



CDM-500

Satellite Modem
Installation and Operation Manual



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Comtech EFData is an ISO 9001
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About this Manual

This manual provides installation and operation information for the Comtech EFData CDM-500 satellite modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CDM-500.

Conventions and References

Cautions and Warnings



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 English to Metric conversions.

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EFData Customer Support Department.

IMPORTANT INFORMATION - PLEASE READ BEFORE INSTALLATION AND USE

SAFETY NOTICES

Electrical Safety

The CDM-500 VSAT Modem has been shown to comply with the following safety standard:

EN 60950: Safety of Information Technology Equipment, including electrical business machines

The equipment is rated for operation over the range 100 - 240 volts AC. It has a maximum power consumption of 25 watts, and draws a maximum of 250 mA.

The user should observe the following instructions:

Fuses

The CDM-500 is fitted with two fuses - one each for line and neutral connections. These are contained within the body of the IEC power inlet connector, behind a small plastic flap.

For 230 volt AC operation, use T0.5A, 20mm fuses.

For 115 volt AC operation, use T1A fuses, 20mm fuses.

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

Environmental

The CDM-500 must not be operated in an environment where the unit is:

- Exposed to extremes of temperature outside the ambient range 0 to 50 C, 0 precipitation, condensation, or humid atmospheres above 95% RH,
- Altitudes (un-pressurised) greater than 2000 metres, excessive dust or vibration, flammable gases, corrosive or explosive atmospheres.
- Operation in vehicles or other transportable installations which are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed.

Installation

The installation and connection to the line supply must be made in compliance to local or national wiring codes and regulations.

The CDM-500 is designed for connection to a power system that has separate earth, line and neutral conductors. The equipment is not designed for connection to power system which has no direct connection to earth.

The CDM-500 is shipped with a line inlet cable suitable for use in the country of operation. If it is necessary to replace this cable, ensure the replacement has an equivalent specification. Examples of acceptable ratings for the cable include HAR, BASEC and HOXXX-X.

Examples of acceptable connector ratings include VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, BS1636A, BSI, SETI, IMQ, KEMA-KEUR and SEV.

Telecommunications Terminal Equipment Directive

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

EMC (Electromagnetic Compatibility)

The CDM-500 VSAT Modem has been demonstrated, by independent testing, to comply with the following standards:

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

FCC Part 15 Class B

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

In order that the Modem continues to comply with these standards, observe the following instructions:

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

Warranty Policy

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

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

Limitations of Warranty

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

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

Exclusive Remedies

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

Disclaimer

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

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

1 Chapter 1. INTRODUCTION

1.0 Introduction

The CDM-500 (Figure 1-1) is a very low-cost Closed Network Satellite Modem, intended for VSAT applications. It offers variable data rates from 2.4 to 512kbps, in BPSK and QPSK modes. It is extremely compact, being 1U high and 12 inches deep, and consumes only 18 watts. It has a front panel VFD display and keypad for local configuration and control, although it can be fully remote-controlled. For 1:1 applications the CDM-500 is supported by a low-cost external switch, the CRS-100. For Hub applications, the CDM-500 is supported by a low-cost 1:N switch, the CRS-200. Its fast acquisition time makes it attractive for both demand-assigned and fixed-assigned SCPC applications.



Figure 1-1. CDM-550 Satellite Modem

The CDM-500 includes, as standard, a universal data interface which eliminates the need to exchange interface cards for different applications. The interfaces offered include RS422 (EIA530) DCE, V.35 DCE, synchronous RS232 DCE, and X.21 DTE and DCE.

The internal software is both powerful and flexible, and permits the user to store, and then retrieve, up to 10 different modem configurations. The unit includes many test modes and loopbacks for rapid verification of the correct functioning of the unit. Of particular note is the IF loopback, which permits the user to perform a quick diagnostic test without having to disturb external cabling. During the loopback, all of the receive configuration parameters are temporarily changed to match those of the transmit side. When normal operation is again selected, all of the previous values are restored.

A perennial problem is that of the IF port impedance. Whilst many users select the universal standard of 50 ohms, there are many users who are still using 75 ohms. In the past this has presented difficulties for the manufacturer, who has traditionally had to offer both options. The CDM-500 eliminates this problem, by offering both impedances in the same unit. The user simply selects from the front panel which impedance he wishes to use.

In order to facilitate network management, the CDM-500 incorporates **EDMAC**, an acronym for Embedded Distant-end Monitor And Control. In this mode, an additional 5% overhead is combined with the traffic data, which permits M&C information to be added (transparently to the user), allowing access to the distant-end modem.

This mode does not require any additional cabling at either the local or distant-end Modems - access to EDMAC is via the standard M&C control port. Full monitor and control is possible, and importantly, the on/off status of the carrier at the distant-end carrier can be controlled.

The CDM-500 has been designed as a companion product for the Comtech EFData line of RF Transceivers. As such, the Modem incorporates an FSK serial link which can be activated on the Receive IF port, for the purpose of communicating with a Transceiver, if connected. In this manner, a user may monitor, configure, and control the Transceiver, using the front panel display and keypad of the Modem. The EDMAC channel may also be used to convey M&C data to a Transceiver at the distant end of a satellite link, if it is connected to a CDM-500.



Chapter 2. INSTALLATION

2.0 Unpacking

Inspect shipping containers for damage. If shipping containers are damaged, they should be kept until the contents of the shipment have been carefully inspected and checked for normal operation.

Remove the packing list from the outside of the shipping carton. Open the carton and remove the contents, checking the contents against the packing list. Verify completeness of the shipment and that the unit functions correctly. If damage is evident, contact the carrier and Comtech immediately and submit a damage report. Be sure to keep all shipping materials for the carrier's inspection.

If the unit needs to be returned to Comtech EFData, please use the original shipping container.

2.1 Mounting

If the CDM-500 is to be mounted in a rack, ensure that there is adequate clearance for ventilation. The CDM-500 does not include a cooling fan, so care must be taken that too many units are not mounted on top of each other. The limit is four units, and then a blank 1U panel must be inserted to allow sufficient airflow around the units. 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.

Note that the CDM-500 is very light - under 7 lbs (3.2 kgs), and very short – 12 ins (305 mm). For this reason, it has not been designed to have rack slides mounted to the side of the chassis. However, Comtech recommends that some method of support within the rack should be employed, such a rack shelves. If the user is any doubt, please consult the factory.

2.2 Configuration

There are no internal jumpers to configure, no interface cards to install, and no other options to install. All configuration is carried out entirely in software. The unit should first be configured locally, using the front panel keypad and display. The unit will ship with a default 64 kbps, QPSK, Rate 1/2 configuration. Please refer to the 'FRONT PANEL OPERATION' section for details on how to fully configure the unit for the desired operating parameters.

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

2.3 Select Internal IF Loop

Correct operation of the unit may be verified rapidly, without the need for externally connected equipment. From the top level menu, select TEST, then IF LOOP (refer to the 'FRONT PANEL OPERATION' section) The demod should synchronize, and the green RECEIVE TRAFFIC LED should illuminate. If the unit does not pass this test, call the factory for assistance.

2.4 Connect External Cables

Having verified correct operation in IF loop, the user should now enter his desired configuration, and proceed to connect all external cables. If difficulties are experienced, please call the factory for assistance.

Please note that the modulator gives an output power level in the range 0 to -20 dBm, and the demodulator expects to see a signal in the range -30 to -60 dBm.

3 Chapter 3. FUNCTION

3.0 Functional Description

The CDM-500 has two fundamentally different types of interface - IF and data. The data interface is a bi-directional path which connects with the customer's equipment (assumed to be the DTE) and the modem (assumed to be the DCE). The IF interface provides a bi-directional link with the satellite via the uplink and downlink equipment.

Transmit data is received by the terrestrial interface where line receivers convert the clock and data signals to CMOS levels for further processing. A small FIFO follows the terrestrial interface to facilitate the various clocking and framing options. If framing is enabled, the transmit clock and data output from the FIFO pass through the framer, where the EDMAC data is added to the main data. Otherwise, the clock and data are passed directly to the Forward Error Correction encoder. In the FEC encoder, the data is differentially encoded, scrambled, and then convolutionally encoded. Following the encoder, the data is fed to the transmit digital filters, which perform spectral shaping on the data signals. The resultant I and Q signals are then fed to the QPSK/BPSK modulator. The carrier is generated by a frequency synthesizer, and the I and Q signals directly modulate this carrier to produce an IF output signal.

The received IF signal is first translated to a fixed IF frequency, using a frequency synthesizer. An AGC circuit maintains the composite level within the IF bandwidth constant over a limited range. Following this, the signal is sampled by a high-speed (flash) A/D converter. All processing beyond this conversion is purely digital. The signal is translated down to near zero frequency by a complex mix, and then is processed by a digital Costas Loop, which performs the functions of Nyquist filtering, carrier recovery, and bit-timing recovery. The resultant demodulated signal is fed, in soft decision form, to the Viterbi (FEC) decoder. After decoding, the recovered clock and data pass to the de-framer (if EDMAC is enabled) where the overhead information is removed.

Following this, the data passes to the Plesiochronous/Doppler buffer, which has a programmable size, or may be bypassed. From here, the receive clock and data signals are routed to the terrestrial interface, and are passed to the externally connected DTE equipment.

4 Chapter 4. PHYSICAL DESCRIPTION

The CDM-500 is constructed as a 1U high rack-mounting chassis, which can be free-standing, if desired. It is provided with rack-handles at the front to facilitate its removal from, and placement into a rack. Figure 1 shows the front and rear panels of the modem.

4.1 Front Panel

On the front panel of the unit is the Vacuum Fluorescent Display (VFD), 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.

The Vacuum Fluorescent Display (VFD) is an active display showing 2 lines, each of 24 characters. It produces a pleasing blue light, the brightness of which can be controlled by the user. It has greatly superior viewing characteristics compared to a Liquid Crystal Display (LCD), and does not suffer problems of viewing angle or contrast.

The keypad comprises six individual keyswitches, mounted directly behind a fully sealed membrane overlay. They have a positive 'click' action, which provides the user with tactile feedback. These six switches are identified as UP ARROW, DOWN ARROW, RIGHT ARROW, LEFT ARROW, ENTER and CLEAR. The functions of these keys are described in the 'Front Panel Operation' section.

There are 8 LED indicators. The functions of these indicators are shown in the Table 1 below:

Table 4-1- Front Panel Led Indicators

LED	Color	Condition
Unit Status	Red	A Unit Fault exists (Example: PSU fault)
	Orange	No Unit Faults, but a Traffic Fault exists
	Green	No Unit Faults, or Traffic Faults
Transmit Traffic	Green	No Tx Traffic Faults
	Off	A Tx Traffic fault exists OR the Tx Carrier is in OFF state
Receive Traffic	Green	No Rx Traffic Faults (demod and Viterbi decoder are locked, everything is OK)
	Off	An Rx Traffic fault exists (the demod may still be OK)
On line	Green	The Unit is On Line, and carrying traffic
	Off	The Unit is Off Line (standby) - forced by externally connected 1:1 or 1:N redundancy system
Stored Event	Orange	There is a Stored Event in the log, which can be viewed from the front panel, or retrieved via the remote control interface
	Off	There are no Stored Events
Remote	Orange	The Unit is in Remote Mode - local monitoring is possible, but no local control
	Off	The Unit is in Local Mode - remote monitoring is possible, but no remote control
EDMAC Mode	Orange	Framing on, EDMAC on, and unit defined as Slave
	Off	Either no EDMAC, EDMAC Master, or Transparent mode is selected
Test Mode	Orange	A Test Mode is selected (Example: IF Loopback)
	Off	There is no Test Mode currently selected

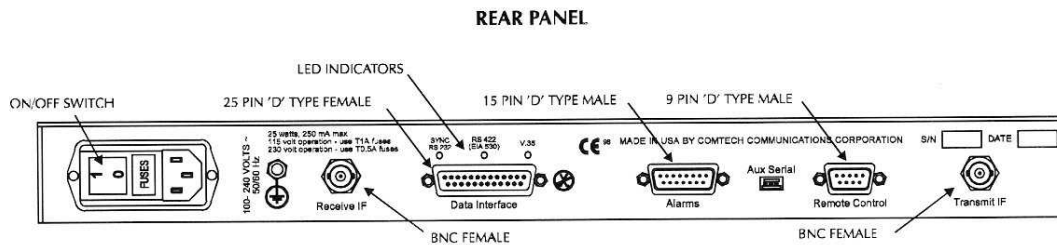
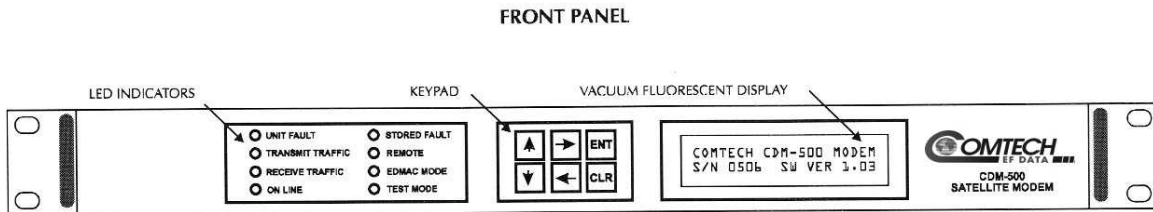


Figure 4-1 Front and Back panels

4.2 Rear Panel

All external cables are attached to connectors on the rear panel of the CDM-500. These comprise the IEC line input connector, the Receive and Transmit IF connectors, the Data connector, Alarms connector, Remote Control connector, and Auxiliary Serial 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.

