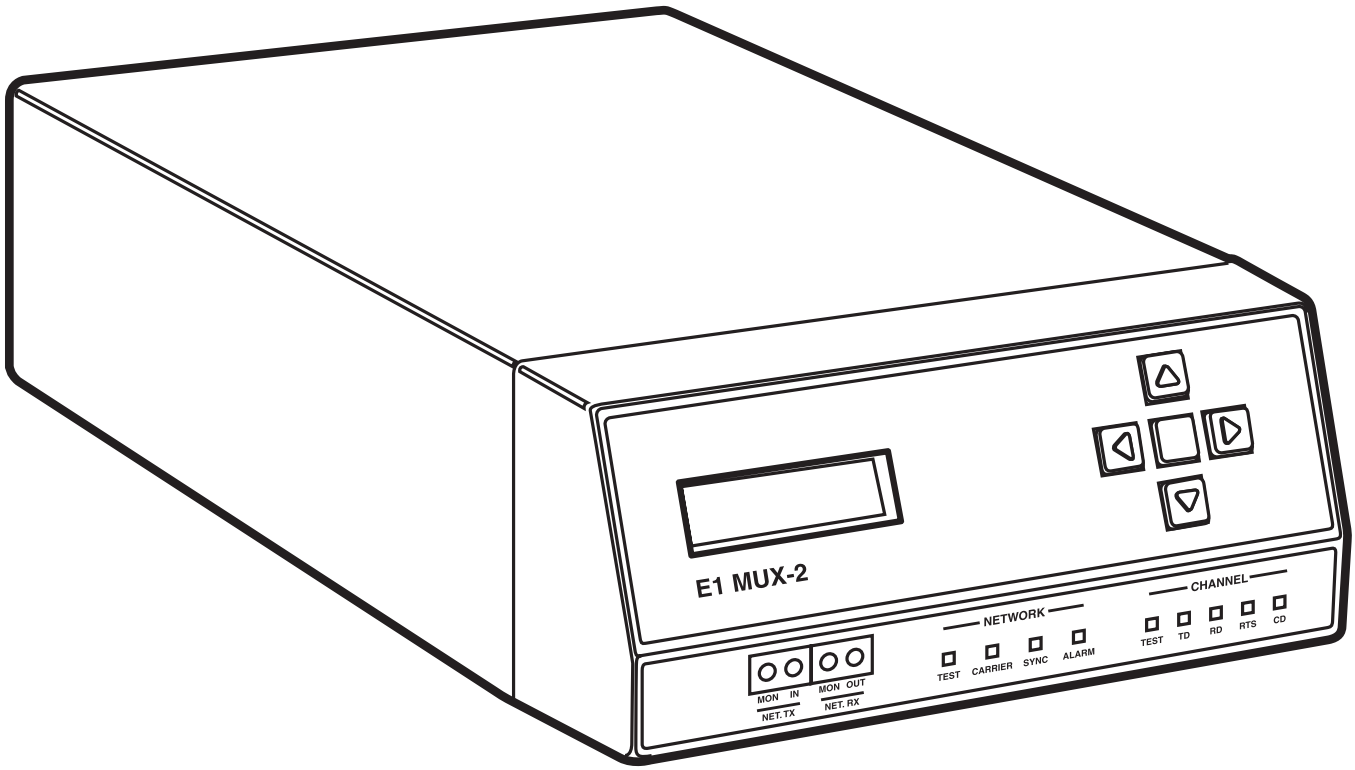
BLACK BOX®
NETWORK SERVICES

MARCH 2001
MT201A-35
MT201A-449
MT203A-35
MT203A-449

E1 MUX-2 and E1 MUX-4



CUSTOMER SUPPORT INFORMATION

Order **toll-free** in the U.S.: Call **877-877-BBOX** (outside U.S. call **724-746-5500**)
FREE technical support 24 hours a day, 7 days a week: Call **724-746-5500** or fax **724-746-0746**
Mailing address: **Black Box Corporation**, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: **www.blackbox.com** • E-mail: **info@blackbox.com**

FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

Part 68 Approved
UL® Approved
Canadian IC-03 Approved

INSTRUCCIONES DE SEGURIDAD (Normas Oficiales Mexicanas Electrical Safety Statement)

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
    - A: El cable de poder o el contacto ha sido dañado; u
    - B: Objectos han caído o líquido ha sido derramado dentro del aparato; o
    - C: El aparato ha sido expuesto a la lluvia; o
    - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
    - E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

ACCUNET and AT&T are registered trademarks of AT&T.

VT100 is a trademark of Digital Equipment Corporation.

UL is a registered trademark of Underwriters Laboratories Incorporated.

Any other trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

Chapter **Page**

1. Introduction 6
   - 1.1 Overview 6
   - 1.2 Specifications 6
   - 1.3 Front-Panel Controls and Indicators 8
   - 1.4 Menu Selection Function Keys 8
   - 1.5 Network Data Monitoring 8
   - 1.6 Network LEDs 9
   - 1.7 Data Channel LEDs 9
   - 1.8 Rear-Panel Controls and Indicators 10
   - 1.9 Channel Interface Connections 10
     - 1.9.1 Printer Interface Port 16
     - 1.9.2 Terminal Interface Port 16
     - 1.9.3 Auxiliary Connection 17
     - 1.9.4 Network Connection 17

2. Installation 18
   - 2.1 Site Preparation 18
   - 2.2 Unpacking the E1 MUX-2/4 18
   - 2.3 Equipment Cabling 18
     - 2.3.1 Network Cabling 18
     - 2.3.2 V.35, RS-449, or RS-232 Channel Cabling 19
     - 2.3.3 Printer and Terminal Interfaces 19
     - 2.3.4 Auxiliary Interface Connector 19
     - 2.3.5 Power Cable 19
   - 2.4 Initial Power Up 19

3. Programming 20
   - 3.1 Introduction 20
   - 3.2 Configuration Worksheet 20
   - 3.3 Configuring the Aggregate 23
   - 3.4 Configuring a Channel 24
   - 3.5 Updating a Configuration 24
   - 3.6 Storing a Configuration 25
   - 3.7 Retrieving a Configuration 25
   - 3.8 View Configuration 26
     - 3.8.1 Aggregate Configuration 26
     - 3.8.2 View Channel Configuration 28
   - 3.9 Modify Configuration 30
     - 3.9.1 Modify the Aggregate 30
     - 3.9.2 Modify Data Channel 32
     - 3.9.3 The Update Function 35
     - 3.9.4 Miscellaneous 37
   - 3.10 Performance 40
     - 3.10.1 Cyclic Redundancy Check 4 40

Chapter **Page**

3.10.2 Frame Word Error 40
3.10.3 Current Errored Seconds 43
3.10.4 History of Errored Seconds 43
3.10.5 Errored Seconds Total 43
3.10.6 Current Severely Errored Seconds 43
3.10.7 History of Severely Errored Seconds 43
3.10.8 Errored Seconds Total 43
3.10.9 Failed Signal State 43
3.10.10 Current Failed Seconds 43
3.10.11 Bipolar Violations 44
3.10.12 Clear Error Events 44
3.10.13 Clear All Registers Command 44
3.10.14 Freeze Registers 44
3.10.15 Alarms 44
3.10.16 Remote Alarms 45
3.11 Diagnostics 46
3.11.1 Local Channel Loopback 46
3.11.2 Local Aggregate Loopback 47
3.11.3 Local Network Loopback 47
3.11.4 Remote Aggregate Loopback 47
3.11.5 Remote Channel Loopback 47
3.11.6 Test Pattern 47
3.11.7 Customer Service 48

Appendix A. Performance Display Overview 49

Appendix B. Programming Menu Tree 51

1. Introduction

1.1 Overview

The E1 MUX-2/4 is a high-speed E1 format processor. It is capable of processing data from four unique channels at speeds from 2.4 kbps to 2.048 Mbps, depending upon the format and density requirements of the application. It provides all the framing and density requirements for data transmission across predefined network facilities, such as International ACCUNET®.

The E1 MUX-2/4, because of its unique design, can accept timing information from any clock. Timing information may be derived from the receive data, an external DTE, the internal crystal oscillator, or station clock.

All application configurations are software selectable through a menu of software-interactive programming commands. These commands may be issued from the front-panel programming keypad or an ASCII terminal.

The E1 MUX-2/4 also has a series of software-selectable diagnostics that allow you to quickly and accurately troubleshoot the E1 MUX-2/4 and the associated network.

1.2 Specifications

Configuration
- Front-Panel LCD and Keypad
- ASCII Terminal Interface
- Four Configuration Storage Banks

Multiplexing Technique: Byte Interleaved

Aggregate
- Recommended Cable Requirement: Twisted Shielded Pair (120 ohm)/Coax (75 ohm)
- Line Rate: 2.048 Mbps ± 50 bps
- Line Format: AMI or HBD3
- Framing Format: G.732
- Pulse Characteristics: G.703
- Output Amplitude: 75-ohm interface = 2.37 volts ± 10%; 120-ohm interface = 3 volts ± 10%
- Receiver Sensitivity: 0 to 6 dB
- Line Distance: Up to 800 feet (244 m)
- Interfaces: 75-ohm coax connectors; 120-ohm DB15 connector
- Signalling: Channel Associated Signalling (CAS); Set Signalling to Idle State

Performance Monitoring
- 15-minute intervals
- 24-hour history maintained
- Information includes:
    - Frame Alignment Word Error Events
    - CRC4 Word Error Events
    - Errored Seconds
    - Severely Errored Seconds
    - Failed Signal State
    - Bipolar Violations

Clocking Modes
- Internally provided
- External from Network (Loop)
- External from Channel 1
- Station Clock Rates: N x 8 kbps where N = 1 to 256

DTE Channels
- 2 or 4 data channels
- Dual-port RS-232 (TS SRDM formatted) 2.4, 4.8, 9.6, and 19.2 kbps
- Dual-port V.35 and RS-449 Interfaces
- Density: Bit 7 stuffing or None
- Selectable DTE Channel Rates N x 56 kbps 8, 16, 24, 32, 40, 48, 56, 64, 112, 168, 192, 224, 280, 320, 336, 448, 560, 672, 840, 960, 1120, 1344, 1680, and 1736 kbps
- Selectable DTE Channel Rates N x 64 kbps 8, 16, 24, 32, 40, 48, 64, 128, 192, 256, 320, 384, 512, 640, 768, 960, 1024, 1280, 1536, 1920, and 1984 kbps
- Selectable DTE Channel Rates Extended 8, 16, 24, 32, 40, 48, 56, 64, 112, 128, 168, 192, 224, 256, 280, 320, 336, 384, 448, 512, 560, 640, 672, 768, 840, 960, 1024, 1120, 1280, 1344, 1536, 1680, 1736, 1920, and 1984 kbps

Compatibilities
- CCITT Recommendations: G.703, G.704, G.732, and G.823
- AT&T® Pub 54019
- Carrier E1 Service offerings

Approvals
- FCC Part 15
- DS&G: UL® 479
- DS&G: CSA C22.2 No. 220-M1980

Diagnostics
- Local and Network Loopbacks
- Local and Remote Individual Channel Loopbacks
- Internal 511 BERT Test Generator
- TX/RX Monitor Jacks, Network In and Network Out Bantam Jack Receptacles

Front-Panel Network Indicators
- Test
- Carrier
- Synchronization
- Alarm

Front-Panel DTE Channel Indicators
- Test
- Carrier Detect (CD)
- Transmit Data (TD)
- Receive Data (RD)
- Request To Send (RTS)

Printer and Terminal Ports
- RJ-48
- 1200, 2400, 4800, or 9600 baud

Environmental

- Temperature: 32 to 122°F (0 to 50°C)
- Relative Humidity: Up to 95% noncondensing

Standalone Unit

- Size: 3.5"H x 8.5"W x 13.5"D (8.9 x 21.6 x 34.3 cm)
- Weight: 6.75 lb. (3.1 kg)
- Power: 115/230 VAC
- Power Dissipation: 35 watts

1.3 Front-Panel Controls and Indicators

The E1 MUX-2/4 contains all the controls and indicators to configure, monitor, diagnose, and operate the system. The front panel contains the 32-character LCD array, the menu selection function keys, four bantam jack receptacles for network data monitoring and test signal injection, and a series of LEDs that reflect the status of both the network and the selected channel. An illustration of an E1 MUX-4 is shown below.

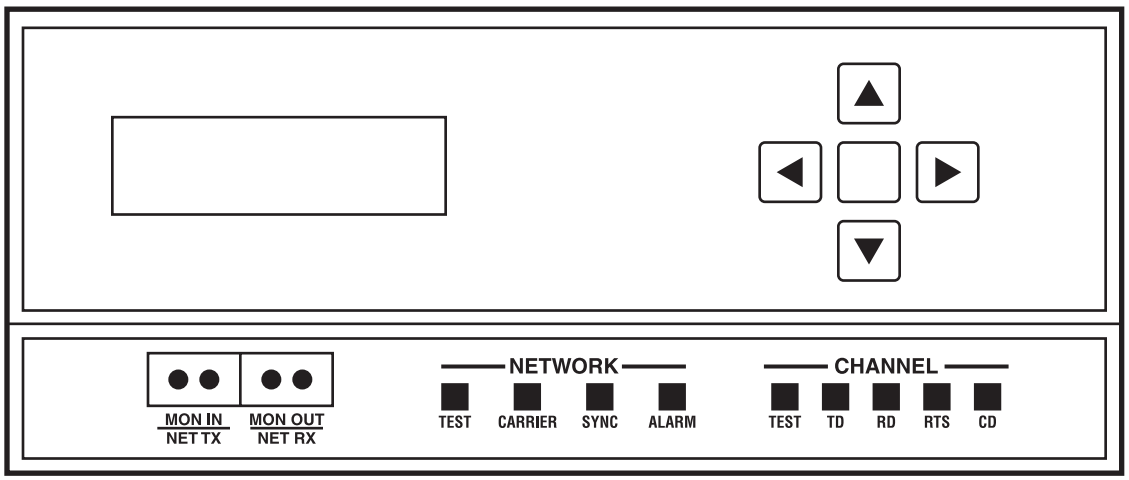


Figure 1-1. E1 MUX-4's Front Panel.

