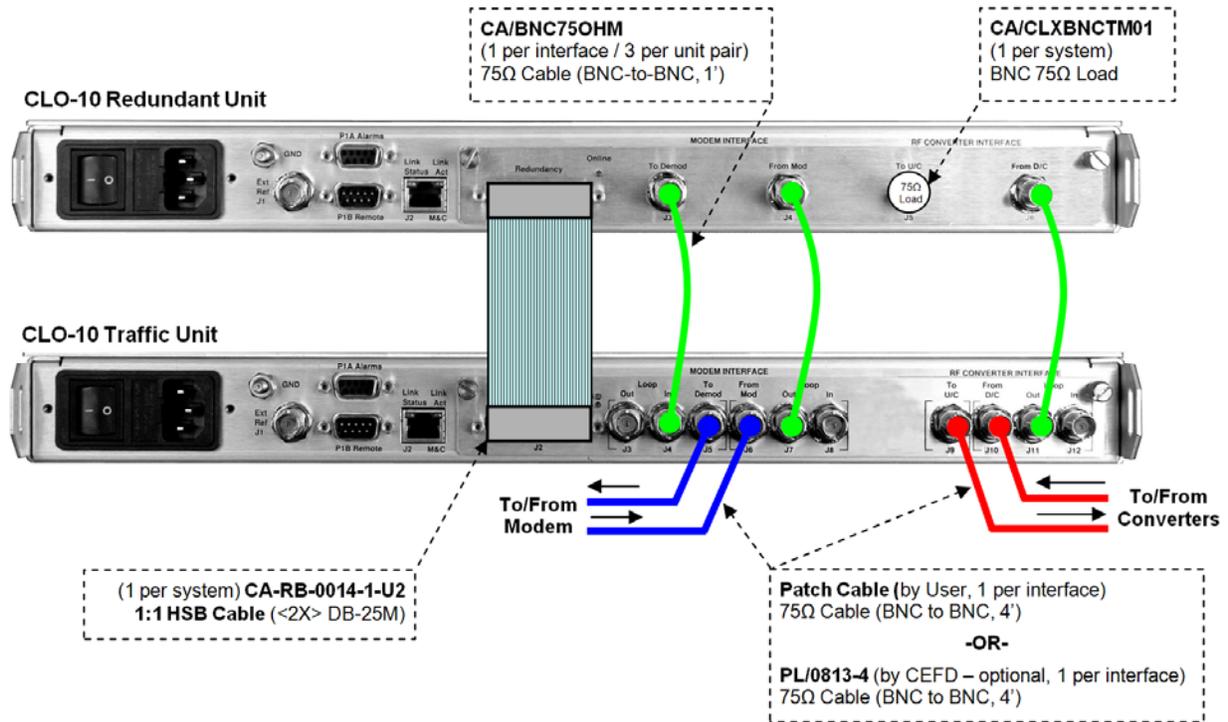


Figure A-10. CLO-10 1:1 Daisy Chain Redundancy Cabling

### A.5.3 1:N Redundancy Configuration Cabling

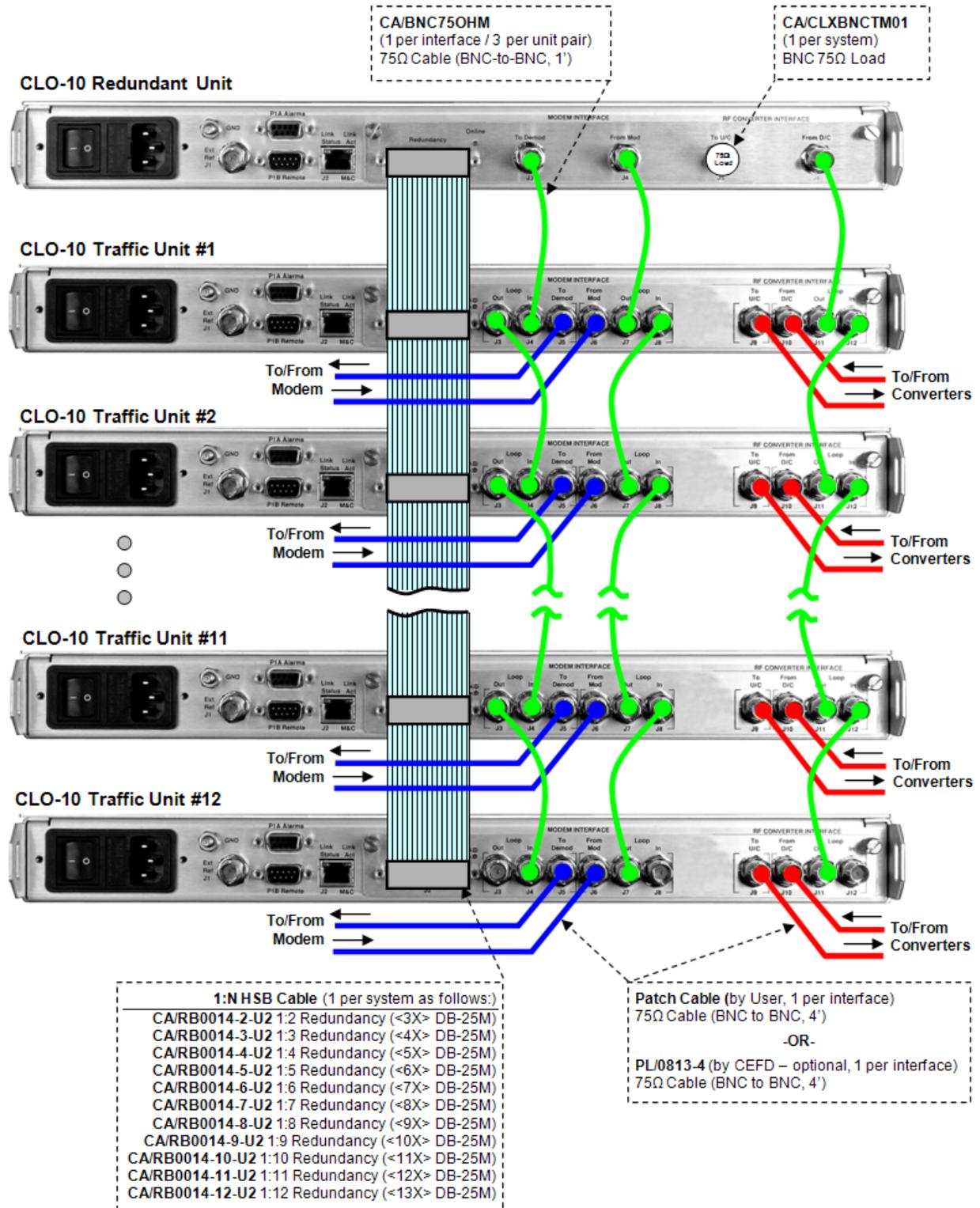


Figure A-11. CLO-10 1:N Daisy Chain Redundancy Cabling (1:12 shown)

## A.5.4 Adding and Removing CLO-10s and/or Modules

► To add an additional CLO-10:

Step	Procedure
1	Attach all cables as outlined in <b>A.3 CABLES AND CONNECTIONS</b> .
2	Configure the modem and Optimizer as outlined in <b>Chapter 4. MODEM AND OPTIMIZER CONFIGURATION</b> .

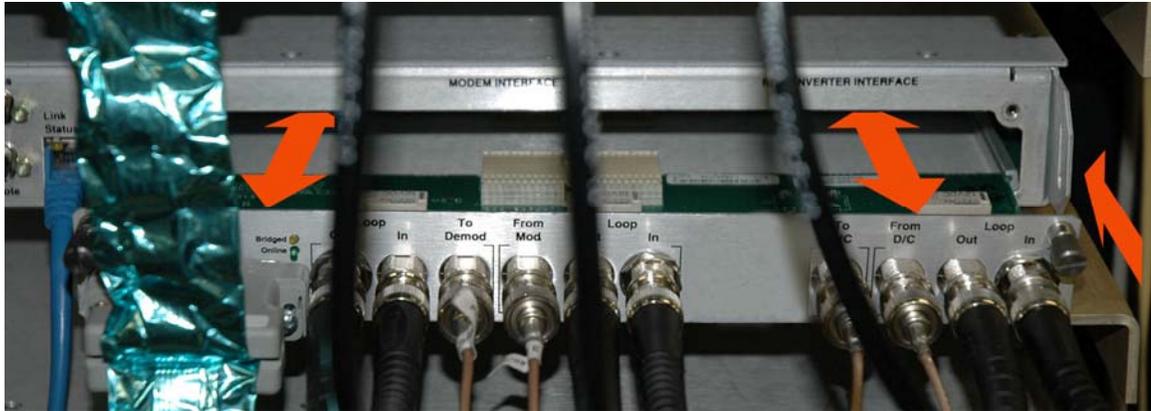


Figure A-12. Module Removal/Installation

► To remove a faulted Traffic Unit that *is not being backed up*:

Step	Procedure
1	De-activate the unit from the configuration.
2	Secure the module to the chassis using the (two) captive thumb screws.
3	Loosen the captive thumb screws securing the IOSM to the CLO-10 chassis. <b>Do not unplug the cable connections.</b>
4	Remove the module from the chassis slot by sliding the module <i>straight out</i> until it is clear of the chassis. See <b>Figure A-15</b> .