For 230 volt AC operation, use T0.5A, (slow-blow) 20mm fuses.

For 115 volt AC operation, use T1A fuses, (slow-blow) 20mm fuses.

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

The IF port connectors are both a 50 ohm BNC female type. 75 ohm cable connectors (male) will have no problem mating with this 50 ohm type. The Data connector is a 25 pin 'D' type female (DB25-F). This connector conforms to the EIA 530 pinout, which allows for connection of different electrical standards, including EIA-422, V.35, and EIA-232. Please note that it is the responsibility of the user to provide the appropriate cables to connect to this EIA 530 connector. A shielded 25 pin 'D' type provides a very solid solution to EMC problems, unlike the sometimes used V.35 Winchester connector. The pinout for the EIA 530 connector is provided in the next section.

Note that currently selected interface type is indicated by a small orange LED which is located immediately above the connector. This provides an easy visual indication to anyone mating a connector at the rear of the unit.

The Alarms connector is a 15 pin 'D' type male (DB15-M). This provides the user with access to the Form-C relay contacts which indicate the fault status of the unit. These are typically connected to an external fault monitoring system, often found in satellite earth stations. In addition, the receive I and Q demodulator samples are provided on this connector. Connecting these signals to an oscilloscope in X,Y mode will provide the receive signal constellation diagram, which is a useful diagnostic aid. A pin is also provided which can mute the transmit carrier. This requires that the pin be shorted to ground, or a TTL 'low', or an EIA-232 'high' signal be applied. The pinout details for this connector are provided in the next section.

The Remote Control connector is a 9 pin 'D' type female (DB9-M). Access is provided to remote control ports of the modem, both EIA-232 and EIA-485. The pinout details for this connector are provided in the next section.

The Auxiliary Serial connector is an HE1402 3 pin header. A suitable mate for this connector is AMP part number 281838-3, with three crimp pins, AMP part number 182734-2, also required. This is an additional EIA-232 serial port, which is only used when the modem is part of a 1:1 pair, at the distant-end of a link, and when both units are defined as EDMAC slaves. The pinout details for this connector are provided in the next section.

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5 Chapter 5. CONNECTOR PINOUTS

5.1 Connector Pinouts

5.1.1 Data Connector - 25 Pin 'D' Type Female

Table 5-1 25 Pin 'D' Type Female

Pin	Generic Signal description	Direction	RS422/ EIA 530	V.35	RS232	Circuit No
1	Shield	-	Shield	FG	AA	101
2	Transmit Data A	DTE to Modem	SD A	SD A	BA	103
3	Receive Data A	Modem to DTE	RD A	RD A	BB	104
7	Signal Ground	-	SG	SG	AB	102
8	Receiver Ready A	Modem to DTE	RR A	RLSD*	CF	109
9	Receive Clock B	Modem to DTE	RT B	SCR B	-	115
10	Receiver Ready B	Modem to DTE	RR B	-	-	109
11	Transmit Clock B	DTE to Modem	TT B	SCTE B	-	113
12	Internal Transmit Clock B	Modem to DTE	ST B	SCT B	-	114
14	Transmit Data B	DTE to Modem	SD B	SD B	-	103
15	Internal Transmit Clock A	Modem to DTE	ST A	SCT A	DB	114
16	Receive Data B	Modem to DTE	RD B	RD B	-	104
17	Receive Clock A	Modem to DTE	RT A	SCR A	DD	115
23	External Carrier Off (RS232 '1' or TTL 'low')	DTE to Modem	-	-	-	-
24	Transmit Clock A	DTE to Modem	TT A	SCTE A	DA	113

NOTES:

- Receiver ready is an RS232-level control signal on a V.35 interface

- DO NOT connect signals to pins which are not shown - these pins are reserved for use by the redundancy system
- 'B' signal lines are not used for RS232 applications
- For X.21 operation, use the RS422 pins, but ignore Receive Clock if the Modem is DTE, and ignore Transmit clocks if the Modem is DCE

5.2 Alarms Connector - 15 Pin 'D' Type Male

Table 5-2 Alarms Connector

Pin	Description
1	Ground
5	Unit Fault Relay - Normally Open
12	Unit Fault Relay - Normally Closed
4	Unit Fault Relay - Common
8	Receive Traffic Relay - Normally Open
15	Receive Traffic Relay - Normally Closed
7	Receive Traffic Relay - Common
14	Transmit Traffic Relay - Normally Open
6	Transmit Traffic Relay - Normally Closed
13	Transmit Traffic Relay - Common
11	Receive I sample (for constellation display)
3	Receive Q sample (for constellation display)
2	Receive AGC voltage
9	External Carrier Off input
10	---- No Connection ----

Note:

'Normally Open' refers to the NON-FAIL state

5.3 Remote Control Connector - 9 Pin 'D' Type Male

Table 5-3 Remote Control Connector

Pin	Description
1	Ground
5	Ground
9	RS485 Transmit Data A
8	RS485 Transmit Data B
7	RS485 Receive Data A
6	RS485 Receive Data B
2	RS232 Transmit Data
3	RS232 Receive Data
4	Reserved - do not connect to this pin

5.4 Auxiliary Serial Connector - He1402 3 Pin Header

Table 5-4 Auxiliary Serial Connector

Pin	Description
1	RS232 Transmit Data
2	Ground
3	RS232 Receive Data

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Chapter 6.

FRONT PANEL OPERATION

6.1 Description

The user can fully control and monitor the operation of the CDM-500 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.

The display has two lines each of 24 characters. On most menu screens, the user will observe a flashing *solid block cursor*, which blinks at a once-per-second rate. This indicates the currently selected item, digit, or field. Where this solid block cursor would obscure the item being edited (for example, a numeric field) the cursor will automatically change to an *underline cursor*.

If the user were to display the same screen for weeks at a time, the display could become 'burnt' with this image. To prevent this, the unit has a 'screen saver' feature which will activate after 1 hour. The top line of the display will show the Circuit ID (which can be entered by the user) and the bottom line will show the circuit Eb/No value (if the demod is locked) followed by 'Press any key...'. The message moves from right to left across the screen, then wraps around. Pressing any key will restore the previous screen.

The keypad has six keys, the functions of which are described below:

RIGHT ARROW	Moves the cursor to the right, when it is displayed
LEFT ARROW	Moves the cursor to the left, when it is displayed
UP ARROW	Used for editing the value at the current cursor position, if appropriate. If this is a numeric field, this will increment the value.
DOWN ARROW	Used for editing the value at the current cursor position, if appropriate. If this is a numeric field, this will decrement the value.
ENTER (ENT)	Used to accept an edited entry. Most menus prompt the user to press this key, by displaying the text (<i>PRESS ENTER</i>), (<i>ENTER</i>) or (<i>ENT</i>). This results in the entry being accepted, and the user is then returned to the previous menu
CLEAR (CLR)	Used to escape from the current operation and return to the previous menu
IMPORTANT NOTE:	The keypad has an <i>auto-repeat</i> 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.

6.2 Menu Trees

Figure 2 shows the menu structure of the CDM-500.

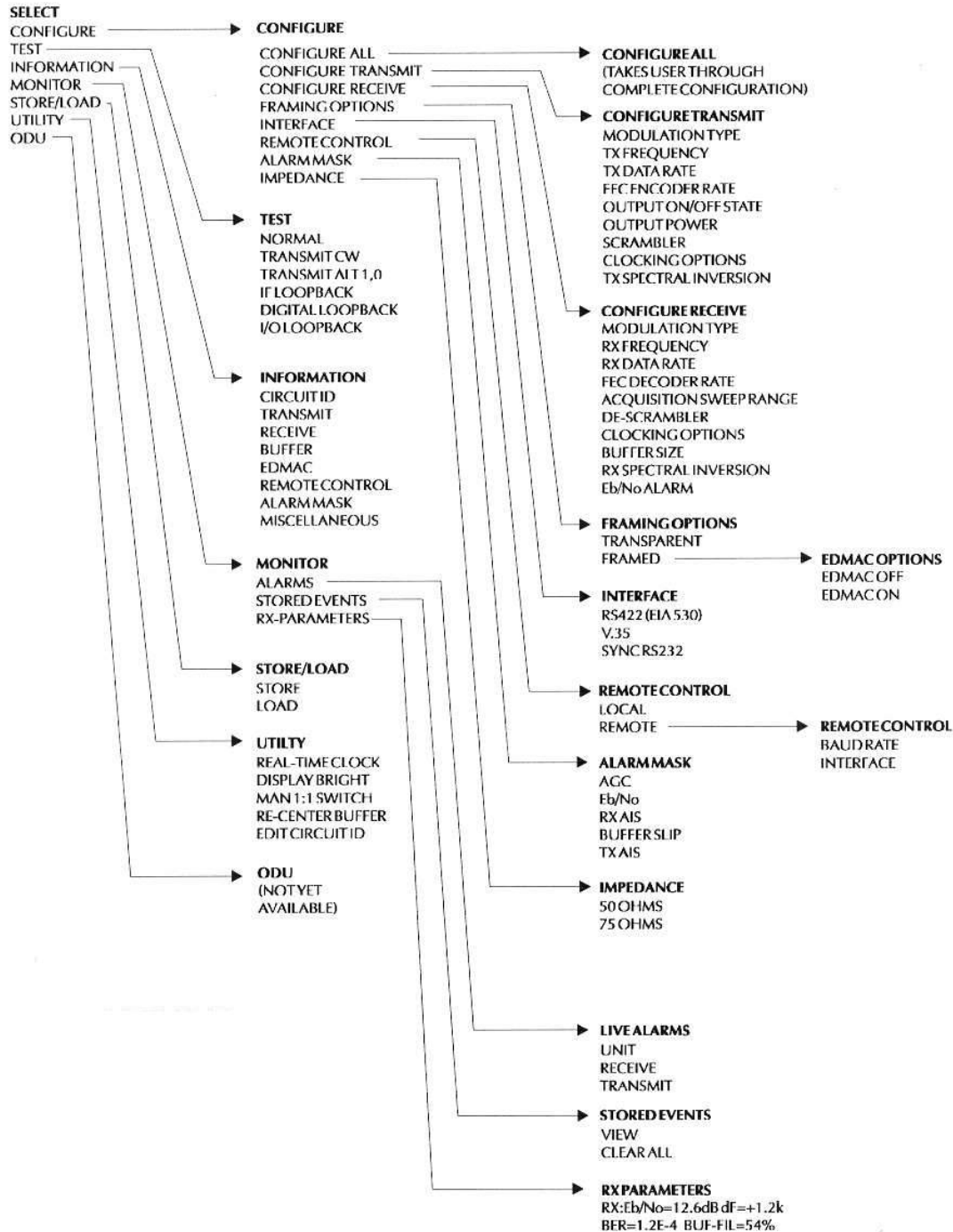


Figure 6-1 Principle Menu Tree

6.3 OPENING SCREEN

```
COMTECH CDM-500 MODEM
S/N 0102 S/W VER 1.01
```

This screen is displayed whenever power is first applied to the unit. Pressing any key will take the user to the top level selection screen:

6.4 SELECT

```
SELECT: CONFIG TEST INFO
MONIT STORE/LD UTIL ODU
```

The user is presented with the following choices:

CONFIG (Configuration)	This menu branch permits the user to fully configure the unit.
TEST	This menu branch permits the user invoke one of several test modes (loopbacks, for example).
INFO (Information)	This menu branch permits the user to view information on the unit, without having to go into configuration screens.
MONIT (Monitor)	This menu branch permits the user to monitor the alarm status of the unit, to view the log of stored events, and to display the Receive Parameters screen.
STORE/LD (Store/Load)	This menu branch permits the user to store and to retrieve up to 10 different modem configurations.
UTIL (Utility)	This menu branch permits the user to perform miscellaneous functions, such as setting the Real-time clock, adjusting the display brightness, etc.
ODU (Outdoor Unit)	This permits the user to monitor and control a Comtech RF Transceiver, if connected.