1.4 Menu Selection Function Keys

The menu selection function keys are a set of five pushbuttons located on the upper right portion of the front panel (see Figure 1-1). These keys allow the operator to scroll up, down, right, and left through the various programming menus. Key-stroke actions are displayed on the LCD panel. The center function key is the ENTER key; it allows the operator to select particular actions or items.

1.5 Network Data Monitoring

The four bantam jacks on the front of the mux allow the operator to monitor both network transmit and receive functions, together with the ability to inject an override bipolar signal into the network via either the transmit logic or disconnect the unit from the network via the receive logic. See Figure 1-1.

1.6 Network LEDs

There are four LEDs associated with the mux's network function. They monitor the TEST, CARRIER, SYNC, and ALARM functions. See Figure 1-1.

The TEST LED (red) lights when the mux is in an aggregate or network test mode. The TEST mode is invoked a) when the mux is in any of the local or remote aggregate or network loopback states or, b) if the mux is generating an in-band pattern to invoke any of these loopbacks.

The CARRIER LED (green) lights when the mux is receiving the E-1 carrier signal.

The SYNC LED (green) lights when the mux is "seeing" the type of framing from the network it is configured to receive.

The ALARM LED (red) lights for one-half second while any one of the following exists:

- Sync Loss (Alarm Indicator Signal)
- TS 16 Loss (Alarm Indicator Signal)
- Remote Alarm
- Bipolar Violations
- CRC4 Error Alarm
- Sync Loss
- TS 16 Loss
- Remote TS 16 Loss
- Frame Error Alarm

1.7 Data Channel LEDs

The five LEDs below the Channel heading represent the status of the Data channel defined by an LCD function within the diagnostic function. See Figure 1-1.

The TEST LED (red) lights whenever the specified channel is in any of the local or remote channel loopback states or if the channel is generating a test signal.

The Transmit Data (TD) LED (green) lights when the specified channel is transmitting a space or data towards the E-1 network.

The Receive Data (RD) LED (green) lights when the specified channel is receiving a space from the E-1 network.

The Request To Send (RTS) LED (green) lights when the specified channel's RTS function is activated.

The Carrier Detect (CD) LED (green) lights when the specified channel has detected data from the network.

1.8 Rear-Panel Controls and Indicators

The E1 MUX-2/4's rear panel permits access to all the physical interface connections necessary to connect the mux to a network. An illustration of the E1 MUX-2/4's rear panel is shown in Figure 1-2.

In addition to the physical interface connections, there are three switches mounted on the mux's rear panel. They are the Power On/Off switch, the Receive Shield Ground switch, and the Network Interface Ohm switch. The power switch has a simple On/Off function. The Receive Shield Ground switch gives you the option of shorting the shield of the Receive signal of the 75-ohm BNC coax connector (J15) to earth ground (POS 2) or isolating the shield from ground (POS 1). The Network Interface Ohm switch selects either the 75-ohm or 120-ohm interface.

NOTE

The power switch toggles left and right. Both the Receive Shield Ground and the Network Interface Ohm switch toggle up and down.

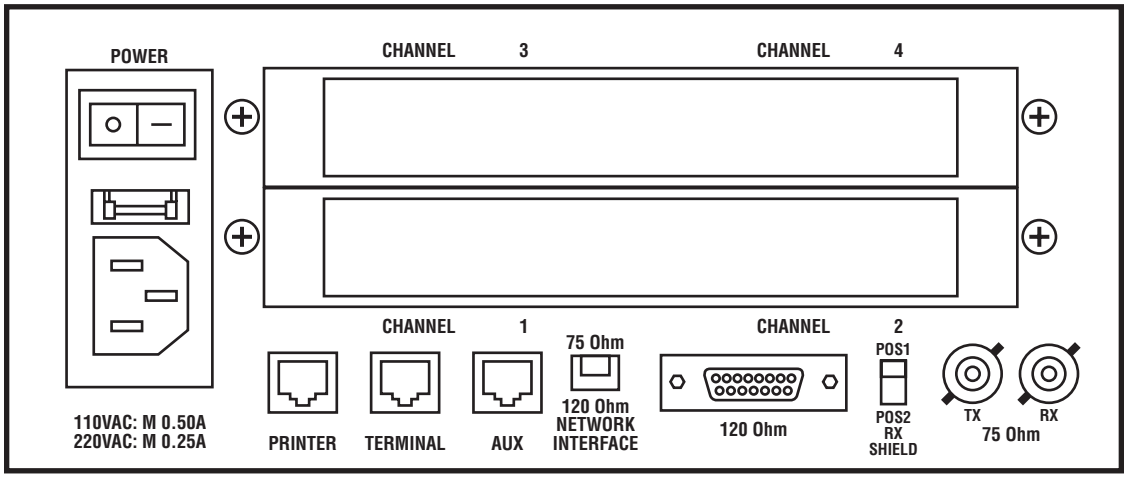


Figure 1-2. Rear-Panel Connections.

1.9 Channel Interface Connections

There are four channel interface connections associated with the E1 MUX-2/4 (see Figure 1-2). The cable associated with channel 1 must be attached to the interface connector labeled CHANNEL 1, the cable associated with channel 2 must be attached to the interface connector labeled CHANNEL 2, etc.

The pinouts for these channel interface connectors and various DTE cables are listed by pin number and function in Tables 1-1 through 1-12.

Table 1-1. V.35 Interface Pin Out.

Pin	Function	Pin	Function
A	Frame Ground	R	RD(A)
B	Signal Ground	S	TD(B)
C	RTS	T	RD(B)
D	CTS	U	SCTE(A)
E	DSR	V	RT(A)
F	DCD	W	SCTE(B)
H	DTR	X	RT(B)
K	LL	Y	ST(A)
L	RL	AA	ST(B)
P	TD(A)	—	—

Table 1-2. V.35-to-V.35 (Straight-Through Cable) Pin Out.

V.35 Pin	Function	V.35 Pin	Function
A	Frame Ground	A	Frame Ground
B	Signal Ground	B	Signal Ground
C	RTS	C	RTS
D	CTS	D	CTS
E	DSR	E	DSR
F	DCD	F	DCD
H	DTR	H	DTR
K	LL	K	LL
L	RL	L	RL
P	TD(A)	P	TD(A)
R	RD(A)	R	RD(A)
S	TD(B)	S	TD(B)
T	RD(B)	T	RD(B)
U	SCTE(A)	U	SCTE(A)
V	RT(A)	V	RT(A)
W	SCTE(B)	W	SCTE(B)
X	RT(B)	X	RT(B)
Y	ST(A)	Y	ST(A)
AA	ST(B)	AA	ST(B)

Table 1-3. V.35-to-V.35 (Cross Over Cable) Pin Out.

V.35 Pin	Function	V.35 Pin	Function
A	Frame Ground	A	Frame Ground
B	Signal Ground	B	Signal Ground
C	RTS	F	DCD
D	NC	D	NC
E	DSR	H	DTR
F	DCD	C	RTS
H	DTR	E	DSR
K	NC	K	NC
L	NC	L	NC
P	TD(A)	R	RD(A)
R	RD(A)	P	TD(A)
S	TD(B)	T	RD(B)
T	RD(B)	S	TD(B)
U	SCTE(A)	V	RT(A)
V	RT(A)	U	SCTE(A)
W	SCTE(B)	X	RT(B)
X	RT(B)	W	SCTE(B)
Y	NC	Y	NC
AA	NC	AA	NC

Table 1-4. RS-449 Interface Pin Out.

DB37 Pin	Function	DB37 Pin	Function
1	SHIELD	19	Signal Ground
2	NC	20	RC
3	NC	21	NC
4	SD(A)	22	SD(B)
5	ST(A)	23	ST(B)
6	RD(A)	24	RD(B)
7	RTS(A)	25	RTS(B)
8	RT(A)	26	RT(B)
9	CTS(A)	27	CTS(B)
10	LL	28	NC
11	DM(A)	29	DM(B)
12	TR(A)	30	TR(B)
13	RR(A)	31	RR(B)
14	RL	32	NC
15	IC	33	SQ
16	SF	34	NC
17	TT(A)	35	TT(B)
18	TM	36	NC
—	—	37	SC

Table 1-5. RS-449-to-RS-449 (Straight-Through Cable) Pin Out.

DB37 Pin	Function	DB37 Pin	Function
1	Shield	19	Signal Ground
2	NC	20	RC
3	NC	21	NC
4	SD(A)	22	SD(B)
5	ST(A)	23	ST(B)
6	RD(A)	24	RD(B)
7	RTS(A)	25	RTS(B)
8	RT(A)	26	RT(B)
9	CTS(A)	27	CTS(B)
10	LL	28	NC
11	DM(A)	29	DM(B)
12	TR(A)	30	TR(B)
13	RR(A)	31	RR(B)
14	RL	32	NC
15	IC	33	SQ
16	SF	34	NC
17	TT(A)	35	TT(B)
18	TM	36	NC
—	—	37	SC

NOTE: The pinouts listed in Table 1-5 apply to each end of the RS-449-to-RS-449 straight-through cable.

Table 1-6. RS-449-to-RS-449 (Crossover Cable) Pin Out.

DB37 Pin	Function	DB37 Pin	Function
1	Shield	1	Shield
4	SD(A)	6	RD(A)
6	RD(A)	4	SD(A)
7	RTS(A)	13	RR(A)
8	RT(A)	17	TT(A)
13	RR(A)	7	RTS(A)
17	TT(A)	8	RT(A)
19	Signal Ground	19	Signal Ground
20	RC	20	RC
22	SD(B)	24	RD(B)
24	RD(B)	22	SD(B)
25	RTS(B)	31	RR(B)
26	RT(B)	35	TT(B)
31	RR(B)	25	RTS(B)
35	TT(B)	26	RT(B)

NOTE: Table 1-6 contains only those pinouts actually used in the RS-449-to-RS-449 crossover cable.

Table 1-7. RS-232 Interface Pin Out.

Pin	Function	Pin	Function	Pin	Function
1	FG	10	NC	19	NC
2	TD	11	NC	20	DTR
3	RD	12	NC	21	NC
4	RTS	13	NC	22	NC
5	CTS	14	NC	23	NC
6	DSR	15	ST	24	TT
7	SG	16	NC	25	NC
8	DCD	17	RT	—	—
9	NC	18	NC	—	—

Table 1-8. RS-232-to-RS-232 (Straight-Through Cable) Pin Out.

DB25 Pin	Function	DB25 Pin	Function
1	FG	1	FG
2	TD	2	TD
3	RD	3	RD
4	RTS	4	RTS
5	CTS	5	CTS
6	DSR	6	DSR
7	SG	7	SG
8	DCD	8	DCD
9	NC	9	NC
10	NC	10	NC
11	NC	11	NC
12	NC	12	NC
13	NC	13	NC
14	NC	14	NC
15	ST	15	ST
16	NC	16	NC
17	RT	17	RT
18	NC	18	NC
19	NC	19	NC
20	DTR	20	DTR
21	NC	21	NC
22	NC	22	NC
23	NC	23	NC
24	TT	24	TT
25	NC	25	NC

Table 1-9. RS-232-to-RS-232 (Crossover Cable) Pin Out.

DB25 Pin	Function	DB25 Pin	Function
1	FG	1	FG
2	TD	3	RD
3	RD	2	TD
4	RTS	8	DCD
6	DSR	20	DTR
7	SG	7	SG
8	DCD	4	RTS
17	RT	24	TT
20	DTR	6	DSR
24	TT	17	RT

NOTE: Table 1-9 contains only those pinouts actually used in the RS-232-to-RS-232 crossover cable.

Table 1-10. RJ-48-to-DB25 Mod Tap Converter Pin Out.

RJ-48 Pin	Function	DB25 Pin	Function
1	CTS	5	CTS
2	DCD	8	DCD
3	RD	3	RD
4	DTR	20	DTR
5	TD	2	TD
6	GND	7	GND
7	DSR	6	DSR
8	RTS	4	RTS

Table 1-11. RJ-48-to-DB9 Mod Tap Converter Pin Out.

RJ-48 Pin	Function	DB9 Pin	Function
1	CTS	8	CTS
2	DCD	1	DCD
3	RD	2	RD
4	DTR	4	DTR
5	TD	3	TD
6	GND	5	GND
7	DSR	6	DSR
8	RTS	7	RTS

Table 1-12. RJ-48-to-RJ-48 (Crossover Cable) Pin Out.