**NOTE:** It is recommended that the unit being serviced is pushed a few inches towards the front of the rack/cabinet in order to provide slack for the installed HSB cable, thus easing removal of the still-cabled module.

- ▶ To replace a faulted Traffic Unit that is being backed up by the Redundant Unit:



***Do not deactivate this unit, as the Traffic path must be maintained.***

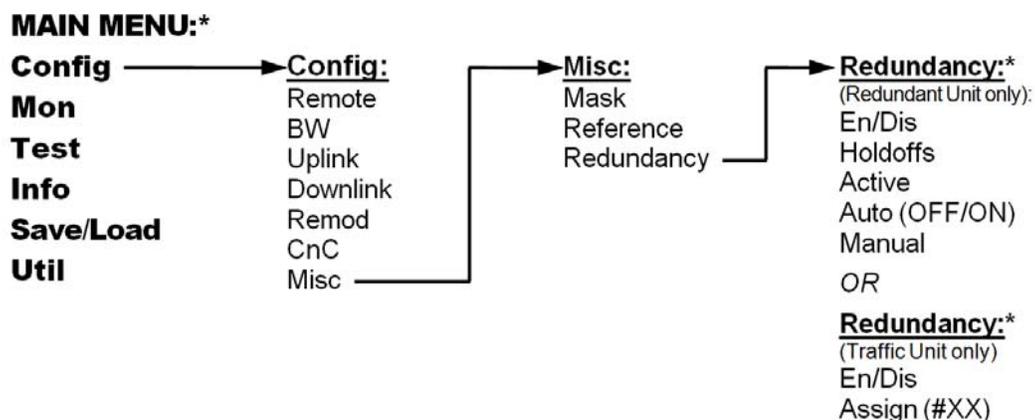
Step	Procedure
1	Power-down the unit.
2	Loosen the thumb screws securing the module to the chassis. <b><i>Do not unplug the cable connections.</i></b>
3	Remove the module from the chassis slot by sliding the module <i>straight out</i> until it is clear of the chassis.  <b>NOTE:</b> It is recommended that the unit being replaced is first pushed a few inches towards the front to the rack/cabinet in order to provide slack for the installed HSB cable, thus easing removal of the still-cabled module.  See <b>Figure A-15</b> .
4	Swap out the faulted unit with the replacement CLO-10 unit.
5	Re-install the module into the replacement CLO-10 unit by inserting the module <i>straight into</i> the chassis slot, using the chassis' internal card guides.
6	Secure the module to the replacement unit using the captive thumb screws.
7	Configure the unit as outlined in <b>Chapter 4. MODEM AND OPTIMIZER CONFIGURATION</b> . <ul style="list-style-type: none"><li>▶ <i>The new Traffic Unit should lock as it is bridging the Redundant Unit. The system will then be ready and able to cope with any other fault that may occur.</i></li><li>▶ <i>If desired, the user can go to <b>AUTO-OFF</b> (manual operation) mode, switch over the active Traffic from the Redundant CLO-10 onto the Traffic CLO-10, and then return to <b>AUTO-ON</b> (automatic operation) mode.</i></li></ul>



**Figure A-13. Operating Configuration**

## A.6 Front Panel Operation

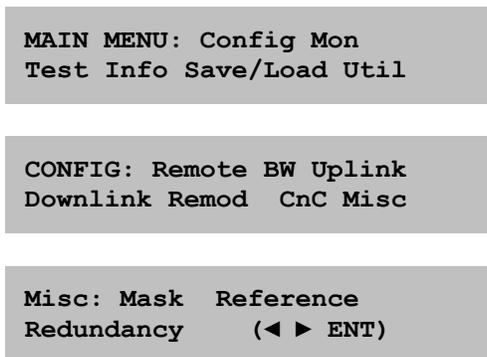
Configuration and operation of the CLO-10 in redundancy is accomplished via the CLO-10 front panel control menus. For a detailed explanation of the CLO-10's front panel, its features, and its operation, refer to **Chapter 6. FRONT PANEL OPERATION**. **Figure A-12** shows the menu tree for functions used to configure either a Redundant or a Traffic CLO-10. With the exception of setting the Redundant Unit Address (see **Sect. A.6.3.5**), all operations are accomplished from these menus:



**\*NOTE:** The appearance of the Redundancy menu will change as shown, based on the unit's configuration as a Redundant Unit (i.e., CLO-10-1 [IOM installed]), or a Traffic Unit (i.e., CLO-10-2 [IOSM installed]).

**Figure A-14. Redundancy Menu Tree**

### A.6.1 Redundancy Menu Access



For all menu selections, use the ◀ ▶ arrow keys, then press **ENTER**.

As depicted in **Figure A-12**, to reach the Redundancy menus, the user should first select the **Config** menu branch from the **MAIN MENU**; from the **CONFIG:** menu branch, select **Misc**; from the **Misc** submenu, select **Redundancy**.

## A.6.2 Traffic Unit Redundancy Configuration

Each Traffic Unit must have its Redundancy *enabled* and must be assigned a *Traffic Unit Number* that corresponds to the number labeled on the High Speed Bus (HSB) cable connector. The **Redundancy** screen is as shown:

```
Redundancy: En/Dis  
Assign (#XX)
```

Select **En/Dis** or **Assign (#XX)** using the ◀ ▶ arrow keys. The user should then press **ENTER**.

If **En/Dis** is selected:

```
Redundancy En/Dis:  
Enabled Disabled
```

This selection activates or deactivates redundancy operation for the unit. Select **Enable** or **Disable** using the ◀ ▶ arrow keys. The user should then press **ENTER**.

If **Assign (#XX)** is selected:

```
Redundancy Assign:  
CLO-10 #XX
```

The currently assigned number for the unit(#01 through #12) will be displayed. Assign the unit number for placement within a 1:N redundancy system by using the ▲ ▼ arrow keys to select **#01** through **#12**. The user should then press **ENTER**.



*The unit's assignment number must match that of the numbered DB-25 connector on the High Speed Bus cable (CEFD P/N CA/RB0014-XX-U2).*

## A.6.3 Redundant Unit Redundancy Configuration

When configuring a Redundant CLO-10, the **Redundancy** screen displays as follows:

```
Red: En/Dis Holdoffs  
Active Auto(OFF) Manual
```

Select **En/Dis**, **Holdoffs**, **Active**, **Auto**, or **Manual** using the ◀ ▶ arrow keys. The user should then press **ENTER**.

**Note:** **Auto (OFF/ON)** indicates the current status of the Operating Mode (*automatic* or *manual operating mode*).

---

### A.6.3.1 Redundancy Enable /Disable

If **En/Dis** is selected:

```
Redundancy En/Dis:  
Enabled Disabled
```

This selection activates or deactivates redundancy operation for the unit. Select **Enable** or **Disable** using the ◀ ▶ arrow keys. The user should then press **ENTER**.

---

### A.6.3.2 Redundancy Holdoffs

If **Holdoffs** is selected:

```
BACKUP HOLDOFF SEC: 05  
RESTORE HOLDOFF SEC: 10
```

Use the ◀ ▶ arrow keys to switch between the **BACKUP HOLDOFF** and **RESTORE HOLDOFF** settings, then use ▲ ▼ arrow keys to adjust the time (in seconds). Both Holdoffs can be set from 1 to 99 seconds.

When the **BACKUP HOLDOFF** and **RESTORE HOLDOFF** times have been edited, press **ENTER** to configure.

The user may set the **Holdoffs** (delay times) between the CLO-10's alarm detection and its reaction to the event. These Holdoffs are only applicable when the CLO-10 is in **AUTO-ON** (*automatic operating*) mode. When an active Traffic Unit exhibits an unmasked fault, it is bridged with the Redundant Unit and checks that the latter is not also faulted. If there is no fault, the **BACKUP HOLDOFF** determines how long the wait will be before the actual backup is performed, or when switchover of traffic to the Redundant Unit takes place.

When a Unit is currently backed up and that offline Unit's fault clears, it will continue to remain backed up unless another active Traffic Unit becomes faulted. In this case, the **RESTORE HOLDOFF** is the length of time that, if the Redundant Unit has faults, the originally faulted Traffic Unit must stay fault-free before it is automatically put back online.

---

### A.6.3.3 Active Unit Selection

If **Active** is selected:

```
ACTIVE CLO-10  
A A A - A A - A A A A A
```

Select which CLO-10 to activate. Use the ◀ ▶ arrow keys to select the unit, then use the ▲ ▼ arrow keys to activate or deactivate the unit. A hyphen (-) appears in place of the "A" (for Active) if it is deactivated. If a Traffic Unit is not installed, that position cannot be activated. A CLO-10 must be active in order for it to be available to bridge or back up. Once activated, the unit is polled for status information.