Each of these options is now described in detail.

6.5 CONFIG:

```
CONFIG: ALL TX RX FRAME
INTFC REMCONT MASK IMPED
```

The sub-branches available are:

ALL	This menu sub-branch permits the user to completely configure the unit, being prompted, step by step, to make choices, or edit data. This is highly recommended for new users, as it will clearly demonstrate all the parameters which need to be set.
TX (Transmit)	This menu sub-branch permits the user to define, on a parameter-by-parameter basis, the transmit configuration of the unit. These menu sub-branches would be used if the user wished to change, for example, just the Transmit frequency.
RX (Receive)	This menu sub-branch permits the user to define, on a parameter-by-parameter basis, the receive configuration of the unit. These menu sub-branches would be used if the user wished to change, for example, just the receive data rate.
FRAME	This menu sub-branch permits the user to define if the unit should operate in a transparent mode (no framing) or in a framed mode. In the framed mode, an overhead of 5% is added to the rate transmitted over the satellite so that M&C information may be passed to the distant end.
INTFC (Interface)	This menu sub-branch permits the user to define which electrical interface type is active at the data connector.
REMCNT (Remote Control)	This menu sub-branch permits the user to define whether the unit is being controlled locally, or remotely.
	<p>IMPORTANT NOTE:</p> <p>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 via may only be changed remote control bus.</p>
MASK	This menu sub-branch permits the user to mask certain traffic alarms, which may cause problems to the user. As an example, certain multiplexers use 'all ones' as an idle pattern. However, by convention, the 'all ones' condition is taken to be the Alarm Indication Signal (AIS). The CDM-500 monitors for the AIS condition, and if desired, this alarm may be masked.
IMPED (Impedance)	This menu sub-branch permits the user to define the impedance at the IF connectors, either 50 or 75 ohms.

Each of these options is now described in detail.

6.5.1 (CONFIG) TX (Transmit)

```
TX: MOD FREQ DATA FEC
ON/OFF PWR SCRAM CLK TSI
```

The sub-branches available are:

6.5.2 (CONFIG, TX) MOD (Modulation)

```
SELECT TX MODULATION:  
BPSK QPSK (PRESS ENTER)
```

Select BPSK or QPSK modulation, using the LEFT/RIGHT arrow keys, then press ENTER.

6.5.3 (CONFIG, TX) FREQ (Frequency)

```
EDIT TX FREQUENCY:  
72.2345 MHz (PRESS ENT)
```

Edit the transmit frequency by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press ENTER. The range of frequencies is from 52 - 88 MHz (70 MHz factory option) or 104 - 176 MHz (140 MHz factory option).

6.5.4 (CONFIG, TX) DATA (Data Rate)

```
EDIT TX DATA RATE:  
512.000 kbps (PRESS ENT)
```

Edit the transmit data rate by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press ENTER. The overall range of data rates is from 2.4 to 512 kbps.

NOTE: The minimum and maximum data rates are dependent on modulation type and FEC encoder rate. If the user changes the modulation or FEC, and the currently selected data rate is then invalid, it will be adjusted automatically.

6.5.5 (CONFIG, TX) FEC (Forward Error Correction)

```
SELECT FEC ENCODER RATE:  
1/2 3/4 7/8 (PRESS ENT)
```

Select either Rate 1/2, Rate 3/4 or Rate 7/8 encoding rate, using the LEFT/RIGHT arrow keys, then press ENTER.

NOTE: If BPSK is selected, only Rate 1/2 is permitted. A warning screen will be displayed if this sub-branch is entered when in BPSK mode.

6.5.6 (CONFIG, TX) ON/OFF

```
SELECT TX OUTPUT STATE:  
ON OFF (PRESS ENTER)
```

Select ON or OFF, using the LEFT/RIGHT arrow keys, then press ENTER.

6.5.7 (CONFIG, TX) PWR (Power)

```
EDIT OUTPUT POWER LEVEL:  
-03.9 dBm (PRESS ENTER)
```

Edit the output power level, over the range 0 to -20 dBm, by selecting the digit to be edited, using the LEFT/RIGHT arrow keys). Change the value of the digit using the UP/DOWN arrow keys. Press ENTER.

6.5.8 (CONFIG, TX) SCRAM (Scrambling)

```
SELECT TX SCRAMBLING:  
OFF ON (PRESS ENTER)
```

Select ON or OFF, using the LEFT/RIGHT arrow keys, then press ENTER. When Transparent mode is selected, a V.35 scrambler is used. In Framed mode, a frame synchronised scrambler is used.

6.5.9 (CONFIG, TX) CLK (Clocking)

```
SELECT TX CLOCKING MODE:  
INT EXT LOOP-TIMED (ENT)
```

Select either INT (Internal), EXT (External) or LOOP-TIMED, using the LEFT/RIGHT arrow keys, then press ENTER.

INTERNAL indicates that the CDM-500 will supply a clock to the DTE, which is derived from its internal high-stability source.

EXTERNAL indicates that the CDM-500 expects to receive a clock from the DTE, to which the unit can phase-lock its internal circuits.

LOOP-TIMED indicates that the transmit timing source should be the receive clock, from the direction of the satellite. This is a useful mode, in that no external connection needs to be made in this mode. If the demodulator loses lock, or if there is no receive signal present, the internal clock is substituted.

6.5.10 (CONFIG, TX) TSI (Transmit Spectral Invert)

```
SELECT TRANSMIT SPECTRAL  
INVERSION: OFF ON(ENTER)
```

Select OFF or ON, using the LEFT/RIGHT arrow keys, then press ENTER. When in the ON position, and QPSK is selected, the transmit spectrum is inverted (which is the same as reversing the direction of phase rotation in the modulator). In BPSK, the time-order of bits out of the FEC encoder is reversed, to make the modem compatible with certain other

manufacturer's modems. (Early versions of the modem did not incorporate this feature - see the INFO, MISC section for details)

6.5.11 (CONFIG) RX (Receive)

```
RX: MOD FRQ DATA FEC ACQ  
DESCRAM CLK BUF RSI Eb/No
```

The sub-branches available are:

6.5.12 (CONFIG, RX) MOD (Modulation)

```
SELECT RX MODULATION:  
BPSK QPSK (PRESS ENTER)
```

Select BPSK or QPSK modulation, using the LEFT/RIGHT arrow keys, then press ENTER.

6.5.13 (CONFIG, RX) FRQ (Frequency)

```
EDIT RX FREQUENCY:  
72.2345 MHz (PRESS ENT)
```

Edit the receive frequency by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter. The range of frequencies is from 52 - 88 MHz (70 MHz factory option) or 104 - 176 MHz (140 MHz factory option).

6.5.14 (CONFIG, RX) DATA (Data Rate)

```
EDIT RX DATA RATE:  
64.000 kbps (PRESS ENT)
```

Edit the receive data rate by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter. The overall range of data rates is from 2.4 to 512 kbps. NOTE: The minimum and maximum data rates are dependent on modulation type and FEC decoder rate. If the user changes the modulation or FEC, and the currently selected data rate is then invalid, it will be adjusted automatically.

6.5.15 (CONFIG, RX) FEC (Forward Error Correction)

```
SELECT FEC DECODER RATE:  
1/2 3/4 7/8 (PRESS ENT)
```

Select either Rate 1/2, Rate 3/4 or Rate 7/8 encoding rate, using the LEFT/RIGHT arrow keys, then press Enter.

NOTE: If BPSK is selected, only Rate 1/2 is permitted. A warning screen will be displayed if this sub-branch is entered when in BPSK mode.

6.5.16 (CONFIG, RX) ACQ (Acquisition sweep range)

```
EDIT RX ACQ SWEEP RANGE :
+/- 25 kHz (PRESS ENTER)
```

Edit the acquisition sweep range of the demodulator by selecting the digit to be edited, using the LEFT/RIGHT arrow keys). Change the value of the digit using the UP/DOWN arrow keys. Press Enter.

The range varies from +/- 1 kHz to +/- 30 kHz. The value entered here determines the amount of frequency uncertainty the demodulator will sweep over in order to find and lock to an incoming carrier. When operating at low bit rates, large values of sweep range (compared to the data rate) will cause excessively long acquisition times. For example: selecting +/- 30 kHz with a data rate of 2.4 kbps, BPSK, will result in an average acquisition time of around 5 minutes.

6.5.17 (CONFIG, RX) DESCAM (Descrambler)

```
SELECT RX DE-SCRAMBLING :
ON OFF (PRESS ENTER)
```

Select ON or OFF, using the LEFT/RIGHT arrow keys, then press Enter. When Transparent mode is selected, a V.35 descrambler is used. In Framed mode, a frame-synchronised descrambler is used. It is recommended that scrambling/descrambling be used at all times.

6.5.18 (CONFIG, RX) CLK (Clocking)

```
SELECT RX CLOCKING MODE :
BUFFER ON OFF (PRESS ENT)
```

Select OFF or ON, using the LEFT/RIGHT arrow keys, then press Enter. When OFF is selected, the Plesiochronous/Doppler buffer is disabled. The receive clock will then be derived from the satellite signal, and will therefore be subject to clock offsets relative to the local transmit clock, and a small amount (< 5%) clock jitter, due to the demodulation bit-timing recovery process at low values of Eb/No.

When ON is selected, the Plesiochronous/Doppler buffer is enabled. The input to the buffer will be the signal from the satellite, with any clock offsets and jitter. The output from the buffer will be derived from the local *TRANSMIT* clock. In this way, the receive data will be perfectly synchronous with this local clock. The CDM-500 can be operated with independent transmit receive and transmit data rates. Even in this configuration, where RX data rate <> TX data rate, the output clock for the buffer will be phase locked to the transmit clock. When the buffer is enabled, the size of the buffer may be selected using the menu below:

6.5.19 (CONFIG, RX) BUF (Buffer size)

```
EDIT RX BUFFER SIZE :  
+/-4096 BITS (PRESS ENT)
```

Edit the size of the Plesiochronous/Doppler Buffer in bits using the UP/DOWN arrow keys. Press Enter. Values of +/- 256, 512, 1024, 2048 and 4096 bits are possible. If the buffer is disabled, a warning message will be displayed if this screen is entered.

6.5.20 (CONFIG, RX) RSI (Receive spectral inversion)

```
SELECT RECEIVE SPECTRAL  
INVERSION: OFF ON(ENTER)
```

Select OFF or ON, using the LEFT/RIGHT arrow keys, then press Enter. This should normally be in the OFF position. When in the ON position, the receive spectrum is inverted (which is the same as reversing the direction of phase rotation in the demodulator). Note that in BPSK mode, the demodulator will automatically synchronize to either the normal time-ordering of bits FEC codeword pairs, or the inverted ordering used by certain other manufacturers.

6.5.21 (CONFIG, RX) Eb/No (Eb/No Alarm)

```
EDIT Eb/No ALARM POINT :  
2.0 dB (PRESS ENTER)
```

Edit the Eb/No alarm point by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter. The range of values is from 2.0 to 16.0 dB. The user may select a value here, and if the Eb/No falls below this value, a receive traffic fault will be generated.

6.5.22 (CONFIG) FRAME (Framing Mode)

```
SELECT FRAMING MODE :  
TRANSPARENT FRAMED (ENT)
```

The sub-branches available are:

6.5.23 (CONFIG, FRAME) TRANSPARENT

No framing is selected. No overhead is added, and the unit will be compatible with other manufacturer's equipment, when operating in a 'standard' configuration (IESS 308 filtering, V.35 scrambling, Viterbi).

6.5.24 (CONFIG, FRAME) FRAMED

```
SELECT FRAMING OPTION:
EDMAC-OFF EDMAC-ON ( ENT )
```

Select EDMAC-OFF or EDMAC-ON, using the LEFT/RIGHT arrow keys, then press Enter.

Embedded Distant-end Monitor And Control is enabled or disabled in this sub-menu.

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

If EDMAC-ON is selected, the user is further prompted to select whether the unit is an EDMAC master, or an EDMAC slave:

6.5.25 (CONFIG, FRAME, FRAMED) EDMAC-ON

```
SELECT EDMAC MODE:
MASTER SLAVE ( ENTER )
```

Select MASTER or SLAVE, using the LEFT/RIGHT arrow keys, then press Enter.

An EDMAC MASTER is a unit which is local to the M&C computer, and which passes messages, via the overhead, to a distant-end modem.

An EDMAC SLAVE is a unit which is *not* local to the M&C computer, which is at the distant-end of a satellite link.

If MASTER is selected then the following sub-menu is displayed:

6.5.26 (CONFIG, FRAME, FRAMED, ON) EDMAC MASTER

```
EDIT DISTANT-END'S ADDR:
0240 ( SEE HANDBOOK ) ( ENT )
```

Edit the address of the distant-end modem to which this unit will pass messages. Select the digit to be edited with the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter.