RJ-48 Pin	Function	RJ-48 Pin	Function
1	CTS	8	RTS
2	NC	2	NC
3	RD	5	TD
4	DTR	7	DSR
5	TD	3	RD
6	GND	6	GND
7	DSR	4	DTR
8	RTS	1	CTS

1.9.1 Printer Interface Port

This is an asynchronous serial interface port that can operate at 1200, 2400, 4800, or 9600 baud. See Figure 1-2. The interface format may be either 7 or 8 data bits per character with odd, even, or no parity. The character set is standard ASCII. These parameters may be selected from the front-panel function keys. Table 1-13 lists the pin assignments associated with the printer's RJ-48 connector. When viewing the connector from the rear of the mux, the connector pins are defined from left to right and numbered from 1 through 8.

1.9.2 Terminal Interface Port

This is an asynchronous serial interface port that can operate at 1200, 2400, 4800, or 9600 baud. See Figure 1-2. The interface format may be either 7 or 8 data bits per character with odd, even, or no parity. The character set is standard ASCII. These parameters may be selected from the front-panel function keys. Attachment of a VT100™ compatible ASCII terminal to this connector allows for remote monitoring and control of the mux. To program (configure) the ASCII terminal interface, refer to **Chapter 3**. Table 1-13 lists the pin assignments associated with the terminal's RJ-48 connector. When viewing the connector from the rear of the mux, the connector pins are defined from left to right and numbered from 1 through 8.

Table 1-13. Printer and Terminal Connector Pin Out.

Pin	Signal
1	CTS
2	DCD
3	RD
4	DTR
5	TD
6	Digital Ground
7	DSR
8	RTS

The mux's network test and alarm status will be conveyed to the VT100 compatible terminal by the message prompts ALARM and/or TEST.

NOTE

The ALARM and TEST message prompts will not be displayed if these states pre-existed before the terminal was connected to the mux.

1.9.3 Auxiliary Connection

The auxiliary connection is an RJ-48 modular connector used to interface an external station clock to the mux. See Figure 1-2. The pin out for this connector is listed in Table 1-14. When viewing the connector from the rear of the mux, the connector pins are defined from left to right and numbered from 1 through 8.

Table 1-14. Auxiliary Connector Pin Out.

Pin	Signal
1	Sync (Active Low TTL)
2	Station (A-Lead RS-422)
3	Station (B-Lead RS-422)
4	NC
5	Alarm (Reserved TTL)
6	Digital Ground
7	+5 volts DC
8	NC

1.9.4 Network Connection

The network connector is either a DB15 connector for 120-ohm applications or a set of BNC coax connectors for 75-ohm applications. The network connector is switch-selectable using the Network Interface Ohm switch discussed earlier. The cable used in the DB15 network connector and its pin out is illustrated in Figure 1-3.

Figure 1-3. DB15 Network Interface Cable.

2. Installation

2.1 Site Preparation

The E1 MUX-2/4 should be installed within 7 feet (2.1 m) of a grounded AC outlet furnishing 115/230 VAC. The equipment location should be clean, well lit, and conform to the standards for computer equipment installations. Allow 36 inches (91.4 cm) of clearance at both front and back for access during equipment operation and maintenance. When connecting the interface cables, allow 4 feet (1.2 m) of slack in the cables so that the mux may be moved to perform service without disconnecting the cabling.

2.2 Unpacking the E1 MUX-2/4

Before you use the E1 MUX-2/4, you'll need to verify that the mux arrived undamaged.

1. Carefully remove all packing material.
2. Inspect the E1 MUX-2/4 for damage that may have occurred during shipping. If any damage is noted, contact the agent responsible for shipping the unit.

NOTE

The E1 MUX-2/4 shipping carton is designed to ensure that the mux arrives undamaged. Save the carton in case you ever need to move the E1 MUX-2/4 to another location.

CAUTION

Before continuing with the installation procedure, make sure that the POWER switch, located on the rear panel, is in the OFF (0) position.

2.3 Equipment Cabling

Depending upon the particular interface associated with the E1 MUX-2/4, there are certain cabling procedures that are applicable to the individual application.

NOTE

All required DTE cables must be properly shielded.

2.3.1 Network Cabling

The network connector is either a single DB15 connector or a pair of BNC coax connectors. Depending upon the configuration of the network, connect either the DB15 network line cable (optionally supplied) directly into the unit or the E1 MUX-2/4 Transmit coax cable to the TX COAX connector and the E1 MUX-2/4 Receive coax to the RX COAX connector.

Select the type of Network Interface, either 75 ohm or 120 ohm, by positioning the Network Interface Ohm switch to the proper position. See Figure 1-2.

2.3.2 V.35, RS-449, or RS-232 Channel Cabling

The E1 MUX-2/4 is configured at the factory to be connected via an industry-standard interface using either a V.35, an RS-449, or an RS-232 female connector. The cable associated with Channel 1 data must be attached to the interface connector labeled CHANNEL 1 (found on the rear of the unit). The identical connection must be made for channels 2, 3, and 4, if required. See Figure 1-2. When the interface cables are in position and seated, secure them with the two jack screws.

2.3.3 Printer and Terminal Interfaces

These ports are identical. See Figure 1-2. They are asynchronous serial interfaces operating at 1200, 2400, 4800, or 9600 baud. Format may be either 7 or 8 data bits per character with odd, even, or no parity. These parameters are software selectable using the front panel's keypad. The physical connection is supplied via an 8-pin RJ-48 female module connector. Attaching a VT100 compatible ASCII terminal to this connector allows the mux to be controlled and monitored through the ASCII terminal.

2.3.4 Auxiliary Interface Connector

The auxiliary interface connector, labeled AUX, is an 8-pin RJ-48 connector located on the mux's rear panel. See Figure 1-2. This connector is used to apply an external station clock to the E1 MUX-2/4. Refer to Table 1-5 for the pin assignment associated with the Auxiliary connector.

2.3.5 Power Cable

NOTE

Before connecting the power cable to the E1 MUX-2/4, make sure that the power ON/OFF switch, located on the rear, is in the OFF (0) position. See Figure 1-2.

Power to the E1 MUX-2/4 is supplied via a 7-foot (2.1-m) AC power cable. Insert the power cable's female connector into the power receptacle at the rear of the mux. See Figure 1-2. Insert the power cable's male connector into a grounded AC power receptacle. At this time power is not applied to the E1 MUX-2/4.

2.4 Initial Power Up

To apply power to the E1 MUX-2/4, put the On/Off switch in the On (1) position. The unit responds by displaying the top menu function on the LCD.

E1 MUX
E1 ACCESS

At this time the mux is ready to be programmed (configured). Refer to **Chapter 3** for the programming instructions.

3. Programming

3.1 Introduction

This chapter contains information that will help you program your E1 MUX-2/4's network and channel ports to satisfy your specific application requirements and to monitor system performance. All application configurations are software selectable through a menu of software interactive programming commands. These commands may be issued from the front-panel programming keypad or from an ASCII Terminal. These programming functions are illustrated in Figure 3-1.

The entire E1 MUX-2/4 programming menu tree is illustrated in **Appendix B**.

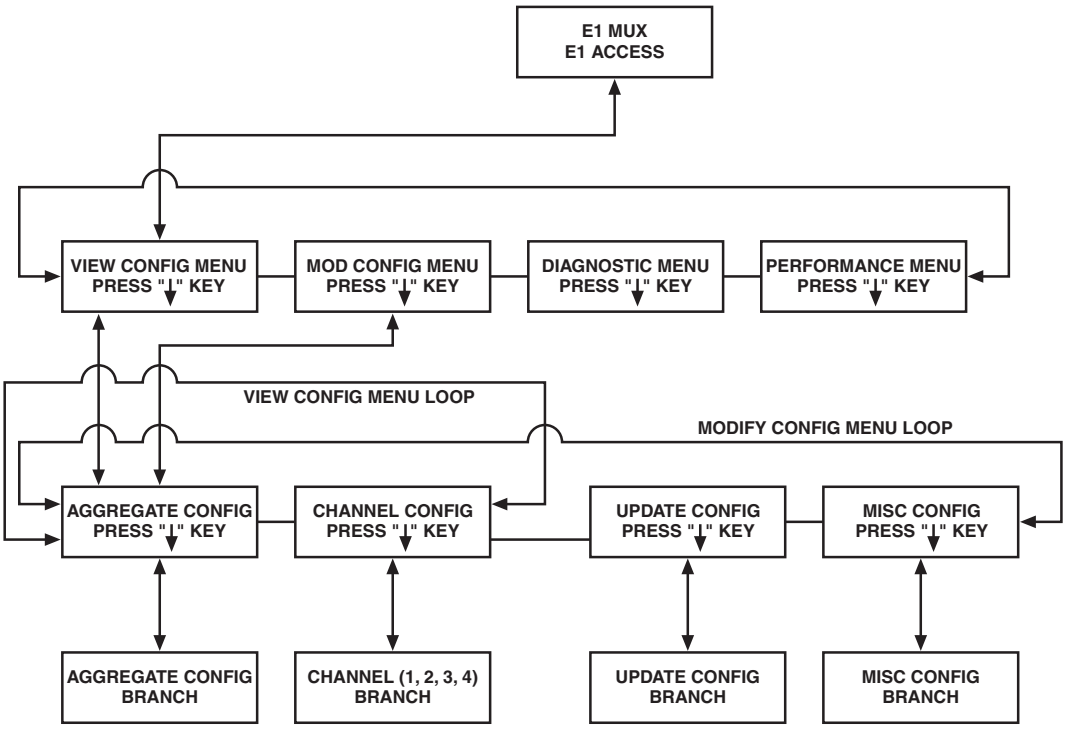


Figure 3-1. Top-Level Programming Menu Tree.

3.2 Configuration Worksheet

Use these configuration worksheets as a reference when programming the E1 MUX-2/4's network and channel ports parameter settings.

NOTE

Completing this worksheet may require referencing the various programming/configuration information contained in the remainder of this chapter.

Modify Configuration Worksheet

CUSTOMER NAME: _____ DATE: _____

CUSTOMER LOCATION: _____ CONFIGURATION: _____

AGGREGATE CONFIGURATION

NETWORK TIMING:
A. INTERNAL(MASTER)___
B. LOOP(SLAVE)___
C. EXTERNAL(CHANNEL 1 TCE)___ (See Note 1)
or
D. STATION CLOCK___ (See Note 2)

NOTE 1: If the External Channel 1 TCE selection is made, then the associated channel timing must be set to Loop 1 Timing. When operating in this mode, the E1 MUX-2/4 derives network timing from the DTE.

NOTE 2: If station clock is selected, then the system allows the user to select the station clock rate. The station clock rate may be any rate from 8 kbps to 2.048 Mbps in multiples of 8 kbps.

FREQUENCY___

NETWORK FRAMING: (2048 kbps)

TIMESLOT 0:
A. CRC4 ENABLE___
B. CRC4 DISABLE___

TIMESLOT 16:
A. MULTIFRAME ALIGNMENT___
B. DATA___

NETWORK LINE CODE:
A. AMI___
B. HDB3___

DTE CHANNEL MULTIPLES: (See Note 3)
N x 56 kbps___
N x 64 kbps___
Extended

Selectable N x 56 Rates: 8, 16, 24, 32, 40, 48, 56, 64, 112, 168, 192, 224, 280, 320, 336, 448, 560, 672, 840, 960, 1120, 1344, 1680, and 1736 kbps.

Selectable N x 64 Rates: 8, 16, 24, 32, 40, 48, 64, 128, 192, 256, 320, 384, 512, 640, 768, 960, 1280, 1536, 1920, and 1984 kbps.

Selectable Extended Rates: 8, 16, 24, 32, 40, 48, 56, 64, 112, 128, 168, 192, 224, 256, 280, 320, 336, 384, 448, 512, 560, 640, 672, 768, 840, 960, 1120, 1280, 1344, 1536, 1680, 1736, 1920, and 1984 kbps.

NOTE 3: This selection does not have any correlation with the Density Format employed when the E1 MUX-2/4 builds the CEPT Frame (for example, N x 56 kbps does not imply "bit 7 stuffing" and N x 64 kbps does not imply "clear channel"). These density selections are made on a per-channel basis within the channel configuration.

When operating with an RS-232 interface, either N x 56 kbps or N x 64 kbps may be selected.

DATA CHANNEL CONFIGURATION

CHANNEL NUMBER:___

CH DENSITY:
A. NONE(CLR CH)___
B. BIT 7 STUFFING___ (1 in 8 Bit Density Inserted) See Note 4

NOTE 4: Selection B above is not applicable with an RS-232 interface.

CHANNEL DATA RATE:___

STARTING TIMESLOT NUMBER:___

CHANNEL TIMING:
A. LOOP 1___(Send timing is looped to the E1 MUX-2/4 as Terminal Timing via the DTE)
B. LOOP 2___(Send timing is loop backed as Terminal Timing internally to the E1 MUX-2/4)

CLOCK INVERT:
A. ON___(See Note 5)
B. OFF___

NOTE 5: This selection will invert the selected CHANNEL TIMING clock. It is most applicable when LOOP 2 Timing is selected.

DATA INVERT:
A. ON___
B. OFF___

RTS: (See Note 6)
A. ON (DCE CONTROL)
B. SWITCHED (DTE CONTROL)

NOTE 6: This option is available for RS-232 channel only. Selection A causes the E1 MUX-2/4 to ignore the DTE's RTS status and will hold it constantly ON. Selection B causes the E1 MUX-2/4 to multiplex the status of RTS (as dictated by the DTE) with the data for transmission across the network. This status is received by the remote channel and interpreted as DCD. In this mode, RTS must be turned on by the DTE to transmit data.