---

### A.6.3.4 Establish the Operating Mode

When adding or removing a CLO-10 in an *operating* 1:N system, it is important to keep the Traffic safe by preventing any contention in the system from an unsuppressed modem Tx carrier.

*Operating Mode* determines if the Redundancy Unit will automatically switch if it detects faults on any active Traffic Units: this is **AUTO-ON**, or *automatic operating mode*. If **AUTO-OFF** mode is selected, then the Redundancy Unit is in *manual operating mode* and it will not backup any traffic unit on its own. The user may select which Traffic Unit he wants bridged or backed up.

#### A.6.3.4.1 Switch Auto Off/On

If **Auto(OFF/ON)** is selected:

```
OPERATING MODE :  
AUTO-OFF AUTO-ON
```

**AUTO-OFF** is the *manual operating mode*, while **AUTO-ON** is the *automatic operation mode*.

Select **AUTO-OFF** or **AUTO-ON** using the ◀ ▶ arrow keys, then press **ENTER**.

When in the **AUTO-OFF** (*manual operating*) mode, the CLO-10 does not respond automatically to any unit faults and simply performs the bridge or backup settings selected by the user from the **Manual** menu (see next subsection).

When in **AUTO-ON** (*automatic operating*) mode, the system has control of backup and will automatically backup any active Traffic Unit based on its fault status.

#### A.6.3.4.2 Redundancy Unit – Manual Select

If **Manual** is selected, one of two screens may be shown.

When in **AUTO-OFF** (*manual switching*) mode, the Manual Select display would appear as shown below:

```
MANUAL SELECT :  
BRIDGE : 02  BACKUP : 02
```

When in **AUTO-OFF** (*manual operating*) mode, both of these selections are available. Use the ◀ ▶ arrow keys to select between BRIDGE and BACKUP then, using the ▲ ▼ arrow keys once again, scroll through and select which active Traffic Unit the user may want bridged or backed up. Once selected, press **ENTER** to configure.

**Figure A-13** illustrates the operational status of the front panel LEDs for a Redundant Unit and two Traffic units (in this example, Traffic Units #1 and #2). In this example, Traffic Unit #2 is being bridged in *manual operating mode*:

- On the Redundant Unit:
  - The orange **STORED EVENT** LED indicator **flashes** to alert the user that it is in Auto-Off (manual operating) mode.

- On Traffic Unit #2:
  - The green **ONLINE** LED **flashes** to indicate if that it is being bridged.

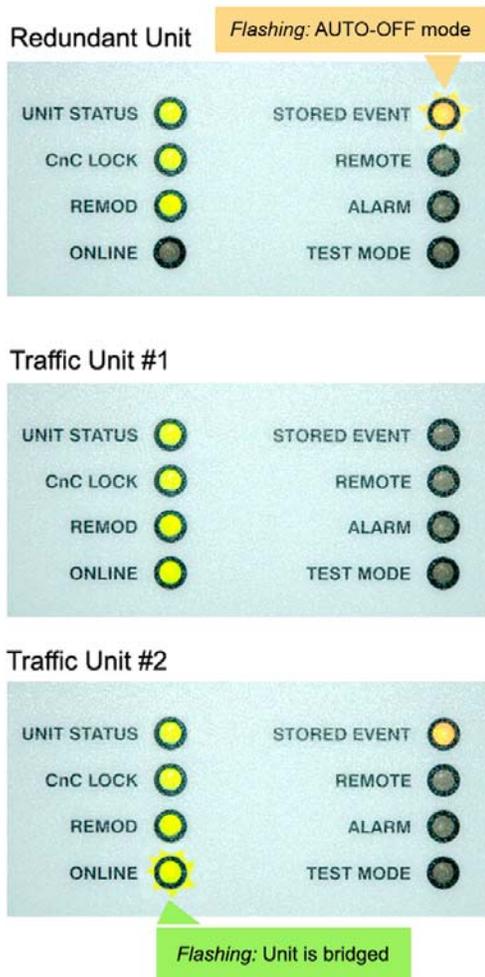
When in **AUTO-ON** (*automatic switching*) mode, the Manual Select display would appear as shown below:

```

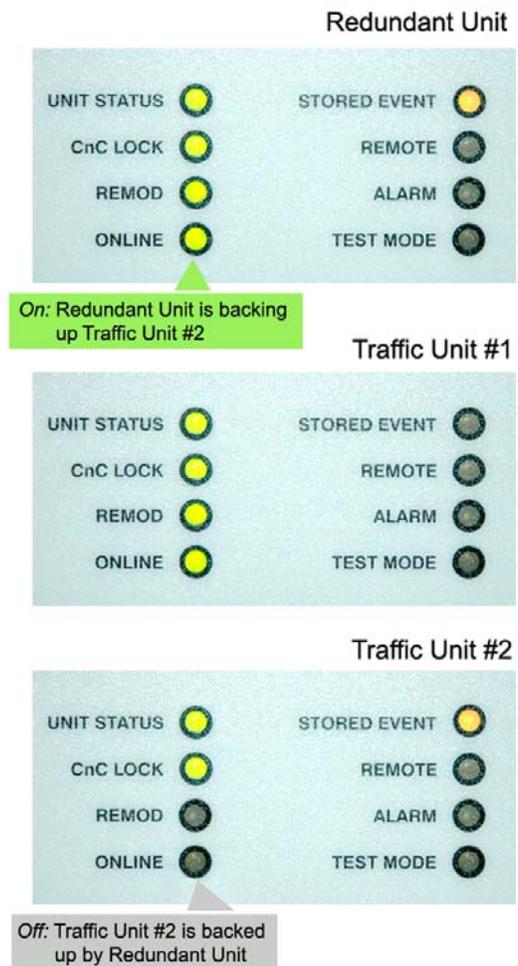
MANUAL SELECT :
BRIDGE : 02  BACKUP : AUTO
  
```

The user may select which Traffic Unit he would like bridged by the Redundancy configuration.

In **AUTO-ON** mode, the **BACKUP** selection is unavailable for manual selection, but the unit being bridged may be changed. Use the **▲ ▼** arrow keys to scroll through all active Traffic Units, skipping inactive unit slots. Press **ENTER** to configure.



**Figure A-15. Unit Bridging in AUTO-OFF (*manual operating*) Mode**



**Figure A-16. Unit Backup in AUTO-ON (*automatic operating*) Mode**

**Figure A-14** illustrates the operational status of the front panel LEDs for a Redundant Unit and two Traffic Units (in this example, Traffic Units #1 and #2). In this example, Traffic Unit #2 experiences a REMOD fault and is being backed up in *automatic operating mode*:

- On the Redundant Unit:
  - The orange **STORED EVENT** LED indicator is **on** to alert the user that a fault event has occurred that requires backup.
  - The green **ONLINE** LED is **on** to indicate that it is *online*, backing up the faulted Traffic Unit #2.
- On Traffic Unit #2:
  - The green **REMOD** LED indicator is **off** because a fault has occurred.
  - The orange **STORED EVENT** LED indicator is **on** because the REMOD fault has occurred.
  - The green **ONLINE** LED indicator is **off** because Traffic Unit #2 has been backed up to the Redundant Unit.

When the system is in **BACKUP** mode, the Redundant Unit is **online**. In this event, the user may not alter the bridge/backup state, and a message is shown instead of the menu:

```
MANUAL SELECT :  
SWITCH IS IN AUTO MODE
```

Press **CLR** or **ENT** to return to the previous menu.

The system learns and retains the configuration of all of the active units in the set-up. This configuration information is used to program the Redundant Unit to match the configuration of the Traffic Unit being bridged.

---

### A.6.3.5 Set the Redundant Unit Address via the Main Menu



**Refer to Sect. A.7 Daisy Chain Remote Addressing for detailed information about address requirements to allow M&C of the Redundant Unit.**

From the **MAIN MENU**, select the **CONFIG:** menu branch, then the **Remote** submenu (see **Sect. 6.4.1** in **Chapter 6. FRONT PANEL OPERATION** for full details).

```
MAIN MENU: Config Mon  
Test Info Save/Load Util
```

```
CONFIG: Remote BW Uplink  
Downlink Remod CnC Misc
```

From the **Remote Control** submenu, select **Serial** using the ◀ ▶ arrow keys, then press **ENTER**:

```
Remote Control:   Local
Serial Ethernet  (< ▶ ENT)
```

Next, select **Interface** using the ◀ ▶ arrow keys, then press **ENTER**. Here, the user is further prompted to enter the bus address.

```
Serial Config: Interface
Baudrate       (< ▶ ENT)
```

```
Serial Interface:   RS232
RS485-2W RS485-4W  (ENT)
```

Once the **Serial Interface** submenu is displayed, select **RS485-2W** (2-wire) or **RS485-4W** (4-wire) using the ◀ ▶ arrow keys, then press **ENTER**.

*If this unit is properly configured as a Redundant Unit, and the Redundant feature has been properly enabled, the user is prompted as follows:*

```
RS-485 Bus Address: 1000
                    (▲ ▼ ENT)
```

Select the RS-485 bus address of this unit using the ▲ ▼ arrow keys. **Valid address values are limited to 1000, 3000, 5000, and 7000.**

Once the bus address is edited, the user should press **ENTER**.