There is a restriction on values which can be entered here - they may only be in increments of 10. This is automatically taken care of - the user may not edit the last digit of the address. This has been implemented so that a single MASTER may pass messages for up to 10 devices at the distant end. The valid range of addresses is from 10 to 9990. But if SLAVE is selected, then the following sub-menu is displayed:

6.5.27 (CONFIG, FRAME, FRAMED, ON) EDMAC SLAVE

```
EDIT THIS UNIT'S ADDRESS  
0245 (SEE HANDBOOK) (ENT)
```

Edit the address of this SLAVE unit. Select the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter. The valid range of addresses is from 1 to 9999, although 'base 10' values will be automatically skipped.

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

6.5.28 (CONFIG) INTFC (Interface)

Select RS422 (EIA 530), V.35, or RS232 (synchronous), using the LEFT/RIGHT arrow keys, then press ENTER.

6.5.29 (CONFIG) REMCONT (Remote control)

```
DATA INTERFACE: RS422  
V.35 SYNC-RS232 (ENTER)
```

Select LOCAL or REMOTE using the LEFT/RIGHT arrow keys, then press Enter.

6.5.30 (CONFIG, LOCAL)

If LOCAL is selected then remote control will be disabled. Remote monitoring is still possible.

6.5.31 (CONFIG, REMOTE)

```
SELECT REMOTE CONTROL:  
LOCAL REMOTE (PRESS ENT)
```

If REMOTE is selected then the following sub-menus will be displayed:

If the unit has not been defined as an EDMAC SLAVE then:

```
REMOTE CONTROL: BAUDRATE  
INTERFACE (PRESS ENTER)
```

Select BAUDRATE or INTERFACE, using the LEFT/RIGHT arrow keys, then press Enter.

6.5.32 (CONFIG, REMOTE, BAUD)

If BAUD RATE is selected:

```
EDIT LOCAL BUS BAUDRATE:
19200 BAUD (PRESS ENTER)
```

Edit the baud rate of the remote control bus connected locally to the M&C computer. Change the value using the UP/DOWN arrow keys. Press Enter. Values of 300, 1200, 2400, 4800, 9600 and 19200 baud are possible.

Note that the asynchronous character format is FIXED at 8 data bits, 1 stop bit, no parity (8-1-N).

6.5.33 (CONFIG, REMOTE, INTFC)

If INTERFACE is selected:

```
ELECT. INTERFACE: RS232
RS485-2W RS485-4W (ENT)
```

Select RS232, RS485 (2-wire), or RS485 (4-wire), using the LEFT/RIGHT arrow keys, then press Enter. At this point the user will be further prompted to enter the bus address. In RS232 mode the bus address is fixed at 0, and the following screen will be displayed:

6.5.34 (CONFIG, REM, INTFC, ADDR) RS232 BUS ADDRESS

```
IN RS232 MODE THE BUS
ADDRESS IS FIXED AT 0000
```

However, if either RS485 mode is selected, the user will be further prompted:

6.5.35 (CONFIG, REM, INTFC, ADDR) RS485 BUS ADDRESS:

```
EDIT UNIT'S BUS ADDRESS:
0245 (PRESS ENTER)
```

Edit the RS485 bus address of this unit. Select the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Press Enter. The valid range of addresses is from 1 to 9999.

6.5.36 (CONFIG) MASK (Alarm mask)

```
ALARM MASK: AGC Eb/No
RX-AIS BUF-SLIP TX-AIS
```

Select AGC, Eb/No, RX-AIS, BUF-SLIP, or TX-AIS, using the LEFT/RIGHT arrow keys, then press Enter.

According to the choice selected, one of the following sub-menus will be displayed:

6.5.37 (CONFIG, MASK) AGC

```
SELECT AGC ALARM MASK :  
ACTIVE MASKED (PRESS ENT)
```

Select ACTIVE or MASKED, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ACTIVE, then a Receive Traffic fault will be generated whenever the demodulator senses that the composite input level being applied will cause compression in the IF stages, and hence degrade the performance of the demodulator.

If the user selects MASKED, no alarm will be generated under these conditions.

6.5.38 (CONFIG, MASK) Eb/No

```
SELECT Eb/No ALARM MASK :  
ACTIVE MASKED (PRESS ENT)
```

Select ACTIVE or MASKED, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ACTIVE, then a Receive Traffic fault will be generated whenever the demodulator determines that the Eb/No of the received carrier has fallen below the threshold defined under CONFIG, RX, Eb/No.

If the user selects MASKED, no alarm will be generated under these conditions.

6.5.39 (CONFIG, MASK) RX-AIS

```
SEL RX-AIS ALARM MASK :  
ACTIVE MASKED (PRESS ENT)
```

Select ACTIVE or MASKED, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ACTIVE, then a Receive Traffic fault will be generated whenever the demodulator senses that the 'all ones' condition is present in the receive data.

If the user selects MASKED, no alarm will be generated under these conditions.

6.5.40 (CONFIG, MASK) BUF-SLIP (Buffer slip)

```
SEL BUF-SLIP ALARM MASK :  
ACTIVE MASKED (PRESS ENT)
```

Select ACTIVE or MASKED, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ACTIVE, then a Receive Traffic fault will be generated whenever the receive circuitry senses that the buffer has either underflowed, or overflowed.

If the user selects MASKED, no alarm will be generated under these conditions.

6.5.41 (CONFIG, MASK) TX-AIS

```
SEL TX-AIS ALARM MASK :  
ACTIVE MASKED (PRESS ENT)
```

Select ACTIVE or MASKED, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ACTIVE, then a Transmit Traffic fault will be generated whenever the transmit circuitry senses that the 'all ones' condition is present in the transmit data.

If the user selects MASKED, no alarm will be generated under these conditions.

6.5.42 (CONFIG) IMPED (IF impedance)

```
SELECT IF IMPEDANCE :  
50 OHMS 75 OHMS (ENTER)
```

Select 50 ohms or 75 ohms, using the LEFT/RIGHT arrow keys, then press Enter.

6.6 TEST

```
TEST: NORM TX-CW TX-1,0
IF] DIG] I/O] (ENT)
```

Select NORM, TX-CW, TX-1,0, IF LOOP, DIG LOOP, or I/O LOOP, using the LEFT/RIGHT arrow keys, then press Enter.

This sub-menu permits the user to select the following test modes:

NORM	(Normal) This clears any test modes or loopbacks, and places the unit back into an operational state
TX-CW	(Transmit CW) This is a test mode which forces the modulator to transmit a pure carrier (unmodulated).
TX-1,0	(Transmit an alternating 1,0,1,0 pattern) This is a test mode which forces the modulator to transmit a carrier modulated with an alternating 1,0,1,0 pattern, at the currently selected symbol rate. This causes two discrete spectral lines to appear, spaced at +/- half the symbol rate, about the carrier frequency. This mode is used to check the carrier suppression of the Modulator.
IF LOOP	(IF Loopback) This test mode invokes an internal IF loop. This is a particularly useful feature, as it permits the user to perform a quick diagnostic test without having to disturb external cabling. Furthermore, all of the receive configuration parameters are temporarily changed to match those of the transmit side. When NORMAL is again selected, all of the previous values are restored.
DIG LOOP	(Digital Loopback) This test mode invokes a digital loopback, which loops data at the output of the digital FIR filter on the transmit side, back into the Viterbi decoder on the receive side. This tests all of the interface, transmit baseband circuits, FEC encoder, FEC decoder, and buffer.
I/O LOOP	(Inward/Outward loopback) This test mode invokes two distinct loopbacks. The first of these is the inward loop, which takes data being received from the satellite direction, and passes it directly to the modulator. Simultaneously, the outward loop is invoked, whereby data being fed to the transmit data interface is routed directly back out of the receive data interface.

6.7 INFO (Information)

```
INFO:ID TX RX BUFF EDMAC
      REMCONT MASK MISC(ENTER)
```

Select ID, TX, RX, BUFF, EDMAC, REMCONT, MASK, or MISC using the LEFT/RIGHT arrow keys, then press Enter.

These screens display information on the current configuration of the unit. Depending on the choice selected, one of the following screens will be displayed:

6.7.1 (INFO) ID (Circuit ID)

```
CIRCUIT ID: (ENTER)
THIS IS A TEST MESSAGE
```

This displays the user-defined Circuit ID string, which is entered via the UTIL, ID screen. To return to the previous menu, then press Enter.

6.7.2 (INFO) TX (Transmit information)

```
Tx:140.0000M 512.000k F
Q R1/2 S LOP -20.0 ON I
```

The information displayed here is as follows:

Top line, left to right:

- Transmit Frequency
- Transmit Data Rate
- Framing status (F = framing on, T = transparent)

Bottom line, left to right:

- Modulation type (Q = QPSK, B = BPSK)
- Code Rate
- Scrambler state (S = Scrambler on, N = Scrambler off)
- Clocking Mode (INT = internal, EXT = external, LOP = loop)
- Output power level
- Transmit output state (ON = on , OFF = off, EOF = external off)
- TSI state (I = Transmit Spectral Inversion on, N = off)

6.7.3 (INFO) RX (Receive information)

```
Rx:140.0000M 512.000k F
B R3/4 D BUFF +/-23.5k I
```

The information displayed here is as follows:

Top line, left to right:

- Receive Frequency
- Receive Data Rate
- Framing status (F = framing on, T = transparent)

Bottom line, left to right:

- Modulation type (Q = QPSK, B = BPSK)
- Code Rate
- Descrambler state (D = Descrambler on, N = off)
- Clocking Mode
- Demod Sweep Acquisition range
- RSI state (I = Receive Spectral Inversion on, N = off)

6.7.4 (INFO) BUFF (Buffer information)

```
BUFFER: ENABLED (TX=RX)
SIZE: +/-4096 BITS
```

This displays if the buffer is enabled or disabled, shows the exact clocking mode (TX=RX, or TX<> RX), and the buffer size. Press Enter to return to the previous menu.

6.7.5 (INFO) EDMAC (Framing and EDMAC information)

```
FRAMING: ON
EDMAC MODE: ON (SLAVE)
```

This screen shows the framing mode, EDMAC mode, and shows if the unit is an EDMAC MASTER or SLAVE. Press Enter to return to the previous menu.

6.7.6 (INFO) REMCONT (Remote Control information)

```
REM-CONTROL:ON RS485-4W
ADDRESS: 0001 19200 BAUD
```

This screen shows if the unit is in LOCAL or REMOTE mode, and gives details of the electrical interface type selected, the unit's address, and the baud rate selected. Press Enter to return to the previous menu.

6.7.7 (INFO) MASK (Alarm mask information)

```
ALARMS MASKED:
RX-AIS TX-AIS
```

This shows, in the same format as the CONFIG, MASK sub menu, which alarms are currently masked. If an alarm is not masked, a blank is displayed in the relevant screen position.

6.7.8 (INFO) MISC (Miscellaneous information)

```
MISC: IF-LOOP 50 OHMS *  
1:1 LINK IDLE ONLINE
```

This screen shows the following:

- Test mode
- IF impedance
- 1:1 link status - if the CRS-100 1:1 module is being used, this shows the status of the serial link between the two units.
- Redundancy status - either online or standby (1:1 or 1:N)

IMPORTANT NOTE: If the asterisk shown in the top right is present, this means that the hardware and software support the 'codeword time-swap' feature when TSI is selected in BPSK mode. If the asterisk is not shown, the modem does not support this feature. In general, these are modems prior to S/N 150, and Software prior to V.1.07.

Press Enter to return to the previous menu.

6.8 MONIT (Monitor)

```
SELECT MONITOR: ALARMS
STORED EVENTS RX-PARAMS
```

Select ALARMS, STORED EVENTS, or RX-PARAMS using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects ALARMS, the following sub-menu is displayed:

6.8.1 (MONIT) ALARMS

```
LIVE ALARMS: UNIT
RECEIVE TRANSMIT
```

Select UNIT, RECEIVE or TRANSMIT, using the LEFT/RIGHT arrow keys, then press Enter.

Depending on the choice selected, one of the following menus will be displayed:

6.8.2 (MON, ALARMS) UNIT (Unit alarms)

```
UNIT FAULT: -12 VOLT PSU
IS UNDER-VOLTAGE
```

The screen will indicate if there are any Unit Faults. If not, it will display 'NONE'. Press Enter to return to the previous menu.

6.8.3 (MON, ALARMS) RECEIVE (Receive alarms)

```
RX TRAFFIC: AGC ALARM
REDUCE COMPOSITE I/P LVL
```

The screen will indicate if there are any Receive Traffic Faults. If not, it will display 'NONE'. Press Enter to return to the previous menu.