CTS: (See Note 7)
A. SWITCH (NET CONTROL)
B. ON (DCE CONTROL)

NOTE 7: This option is available for V.35 and RS-449 channels only. Selection A causes CTS to follow RTS unless the network is out of sync. In this case, CTS will drop low (inactive signal). An active CTS is required to transmit. Selection B causes CTS to follow RTS under all circumstances.

STORE CONFIGURATION IN BANK___

OR UPDATE CURRENT CONFIGURATION___

3.3 Configuring the Aggregate

Using the completed worksheet as a guide, enter the aggregate information into the E1 MUX-2/4 as follows:

NOTE

For additional information on programming the aggregate, refer to Sections 3.8 and 3.9.

1. Select MODIFY CONFIGURATION by scrolling down one level from the top level sign-on message—E1 MUX-2/4—and then right or left until the MODIFY CONFIGURATION selection appears.

2. When the MODIFY CONFIGURATION function appears on the LCD, scroll down one level, then right or left until the AGGREGATE CONFIGURATION function appears on the LCD.

3. Scroll down to the NETWORK TIMING function and then right or left until the desired selection appears on the LCD.

4. If Station Clock is selected, the next selection down is Station Clock Frequency. Scroll right or left to select the desired rate.

5. Scroll down to the NETWORK FRAMING function. Network framing of 2048 kbps CEPT is the only selection available.

6. Scroll down to the TIMESLOT 0 function. Enable or disable CRC4 by scrolling left or right and selecting the desired function.

7. Select the state of TIMESLOT 16 function by scrolling down and right or left until the desired state is displayed on the LCD.

8. Scroll down to the NETWORK LINE CODE function and select AMI or HDB3 as desired.

9. Scroll down to the DTE CHANNEL MULTIPLES function, and choose either N x 64K, N x 56K, or Extended Rates by scrolling either right or left. This selection dictates what rates are available for all channels.

NOTE

Any DTE CHANNEL MULTIPLES selection is acceptable when operating with an RS-232 interface.

10. The last selection in the AGGREGATE CONFIGURATION function is NETWORK INTERFACE. This always displays SEE REAR PANEL. The network interface is selected by setting the Network Interface Ohm switch, located on the rear panel, to the desired position. The network interface can be 75 ohm for BNC coax connections, or 120 ohm for a DB15 connector.

3.4 Configuring a Channel

Using the completed worksheet as a guide, enter the channel(s) information into the E1 MUX-2/4 as follows:

NOTE

For additional information on programming (configuring) a channel, refer to Sections 3.8 and 3.9.

1. Scroll down from the MODIFY CONFIGURATION one level and then either right or left until the CHANNEL CONFIG function is displayed.

2. Scroll down and then right or left until the desired channel number is displayed.

3. Scroll down and then right or left until the correct CH DENSITY function is displayed.

4. Again, scroll down until the CH DATA RATE function is displayed and then right or left until the desired rate is displayed.

5. Scroll down until the STARTING TIMESLOT NUMBER function is displayed. Scroll down and right or left until the desired timeslot number is displayed.

NOTE

If the aggregate parameter "TIMESLOT 16" is selected for Multiframe Alignment information, it will not be available to carry date.

6. CH TIMING is the next function to be accessed. Select either LOOP 1 or LOOP 2 by scrolling right or left until the desired timing is displayed.

7. CLOCK INVERT is the next function to be determined. Select either ON or OFF by scrolling right or left after the CLOCK INVERT function is displayed.

8. DATA INVERT is the next function to be displayed. Once displayed, select either ON or OFF by scrolling right or left until the desired alternative is displayed.

9. RTS options are displayed for RS-232 channels only. Select either ON (DCE CONTROL) or SWITCHED (DTE CONTROL) by scrolling right or left.

10. CTS options are displayed for V.35 and RS-449 channels only. Select either SWITCH (NET CONTROL) or ON (DCE CONTROL) by scrolling right or left.

3.5 Updating a Configuration

When either the AGGREGATE CONFIGURATION and/or the CHANNEL CONFIGURATION has been changed, it is necessary to UPDATE the current configuration or STORE the changes in a configuration bank. If the latest changes are not desired, the operator can CLEAR the latest entries made during the configuration function. The operator can also retrieve a previously stored configuration from any one of the four storage banks available in the E1 MUX-2/4.

NOTE

For additional information on updating a configuration, refer to Sections 3.8 and 3.9.

To update the E1 MUX-2/4 configuration previously entered or retrieved, perform the following steps.

1. Scroll down the MODIFY CONFIGURATION menu one level and then right or left until the UPDATE function appears on the LCD.
2. Scroll down to the display TO UPDATE CONFIG PRESS ENTER. If the configuration is correct, press the ENTER key. The updated configuration is now on-line.

3.6 Storing a Configuration

To store a configuration defined during the MODIFY CONFIGURATION function, perform the following steps.

NOTE

For additional information on storing a configuration, refer to Sections 3.8 and 3.9.

1. Scroll down from the MODIFY CONFIGURATION one level and then right or left until the UPDATE function appears on the LCD.
2. Scroll right or left until the STORE CONFIGURATION function appears on the screen.
3. Scroll down and then right or left until the desired storage bank number appears on the display.
4. When the desired storage bank number appears on the display, press ENTER.

3.7 Retrieving a Configuration

To retrieve a previously stored configuration, perform the following procedure.

NOTE

For additional information on storing a configuration, refer to Sections 3.8 and 3.9.

1. Scroll down from the MODIFY CONFIGURATION one level and then right or left until the RETRIEVE CONFIGURATION function appears on the display.
2. Scroll down and then right or left until the desired storage bank number appears on the display.
3. Press ENTER. The desired configuration has been retrieved. To bring this configuration on-line, perform the UPDATE configuration operation previously discussed.

NOTE

If an attempt is made to retrieve from a storage bank that does not contain a configuration, the following message is displayed: ILLEGAL CONFIG. If there is a configuration available, then the following message appears: RETRIEVED.

3.8 View Configuration

The VIEW CONFIGURATION function (see Figure 3-1) allows the operator to step through the aggregate and channel configurations presently set up to run the E1 MUX-2/4. Although both the aggregate and each channel configuration may be viewed, they may not be altered while in this menu selection. A lower case "v" appears in the lower right-hand corner of the display to indicate that the unit is accessing the VIEW function. To escape from this function or any other function, press the UP arrow key until the E1 MUX-2/4 display appears on the LCD.

The following subsections describe the various View Configuration menu trees.

3.8.1 Aggregate Configuration

If the AGGREGATE (see Figure 3-2) function is selected for viewing, the first display is the type of NETWORK TIMING presently employed by the aggregate to transmit data to the network. There are four types of timing available for the E1 MUX-2/4. They are INTERNAL (MASTER), EXTERNAL (CH1 TCE), STATION CLOCK, and LOOP (SLAVE).

NOTE

If STATION CLOCK is selected, the user is then directed to specify the exact station clock speed (8 kbps to 2.048 Mbps in 8-kbps multiples) by scrolling through the STATION CLOCK FREQ menu that follows the NETWORK TIMING menu. Station Clock must be supplied at the Auxiliary port as a balanced signal per RS-422 electrical requirements.

If the mux is in the VIEW mode and EXT CLOCK is lost, a blinking "v" appears at the EXT TIMING selection.

The next function to be viewed is NETWORK FRAMING. There is only one type of Network Framing available on the E1 MUX-2/4. It is 2.048 Mbps CEPT framing.

Following the NETWORK FRAMING function, the operator may view the status of the CRC4 function of TIMESLOT 0. TIMESLOT 0 may have the CRC4 function either enabled or disabled. Enabling CRC4 provides a cyclic redundancy check and remote alarm indication resident in TIMESLOT 0 of certain frames per CCITT Recommendation G.704. Disabling the CRC4 option will cause all ONES in this bit position. The CRC4 bit, if enabled, will provide enhanced error monitoring capability as well as guard against false frame acquisition.

The next display is the status of TIMESLOT 16. TIMESLOT 16 may be configured as either the multiframe alignment structure or as an extra data channel. If TIMESLOT 16 is selected, to contain the multiframe alignment sequence, the E1 MUX-2/4 network framing conforms to Channel Associated Signalling as defined in CCITT Recommendation G.704. In this mode, signalling bits a, b, c, and d for all channels are encoded to 1, 1, 0, and 1 respectively. In this mode, TIMESLOT 16 is not available to carry any user data. Also, the proper multiframe alignment signal must be received for the unit to acquire frame synchronization. If TIMESLOT 16 is selected to carry data, the operator may use it as a data-carrying timeslot.

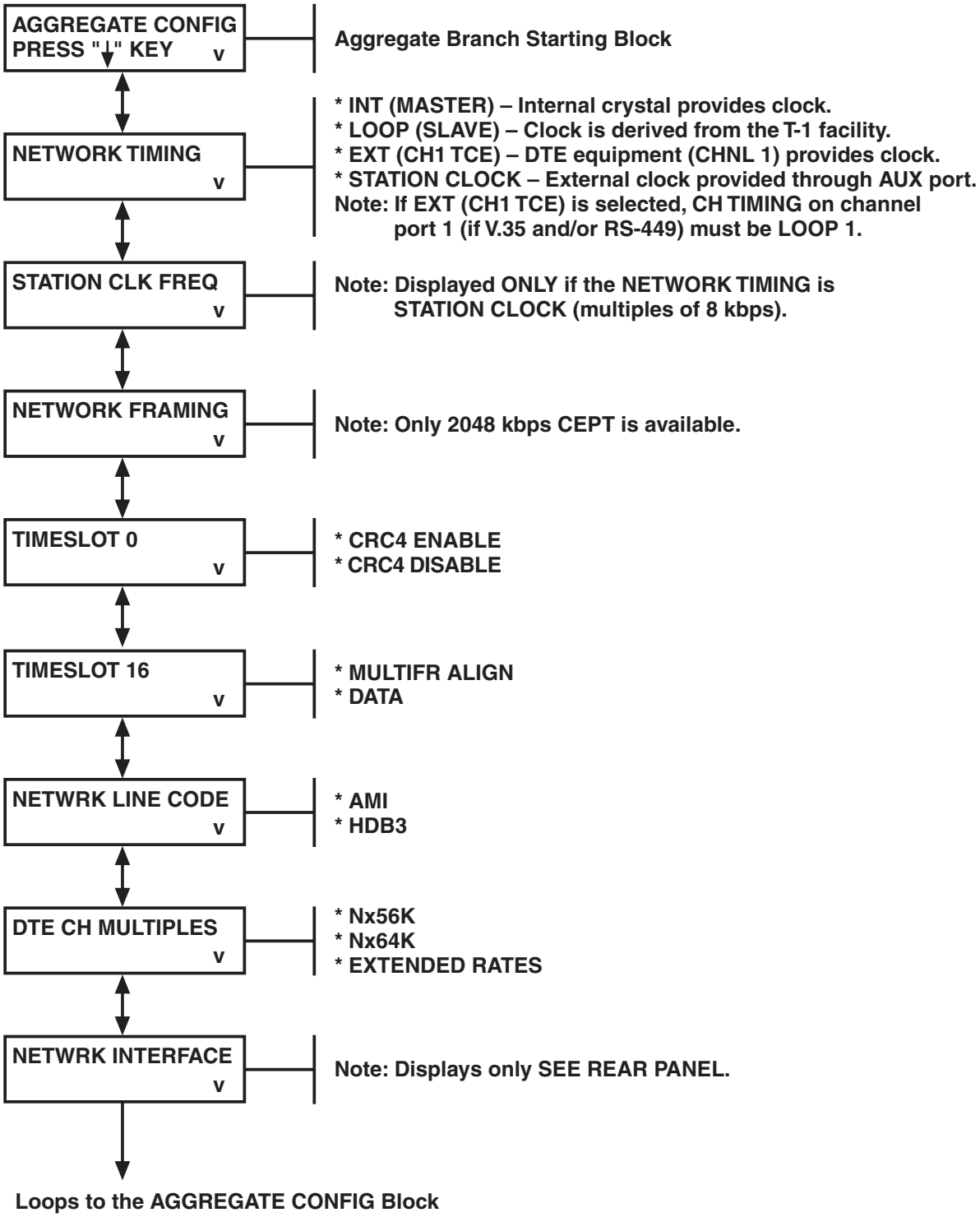


Figure 3-2. The View Aggregate Menu.

The next display down allows the operator to view the current NETWORK LINE CODE. The LINE CODE is either AMI or High Density Bipolar 3 (HDB3).

The next display down is DTE CHANNEL MULTIPLES specified as N x 64K, N x 56K, or Extended Rates. When the selection is made, the operator has a choice of three sets of unique channel data rates that may be selected.

Finally the NETWORK INTERFACE (see rear panel) message is displayed. To view the state of the NETWORK INTERFACE, the operator must locate the NETWORK INTERFACE switch on the E1 MUX-2/4's rear panel. The position of this switch determines the state of the NETWORK INTERFACE.

3.8.2 View Channel Configuration

To VIEW the channel configuration (see Figure 3-3), enter the VIEW CONFIGURATION function and press the DOWN ARROW. This displays either the AGGREGATE or CHANNEL function depending on the way the unit was last accessed. If the word AGGREGATE is displayed, then press the right or left arrow key and the words CHANNEL CONFIG will appear. When these words appear, press the DOWN arrow and one of the four channels will appear in the LCD display. To VIEW an individual channel, press the right or left arrow key until the number of the desired channel appears in the LCD.