## A.6.4 Set Operation Mode

The CLO-10 is shipped in the **AUTO-OFF** (*manual operating*) mode. This setting causes the orange Stored Event LED to flash. The system is operational; however, it is still operating in **AUTO-OFF** (*manual operating*) mode. While in this mode, the user can manually select which Traffic Unit will be bridged or backed-up.

While in **AUTO-OFF** (*manual operating*) mode, the Redundant Unit does not *automatically* react to any Traffic Unit failures it detects. Comtech EF Data recommends that an unattended system be configured to operate in **AUTO-ON** (*automatic operation*) mode.

When **AUTO-ON** (*automatic operation*) mode is enabled, the first active Traffic Unit that fails is first bridged by the Redundant Unit, then backed up.

To enable **AUTO-ON** (*automatic operation*) mode:

Step	Procedure
1	Go to the <b>CONFIG → MISC → REDUNDANCY → AUTO (OFF/ON)</b> menu and select the <b>AUTO-ON</b> mode.
2	Verify that the Stored Event LED stops flashing.

### A.6.4.1.1 Set Holdoff Period

A *holdoff period* prevents unwarranted backups due to an intermittent fault. When in **AUTO-ON** (*automatic operation*) mode, additional delays may be introduced to the backup procedure by setting the number of seconds for "holdoff" before a faulted Traffic Unit cedes operation to the Redundant Unit (*backup*), or operation is returned from the Redundant Unit back to the Traffic Unit (*restore*).

The process is further explained:

If a fault occurs in a Traffic Unit, and the Redundant Unit operation is fault-free, *backup* is initiated once the configured **Backup Holdoff Period** lapses. However, if the fault clears within the holdoff's configured timeframe, no transfer of operation occurs.

Similarly, if a fault occurs in the Redundant Unit, and the Traffic Unit's operation is fault-free, *restore* is initiated once the configured **Restore Holdoff Period** lapses.

The default holdoff period is 10 seconds (a minimum of 1 second and a maximum of 99 seconds is allowed).

### A.6.4.1.2 Set Backup Holdoff Period

If a Traffic Unit fails, the Switch waits for the backup holdoff time to determine two things:

- 1) Does the Traffic Unit remain faulted?
- and*
- 2) Is the Redundant Unit not exhibiting the same fault?

If the answer is *yes* to both questions for the entire backup holdoff time, then the Redundant Unit first bridges the faulted unit. If the fault is sustained, then the switchover to the Redundant Unit is completed and the Redundant Unit carries the traffic.

There will be no switchover if the Redundant Unit is faulted. Ensure that the Holdoff times are long enough (default = 10 seconds) for the Redundant Unit to be configured and to lock onto the signal.

To set the **Backup Holdoff Period**:

Step	Procedure
1	Go to the <b>CONFIG → MISC → REDUNDANCY → HOLDOFFS</b> menu.
2	Change the <b>BACKUP HOLDOFF</b> to any number in the range of 1 to 99 seconds.

**NOTE:** The menu options available under **REDUNDANCY** automatically adjust to the configured presence of a CLO-10-1 or CLO-10-2 unit.

### A.6.4.1.3 Set Restore Holdoff Period

The "**Restore Holdoff**" setting, which is also programmable from 1 to 99 seconds, determines the Redundant Unit's ability to automatically put a backed-up Traffic Unit online again if its fault clears.

Normally, a failed unit that was taken offline will remain offline indefinitely. If the fault clears, traffic will be returned to the unit (in **AUTO-ON** (*automatic operation*) mode) only if another Traffic Unit then fails.

If the fault on the originally failed unit has been clear for the full programmed Restore Holdoff time, the Redundant Unit places that Traffic Unit back online, and bridges the newly faulted Traffic Unit. If the new fault is sustained, the Redundant Unit can then be used to backup the newly faulted Traffic Unit.

To set the **Restore Holdoff Period**:

Step	Procedure
1	Go to the <b>CONFIG → MISC → REDUNDANCY → HOLDOFFS</b> menu.
2	Change the <b>RESTORE HOLDOFF</b> to any number in the range of 1 to 99 seconds.

**NOTE:** The menu options available under **REDUNDANCY** automatically adjust to the configured presence of a CLO-10-1 or CLO-10-2 unit.

## A.7 Daisy Chain Remote Addressing

This appendix provides details of the address requirements to allow M&C of the Redundant Unit and each of the Traffic Units.

### A.7.1 Introduction to Addressing

The user can remotely communicate to the Redundancy Unit controller or any of the Traffic Units via the DB-9 RS-232/RS-485 Remote connector on the CLO-10 Redundant Unit. A direct User-to-Traffic Unit connection is not permissible in the Daisy Chain configuration: the Redundancy Unit communicates to all the Traffic Units via a DB-25 High Speed Bus (HSB) data cable.

### A.7.2 Switching Addresses

The permitted base addresses for user remote serial communication are:

- **For RS-485** connections, the only permitted addresses are 1000, 3000, 5000, and 7000.
- **For RS-232**, the only permitted address is 0000.

**Note:** The user serial remote settings within the Redundant Unit are totally independent from the internal communication between the Redundant Unit and Traffic Units.

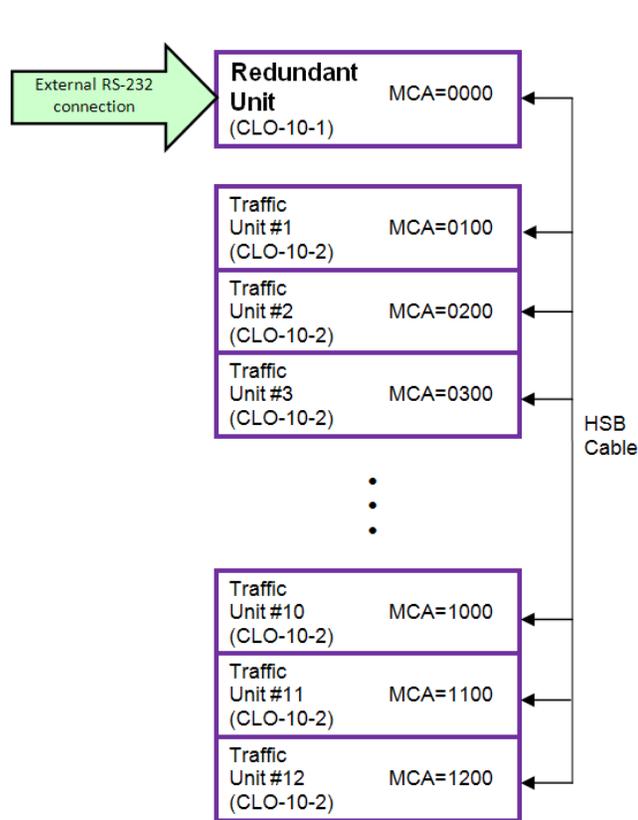
### A.7.3 Traffic Unit Addresses

Diagrams providing examples of RS-232 and RS-485 addressing schemes are included in this section, and incorporate the following terminology:

Abbreviation	Explanation
MCA	Monitor & Control Address, to be entered as the address of a unit into an M&C application.  Unit addresses are automatically assigned by the Position on the Dasiy-chained HSB to which they are associated within the redundant system.  When using RS-485 multi-drop, the redundant system RS-485 base address can be changed on the Redundant Unit by the user to 1000, 3000, 5000, or 7000 (7000 is shown in the figures in this appendix as an example only).
RCA	Remote Control Address, to be configured via the unit front panel ( <b>Main Menu: Config → Remote</b> )

In the figures that follow:

- **Figure A-17** illustrates an external RS-232 addressing scheme within a redundant system.
- **Figure A-18** depicts an external RS-485 connection within a redundant system.
- **Figure A-19** depicts an external RS-485 connection between multiple redundant systems.

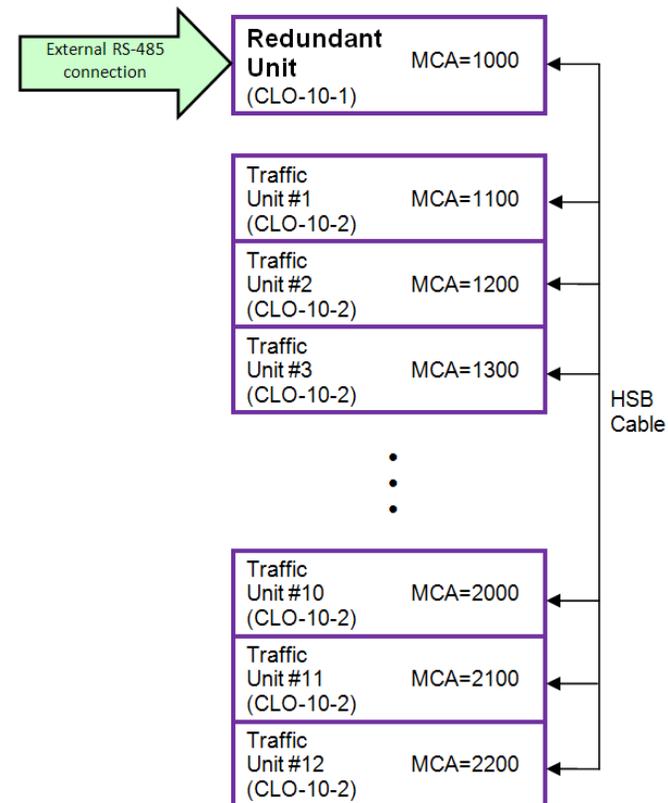


**KEY**

**MCA** = Address used by user for Monitor & Control applications for Redundant Unit and Traffic Units.

**Note:** This configuration will be supported in firmware versions beyond Version 1.2.1.

**Figure A-17. CLO-10 Daisy Chain Addressing Scheme Example: User Remote M&C RS-232**



**KEY**

**MCA** = Address used by user for Monitor & Control applications for Redundant Unit and Traffic Units.

MCA can be 1000, 3000, 5000, 7000 Base Address.