6.8.4 (MON, ALARMS) TRANSMIT (Transmit alarms)

```
TX TRAFFIC: NO CLOCK
DETECTED FROM INTERFACE
```

The screen will indicate if there are any Transmit Traffic Faults. If not, it will display 'NONE'. Press Enter to return to the previous menu.

If the user selects STORED EVENTS, the following sub-menu is displayed:

6.8.5 (MONIT) STORED EVENTS

```
STORED EVENTS: VIEW  
CLEAR ALL (PRESS ENTER)
```

Select VIEW or CLEAR ALL, using the LEFT/RIGHT arrow keys, then press Enter.

If the user selects VIEW, the following screen is displayed:

6.8.6 (MON, EVENTS) VIEW

```
LOG23: 30/11/97 10:37:32  
FT - DEMOD LOCK (UP/DWN)
```

Scroll backwards or forwards through the entries in the event log, using the UP/DOWN arrow keys. Press ENTER or CLEAR to return to the previous menu. The event log can store up to 100 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 below:

```
LOG24: 30/11/97 10:37:35  
OK - DEMOD LOCK (UP/DWN)
```

If the user selects CLEAR ALL, the event log is cleared, and 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.

If the user selects RX-PARAMS, the following sub-menu is displayed:

6.8.7 (MONIT) RX-PARAMS (Receive Parameters)

```
RX:EbNo=5.7dB dF=+11.7k
BER=3.4E-9 BUF-FILL=50%
```

If the demodulator is locked, this screen shows the following:

Eb/No	This shows the value of Eb/No calculated by the demodulator. The value referred to here is the energy per information bit (Ebi), divided by the noise spectral density (No).
dF	This is the frequency offset of the received carrier, in kHz, with a displayed resolution of 100 Hz.
BER	This is an estimate of the corrected BER. This figure is derived from an accurate measurement of the uncorrected error rate (from the Viterbi decoder), applied to a look-up table.
BUF-FILL	(Buffer fill state) This gives the value, in percent, of the current fill state of the Plesiochronous-Doppler Buffer. Following a reset, it will read 50%. A value < 50% indicates that the buffer is emptying, and >50% indicates that it is filling.

If the demodulator is not locked, this screen shows the message 'DEMOMULATOR NOT LOCKED'. Pressing ENTER or CLEAR will take the user back to the previous menu.

6.9 STORE/LD (Store/Load)

```
STORE/LOAD CONFIG:
STORE LOAD (PRESS ENTER)
```

Select STORE or LOAD using the LEFT/RIGHT arrow keys, then press Enter.

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

Selecting STORE will display the following screen:

6.9.1 (STORE/LD) STORE

```
STORE CONFIGURATION TO
LOCATION: 10 (ENTER)
```

Select the location to store the current configuration to, using the UP/DOWN 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 STORED! (ENTER)
```

Press ENTER or CLEAR to return to the previous menu.

If, however, the selected location contains a previously stored configuration, the following screen is displayed:

```
WARNING! LOC 10 CONTAINS
DATA! OVERWRITE? NO YES
```

Select NO or YES using the LEFT/RIGHT arrow keys, then press Enter.

Selecting YES will overwrite the existing configuration at the selected location.

Selecting STORE will display the following screen:

6.9.2 (STO/LD) LOAD

```
LOAD CONFIGURATION FROM
LOCATION: 10 (ENTER)
```

Select the location to load a configuration from, using the UP/DOWN arrow keys, then press Enter. Locations 1 through 10 are available.

If the selected location contains valid data, the following screen will be displayed:

```
THE NEW CONFIGURATION  
HAS BEEN LOADED (ENTER)
```

Press ENTER or CLEAR to return to the previous menu.

If, however, the selected location does not contain valid data, the following screen will be displayed:

```
WARNING! LOC 10 CONTAINS  
NO DATA! (ENTER)
```

Press ENTER or CLEAR to return to the previous menu.

6.10 UTIL (Utility)

```
UTILITY: SET-RTC DISPLAY  
MAN-1:1 RECENTER-BUF ID
```

Select SET-RTC, DISPLAY MAN-1:1, RECENTER-BUF, OR ID, using the LEFT/RIGHT arrow keys, then press Enter.

This sub-menu permits the user to select from a number of different utility functions, which are described below:

6.10.1 (UTIL) SET-RTC (Set real-time clock)

```
EDIT REAL TIME CLOCK:  
12:00:00 24/04/98 (ENT)
```

Edit the time and date settings of the real-time clock by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. Change the value of the digit using the UP/DOWN arrow keys. Note that in accordance with international convention, the date is shown in DAY-MONTH-YEAR format. Press Enter.

6.10.2 (UTIL) DISPLAY (Display brightness)

```
EDIT DISPLAY BRIGHTNESS:  
100% (PRESS ENTER)
```

Edit the display brightness, using the UP/DOWN arrow keys. Press Enter.

6.10.3 (UTIL) MAN-1:1 (Manual 1:1 switchover)

```
PRESS ENT TO FORCE THIS  
UNIT TO STDBY (1:1 ONLY)
```

If the unit is part of a 1:1 redundant pair of modems, and this unit is currently on-line, pressing ENTER will cause the unit to switch to standby.

6.10.4 (UTIL) RECENTER-BUF (re-center buffer)

```
PRESS ENTER TO RE-CENTER  
THE RECEIVE BUFFER
```

Press ENTER to cause a forced re-centering of the Plesiochronous/Doppler buffer.

6.10.5 (UTIL) ID (Circuit ID)