Press the down arrow and the first of the channel configuration functions comes into view (CH DENSITY). Depending on the current configuration of the E1 MUX-2/4, one of the following is displayed on the LCD:

NONE (CLR CH)
BIT 7 STUFFING

NONE causes all eight bits in the selected channel timeslots to be available for user data. BIT 7 STUFFING causes the eighth bit to be a ONE and the remaining seven bits of each selected channel timeslot to carry data.

Once the CH DENSITY function has been viewed, the operator can access the data rate associated with the selected channel by pressing the down arrow. Included in the CHANNEL DATA RATE display is the count of the number of TimeSlots (TS) necessary to support the desired rate.

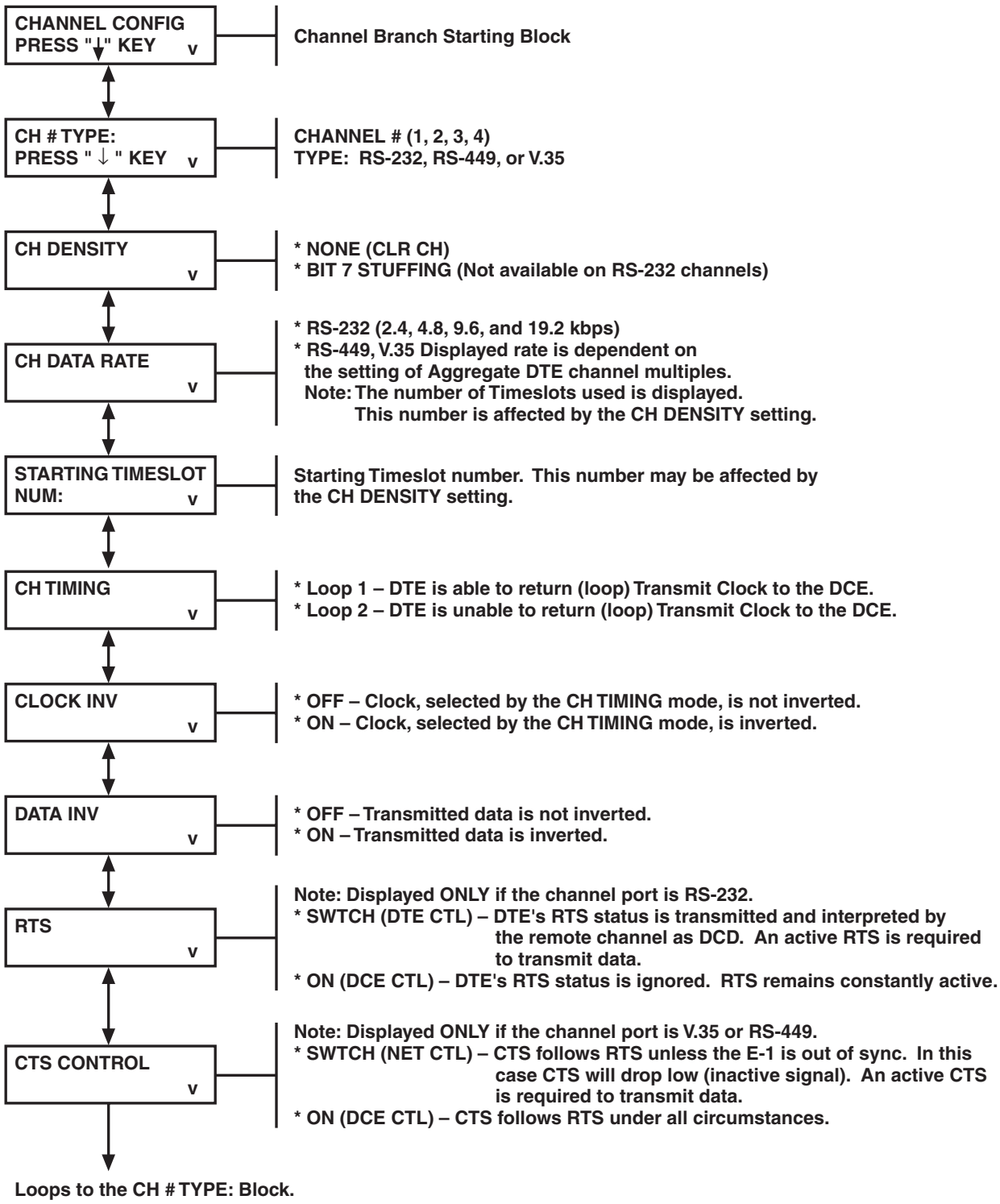


Figure 3-3. The View Channel Menu.

Following the data rate display, the STARTING TIMESLOT address of the selected channel is displayed. This is a TIMESLOT number from one to thirty-one.

The next function down is the CHANNEL TIMING mode previously selected for the particular channel being accessed. Depending on the type of timing required for the channel function, either LOOP 1 or LOOP 2 is displayed on the LCD.

The next function to be displayed is the CLOCK lNVERT information. This function is either ON or OFF depending upon the particular application.

Next, the DATA INVERT function is displayed. This function is either ON or OFF depending upon the particular application.

An additional display exists for RS-232 channels only: it is RTS and it will be either ON (DCE CONTROL) or SWITCHED (DTE CONTROL).

An additional display exists for V.35 and RS-449 channels only: it is CTS and it will be either SWITCH (NET CONTROL) or ON (DCE CONTROL).

3.9 Modify Configuration

The MODIFY CONFIGURATION function (see Figure 3-1) allows the operator to initially program the E1 MUX-2/4, change any of the parameters already programmed, perform the update function, or address the miscellaneous functions available with the E1 MUX-2/4.

When accessing the MODIFY CONFIGURATION function, the letter “m” appears in the lower right-hand corner of the display to indicate that the operator is in the MODIFY CONFIGURATION function. To configure the E1 MUX-2/4 to meet your application, scroll through the AGGREGATE and CHANNEL functions making the required changes by using the right and left function keys. If it is decided that the configuration previously entered is not required, go to the UPDATE function and invoke the CLEAR CONFIGURATION command. After making all of the desired changes, go to the UPDATE function and invoke the UPDATE LOCAL UNIT command to actually bring the modified configuration on-line.

Within the AGGREGATE CONFIG and CHANNEL CONFIG functions, when a difference exists between the displayed selection and the downloaded selection, the letter “m” will blink in the selected display as well as the top level display. Note that the VIEW CONFIGURATION will always represent the downloaded configuration.

Changes within the MISCELLANEOUS function such as TIME/DATE, PRINTER, and TERMINAL configurations, take place immediately and do not require an UPDATE command.

The following subsections describe the various Modify Configuration menu trees.

3.9.1 Modify the Aggregate

To initially program or to modify the existing aggregate parameters (see Figure 3-4), press the down arrow and then either the right or left arrow until the words AGGREGATE CONFIGURATION appear in the LCD. Then press the down arrow and the function NETWORK TIMING appears along with the default or current selection for the timing source. There are four alternatives available at this location. They are INTERNAL (MASTER), LOOP (SLAVE), EXTERNAL (CH1 TCE), or STATION CLOCK.

NOTE

If STATION CLOCK is specified, the user must specify the exact station clock speed (any speed is acceptable from 8 kbps to 2.048 Mbps in 8-kbps increments) by scrolling through the STATION CLOCK FREQ menu that follows the NETWORK TIMING menu. It depends upon the speed of the station clock itself and must correspond to that speed.

If the operator intends to use the on-board crystal associated with the E1 MUX-2/4 for the timing source, then the selection INT (MASTER) is made. If the transmission of data is to be timed from the Channel 1 Terminal Timing Signal, then the selection is EXTERNAL. When the operator wants to time the data transmission with the timing signal derived from the network receive data, then the proper selection is LOOP.

Once the network's AGGREGATE TIMING function has been determined, the NETWORK FRAMING type may be entered. There is only one FRAMING TYPE available with the unit. That FRAMING TYPE is the 2048 kbps CEPT frame.

The next selection is the TIMESLOT 0 function. It allows you to enable or disable the CRC4 function.

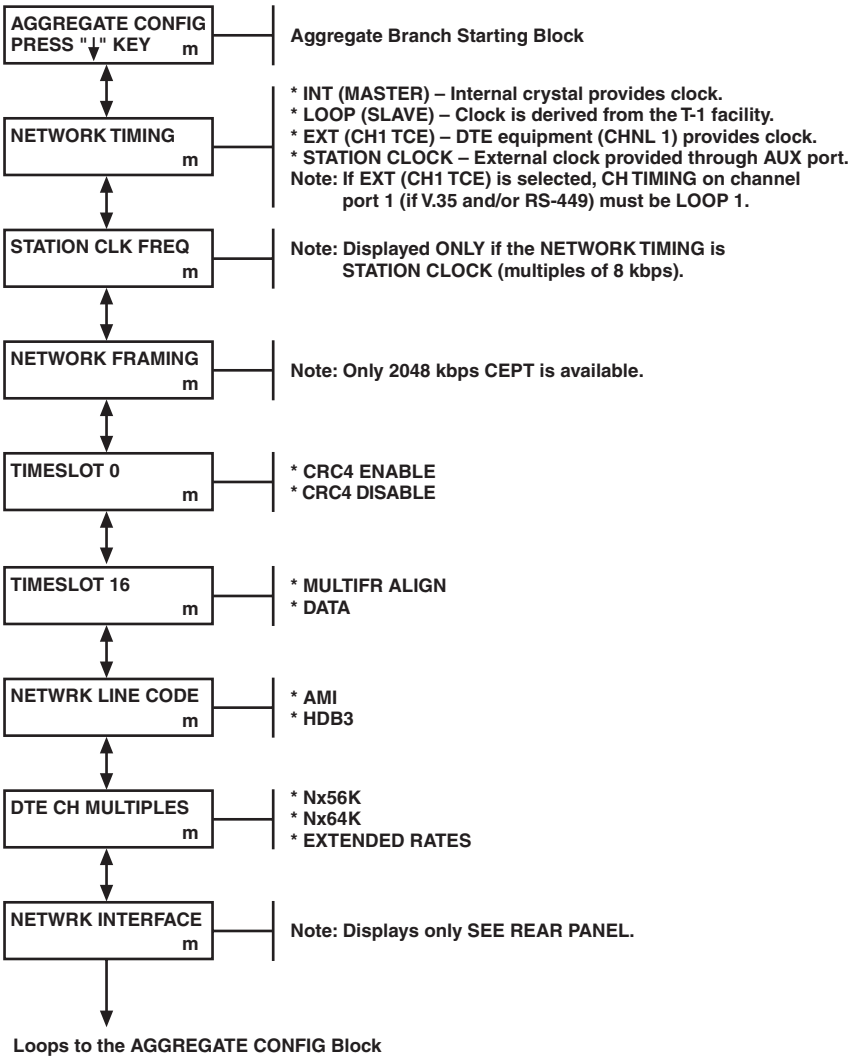


Figure 3-4. The Modify Aggregate Menu.

Following the TIMESLOT 0 entry, the condition of TIMESLOT 16 is specified. TIMESLOT 16 may be configured for multiframe alignment signal (framing) or data.

The next selection is the NETWORK LINE CODE. Choices for the Bipolar network data encoding scheme are either the Alternative Mark Inversion (AMI) method or the HDB3 method.

The DTE CHANNEL MULTIPLES is the next function specified. It is specified as either N x 64K, N x 56K, or Extended Rates depending on the desired set of channel data rates. These rates are listed below:

Selectable N x 56 Rates:	8, 16, 24, 32, 40, 48, 56, 64, 112, 168, 192, 224, 280, 320, 336, 448, 560, 672, 840, 960, 1120, 1344, 1680, and 1736 kbps.
Selectable N x 64 Rates:	8, 16, 24, 32, 40, 48, 64, 128, 192, 256, 320, 384, 512, 640, 768, 960, 1280, 1536, 1920, and l 984 kbps.
Selectable Extended Rates:	8, 16, 24, 32, 40, 48, 56, 64, 112, 128, 168, 192, 224, 256, 280, 320, 336, 384, 448, 512, 560, 640, 672, 768, 840, 960, 1120, 1280, 1344, 1536, 1680, 1736, 1920, and 1984 kbps.

NOTE

If channel rates are programmed and the N x 64, N x 56, or the Extended Rates entry is changed, then the data rate information is corrupted and must be re-entered.

This selection does not have any correlation with the Density Format employed when the E1 MUX-2/4 builds the E-1 Frame: for example, N x 56 kbps does not imply “bit 7 stuffing” and N x 64 kbps does not imply “clear channel.” These density selections are made on a per-channel basis within the channel configuration.

When operating with an RS-232 interface, either selection is appropriate.

The last display is the NETWORK INTERFACE function. This always displays SEE REAR PANEL. The NETWORK INTERFACE is selected by setting the network interface switch, located on the rear panel, to either the 75-ohm position when using the COAX connectors or to the 120-ohm position if using a DB15 connector.

3.9.2 Modify Data Channel

The MODIFY CHANNEL function (see Figure 3-5) allows the operator to configure individual channels to correspond to required applications.

When it is necessary to initially configure a channel or to change a channel’s configuration already in place, the first function to accomplish is the actual channel selection process. Scrolling right from the AGGREGATE CONFIGURATION selection (located under MODIFY CONFIGURATION), the CHANNEL CONFIGURATION function is entered. At this time scroll down and then left or right through the channel numbers until the number of the desired channel appears on the LCD. Press the DOWN function key and the CH DENSITY function appears on the screen.