**Note:** Example depicts use of 1000 Base Address.

**Figure A-18. CLO-10 Daisy Chain Addressing Scheme Example: User Remote M&C RS-485**

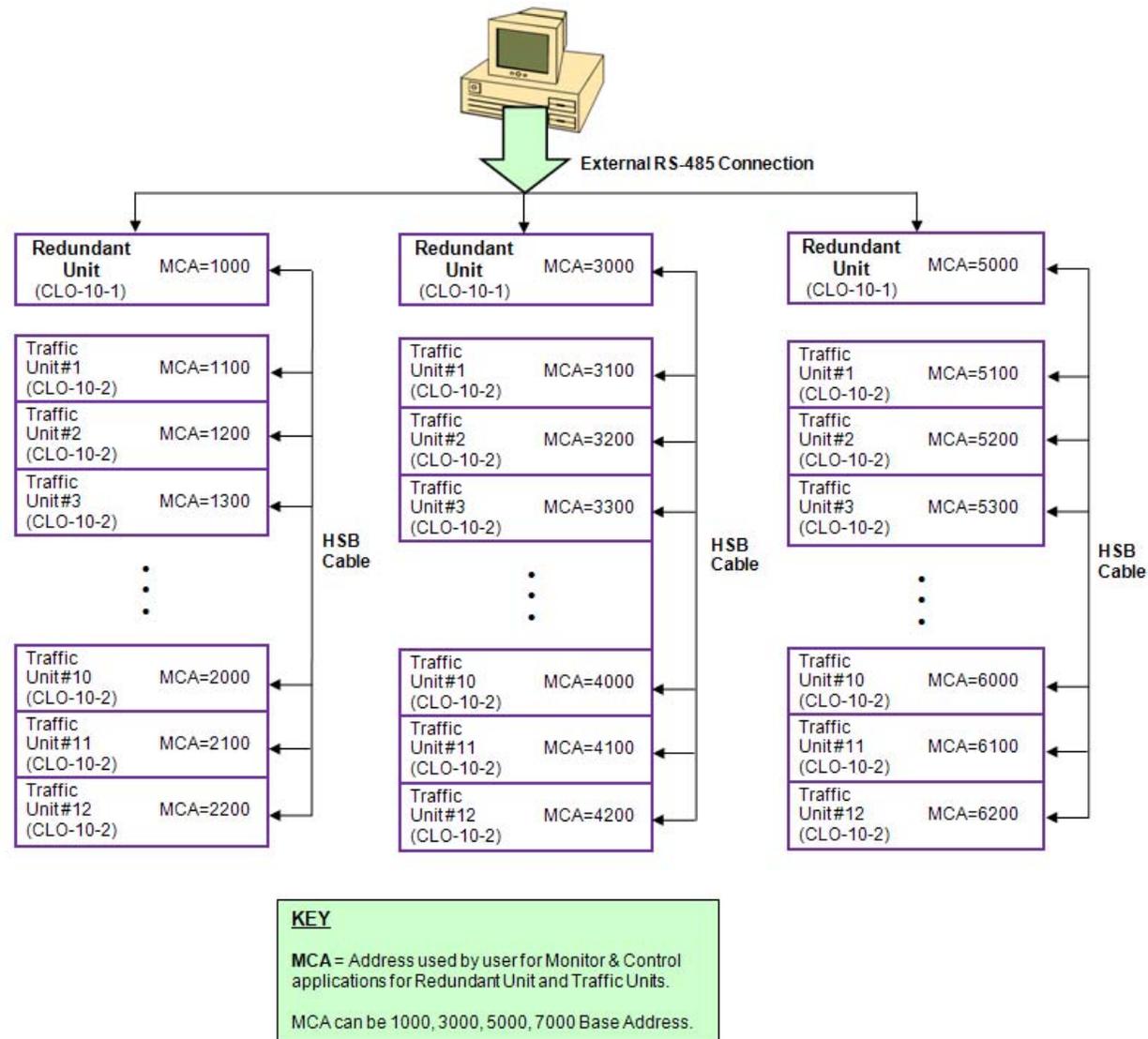


Figure A-19. CLO-10 Base Addressing Scheme Example for Daisy Chained Multiple Redundant Systems: User Remote M&C RS-485

# Appendix B. REMOTE CONTROL

---

## B.1 Overview

This section describes the protocol and message command set for remote monitor and control of the CLO-10 Link Optimizer. The protocol is based on the CLO-10, but is modified to add the new features and to separately address the four plug-in slots.

The electrical interface is either an RS-485 multi-drop bus (for the control of many devices) or an RS-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets, of variable length, in accordance with the structure and protocol defined in later sections.

---

## B.2 RS-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire) RS-485 is preferred. Half-duplex (2-wire) RS-485 is possible, but is *not preferred*.

In full-duplex RS-485 communication there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions. It is assumed that there is a 'controller' device (a PC or dumb terminal), which transmits data, in a broadcast mode, via one of the pairs. Many 'target' devices are connected to this pair, which all simultaneously receive data from the controller. The controller is the only device with a line-driver connected to this pair - the target devices only have line-receivers connected.

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

Each target has a unique address, and each time the controller transmits, in a framed 'packet' of data, the address of the intended recipient target is included. All of the targets receive the packet, but only one (the intended) will reply. The target enables its output line driver, and transmits its return data packet back to the controller, in the other direction, on the physically separate pair.

RS-485 (full duplex) summary:

Two differential pairs - one pair for **Controller-to-target**, one pair for **Target-to-controller**.

- a. **Controller-to-target** pair has one line driver (controller), and all targets have line-receivers.
- b. **Target-to-controller** pair has one line receiver (controller), and all targets have tri-state drivers.

### B.3 RS-232

This a much simpler configuration in which the controller device is connected directly to the target via a two-wire-plus-ground connection. Controller-to-target data is carried, via RS-232 electrical levels, on one conductor, and target-to-controller data is carried in the other direction on the other conductor.

### B.4 Basic Protocol

Whether in RS-232 or RS-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. In this case, the asynchronous character format is fixed at 8N1. The baud rate may vary between 1200 and 38,400 baud.

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

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

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

### B.5 Packet Structure

**Controller-to-target:**

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60  (1 character)	(4 characters)	/ ASCII code 47  (1 character)	(3 characters)	= or ? ASCII code 61 or 63  (1 character)	(n characters)	Carriage Return ASCII code 13  (1 character)

**Example:** <0135/TRQ=70.2345{CR }

### Target-to-controller:

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62  (1 character)	(4 characters)	/ ASCII code 47  (1 character)	(3 characters)	=,?,!,*,# or - ASCII code 61, 63,33,42,35, 126 (1 character)	(From 0 to n characters)	Carriage Return, Line Feed ASCII code 13,10  (2 characters)

**Example:** >0654/RSW=32{CR} {LF}

Each of the components of the packet is explained as follows:

#### B.5.1 Start of Packet

**Controller-to-Target:** This is the character ‘<’ (ASCII code 60)

**Target-to-Controller:** This is the character ‘>’ (ASCII code 62)

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message.

The controller sends a packet with the address of a target – the destination of the packet. When the target responds, the address used is the same address to indicate to the controller the source of the packet. The controller does not have its own address.

#### B.5.2 Address

The base address is programmed into a target unit using the front panel keypad.

Up to 9996 devices can be uniquely addressed. In RS-232 applications this value is set to 0; in RS-485 applications, the permissible range of values is 1 to 9996.



***The controller sends a packet with the address of a target - the destination of the packet. When the target responds, the address used is the same address, to indicate to the controller the source of the packet. The controller does not have its own address.***

#### B.5.3 Instruction Code

This is a three-character alphabetic sequence that identifies the subject of the message. Wherever possible, the instruction code is devised to serve as a mnemonic for the specific Command or Query.

**For example:** UFQ for uplink frequency

This aids in the readability of the message, should it be displayed in its raw ASCII form. Only upper case alphabetic characters may be used (A–Z, ASCII codes 65 – 90).