```
EDIT CIRCUIT ID: (ENTER)  
THIS IS A TEST MESSAGE
```

Edit the Circuit ID string, using the LEFT/RIGHT and UP/DOWN arrow keys. Only the bottom line is available (24 characters). The cursor selects the position on the bottom line (LEFT/RIGHT) and the character is then edited (UP/DOWN). The following characters are available:

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

After composing the string, press Enter.

7 Chapter 7. CLOCKING

When dealing with satellite modems, the subject of clocking can be a complex issue. This section describes the various clocking options which are available with the CDM-500.

7.1 Transmit Clocking

There are three transmit clocking modes in the CDM-500. EIA-422/449 signal mnemonics will be used for illustration, but the description applies equally to V.35, and synchronous EIA-232.

7.1.1 Internal Clock

In this mode, the modem, assumed always to be the DCE, supplies the clock to the DTE. (The EIA-422/449 name for this signal is Send Timing, or ST.) The DTE then clocks from this source, and gives the modem transmit data (Send Data, or SD), synchronous with this clock. It is optional whether the DTE also returns the clock (Terminal Timing, or TT) – the modem can accept if it is present, but uses ST if it is not.

7.1.2 External Clock

In this mode, the modem expects to see the DTE provide the clock, so that it can phase-lock its internal circuits. In this case, the modem does not provide any signal on ST, but instead requires a clock signal on Terminal Timing (TT), synchronous with the data. If no clock is present, an alarm will be generated.

7.1.3 Loop-Timed

In certain circumstances, a terminal at the distant-end of a satellite link may be required to provide a clock to the DTE equipment which is locked to the receive satellite signal. This is similar to Internal Clock mode, in that the modem will source Send Timing (ST) to the DTE, but now the timing is derived from the demodulator. The DTE then clocks from this source, and gives the modem transmit data (Send Data, or SD), synchronous with this clock. It is optional whether the DTE also returns the clock (Terminal

Timing, or TT) - the modem can accept if it is present, but uses ST if it is not. If the demodulator loses lock, the modem's internal clock will be substituted, so an accurate and stable clock is present on ST, rather than a clock which may jitter and wander in a random fashion.

7.2 Receive Clocking

Like the transmit side, there are three receive clocking modes in the CDM-500.

7.2.1 Buffer Disabled

When the buffer is disabled, the receive clock (Receive Timing, or RT) is derived directly from the demodulator, and hence will be subject to plesiochronous and Doppler offsets. In certain instances, this may be acceptable, and in the case of Loop Timing, it is essential that the buffer is disabled (which is done automatically).

7.2.2 Buffer Enabled, Rx=Tx

In this instance, it is required that buffer be enabled, so that the clock and data appearing on Receive Timing and Receive Data (RT and RD respectively) are synchronous with the transmit clock. This is a relatively simple case, as the output clock for the buffer is derived directly from either ST or TT.

7.2.3 Buffer Enabled, Rx<>Tx

This is an uncommon case, where the receive and transmit data rates are not equal. The modem will generate a phase-locked buffer output clock which uses the transmit clock, regardless of its frequency in relation to the receive data rate.

7.3 X.21 Notes

For X.21 operation, use the EIA-422 pins, but ignore Receive Clock if the Modem is DTE, and ignore Transmit clocks if the Modem is DCE.

Chapter 8. EDMAC CHANNEL

8.1 Theory Of Operation

As explained earlier, EDMAC is an acronym for Embedded Distant-end Monitor And Control. This is a feature which permits the user to access the M&C features of modems which are at the distant-end of a satellite link. This is accomplished by adding extra information to the user's data, but in a manner which is completely transparent to the user.

On the transmit side:

The data is split into frames - each frame containing 1008 bits. 960 of these bits are the user's data, the remaining 48 bits are overhead. This increases the rate of transmission by 5%. (For example, if the user's data rate is 64 kbps, the actual transmission rate will now be at 67.2 kbps)

At the start of each frame a 12 bit synchronization word is added. This allows the demodulator to find and lock to the start of frame. At regular intervals throughout the frame additional data bytes and flag bits are added (a further 36 bits in total). It is these additional bytes which convey the M&C data.

When framing is used, the normal V.35 scrambler is no longer used. This V.35 approach is called 'self synchronizing', because in the receiver, no external information is required in order for the de-scrambling process to recover the original data. The disadvantage of this method is that it multiplies errors. On average, if one bit error is present at the input of the descrambler, 3 output errors are generated. However, there is an alternative when the data is in a framed format. In this case, a different class of scrambler may be used - one which uses the start of frame information to start the scrambling process at an exact known state. In the receiver, having synchronised to the frame, the de-scrambler can begin its processing at exactly the right time. This method does not multiply errors, and

therefore has a clear advantage over V.35 scrambling. This is fortunate, as there is a penalty to be paid for adding the framing. By adding the extra 5% to the transmitted data rate, the effective E_b/N_0 seen by the user will degrade by a factor of $10\log(1.05)$, or 0.21 dB. The use of an externally synchronized scrambler and descrambler almost exactly compensates for this degradation. The net effect is that the user will see effectively identical BER performance whether framing is used or not.

On the receive side:

When the demodulator locks to the incoming carrier, it must go through the additional step of searching for, and locking to the synchronization word. This uniquely identifies the start of frame, and permits the extraction of the overhead bytes and flag bits at the correct position within the frame. In addition, the start of frame permits the de-scrambler to correctly recover the data. The user's data is extracted, and sent through additional processing, in the normal manner. The extracted overhead bytes are examined to determine if they contain valid M&C bytes.

8.2 M&C Connection

Data to be transmitted to the distant-end is sent to a local unit via the remote control port. A message for the distant-end is indistinguishable from a 'local' message - it has the same structure and content, only the address will identify it as being for a distant-end unit.

Before the M&C data can be successfully transmitted and received, pairs of units must be split into EDMAC Masters and EDMAC Slaves. Masters are local to the M&C Computer, and Slaves are distant-end.

Now, a unit which has been designated an EDMAC master not only responds to its own unique bus address, but it will also be configured to listen for the address which corresponds to its EDMAC Slave. When a complete message packet has been received by the EDMAC Master, it will begin to transmit this packet over the satellite channel, using the overhead bytes which become available.

(Note: The 'normal' protocol for the message packet is not used over the satellite path, as it is subject to errors. For this reason, a much more robust protocol is used which incorporates extensive error checking.)

At the distant-end, the EDMAC slave, configured for the correct address, receives these bytes, and when a complete packet has been received, it will take the action requested, and then send the appropriate response to the EDMAC Master, using the return overhead path on the satellite link. The EDMAC Master assembles the complete packet, and transmits the response back to the M&C Computer.

Apart from the round-trip satellite delay, the M&C Computer does not see any difference between local and distant-end units - it sends out a packet, addressed to a particular unit, and gets back a response. It can be seen that the EDMAC Master simply acts as forwarding service, in a manner which is completely transparent.

This approach does not require any additional cabling - connection is made using the normal M&C remote port. Furthermore, the user does not have to worry about configuring the baud rate of the M&C connection to match the lowest data rate modem in the system. The M&C system can have mixed data-rate modems, from 2.4 kbps to 512 kbps, and still run at 19,200 baud. (It should be pointed out that at 2.4 kbps, the effective throughput of the overhead channel is only 11 async characters/second. For a message of 24 bytes, the time between sending a poll request and receiving a response will be around 5 seconds.)

8.3 Setup Summary

To access a distant-end unit:

- Designate a Master/Slave pair - Master at the local-end, Slave at the distant-end
- On the local-end unit, enable framing, and EDMAC, define the unit as MASTER, then enter the bus address of the SLAVE. This is constrained to be 'base 10' meaning that only addresses such as 10, 20, 30, 40 etc, are allowed.
- Choose a unique bus address for the distant-end. This should normally be set to the 'base 10' address + 1. For example, if the MASTER unit is set to 30, choose 31 for the distant-end unit.
- On the distant-end unit, enable framing, and EDMAC, define the unit as SLAVE, then enter the bus address. The orange EDMAC Mode LED should be illuminated.
- Set the local-end unit to RS485 remote control, and set the bus address of this local unit. The orange Remote Mode LED should be illuminated.
- Once the satellite link has been established, connect the M&C Computer, and begin communications, with both the local and distant end units.

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Appendix A.

SUMMARY OF SPECIFICATIONS

A.1 Modulator

Data rate range	Overall, 2.4 - 512 kbps 2.4 kbps - 256 kbps, Rate 1/2 BPSK 4.8 kbps - 512 kbps Rate 1/2 QPSK 7.2 kbps - 512 kbps Rate 3/4 QPSK 8 kbps - 512 kbps Rate 7/8 QPSK
Operating modes	Transparent, Closed Network Proprietary EDMAC framed mode - 5% overhead addition
Scrambling	Transparent mode - per CCITT V.35 EDMAC mode - externally synchronized
FEC	Convolutional, k=7, standard polynomials BPSK: Rate 1/2 QPSK: Rate 1/2, Rate 3/4 and Rate 7/8
Transmit filtering	6th order Butterworth, aperture and group delay equalised per INTELSAT IESS 308 (32 to 256 tap FIR digital filter implementation)
Output frequency	52 - 88 MHz, 100 Hz resolution (140 MHz band optional, 104 - 176 MHz) Stability ± 1 ppm, 0 to 40° C
Harmonics and spurious	Better than -55 dBC/4 kHz (typically <-60 dBC/4kHz)
Transmit on/off ratio	55 dB minimum
Output phase noise	< 0.24 rms double sided, 100 Hz to 250 kHz (minimum of 22 dB better overall than the INTELSAT IESS 308/308 requirement)
Output power	0 to -20 dBm, 0.1 dB steps
Accuracy	± 0.5 dB over frequency and temperature

Output impedance	50 and 75 ohms, front panel selectable 17 dB minimum return loss
Output connector	BNC female
Clocking options	Internal, ± 1 ppm External, locking over a ± 100 ppm range Loop timing (Rx satellite clock)
External TX Carrier Off	By TTL 'low' signal or external contact closure hardware function automatically over-rides processor

A.2 Demodulator

(Data rate range, operating modes, de-scrambling, input impedance/return loss etc, as per Modulator specs)

Input power range	-30 to -60 dBm (desired carrier) -8 dBm max composite			
FEC	Viterbi, 3 bit soft decision			
Acquisition range	± 1 to ± 32 kHz, programmable in 1kHz increments			
Acquisition time	Highly dependent on data rate, FEC rate, and demodulator acquisition range. Examples: 250 milliseconds average at 512 kbps, R1/2 QPSK, ± 30 kHz acquisition sweep range, 6dB Eb/No 5 seconds average at 16 kbps, R1/2 QPSK, ± 5 kHz acquisition range, 6dB Eb/No 21 seconds average at 8.2 kbps, R7/8 QPSK, ± 2 kHz acquisition sweep range, 6dB Eb/No Note that Rate 3/4 and Rate 7/8 FEC rates slow acquisition time considerably, due to the additional time taken for the Viterbi decoder to declare synchronization.			
Clock tracking range	± 100 ppm min			
BER Performance (met in the presence of two adjacent carriers, each 7 dB higher than the desired carrier)	For: BER= 10^{-5} BER= 10^{-6} BER= 10^{-7}	Rate 1/2 Guaranteed Eb/No: (typical value in parentheses) 5.4dB (4.9 dB) 6.0dB (5.5 dB) 6.7dB (6.2 dB)	Rate 3/4 Guaranteed Eb/No: (typical value in parentheses) 6.8dB (6.3 dB) 7.4dB (6.9 dB) 8.2dB (7.7 dB)	Rate 7/8 Guaranteed Eb/No: (typical value in parentheses) 7.7dB (7.2 dB) 8.4dB (7.9 dB) 9.0dB (8.6 dB)
Buffer	Plesiochronous/Doppler buffer with selectable size of 512, 1024, 2048, 4096 or 8192 bits			
Monitor Functions	Eb/No estimate Corrected Bit Error Rate Frequency offset Buffer fill state			

A.3 Data Interfaces

Built in	RS422/EIA530 DCE (also supports X.21 DCE and DTE) V.35 DCE Synchronous RS232 (Front panel selectable)
Pinout	Per EIA530 (25 pin 'D' type female)

A.4 Miscellaneous

Front panel	Tactile keypad, 6 keys (Up/Down, Left/Right, Enter/Clear) Vacuum Fluorescent Display (blue) - 2 lines of 24 characters
Loopbacks	Internal IF, digital, and near/far
Fault relays	Hardware fault, Rx and Tx Traffic Alarms
M&C Interface	RS232 and RS485 (addressable multidrop) RS485 may be either 2-wire or 4-wire
M&C Software	EDMAC software for control of local and distant units
Dimensions	1U high, 12 inches (305 mm) deep
Weight	7 lbs (3.2 kgs) max
AC consumption	18 watts (typical) 25 watts (maximum)
Operating voltage	100 - 240 volts AC, +6%/-10% - autosensing (total absolute max. range is 90 - 254 volts AC)
Operating temp	0 to 50 C

A.5 Approvals

CE' as follows:	EN 55022 Class B (Emissions) EN 50082-1 (Immunity) EN 60950 (Safety)