The CH DENSITY function defines how the individual channel’s data is formatted into the CEPT frame. One of two types of channel mapping is selected on a per-channel basis:

NONE (CLR CH)
BIT 7 STUFFING

If NONE (CLR CH) is selected then data is mapped as 8 bits per timeslot. If BIT 7 STUFFING is selected, data is mapped as 7 bits per timeslot and the eighth bit is forced to a ONE state. Scroll through the CH DENSITY selections until the desired mapping function is displayed.

The next function to be defined is the CHANNEL DATA RATE function. This function specifies the data rate associated with the channel being configured. To assign a data rate to an individual channel, bring up the DATA RATE display and scroll through the data rate selections until the desired rate is displayed. Included in this display is the number of TimeSlots (TS) necessary to support the desired rate.

NOTES

1. If the actual data rate was previously programmed and the channel mapping is changed, then the data rate is corrupted.

2. Once a data rate is selected for an individual channel, then only the data rates remaining are displayed on the LCD for the other channels.

Following the data rate selection, the next function down is the STARTING TIMESLOT NUMBER for this individual channel or the first timeslot assigned to this channel. Note that illegal addresses are not displayed. When configuring the next channel, note that only the available TS addresses are displayed on the LCD.

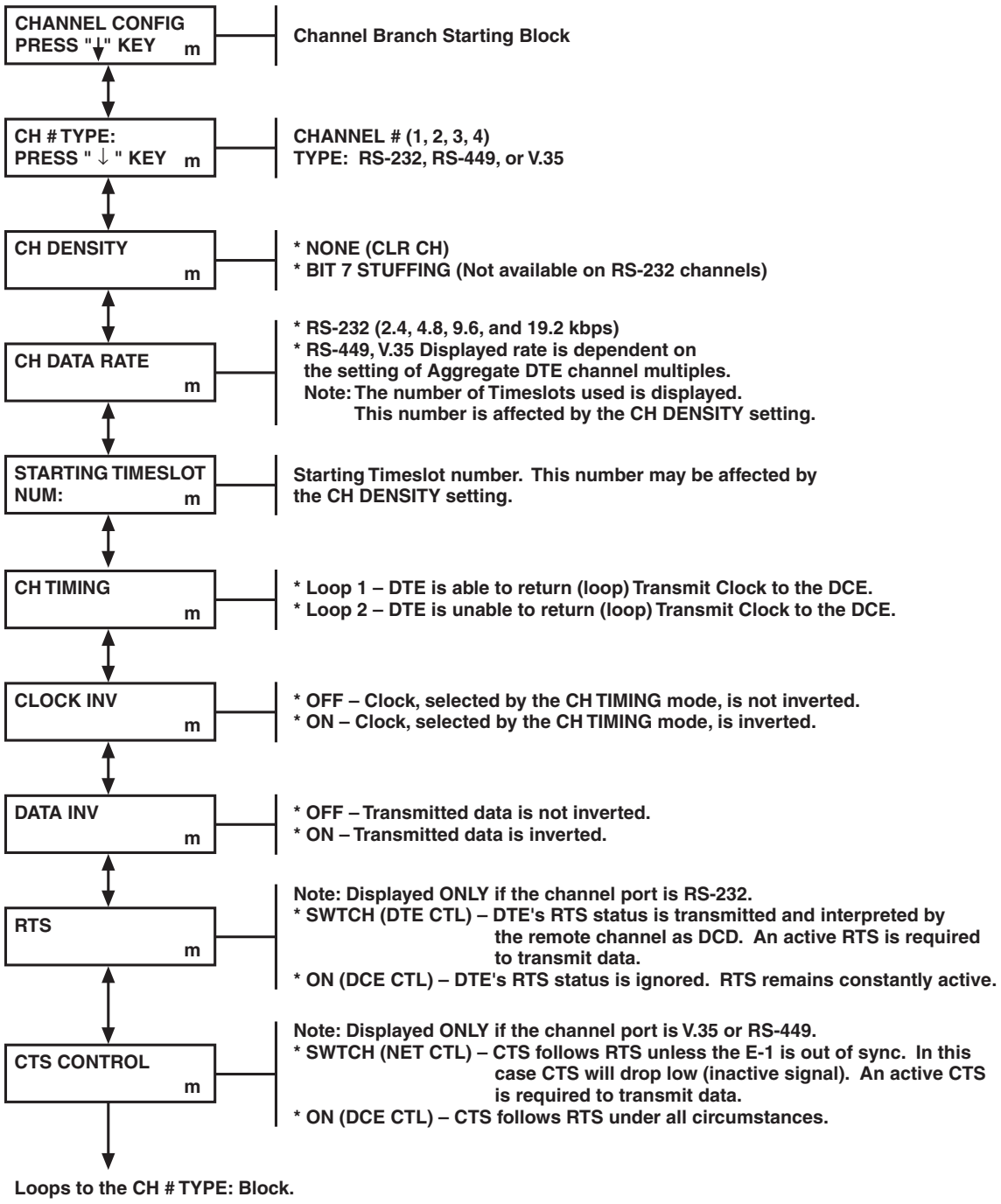


Figure 3-5. The Modify Channel Menu.

The next function down is the CHANNEL TIMING. Depending on the requirements of the type of equipment attached to the individual channel, the channel timing may be specified as one of two modes. The modes are LOOP 1 or LOOP 2. Loop 1 timing, the preferred mode, is when the attached equipment transmits a clock signal (terminal timing or Transmit Clock External) along with the transmit data and the E1 MUX-2/4 uses this for its channel timing. The Loop 2 timing is specified when the attached equipment does not transmit a clocking signal to be used by the E1 MUX-2/4. In this mode, the clock transmitted from the E1 MUX-2/4 to the DTE, SEND TIMING, is used.

NOTE

If Loop 1 Timing is selected and the clock is not present at these leads, the E1 MUX-2/4 will default to Loop 2 Timing until the clock becomes active.

Table 3-l lists the various timing options available to the E1 MUX-2/4.

Table 3-1. Timing Selections.

Selection	Source	Comments
INT (Master)	On Board Crystal	None
Loop (Slave)	Received Clock	None
EXT (CH1 TCE)	Channel 1 Terminal Timing	Channel 1 must be in Loop 1 timing
Station Clock	Station	Station Clock rate must be specified

Following the channel timing selections is the CLOCK INVERT function. INVERT CLOCK, when selected as ON, inverts the clock selected by the channel timing mode. This is often used when LOOP 2 timing is selected.

Following the clock invert function is the INVERT DATA function. When this function is ON, the channel data is inverted over the network.

An additional display exists for RS-232 channels only; it is RTS and will be either ON (DCE CONTROL) or SWITCHED (DTE CONTROL). Selection A causes the E1 MUX-2/4 to ignore the DTE's RTS status and will hold it constantly ON. Selection B causes the E1 MUX-2/4 to multiplex the status of RTS (as dictated by the DTE) with the data for transmission across the network. This status is received by the remote channel and interpreted as DCD. In this mode, RTS must be turned on by the DTE to transmit data.

An additional display exists for V.35 and RS-449 channels only; it is CTS and will be either SWITCH (NET CONTROL) or ON (DCE CONTROL). Selection A causes CTS to follow RTS unless the network is out of sync. In this case CTS will drop low (inactive signal). An active CTS is required to transmit. Selection B causes CTS to follow RTS under all circumstances.

3.9.3 The Update Function

The UPDATE function (see Figure 3-6) allows the operator to perform four unique E1 MUX-2/4 programming operations. Scrolling right from the CHANNEL CONFIG selection (located under MODIFY CONFIG) accesses the UPDATE function. There are four UPDATE operations; STORE can store as many as four alternative configurations, RETRIEVE can retrieve any one of the four alternative configurations, CLEAR can clear any configuration currently being modified, and the actual UPDATE operation which updates the configuration presently controlling the operation of the system.

NOTE

If EXT (CH1 TCE) is chosen for timing and the data rate for the corresponding channel is not specified, then the UPDATE will default to MASTER TIMING.

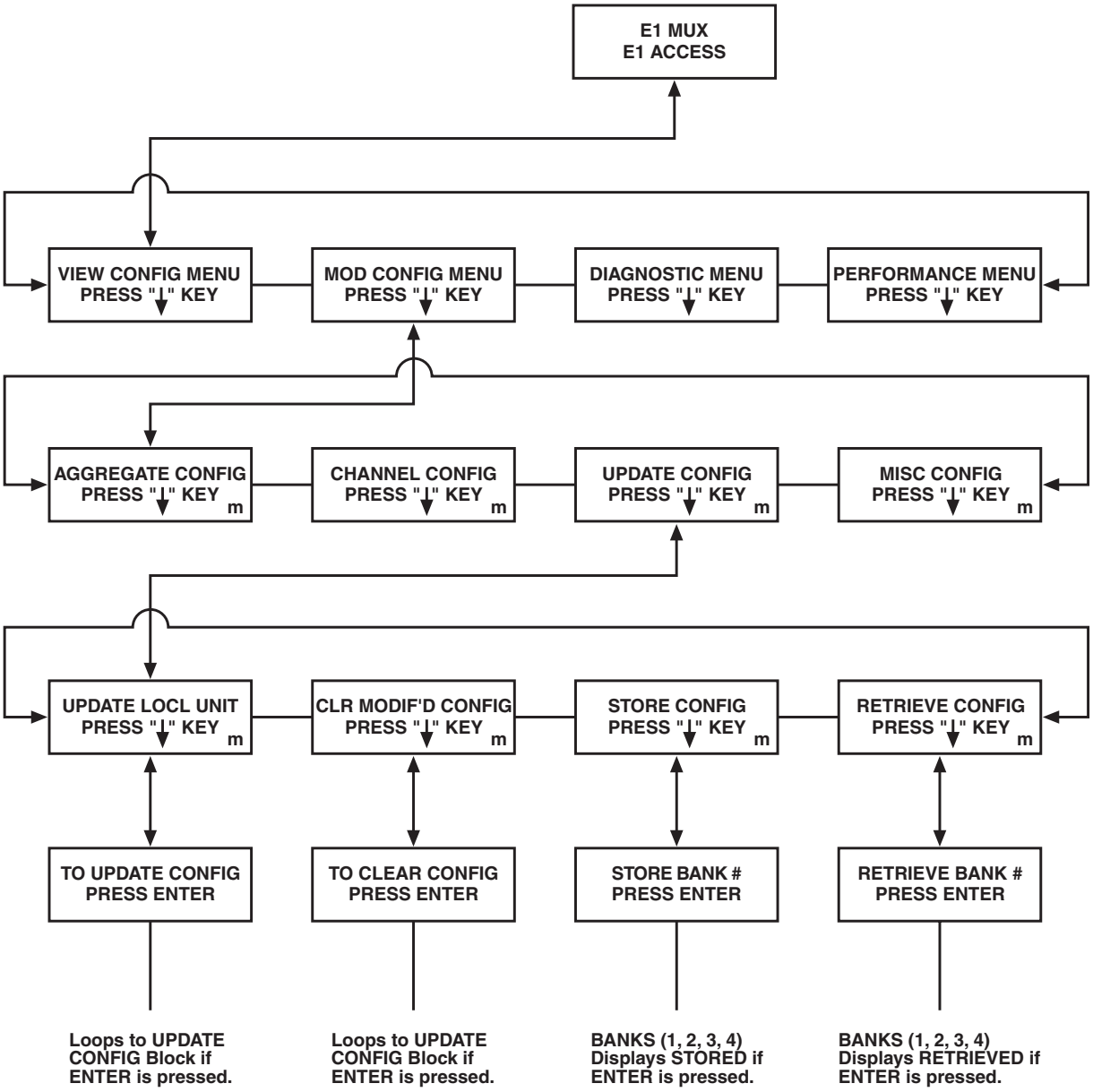


Figure 3-6. The Update Function Menu.

3.9.3.1 Retrieve Configuration

To retrieve a previously stored configuration, enter the RETRIEVE SETUP function (see Figure 3-6) and then scroll through the four storage banks to access the desired configuration. To retrieve the desired configuration, press the ENTER key. If a configuration is present, then the LCD will display the message: RETRIEVED. If the configuration is missing then the LCD will display the message: ILLEGAL. When the desired configuration is accessed, it may be viewed with the MODIFY function to verify its contents. If the configuration is not the desired configuration then clear it by entering the CLEAR CONFIG. If the configuration is correct, then use the UPDATE function to bring the configuration on-line.

3.9.3.2 Store Configuration

To store a configuration generated during the MODIFY CONFIGURATION function, enter the STORE CONFIGURATION function (see Figure 3-6) and scroll through the storage banks until the desired bank is accessed. Press the ENTER key.

3.9.3.3 Clear Configuration

The CLEAR CONFIGURATION function (see Figure 3-6) allows the operator to erase any configuration modification accomplished before the UPDATE function is activated to implement the modified configuration. Once the modified configuration is cleared, the system reverts back to the previous controlling configuration. To clear a presently modified configuration, press the ENTER key while in CLEAR CONFIGURATION.

3.9.3.4 Update

The UPDATE function (see Figure 3-6) performs the actual configuration change from what is presently controlling the operation of the system to the new modified configuration or to a previously stored and accessed configuration. To change the operating configuration, enter the UPDATE function and then press the ENTER key. The new configuration immediately takes control of the E1 MUX-2/4. During an UPDATE operation, all keypad buttons are inoperative.