## B.5.4 Instruction Code Qualifier

This single character further qualifies the preceding instruction code. Code Qualifiers obey the following rules:

1. From **Controller to Target**, the only permitted values are:

<b>=</b> (ASCII code 61)	The = (ASCII code 61) is used as the <b>assignment</b> operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) that follow it.  <b>For example:</b> In a message from controller to target, TFQ=0070.0000 would mean 'set the transmit frequency to 70 MHz.'
<b>?</b> (ASCII code 63)	The ? (ASCII code 63) is used as the <b>query</b> operator, and is used to indicate that the target should return the current value of the parameter defined by the preceding byte.  <b>For example:</b> A message from the controller to target, TFQ? Would mean 'return the current value of the transmit frequency.'

2. From **Target to Controller**, the only permitted values are:

<b>=</b> (ASCII code 61)	<i>The '=' code (Target to Controller) is used in two ways:</i>  <b>First</b> , if the controller has sent a query code to a target – for example, TFQ? meaning 'what's the Transmit frequency?' – the target would respond with TFQ=xxxx.xxxx, where xxxx.xxxx represents the frequency in question.  <b>Second</b> , if the controller sends an instruction to set a parameter to a particular value, then, providing the value sent in the argument is valid, the target will acknowledge the message by replying with TFQ= (with no message arguments).
<b>?</b> (ASCII code 63)	<i>The ? code (Target to Controller) is only used as follows:</i>  If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the target will acknowledge the message by replying with (for example) TFQ? (with no message arguments). This indicates that there was an error in the message sent by the controller.
<b>!</b> (ASCII code 33)	<i>The ! code (Target to Controller) is only used as follows:</i>  If the controller sends an instruction code which the target does not recognize, the target will acknowledge the message by echoing the invalid instruction, followed by the ! character with (for example) XYZ!
<b>*</b> (ASCII code 42)	<i>The * code (Target to Controller) is only used as follows:</i>  If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is valid, BUT the link optimizer will not permit that particular parameter to be changed at that time, the target will acknowledge the message by replying with (for example) TFQ* (with no message arguments).

<b>#</b> (ASCII code 35)	<i>The # code (Target to Controller) is only used as follows:</i> If the controller sends a correctly formatted command, BUT the link optimizer is not in remote mode, it will not allow reconfiguration, and will respond with TFQ#.
<b>~</b> (ASCII Code 126)	<i>The ~ code (Target to Controller) is only used as follows:</i> This message indicates that the CLO-10 Redundancy Unit has timed out while waiting for a response from the Traffic CLO-10. Causes include unit unavailable or power 'off' condition.
<b>^</b> (ASCII Code 94)	<i>The ^ code (target-to-controller) is only used as follows:</i> The target acknowledges the message indicating that the unit is in Ethernet mode. While in Ethernet mode, the unit cannot be serially queried for link optimizer parameters. This mode will allow the user to access Telnet.
<b>@</b> (ASCII Code 64)	<i>The @ code (target-to-controller) is only used as follows:</i> The target acknowledges the message.

### B.5.5 Message Arguments

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

### B.5.6 End Of Packet

**Controller-to-Target:** This is the 'Carriage Return' character (ASCII code 13)

**Target-to-Controller:** This is the two-character sequence 'Carriage Return', 'Line Feed' (ASCII code 13, and code 10).

Both indicate the valid termination of a packet.

## B.6 Remote Commands and Queries

This section organizes the remote command and query tables in the following order:

- Switch Remote Commands and Queries for the CLO-10 Link Optimizer
- Remote Commands and Queries for the CLO-10 Link Optimizer
- Queries
- Bulk Commands and Queries

### Commands and Queries Index

Where Column 'C' = Command; Column 'Q' = Query; Columns marked (X) indicate Command only, Query only, or Command/Query for Instruction Code.

Instr Code	C	Q	Page
ACT	X	X	B-7
AUQ		X	B-7
BBU	X	X	B-7
BKH	X	X	B-7
BWC	X	X	B-10
CAE	X		B-14
CCF	X	X	B-10
CDM		X	B-18
CFM		X	B-18
CID	X	X	B-14
CLD	X		B-13
CSD	X	X	B-11
CST	X		B-13
DAY	X	X	B-14

Instr Code	C	Q	Page
EID		X	B-15
ERF	X	X	B-12
FLT		X	B-16
FRW		X	B-18
IEP	X		B-14
IMG	X	X	B-18
IPA	X	X	B-13
IRA	X	X	B-12
ITP		X	B-19
LRS	X	X	B-13
MGC	X	X	B-19
MSK	X	X	B-13
NUE		X	B-17
OPM	X	X	B-7

Inst Code	C	Q	Page
RFQ	X	X	B-9
RNE		X	B-17
RSH	X	X	B-8
SGC	X	X	B-8
SNM		X	B-18
SWR		X	B-18
TAT	X	X	B-9
TFQ	X	X	B-9
TIM	X	X	B-14
TST	X	X	B-12
TXO	X	X	B-9
UFQ	X	X	B-9
UID		X	B-15

### 'Response to Command' Codes

The following codes are used in the 'Response to Command' column:

- = Message OK
- ? Received OK, but invalid arguments found
- \* Message OK, but not permitted in current mode
- # Message OK, but unit is not in **Remote** mode
- ~ Time out of a traffic unit message
- @ Message OK
- ^ Message OK, but unit is in **Ethernet** mode.

### B.6.1 Switch Remote Commands and Queries for the CLO-10 Link Optimizer

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Operating Mode	OPM=	1 byte	Command or Query. 'x' indicates the operating mode, where: 0 = manual mode 1 = auto mode	OPM= OPM? OPM* OPM# OPM^ OPM@	OPM?	OPM=x
Bridged or Back-up Unit Number	BBU=	3 bytes	Command or Query. The bridge/back-up state, followed by the selected TU to be acted on:  x is 0 = bridge 1 = backup (only possible when in manual mode) yy is 01:12 for traffic unit number	BBU= BBU? BBU* BBU# BBU^ BBU@	BBU?	BBU=xyy
Active Units	ACT=	12 bytes	Command or Query. 'x' indicates the active state of all 12 traffic units, where: 0 = de-activate traffic unit (except in back-up) 1 = activate traffic unit	ACT= ACT? ACT* ACT# ACT^ ACT@	ACT?	ACT=xxxxxxxxxx (see description of arguments)
Active Unit Query	N/A	12 bytes	Query only. 'x' Indicates the state of all 12 traffic units, where: 0 = TU not Activated 1 = TU activated but not responding 2 = TU activated and responding	AUQ= AUQ? AUQ* AUQ# AUQ^ AUQ@	AUQ?	AUQ=xxxxxxxxxx (see description of arguments)
Backup Holdoff Time	BKH=	3 bytes	Command or Query. The backup holdoff time is the delay when auto mode prepares to backup a faulted traffic unit.	BKH= BKH? BKH * BKH # BKH ^ BKH @	BKH?	BKH =xxx (see description of arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Restore Holdoff Time	RSH=	3 bytes	Command or Query. The restore holdoff time is the delay when auto mode prepares to return a unit (previously faulted, now good) back online due to a different traffic units failure.	RSH= RSH? RSH* RSH# RSH^ RSH@	RSH?	RSH=xxx (see description of arguments)
Switch Global Configuration	SGC=	46 bytes	Command or Query. Global configuration of the switch, in the form: SGC=OBccbbrrraaaaaaaaaaaxxxxxxxxxxxxxxxxxxxxxxxxxx, where: O = Operating Mode B=Bridge/Backup State, cc traffic unit 1-12 bbb=Backup Hold-off Time rrr=Restore Hold-off Time aaaaaaaaaaaa=Active Traffic Unit xxxxxxxxxxxx = reserved xxxxxxxxxxxx = reserved	SGC = SGC ? SGC * SGC # SGC ^	SGC?	SGC=OBccbbrrraa aaaaaaaaaaxxxxxx xxxxxxxxxxxxxxxx

## B.6.2 Remote Commands and Queries For the CLO-10 Link Optimizer

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Uplink Frequency	UFQ=	9 bytes	Command or Query. 50 to 90/100 and 180 MHz (70/140 MHz units) Resolution = 100 Hz  <b>Example:</b> UFQ=0070.0000	UFQ= UFQ? UFQ* UFQ# UFQ^ UFQ@	UFQ?	UFQ=xxxx.xxxx (see description of arguments)
Downlink Frequency	RFQ=	9 bytes	Command or Query. 50 to 90/100 and 180 MHz (70/140 MHz units) Resolution = 100 Hz  <b>Example:</b> RFQ=0070.0000	RFQ= RFQ? RFQ* RFQ# RFQ^ RFQ@	RFQ?	RFQ=xxxx.xxxx (see description of arguments)
Remod Frequency	TFQ=	9 bytes	Command or Query. 50 to 90 and 100 to 180 MHz (70/140 MHz units) Resolution=100 Hz  <b>Example:</b> TFQ=0070.0000	TFQ= TFQ? TFQ* TFQ# TFQ^ TFQ@	TFQ?	TFQ=xxxx.xxxx (see description arguments)
Remod Output Enable	TXO	1 byte value. 0, 1	Command or Query. 1 = Enable the remodulation output 0 = Disable the remodulation output  <b>Example:</b> TXO=1 – Turn the remodulation output <b>on</b>	TXO= TXO? TXO* TXO# TXO^ TXO@	TXO	TXO=x
Remod Output Attenuation	TAT	1 byte value. 0 to 31.5 dB	Command or Query. 0 to 31.5 dB output attenuation in 0.5 dB steps  <b>Example:</b> TAT=25.5	TAT= TAT? TAT* TAT# TAT^ TAT@	TAT	TAT=xx.x