FCC	FCC Part 15 Class B

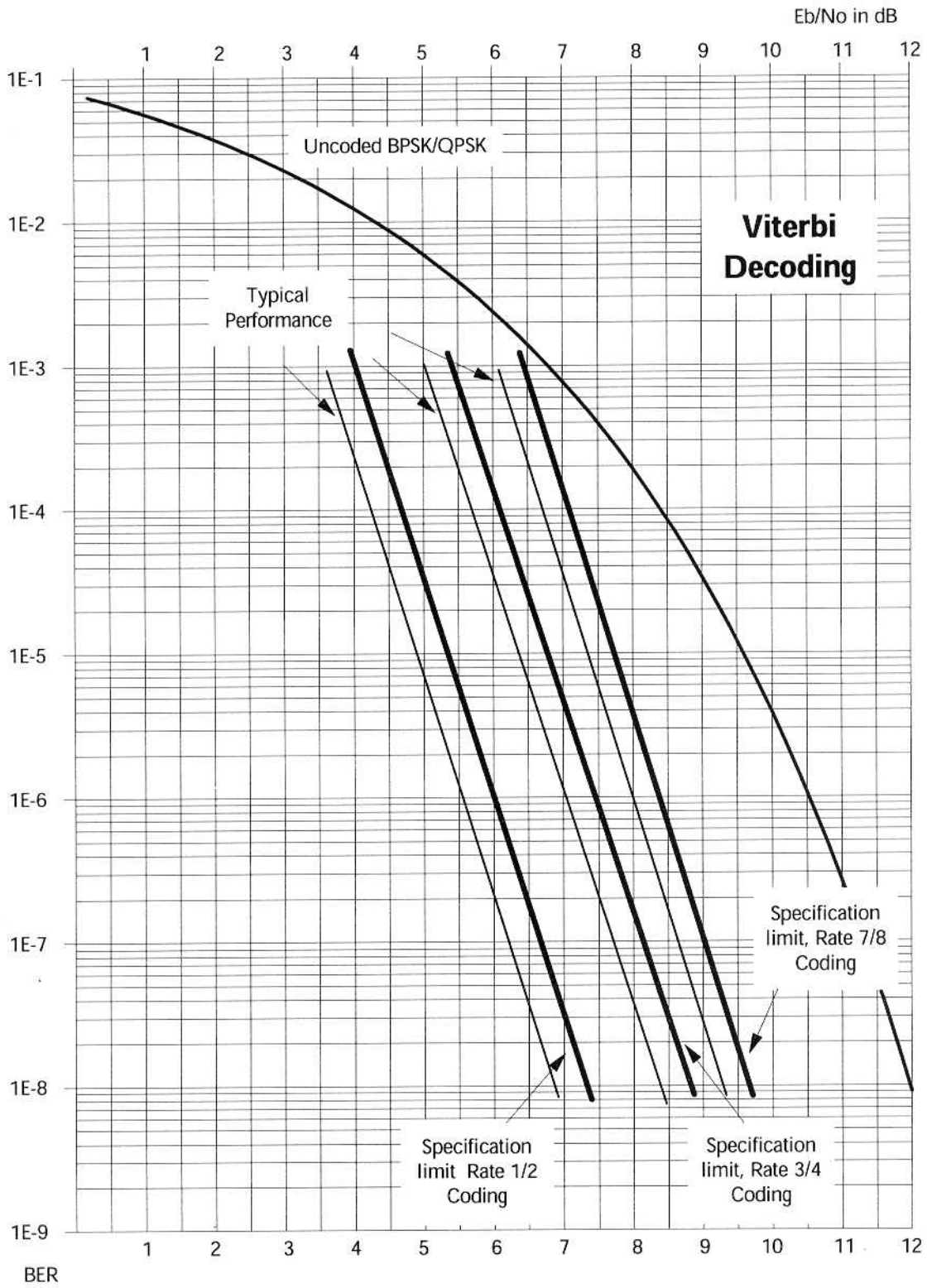


Figure A-1 BER Viterbi Decoding

B

Appendix B. REMOTE CONTROL

B.1 Introduction

This section describes the protocol and message command set for remote monitor and control of the CDM-500 Modem.

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

B.2 EIA-485

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

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

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

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

EIA 485 (full duplex) summary:

- Two differential pairs - one pair for controller to target, one pair for target to controller.
- Controller-to-target pair has one line driver (controller), and all targets have line-receivers.
- Target-to-controller pair has one line receiver (controller), and all targets have tri-state drivers.

B.3 EIA-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 EIA-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 EIA-232 or EIA-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. In this case, the asynchronous character format is fixed at 8 data bits, one stop bit, no parity. The baud rate may vary between 50 baud and 19,200 baud.

All data is transmitted in framed packets. The controller is assumed to be a PC or ASCII dumb terminal, which is in charge of the process of monitor and control. The controller is the only device 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 EIA-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 code60 (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/TFQ=70.2345{CR}

Target-to-controller:

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code62 (1 character)	(4 characters)	/ ASCII code 47 (1 character)	(3 characters)	= or ? ASCII code 61, 33 or 42 (1 character)	(From 0 to n characters)	CarriageReturn Line Feed ASCII code 13,10 (2 characters)

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

Each of the components of the packet is now explained.

B.5.1 Start Of Packet

Controller to Target: This is the character '<' (ASCII code 61)

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.

B.5.2 Address

Up to 9,999 devices can be uniquely addressed. In EIA-232 applications this value is set to 0. In EIA-485 applications, the permissible range of values is 1 to 9999. It is programmed into a target unit using the front panel keypad. Important note: 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 which identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance. For example TFQ for transmit frequency, RMD for receive modulation type, etc. This aids in the readability of the message, should it be displayed in its raw ASCII form. Only upper case alphabetic characters may be used (A-Z, ASCII codes 65 - 90).

B.5.4 Instruction Code Qualifier

This is a single character which further qualifies the preceding instruction code.

Code Qualifiers obey the following rules:

- 1) From Controller to Target, the only permitted values are:
 - = (ASCII code 61)
 - ? (ASCII code 63)

They have these meanings:

The '=' code (controller to target) is used as the assignment operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) which follow it.

For example, in a message from controller to target, TFQ=070.0000 would mean 'set the transmit frequency to 70 MHz'

The '?' code (controller to target) is used as the query operator, and is used to indicate that the target should return the current value of the parameter defined by the preceding byte.

For example, in a message from controller to target, TFQ? would mean 'return the current value of the transmit frequency'

- 2) From Target to Controller, the only permitted values are:

- = (ASCII code 61)
- ? (ASCII code 63)
- ! (ASCII code 33)
- * (ASCII code 42)

They have these meanings:

The '=' code (target to controller) is used in two ways:

First, 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=xxx.xxxx, where xxx.xxxx represents the frequency in question.

Second, 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).

The ? code (target to controller) is only used as follows:

If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the target will acknowledge the message by replying (for example) with TFQ? (with no message arguments). This indicates that there was an error in the message sent by the controller.

The * code (target to controller) is only used as follows:

If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is valid, BUT the modem will not permit that particular parameter to be changed at that time, the target will acknowledge the message by replying (for example) with TFQ* (with no message arguments).

The ! code (target to controller) is only used as follows:

If the controller sends an instruction code which the target does not recognize, the target will acknowledge the message by echoing the invalid instruction, followed by the ! character with.

Example: XYZ!

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).

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.

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Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Tx Frequency	TFQ=	8 bytes	Command or Query. Tx Frequency, 52 MHz to 88 MHz, (70 MHz band) or 104 MHz to 176 MHz, (140 MHz band). Resolution = 100Hz. Example: TFQ=072.9876 (70 MHz option) TFQ=148.0000 (140 MHz option) Note: Querying 'Options Fitted' (using EID?) will indicate if the unit has the 70 MHz or 140 MHz synthesizer option fitted.	TFQ= (message ok) TFQ? (received ok, but invalid arguments found) TFQ* (message ok, but not permitted in current mode)	TFQ?	TFQ=xxx.xxxx (same format as command arguments)
Tx Data Rate	TDR=	7 bytes	Command or Query. Tx Data rate, in kbps, between 2.4 kbps and 512 kbps. Resolution = 1 bps. Example: TDR=511.999 (which is 511.999 kbps)	TDR= (message ok) TDR? (received ok, but invalid arguments found) TFQ* (message ok, but not permitted in current mode)	TDR?	TDR=xxx.xxx (same format as command arguments)
Tx FEC Code Rate	TCR=	1 byte, value of 1,3 or 7	Command or Query. Tx FEC Code rate, where: 1 = Rate 1/2 3 = Rate 3/4 7 = Rate 7/8 All other codes invalid. Example: TCR=1 (which is Rate 1/2)	TCR= (message ok) TCR? (received ok, but invalid argument found) TCR* (message ok, but not permitted in current mode)	TCR?	TCR=x (same format as command argument)
Tx Modulation Type	TMD=	1 byte, value of 1 or 2	Command or Query. Tx Modulation type, where: 1 = BPSK, 2 = QPSK All other codes invalid. Example: TMD=2 (which is QPSK)	TMD= (message ok) TMD? (received ok, but invalid argument found) TMD* (message ok, but not permitted in current mode)	TMD?	TMD=x (same format as command argument)
Tx Spectrum Invert	TSI=	1 byte, value of 0 or 1	Command or Query. Tx Spectrum Invert selection, where: 0 = Normal, 1 = Tx Spectrum Inverted All other codes invalid. Example: TSI=0 (which is normal)	TSI= (message ok) TSI? (received ok, but invalid arg. found) TSI* (message ok, but not permitted in current mode)	TSI?	TSI=x (same format as command argument)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Tx Scrambler	TSC=	1 byte, value of 0 or 1	Command or Query. Tx Scrambler state, where: 0 = Off 1 = On (V.35 in transparent mode, synchronous in framed mode) All other codes invalid. Example: TSC=1 (which is scrambler On)	TSC= (message ok) TSC? (received ok, but invalid argument found) TSQ* (message ok, but not permitted in current mode)	TSC?	TSCS=x (same format as command argument)
Tx Power Level	TPL=	4 bytes	Command or Query. Tx Output power level between 0 and -20 dBm (minus sign assumed). Example: TPL=13.4 (which is -13.4 dBm)	TPL= (message ok) TPL? (received ok, but invalid arguments found) TPL* (message ok, but not permitted in current mode)	TPL?	TPL=xx.x (same format as command arguments)
Tx Clock Source	TCK=	1 byte, value of 1,2 or 3	Command or Query. Tx Clock source, where: 1 = Internal 2 = External 3 = Loop timed (use Rx satellite clock) All other codes invalid. Example: TCK=2 (which is External Clock)	TCK= (message ok) TCK? (received ok, but invalid argument found) TCK* (message ok, but not permitted in current mode)	TCK?	TCK=x (same format as command argument)
Tx Carrier On/Off State	TXO=	1 byte, value of 0, 1 or 2	Command or Query. Tx Carrier On/Off state, where: 0 = Off due to front panel or rem. control command 1 = On 2 = Off due to ext H/W Tx Carrier Off command (not a valid argument when used as a command) All other codes invalid. Example: TXO=1 (which is Tx Carrier On)	TXO= (message ok) TXO? (received ok, but invalid argument found) TXO* (message ok, but not permitted in current mode)	TXO?	TXO=x (Note that 2 is not a valid argument when used as a command)
Rx Frequency	RFQ=	8 bytes	Command or Query. Rx Frequency, 52 MHz to 88 MHz, (70 MHz band) or 104 MHz to 176 MHz (140 MHz band). Resolution = 100 Hz. Example: RFQ=143.4567 (which is 143.4567 MHz) Note: Querying 'Options Fitted' (using EID?) will indicate if the unit has the 70 MHz or 140 MHz synthesizer option fitted.	RFQ= (message ok) RFQ? (received ok, but invalid arguments found) RFQ* (message ok, but not permitted in current mode)	RFQ?	RFQ=xxx.xxxx (same format as command arguments)
Rx Data Rate	RDR=	7 bytes	Command or Query. Rx Data rate, in bps, between 2.4 kbps and 512 kbps. Resolution = 1 bps. Example: RDR=002.400 (which is 2.4 kbps)	RDR= (message ok) RDR? (received ok, but invalid arguments found) RDR* (message ok, but not permitted in current mode)	RDR?	RDR=xxx.xxx (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Rx FEC Code Rate	RRC=	1 byte, value of 1,3 or 7	Command or Query. Rx FEC Code rate, where: 1 = Rate 1/2, 3 = Rate 3/4, 7 = Rate 7/8 All other codes invalid. Example: RRC=1 (which is Rate 1/2)	RRC= (message ok) RRC? (received ok, but invalid argument found) RRC* (message ok, but not permitted in current mode)	RRC?	RRC=x (same format as command argument)
Rx Modulation Type	RMD=	1 byte, value of 1 or 2	Command or Query Rx Modulation type, where: 1 = BPSK 2 = QPSK All other codes invalid. Example: RMD=1 (BPSK)	RMD= (message ok) RMD? (received ok but invalid argument found) RMD* (message ok, but not permitted in current mode)	RMD?	RMD=x (same format as command argument)
Rx Spectrum Invert	RSI=	1 byte, value of 0 or 1	Command or Query. Rx Spectrum Invert selection, where: 0 = Normal 1 = Rx Spectrum Inverted All other codes invalid.	RSI= (message ok) RSI? (received ok, but invalid argument found) RSI* (message ok, but not permitted in current mode)	RSI?	RSI=x (same format as command argument)
Rx Descrambler	RDS=	1 byte, value of 0 or 1	Command or Query. Rx De-scrambler state, where: 0 = Off 1 = On (V.35 in unframed mode, synchronous in framed mode) All other codes invalid. Example: RDS=1 (which is de-scrambler On)	RDS= (message ok) RDS? (received ok, but invalid argument found) RDS* (message ok, but not permitted in current mode)	RDS?	RDS=x (same format as command argument)
Rx Demod Acq Sweep Width	RSW=	2 bytes, numerical	Command or Query. Rx \pm acquisition sweep range of demodulator, in kHz, ranging from ± 1 kHz to ± 30 kHz. Example: RSW=09 (which is 9 kHz)	RSW= (message ok) RSW? (received ok, but invalid arguments found) RSW* (message ok, but not permitted in current mode)	RSW?	RSW=xx (same format as command arguments)
Rx Clock Mode	RCK=	1 byte, value of 0 or 1	Rx Clock mode, where: Command or Query. 0 = Buffer disabled 1 = Buffer enabled All other codes invalid. Example: RCK=0 (which is buffer disable)	RCK= (message ok) RCK? (received ok, but invalid argument found) RCK* (message ok, but not permitted in current mode)	RCK?	RCK=x (same format as command argument)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Eb/No Alarm Point	EBA=	4 bytes, numerical	Command or Query. Eb/No alarm point, with a range of Eb/No between 2 and 16 dB. Resolution 0.1 dB. Example: EBA=12.3 (which is Eb/No = 12.3 dB)	EBA= (message ok) EBA? (received ok, but invalid arguments found)	EBA?	EBA=xx.x (same format as command arguments)
Rx Buffer Size	RBS=	1 byte, value of 1,2,3,4 or 5	Command or Query. Rx buffer size, where: 1 = +/- 256 bits 2 = +/- 512 bits 3 = +/- 1024 bits 4 = +/- 2048 bits 5 = +/- 4096 bits	RBS= (message ok) RBS? (received ok, but invalid argument found) RBS* (message ok, but not permitted in current mode)	RBS?	RBS=x (same format as command argument)
Unit Interface Type	ITF=	1 byte, value of 1,2 or 3	Command or Query. Terrestrial interface type, where: 1 = RS422/EIA530 DCE, 2 = V.35 DCE 3 = RS232 (sync). All other codes invalid. Example: ITF=2 (V.35)	ITF= (message ok) ITF? (received ok, but invalid args found) ITF* (message ok, but argument) not permitted in current mode)	ITF?	ITF=x (same format as command)
Unit Framing Mode	FRM=	1 byte, value of 0 or 1	Command or Query. Unit operating mode, where 0 = Unframed - transparent (distant-end M&C not possible) 1 = Framed (EDMAC distant-end M&C possible) Example: FRM=1 (which is framed)	FRM= (message ok) FRM? (received ok, but invalid argument found) FRM* (message ok, but not permitted in current mode)	FRM?	FRM=x (same format as command argument)
Unit Test Mode	TST= 1	byte, value of 0,1,2,3,4 or 5	0 = Normal 1 = IF loopback 2 = Digital loopback 3 = I/O loopback 4 = Tx CW 5 = Tx Alternating 1,0 pattern All other codes invalid. Example TST=4 (which is transmit CW)	TST= (message ok) TST? (received ok, but invalid argument found) TST* (message ok, but not permitted in current mode)	TST?	TST=x (same format as command argument)
Unit IF Impedance	IMP=	1 byte, value of 5 or 7	Command or Query. IF interface impedance, where: 5 = 50 ohms 7 = 75 ohms All other codes invalid. Example IMP=7 (75 ohms)	IMP= (message ok) IMP? (received ok, but invalid argument found)	IMP?	IMP=x (same format as command argument)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Unit Alarm Mask	MSK=	5 bytes, each with a value of 0 or 1	Command or Query. Alarm mask conditions, in the form abcde, where: a = mask Tx AIS alarm, b = mask Rx AGC alarm c = mask buffer alarms, d = mask Rx AIS alarm e = mask Eb/No alarm Setting any of these bytes to 0 unmask alarm, setting to 1 masks them. Example: MSK=01011	MSK= (message ok) MSK? (received ok, but invalid arguments found) MSK* (message ok, but not permitted in current mode)	MSK?	MSK=abcde (same format as command arguments)