3.9.4 Miscellaneous

The Miscellaneous function (see Figure 3-7) allows the operator to set the Date and Time, configure both the printer and terminal ports, and view the software revision level of the E1 MUX-2/4. Scrolling right from the UPDATE CONFIG function (located under MODIFY CONFIG) accesses the MISCELLANEOUS function.

3.9.4.1 Date and Time

The date and time allows the operator to set the current date and time so that all reports and alarms will have the proper date/time stamp. See Figure 3-7. To set the correct time, scroll down through the current time to the SET TIME COMMAND. Then press ENTER. This allows the operator to access the SET HOURS function. The clock may be either a 24-hour or a 12-hour clock. To select the type of clock, press the right or left key until the desired type of clock is displayed. Then scroll through the numbers until the correct hour is displayed. Then press the DOWN key.

To set the minutes function, enter the SET MINUTES command. Scroll through the numbers 1 through 59 using the right or left arrow. When the correct number is displayed, press the DOWN key.

NOTE

To exit from the set time function, press the ENTER key.

To set the correct date, scroll down through the current date to the SET DATE COMMAND. Then press the ENTER key. This allows the operator to access the SET MONTH function. Scroll right or left until the number (l–12) corresponding to the desired month appears on the screen. Then press DOWN key.

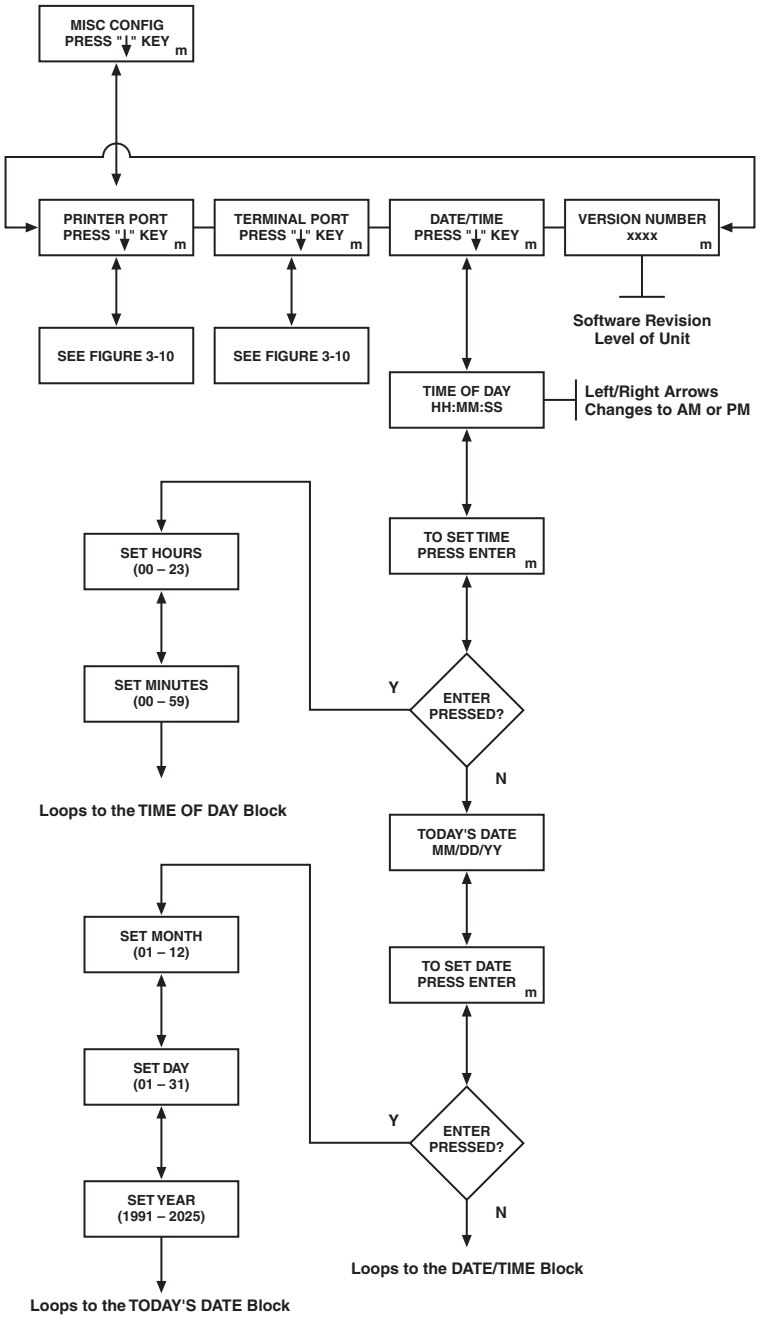


Figure 3-7. The Miscellaneous Menu.

Pressing the DOWN key displays the SET DAY function. Scrolling right or left through this function displays the numbers 1 through 31 which corresponded to the days of the month. Press the DOWN key to select the correct day.

Pressing the DOWN key displays the SET YEAR comment. Scrolling through this function with the right or left arrows lets you select the correct year. Press the DOWN key when the correct year is specified.

NOTE

Pressing the ENTER key will exit the user from this function.

3.9.4.2 Revision Level

The E1 MUX-2/4's software revision level is displayed in a single menu block. See Figure 3-7. Once displayed, no additional menu key strokes are required (single block tree). To view the revision level, scroll right or left to the block labeled VERSION NUMBER located under the MISCELLANEOUS function.

3.9.4.3 Terminal and Printer

The TERMINAL and PRINTER functions allow the operator to configure the asynchronous serial terminal or printer interface port. See Figure 3-8. Attachment of a VT100 compatible ASCII terminal to either of these interface ports will allow the unit to be controlled and monitored through the ASCII terminal. To configure either of these interfaces, scroll right or left to the TERMINAL or PRINTER PORT function located under the MISCELLANEOUS function. See Figure 3-7. Use the unit's keypad to move down through the TERMINAL or PRINTER PORT branch. Refer to the TERMINAL branch shown in Figure 3-8 to configure either port.

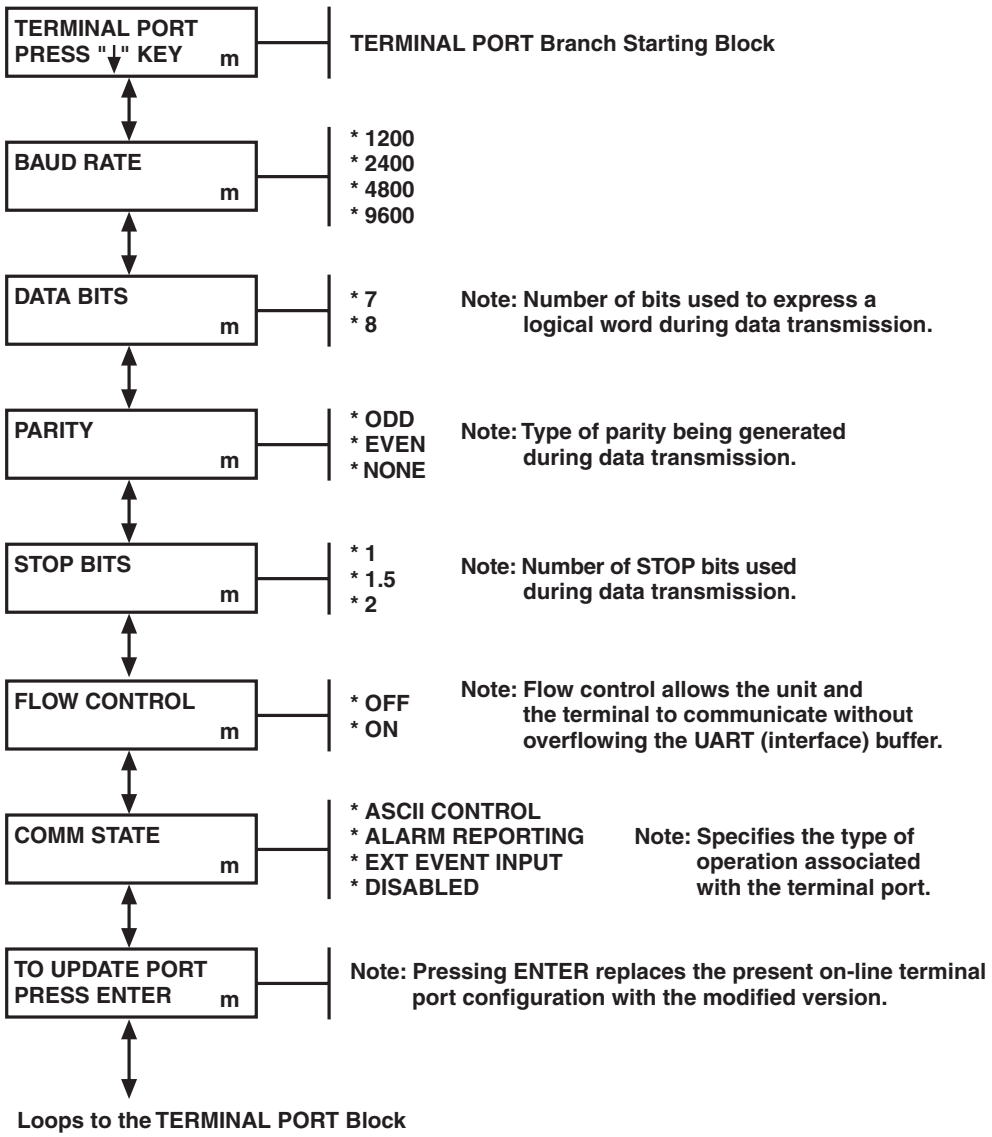


Figure 3-8. The Terminal/Printer Function Menu.

3.10 Performance

There is a difference between failure and approaching failure in CEPT networks. The PERFORMANCE function (see Figure 3-l) monitors the vital signs of the network. This allows a user to predict a network failure and, via preventative maintenance, avert extensive down time. The performance monitoring encompasses: Cyclic Redundancy Check 4, Frame Word Errors, Errored Seconds, Severely Errored Seconds, Failed Signal State, Failed Seconds, and Bipolar Violations. In addition, there is an alarm function and the ability to clear or freeze registers. Separate banks of information are maintained for both the user and the service provider. The user bank of information is completely controlled (cleared or frozen) by the user while the service provider bank of information can be controlled (cleared or frozen) only from the network. Refer to Figure 3-9 (divided into two parts and contained on the next two pages) for the following discussion.

3.10.1 Cyclic Redundancy Check 4

The Cyclic Redundancy Check 4 function (available only when TIMESLOT 0 has CRC 4 enabled) permits the unit sending the data to perform a calculation on the data using a predefined algorithm (the result of which is sent along with data). The receiving unit strips out this calculation, performs the same calculation on the data, and then compares the two results. If the results compare, then the data is valid. If the calculations do not compare, then there is a CRC 4 error. The CRC 4 mechanism permits the user a complete view of the E- 1 transmission quality. It can be translated into a bit error rate. The assumption can be made that each CRC error is equal to one bit error. Therefore, monitoring the CRC errors gives the user an accurate indicator of degrading transmission performance. This makes it possible to initiate repairs before a critical outage occurs. The CRC 4 calculations are defined in CCITT Recommendation G.704.

To clear this register, invoke the Clear Error Events or Clear All Registers function.

3.10.2 Frame Word Error

When a single frame alignment signal is incorrect, a FRAME WORD ERROR event occurs and the Frame Error Count Register is incremented. The information is accessed by the user only, and the storage register is cleared by either the Clear All Registers or the Clear Error Events Command.

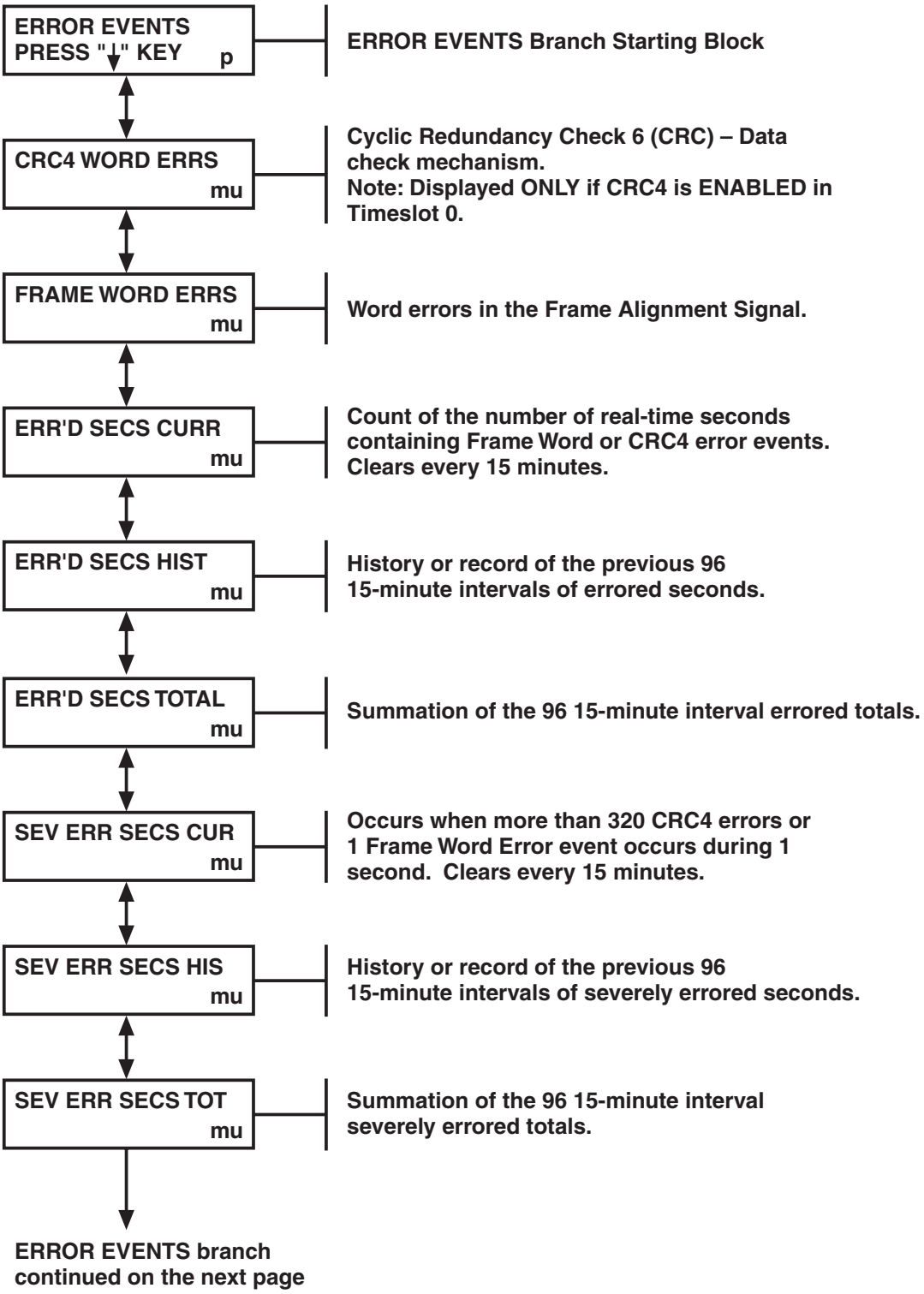


Figure 3-9. The Performance Menu.