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Bandwidth Command	BWC=	5 bytes	Command or Query: 8 kHz to 10 MHz Valid Bandwidth Values: 256 kHz, 512 kHz, 1024 kHz, 2048 kHz, 4096 kHz, 8192 kHz, 10000 kHz  <b>Example:</b> BWC =00128 represents 128 kHz	BWC = BWC? BWC* BWC# BWC^ BWC@	BWC?	BWC =xxxxx (see description of arguments)
Carrier-in-Carrier (CnC) Frequency Offset	CCF=	9 bytes	Command or Query. CnC Sweep frequency range from 0 to 32 kHz Syntax: CCF=xxx  <b>Example:</b> CCF=030	CCF= CCF? CCF * CCF # CCF ^ CCF @	CCF?	CCF =xxx,yyy (see description of arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Carrier-in-Carrier (CnC) Search Delay	CSD=	6 bytes	<p>Command or Query.</p> <p>CnC Search Delay consists of two parameters: Link Delay and Delay Range. Link Delay 000 ms to 330 ms Delay Range 000 ms to 025 ms Search Delay Range = Link Delay +/- Delay Range Search Delay Min = Link Delay - Delay Range Search Delay Max = Link Delay + Delay Range</p> <p>This command will be rejected if any combination of the above two parameters results in a Search Delay Max that is &gt; 330 ms or a Search Delay Min &lt; 0 ms.</p> <p>Syntax: CSD=xxxxyy Where: xxx=Link Delay yyy=Delay Range</p> <p><b>Example:</b> 100020 Where Link Delay=100 ms and Delay Range=20 ms Resulting search delay min = 80 ms Resulting Search Delay max = 120 ms To set a search delay Min of 0 ms and Max = 30 ms: <b>Example:</b> 015015 Where Link Delay=015 ms and Delay Range=015 ms Resulting search delay min = 000 ms Resulting Search Delay max = 030 ms To set a search delay Min of 280 ms and Max = 330 ms: <b>Example:</b> 305025 Where Link Delay=305 ms and Delay Range=025 ms Resulting search delay min = 280 ms Resulting Search Delay max = 330 ms</p>	CSD= CSD? CSD* CSD# CSD^ CSD@	CSD?	CSD=xxxxyy (see description of arguments)
External Reference Frequency	ERF=	1 byte, value of 0 through 4 and 7	<p>Command or Query.</p> <p>External Reference Frequency, where: 0=Internal, external reference connector not used 1=External 1 MHz 2=External 2 MHz 3=External 5 MHz 4=External 10 MHz 7=External auto detect(1,2,5 or 10 MHz)</p> <p><b>Example:</b> ERF=0 (External reference not used, uses Internal)</p>	ERF= ERF? ERF* ERF# ERF^	ERF?	ERF=x (see description of arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Internal Reference Oscillator Adjust	IRA=	5 bytes, numeric	Command or Query. Fine adjustment to the internal reference oscillator tuning voltage, thereby, fine tuning the required internal reference frequency. Syntax: IRA=sxxxx Where: s = sign (- or +) Range: -2048 to +2047. <b>Example:</b> IRA=+0192	IRA= IRA? IRA* IRA# IRA^	IRA?	IRA=x (see description of arguments)
Test Mode	TST=	1 byte, value of 0 through 4	Command or Query. CLO-10 Test Mode, where: 0=Normal Mode (No Test) 1=Bypass 2=Uplink 3=TX CW 4=TX Alternating 1,0 Pattern <b>Example:</b> TST=1 (Bypass)	TST= TST? TST* TST# TST^ TST@	TST?	TST=x (see description of arguments)
Alarm Mask	MSK=	10 bytes	Command or Query. Alarm mask condition, in form abcdefghij, where: a=Unit Ext Ref Alarm (0=Unmasked, 1=Masked, X= b=Unit Acq Failure Alarm (0=Unmasked, 1=Masked, X= c=spare d=Uplink AGC Alarm (0=Unmasked, 1=Masked, X= e=Dnlink AGC Alarm (0=Unmasked, 1=Masked, X= f,g,h,i,j=spare <b>Example:</b> MSK=1001000011	MSK= MSK? MSK* MSK# MSK^	MSK?	MSK=abcdefghij (see description or arguments)
Local/Remote Status	LRS=	1 byte, value of 0, 1	Command or Query. Local/Remote status, where: 0=Local 1=Serial Remote 3=Ethernet Remote <b>Example:</b> LRS=1 (Serial Remote)	LRS= LRS? LRS* LRS#	LRS?	LRS=x (see description of arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
IP Address	IPA=	18 bytes numerical	Command or Query. Used to set the IP Address and network prefix for the 10/100 BadeTX Ethernet management port, in the format: xxx.xxx.xxx.xxx.yy, where: yy is the network prefix (0 to 31) <b>Example:</b> 010.006.030.001.24	IPA= IPA? IPA* IPA#	IPA?	IPA=xxx.xxx.xxx.xxx.yy (see description of arguments)
Configuration Save	CST=	1 byte	Command only. Causes the CLO-10 to store the current unit configuration (common functions and all four slots) in Configuration Memory location defined by the 1-byte argument (0 to 9) <b>Example:</b> CST=4 (store the current configuration in location 4)	CST= CST? CST* CST# CST^	N/A	N/A
Configuration Load	CLD=	1 byte	Command only. Causes the CLO-10 to retrieve a previously stored unit configuration (common functions and all four slots) in Configuration Memory location defined by the 1-byte argument ( 0 to 9) <b>Example:</b> CLD=4 (retrieve unit configuration from location 4)	CLD= CLD? CLD* CLD# CLD^	N/A	N/A
RTC Date	DAY=	6 bytes	Command or Query. A date in the form ddmmyy, where: dd=day of the month (01 to 31) mm=month (01 to 12) yy=year (00 to 99) <b>Example:</b> DAY=240457 (April 24, 2057)	DAY= DAY? DAY* DAY# DAY^	DAY?	DAY=ddmmyy (see description of arguments)
RTC Time	TIM=	6 bytes	Command or Query. A 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) <b>Example:</b> TIM=231259 (23 hours, 12 minutes, 59 seconds)	TIM= TIM? TIME* TIM# TIM^	TIM?	TIM= hhmmss (see description and arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Clear All Stored Events	CAE=	None	Command only. Forces the software to clear the software events log. <b>Example:</b> CAE= <b>Note:</b> This command takes no arguments.	CAE= CAE? CAE* CAE# CAE^	N/A	N/A
Initialize Events Pointer	IEP=	None	Command only. Resets internal pointer to allow RNE? Queries to start at the beginning of the stored events log.	IEP= IEP# IEP^	N/A	N/A
Circuit ID String (valid only in FW Ver. 1.2.1 or later)	CID=	28 bytes	Command or Query. Sets or queries the user-defined Circuit ID string which is a fixed length of 28 characters. Valid characters include: [Space] ( ) * + - . / 0-9 A-Z	CID= CID? CID* CID# CID^	CID?	CID= xxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxx (see description of arguments)

### B.6.3 Commands and Queries

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Equipment ID	N/A	6 bytes	<p>Query only.</p> <p>Unit returns information concerning the equipment identification and the option field in the form: aaabcd, where:</p> <p>aaa=defines the model number (CLO-10 in this case) aaa=010 for CLO-10</p> <p>b=Defines Bandwidth Options: 1=2048 MHz 2=4096 MHz 3=8192 MHz 4=10000 MHz c,d reserved</p> <p><b>Example:</b> EID=010200 means CLO-10 with 2048 Mhz option, c,d reserved (c,d always set to 0,0)</p>	N/A	EID?	EID=aaabcd  (see description of arguments)
Unit ID	N/A	4 bytes	<p>Query only.</p> <p>Unit returns information concerning the base unit identification and the option field in the form: abcdefg, where:</p> <p>a=IF Mhz 1=70/140 MHz</p> <p>b,c,d reserved b,c,d always set to 0,0,0</p>	N/A	UID?	UID=abcd (see description of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Faults and Status	N/A	12 bytes	<p>Query only.</p> <p>Unit returns the current <b>highest-priority</b> fault and status codes for the Unit (hardware), Uplink Traffic, Downlink Traffic, and Remod in the form abcdef, where:</p> <p><b>a=Unit Faults:</b>            0=No Faults            1=Power Supply Fault, +5 volts            2=Power Supply Fault, +12 volts            3=Power Supply Fault, -12 volts            4=Reference PLL Fault            5=RU Configuration Error Fault            6= Loss Of CnC Lock Alarm            7=Ext Reference Clock Alarm            8=RU Traffic Unit Communication Timeout Alarm            9=RU Traffic Unit Error Alarm            a=RU Traffic Unit Invalid Configuration Alarm            the rest are reserved for future expansion</p> <p><b><u>Items 5, 8 and 9 apply to Redundant Unit mode</u></b></p> <p><b>b=Uplink Status:</b>            0=Uplink OK            1=1<sup>st</sup> LO Synthesizer Lock Fault            2=2nd LO Synthesizer Lock Falut            3=Reference AGC Out Of Range Alarm            the rests are reserved for future expansion</p> <p><b>c=Downlink Status:</b>            0=Downlink OK            1=1<sup>st</sup> LO Synthesizer Lock Fault            2=2nd LO Synthesizer Lock Fault            3=AGC Out Of Range Alarm            the rests are reserved for future expansion</p> <p><b>d=Remod status:</b>            0= REMOD OK            1=1<sup>st</sup> LO Synthesizer Lock Fault            2=2nd LO Synthesizer Lock Fault</p>	N/A	FLT?	<p>FLT=abcdef (see description of arguments)</p> <p>e=Change in fault status since last poll.</p> <p>f=Change in unit configuration since last poll</p> <p>(see description of arguments)</p>