EDMAC Slave Address	ESA=	4 bytes, numerical	Command or Query. EDMAC Slave Address - sets the range of addresses of distant-end units (modems or transceivers) which this unit will forward messages for. Only values which are integer multiples of ten are permitted. (0010, 0020, 0030, 0040 etc.) Example: ESA=0890 Important Note: Setting the value of the EDMAC Slave Address to 0000 disables this function. Setting a valid address here will automatically define the unit as being an EDMAC Master. This command is only valid for an EDMAC master. When used as a Query, it may be sent to an EDMAC slave, which will respond with the appropriate address.	ESA= (message ok) ESA? (received ok, but invalid arguments found) ESA* (message ok, but not permitted in current mode – for example if ESA= is sent to a distant-end slave unit)	ESA?	ESA=xxxx (same format as command arguments)
Circuit ID string	CID=	24 bytes, ASCII	Command or Query. Sets or queries the user-defined Circuit ID string, which is a fixed length of 24 characters. Valid characters include: Space () * + - , . / 0-9 and A-Z	CID= (message ok) CID? (received ok, but invalid arguments found)	CID?	CID=xxxxxxxxxxxxxxxxxxxx (same format as command arguments)
Outdoor Unit Comms	ODU=	1 byte, of 0 or 1 value	Command or Query. Enables or disables communication, via an FSK serial link, with a Comtech Transceiver (Outdoor unit). 0 = disabled 1 = enabled Example: ODU=0	ODU= (message ok) ODU? (received ok, but invalid arguments found) ODU* (message ok, but not permitted in current mode)	ODU?	ODU=x (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Global Configuration	MGC=	74 bytes, with numerical entries, fixed value entries, and delimiters	<p>Command or Query.</p> <p>Global configuration of unit, in the form: FFF.FFFF DDD.DDDRMVSP.PCXfff.ffffddd.dddrmvsww ctt.tbIOTZAAAAAUEEEEEYYYYYYYY, where:</p> <p>F = Tx Frequency - same as TFQ= (8 bytes) D = Tx Data Rate - same as TDR= (7 bytes) R = Tx FEC Code Rate - same as TCR= (1 byte) M = Tx Modulation - same as TMD= (1 byte) V = Tx Spectrum Invert - same as TSI= (1 byte) S = Tx Scrambler State - same as TSC= (1 byte) P = Tx Power Level - same as TPL= (4 bytes) C = Tx Clock Source - same as TCK= (1 byte) X = Tx Carrier Status - same as TXO= (1 byte) f = Rx Frequency - same as RFQ= (8 bytes) d = Rx Data Rate - same as RDR= (7 bytes) r = Rx FEC Code Rate - same as RCR= (1 byte) m = Rx Modulation - same as RMD= (1 byte) v = Rx Spectrum Invert - same as RSI= (1 byte) s = Rx De-scrambler - same as RDS= (1 byte) w = Rx Sweep Width - same as RSW= (2 bytes) c = Rx Clock Mode - same as RCM= (1 byte) t = Eb/No Alarm Point - same as EBA= (4 bytes) b = Rx Buffer Size - same as RBS= (1 byte) I = Unit Interface Type - same as ITF= (1 byte) O =Unit Framing Mode - same as FRM= (1 byte) T = Unit Test Mode - same as TST= (1 byte) Z = Unit IF Impedance - same as IMP= (1 byte) A = Alarm Mask - same as MSK= (5 bytes) U= ODU Comms - same as ODU= (1 byte) E= EDMAC Slave address - same as ESA= (4 bytes) Y = expansion (8 bytes), reserved - set to '0'</p> <p>Example: MGC=074.5678064.000720112.720082.6543 128.000320116109.812111000001023600000000</p>	MGC= (message ok) MGC? (received ok, but invalid arguments found)	MGC?	MGC=FFF.F FFF.DDD. DDDRMV SPP.PCXff f.ffffddd. dddrmvsw wctt.tbIO TZAAAAA UEEEYY Y YYYYY (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Config Store	CST=	1 byte, numerical, 0 to 9	Forces the unit to store the current modem configuration in Configuration Memory location defined by the one byte argument (0 to 9). Example CST=4 (Store current config in location 4) WARNING: Use with caution! If the location already contains data it will be automatically overwritten. If in doubt, query the location first.	CST= (message ok) CST? (received ok, but invalid arguments found)	CST?n where n is 0 to 9 CST?0, or CST?1, or CST?2, or CST?3, or CST?4, or CST?5, or CST?6, or CST?7, or CST?8, or CST?9	Return the same format as the MGC with the form: CST= for a valid config, and CST* where no valid config is found in that n
Config Load	CLD=	1 byte, numerical, 0 to 9	Command only. Forces the unit to retrieve the Configuration Memory location defined by the one byte argument (0 to 9) and to re-program the unit with that stored configuration.	CLD= (message ok) CLD? (message received ok, but either an invalid argument was found, or the requested location does not contain a valid configuration)	N/A	N/A
Re-center Buffer	RCB=	None	Command only. Forces the unit to re-center the receive plesiochronous/doppler buffer. This command takes no arguments.	RCB= (message ok)	N/A	N/A
Force 1:1 Switch	FSW=	None	Command only. Forces the unit to toggle the Unit Fail relay to the 'fail' state for approx 500ms. If the unit is a 1:1 pair, and it is currently the 'On Line' unit, this will force a switchover, so the unit will then be in 'Standby' mode. The command is always executed by the unit, regardless of whether it is stand-alone, in a 1:1 pair, or part of a 1:N system. This command takes no arguments.	FSW= (message ok)	N/A	N/A
10dB attenuator set	ATS=	1 byte, value of 0 or 1	FACTORY USE ONLY Modulator output 10dB attenuator setting, where 0 = no attenuation 1 = 10 dB attenuation Example: ATS=0 (Used for power-level calibration)	ATS= (message ok) ATS? (received ok, but invalid arguments found) ATS* (message ok, but not permitted in current mode)	ATS?	ATS=n where n is 0 or 1

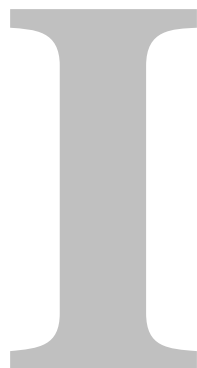
Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Power level DAC set	DAC=	4 bytes, numerical	FACTORY USE ONLY Modulator power output DAC setting. An argument between 0000 and 4095 is required Example: DAC=1287 (Used for power-level calibration)	DAC= (message ok) DAC? (received ok, but invalid arguments found) DAC* (message ok, but not permitted in current mode.	DAC?	DAC=xxxx where xxxx is a value between 0000 and 4095
Write EEPROM Value	EWR=	7 bytes	Command only. FACTORY USE ONLY A command in the form ddd,aaa, where ddd is a single byte data value between 0 and 255, and aaa is a starting address (in the range 0 - 127) within the serial EEPROM, where the data is to be written. Example: EWR=127,104 means write the value 127 starting at address location 104. (Used for power-level cal, amongst other things)	EWR= (message ok) EWR? (received ok, but invalid arguments found) EWR* (message ok, but not permitted in current mode	N/A	N/A
Read EEPROM Value	N/A	3 bytes	Query only. FACTORY USE ONLY A query in the form aaa where aaa is a starting bit address (in the range 0 - 127) within the modem's serial EEPROM, requesting that the byte stored at that location be returned. Example: ERD?063 returns the value of the byte stored at location 063. (Used for power-level cal, amongst other things)	N/A	ERD?	ERD=xxx where xxx is a value between 0 and 255
Set RTC Date	DAY=	6 bytes, numerical	Command or query A command in the form ddmmyy, where; dd = day of the month, between 01 and 31, mm = month of the year, between 01 and 12 and yy = year, between 97 and 96 (1997 to 2000, then 2000 to 2096) Example: DAY=240457 would be April 24, 2057	DAY= (message ok) DAY? (received ok, but invalid arguments found) DAY* (message ok, but not permitted in current mode	DAY?	DAY=xxxxxx (same format as command arguments)
Set RTC Time	TIM=	6 bytes, numerical	Command or query A command in the form hhmmss, indicating the time from midnight, where hh = hours, between 00 and 23; mm = minutes, between 00 and 59, and ss = seconds, between 00 and 59 Example: TIM=231259 would be 23 hours, 12 minutes and 59 seconds from midnight.	TIM= (message ok) TIM? (received ok, but invalid arguments found) TIM* (message ok, but not permitted in current mode	TIM?	TIM=xxxxxx (same format as command arguments)
Clear All Stored Events	CAE=	None	Command only Instructs the unit to clear all Stored Events This command takes no arguments.	CAE= (message ok)	N/A	N/A

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve next 5 unread Stored Events	N/A	75 bytes	Query only 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, where Sub-body= ABCmmddyhhmss, A being the fault/clear indicator. F=Fault C=Clear I=Info B being the fault type where: 1=Unit 2=Rx Traffic 3=Tx Traffic 4=Power on/off, or log cleared and C being the fault code, as defined under the 'FLT' message table entry, except Info codes, which are: 0=power off, 1=power on, 2=log cleared, 3=global config change, and 4= redundancy config change. If there are no new events, the unit replies with RNE? If there are less than 5 events to be retrieved, the remaining positions are padded with zeros.	N/A	RNE?	RNE={CR}ABCmmddyhhmss{CR}ABCmmddyhhmss{CR}ABCmmddyhhmss{CR}ABCmmddyhhmss{CR}ABCmmddyhhmss{CR}ABCmmddyhhmss (see description for details of arguments)
Retrieve Number of unread Stored Events	N/A	2 bytes, numerical	Query only. Unit returns the number of Stored Events which remain unread, in the form xx. Note: This means unread over the remote control - viewing the stored events from the front panel of the modem does not affect this value. Example reply: NUE=98	N/A	NUE?	NUE=xx (see description for details of arguments)
Rx Eb/No	N/A	4 bytes, numerical	Query only. Unit returns the value of Ebi/No, between 2 and 16dB. Resolution 0.1 dB. Returns 99.9 if demod is unlocked. Example: EBN=12.3 (which is Eb/No = 12.3 dB) For values greater than 16.0 dB, the reply will be EBN=+16.	N/A	EBN?	EBN=xx.x (see description for details of arguments)
Rx Freq Offset	N/A	5 bytes, 1st , + or -, next 4bytes numerical	Query only. Unit returns the value of freq. offset of the carrier being demodulated. Values range from ± 0 to ± 30 description for kHz, 100 Hz resolution.Example: RFO=+023 (offset is +2.3 kHz) Returns 9999 if demod unlocked.	N/A	RFO?	RFO=nxx.x (see details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Buffer Fill State	N/A	2 bytes, numerical	Query only. Unit returns the value of the buffer fill state. Values range from 1 to 99% .Example: BFS=33 (buffer fill state is 33%) Returns 00 if demod unlocked.	N/A	BFS?	BFS=xx (see description for details of arguments)
Rx BER	N/A	5 bytes	Query only. Unit returns the value of the estimated corrected BER in the form a.b x 10exp-c. First and second bytes are value, 3rd and 4th bytes are the exponent. Returns 99999 if demod is unlocked. Example: BER=4.8E3 (BER is 4.8 x 10-3)	N/A	BER?	BER=a.bEc (see description for details of arguments)
Redundancy State	N/ A	1 byte, value of 0 or 1	Query only. Returns the redundancy state of the unit, where: 0 = Off Line (forced into standby by 1:N or 1:1 Switch) 1= On Line (normal). All other codes invalid. Example: RED=1 (On Line)	N/A	RED?	RED=x (see description for details of arguments)
Local/Remote Status	N/A	1 byte, value of 0 or 1	Query only. Returns the local/remote status of the unit, where: 0 = local 1= remote Example: LRS=1 (unit is in remote mode)	N/A	LRS?	LRS=x (see description for details of arguments)
Serial Number	SNO=	4 bytes numerical	Command portion is FACTORY USE ONLY. Used to set or Query the units 4 digit serial number. 0000 to 9999 Unit returns its S/N, in the form xxxx. Example: SNO=1765	SNO= (message ok)	SNO?	SNO=xxxx (see description for details of arguments)
Software Revision	N/A	4 bytes, numerical	Query only. Unit returns the value of internal software revision installed in the unit, in the form x.xx Example: SWR=1.03 (Ver 1.03)	N/A	SWR?	SWR=x.xx (see description for details of arguments)
Equipment ID	N/A	6 bytes, numerical	Query only. Unit returns information concerning the equipment identification, and the options fitted, in the form aaaabc, where: aaaa defines the Modem model number. Example: 0500 is CDM-500 b defines the IF band, with 1 = 70MHz, 2 = 140MHz c defines RX only, with 1 = RX/TX, 2 = RX only Ex: EID=050012 (CDM-500, 70 MHz band, RX only)	N/A	EID?	EID=aaaabc (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Faults and Status	N/A	5 bytes, first 3 bytes numerical, 4th and 5th bytes, value of 0 or 1	<p>Query only.</p> <p>Unit returns the current fault and status codes for the Unit (hardware), Tx Traffic and Rx Traffic, in the form abcde, where:</p> <p>a = Unit fault status, b = Tx Traffic status, c = Rx Traffic Status, d = Change in Fault Status since last poll (0 = none, 1 = change), e = Change in Unit Configuration since last poll (0 = none, 1 = change)</p> <p>Unit faults: 0 = No faults 1 = Power supply fault, 5 volts 2 = Power supply fault, 12 volts 3 = Power supply fault, -5 volts 4 = Power supply fault, 18 volts 5 = Power supply fault, -12 volts 6 = FPGA load fail 7 = Tx synthesiser lock 8 = Rx synthesiser 9 = Power cal Checksum error</p> <p>Tx Traffic status: 0 = Tx traffic OK 1 = No clock from terrestrial interface 2 = Tx FIFO slip 3 = AIS detected on incoming data</p> <p>Rx Traffic status: 0 = Rx Traffic OK 1 = Demodulator unlocked 2 = AGC Alarm - signal level too high 3 = Frame sync lost (EDMAC mode only) 4 = Buffer Underflow 5 = Buffer Overflow 6 = AIS detected on incoming data 7 = Eb/No threshold exceeded</p>	N/A	FLT?	FLT=abcde (see description for details of arguments)

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METRIC CONVERSIONS

Units of Length

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

Temperature Conversions

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

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

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^3	35.27	32.15	2.205	2.679	—



2114 WEST 7TH STREET TEMPE ARIZONA 85281 USA
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480 • 333 • 2161 FAX