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Number of Unread Stored Events	N/A	3 bytes	<p>Query only.</p> <p>Unit returns the number of stored Events, which remain Unread, in the form of xxx.</p> <p><b>Note:</b> This means unread over the remote control.</p> <p><b>Example:</b> NUE=126</p>	N/A	NUE?	NUE=xxx (see description of arguments)
Retrieve next 5 unread stored Events	N/A	80 bytes	<p>Query only.</p> <p>Unit returns the oldest 5 Stored Events, which have not yet been read over the remote control. Reply format: {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}, where:</p> <p>Sub-body = ABCCddmmyyhmmss:  A being the fault/clear indicator, where:  F=Fault  C=Clear  I=Info  B being the fault type, where:  1=Unit  2=Uplink  3=Downlink  4=Remod  5=Power ON/OFF, or log cleared  CC being the Info Code, where:  0=Power Off  1=Power On  2=Log Cleared  3=Global Config Change  4=Reserved</p> <p><b>CC Fault Code numbers, as in FLT? (See FLT Query)</b></p> <p>If there are less than 5 events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNE*.</p>	N/A	RNE?	RNE= {CR}ABCCddmmyyhmm ss{CR}ABCCddmmyyhmm mss{CR}ABCCddmmyyh mss {CR}ABCCddmmyyhmm ss{CR}ABCCddmmyyhmm mss  (see description of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
CnC Delay Monitor	N/A	5 bytes	Query only. Monitors the estimated delay value of the interferer in milliseconds.  <b>Example 1:</b> CLO=229.5 (229.5 ms)	N/A	CDM?	CDM=xxx.xxx (see description of arguments)
CnC Freq Offset Monitor	N/A	6 bytes	Query only. Monitors the estimated frequency offset between desired and interferer will be calculated. Unit is in kilohertz ( kHz).  <b>Example 1:</b> CFM=+001.0 (1 kHz) <b>Example 2:</b> CFM=9999.9 (CnC not locked)	N/A	CFM?	CFM=xxxx.x (see description of arguments)
Software Revision	N/A	34-37 bytes	Query only. Unit returns the value of the internal software revision installed in the unit, in the form: Boot:x.y.z Bulk1:x.y.z Bulk2:x.y.z or Boot:x.y.zz Bulk1:x.y.zz Bulk2:x.y.zz	N/A	SWR?	SWR=Boot:x.y.zz Bulk1:x.y.zz Bulk2:x.y.zz (see description of arguments)
Software Information	N/A	variable	Query only. Complete unit software information: <b>Example:</b> FRW= Boot: FW/xxxxx-1- 1.1.1 04/30/07 Bulk1: FW/11245- 1.1.1 11/11/04 FW/11247-1- 1.1.1 11/11/04 Bulk2: FW/11245A 1.1.1 11/11/04 FW/11247-1A 1.1.1 11/11/04	N/A	FRW?	FRW=x...x (see description of arguments)
Software Image	IMG=	1 byte, value of 1 or 2	Command or Query. Current active software image, where: 1=Bulk Image #1 currently active 2=Bulk Image #2 currently active	IMG= IMG? IMG+ IMG# IMG^	IMG?	IMG=x (see description of arguments)
Serial Number of Base Unit	N/A	9 bytes	Query only. Used to query the 9-digit serial number of the unit in the form: xxxxxxxxx	N/A	SNM?	SNM=xxxxxxxxx (see description of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)
Temperature of the Base Unit	N/A	4 bytes	<p>Query only.</p> <p>Unit returns the value of the internal base unit temperature, in the form of sxxx (degrees C), where: s=sign (+ or – character) xxx=value</p> <p><b>Example:</b> ITP=+127</p>	N/A	ITP?	<p>ITP=sxxx</p> <p>(see description of arguments)</p>

### B.6.4 Bulk Commands and Queries

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments	Response to Command (Target to Controller)	Query (Instruction Code and Qualifier)	Response to query (Target to Controller)																										
Global Configuration	MGC=	80 bytes, with numerical entries, fixed values and delimiters	<p>Command or Query.</p> <p>The format is: MGC=uuuu.uuuudddd.ddddrrrr.rrrrbbbbfffggghhemmmmmmmmmcaaa.atxxxxxxxxxxxxxxxxxxxxxxxx, where:</p> <table border="0"> <tr> <td>uuuu.uuuu=Uplink Frequency</td> <td>same as UFQ</td> </tr> <tr> <td>dddd.dddd=Downlink Frequency</td> <td>same as RFQ</td> </tr> <tr> <td>rrrr.rrrr=Remod Frequency</td> <td>same as TFQ</td> </tr> <tr> <td>bbbb=Bandwidth Command</td> <td>same as BWC</td> </tr> <tr> <td>fff=CnC Frequency Offset</td> <td>same as CCF</td> </tr> <tr> <td>ggghh=CnC Search Delay</td> <td>same as CSD</td> </tr> <tr> <td>e=External Reference Clock</td> <td>same as ERF</td> </tr> <tr> <td>mmmmmmmm=Unit Alarm Mask</td> <td>same as MSK</td> </tr> <tr> <td>c=Remod Output Control</td> <td>same as TXO</td> </tr> <tr> <td>aa.a=Remod Output Attenuation</td> <td>same as TAT</td> </tr> <tr> <td>t=Unit Test Mode (Read only)</td> <td>same as TST</td> </tr> <tr> <td>xxxxxxxxxx = reserved</td> <td>reserved</td> </tr> <tr> <td>xxxxxxxxxx = reserved</td> <td>reserved</td> </tr> </table>	uuuu.uuuu=Uplink Frequency	same as UFQ	dddd.dddd=Downlink Frequency	same as RFQ	rrrr.rrrr=Remod Frequency	same as TFQ	bbbb=Bandwidth Command	same as BWC	fff=CnC Frequency Offset	same as CCF	ggghh=CnC Search Delay	same as CSD	e=External Reference Clock	same as ERF	mmmmmmmm=Unit Alarm Mask	same as MSK	c=Remod Output Control	same as TXO	aa.a=Remod Output Attenuation	same as TAT	t=Unit Test Mode (Read only)	same as TST	xxxxxxxxxx = reserved	reserved	xxxxxxxxxx = reserved	reserved	<p>MGC=</p> <p>MGC?</p> <p>MGC*</p> <p>MGC#</p> <p>MGC^</p>	<p>MGC?</p> <p>MGC?n</p>	<p>MGC=uuuu.uuuudddd.ddddrrrr.rrrrbbbbfffggghhemmmmmmmmmcaaa.atxxxxxxxxxxxxxxxxxxxxxxxxxxxx</p> <p>Where n=0 to 9</p> <p>Returns the MGC portion of 1 of 10 stored configurations</p> <p>(see description of arguments)</p>
uuuu.uuuu=Uplink Frequency	same as UFQ																															
dddd.dddd=Downlink Frequency	same as RFQ																															
rrrr.rrrr=Remod Frequency	same as TFQ																															
bbbb=Bandwidth Command	same as BWC																															
fff=CnC Frequency Offset	same as CCF																															
ggghh=CnC Search Delay	same as CSD																															
e=External Reference Clock	same as ERF																															
mmmmmmmm=Unit Alarm Mask	same as MSK																															
c=Remod Output Control	same as TXO																															
aa.a=Remod Output Attenuation	same as TAT																															
t=Unit Test Mode (Read only)	same as TST																															
xxxxxxxxxx = reserved	reserved																															
xxxxxxxxxx = reserved	reserved																															



## METRIC CONVERSIONS

### Units of Length

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

### Temperature Conversions

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

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

### Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound 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	$1.0 \times 10^3$	35.27	32.15	2.205	2.679	—



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480 • 333 • 2200 PHONE

480 • 333 • 2161 FAX