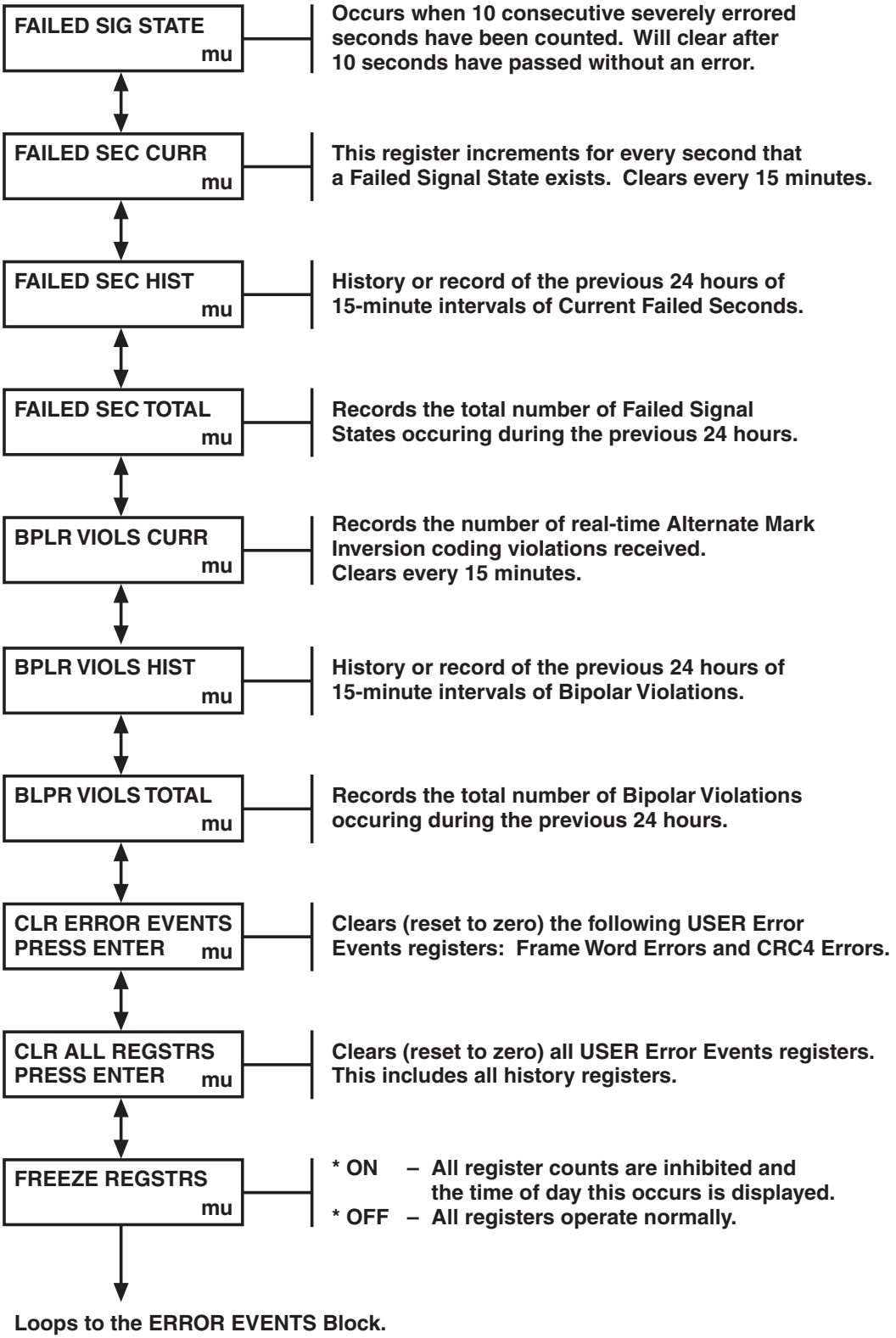


Figure 3-9 (continued). The Performance Menu.

3.10.3 Current Errored Seconds

This information is a count of the number of time seconds containing one or more CRC4/Frame Word error events. The processor polls the CRC4/Frame Word Error Events Register every second and increments the Current Errored Seconds register if an event has occurred. This count continues for 15 minutes, and then the register is cleared and a new count is initiated. A history of this register is contained in the History of Errored Seconds Registers. This register is cleared with the Clear All Register function.

NOTE

All "current" error displays are updated each second and contain the number of errors followed by the number of seconds into the current interval.

3.10.4 History of Errored Seconds

A history of the Errored Seconds contains the record of the previous ninety-six l5-minute intervals of errored seconds. This register is cleared with the Clear All Register function.

3.10.5 Errored Seconds Total

The total of the Errored Seconds is a computation of ninety-six 15-minute interval totals. This register is cleared with the Clear All Register function.

3.10.6 Current Severely Errored Seconds

If more than 915 CRC 4 errors or 1 Sync Loss occurs during a second, a Severely Errored Second has occurred. The contents of this register can be accessed by both the user and the network. This count continues for 15 minutes and then the register is cleared and a new count is initiated. A history of this register is maintained in the Severely History Errored Seconds register. This register is cleared with the Clear All Register function.

3.10.7 History of Severely Errored Seconds

A history of the Severely Errored Seconds contains the record of the previous ninety-six 15-minute intervals of errored seconds. This register is cleared with the Clear All Register function.

3.10.8 Errored Seconds Total

The Errored Seconds Total is the summation of ninety-six 15-minute intervals.

3.10.9 Failed Signal State

A failed signal state is present (indicated if YES is displayed) when 10 consecutive severely errored seconds have been counted. This state exists until 10 consecutive seconds without a severely errored second have passed. During a Failed Signal State, errored seconds are not counted.

3.10.10 Current Failed Seconds

For every second that a Failed Signal State exists, the Failed Second Register is incremented. A 24-hour history of 15 minute intervals is maintained as well as the total number of failed signal states for the previous 24 hours. This register is cleared with the Clear All Register function.

3.10.11 Bipolar Violations

A running total of the received bipolar violations is maintained. It is maintained in 15-minute intervals as the Current Bipolar Violations. A 24-hour record is maintained of the 15-minute intervals. This is called a History of the Bipolar Violations. A total History of the bipolar violations is also maintained.

3.10.12 Clear Error Events

The Clear Error Events allows the user to clear all error event registers. These registers are the Frame Word Error events and the CRC 4 error event registers.

3.10.13 Clear All Registers Command

This command allows the user to clear all the Performance registers, including all History Registers, so that the Performance Monitoring function can be re-initiated.

3.10.14 Freeze Registers

When On, all counts are inhibited and the time of day that this occurs is recorded. When OFF, everything operates normally.

3.10.15 Alarms

There are nine alarm states that can be displayed on the LCD. The LCD display will be updated every one-half second. If any state exists during that interval then that state will be displayed. A state will only be displayed if there are no existing alarms of a higher priority currently being displayed.

The network alarm is displayed under the ALARMS function. See Figure 3-10. Once displayed, no additional menu key strokes are required (two block menu tree). To view the NETWORK ALARM block, scroll right or left to the ALARMS function located under PERFORMANCE and then press the DOWN keypad button.

The following is a list of the nine alarms in order of priority and a definition of each.

- SYNC LOSS (AIS)—This signal is activated when a receive loss of SYNC and received unframed all ONES are detected. This is a priority 1 indication.
- SYNC LOSS—This signal is activated if a receive loss of SYNC is detected without detecting all ONES. This is a priority 2 indication.
- TS 16 LOSS (AIS)—This is activated if the receive signal contains the correct Multiframe alignment signal, but all ONES are detected for each channels' a, b, c, and d signaling.
- TS16 LOSS—This signal is activated if TIMESLOT 16 is configured for Multiframe alignment and the Multiframe alignment signal is not being received in the TIMESLOT 16. There is no indication if TIMESLOT 16 is configured for data.
- REMOTE ALARM—This is activated if a Remote Alarm Indication is detected. This is a Priority 5 indication. Remote alarm is indicated by the status of a bit within TIMESLOT 0 per CCITT Recommendation G.704
- REMOTE TIMESLOT 16 LOSS—This is activated if TIMESLOT 16 is configured for Multiframe and an alarm indication is received per CCITT Recommendation G.704. This is a Priority 6 indication. There is no indication if TIMESLOT 16 is configured for data.

- BPV ALARM—This is activated if any non-HDB3 Bipolar Violations are detected. This is a Priority 7 indication.
- FRAME ERROR ALARM—This is activated if any Frame Word Error is detected.
- CRC4 Error Alarm—This is activated if TIMESLOT 0 has CRC4 enabled and any CRC4 words errors are detected. There is no indication if TIMESLOT 0 has CRC4 disabled.

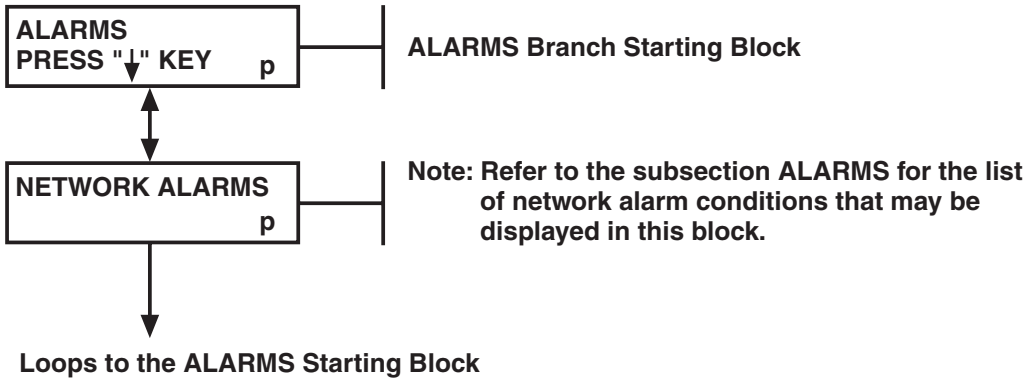


Figure 3-10. The Alarms Menu.

3.10.16 Remote Alarms

Three alarm messages may be transmitted to the remote unit. Transmit Remote Alarm inserts a logical One into TIMESLOT 0, Bit 3, CRC4 Error Indication inserts a ONE into TIMESLOT 0 Bit 1 frames 13 and 15, and Transmit Remote Multiframe Alarm inserts a Logical One into TIMESLOT 16 Bit 6 of Frame 0. If a Sync Loss (with or without an Alarm Indication Signal) occurs, a Remote Alarm is transmitted. If TIMESLOT 16 is in Multiframe, in addition to the Remote Alarm a Remote Multiframe Alarm is transmitted. The CRC4 Error Indication is transmitted if CRC4 is enabled and the previous Multiframe contained CRC errors.

A TIMESLOT 16 LOSS (with or without Alarm Indication Signal) causes a Remote Multiframe alarm to be transmitted.

Excessive errors in the Frame Alignment Word (>/- 1X10-3 for 4 seconds) causes a remote alarm to be transmitted.

3.11 Diagnostics

The diagnostics function (see Figure 3-1) allows the operator to perform a series of loopbacks and to generate test signals that will aid in the troubleshooting of the E1 MUX-2/4 and the network itself. The diagnostic functions performed are local channel loopback, local aggregate loopback, local network loopback, remote aggregate loopback, remote channel loopback, and test pattern generation. For this discussion refer to Figure 3-11.

3.11.1 Local Channel Loopback

The Local Channel Loopback, when selected, verifies the integrity of the individual channel under test. To perform this test, enter the Diagnostic function and scroll down to the LOCAL CHN LPBK function. To turn this function ON, press the ENTER key. To turn the function OFF, press the ENTER key again.

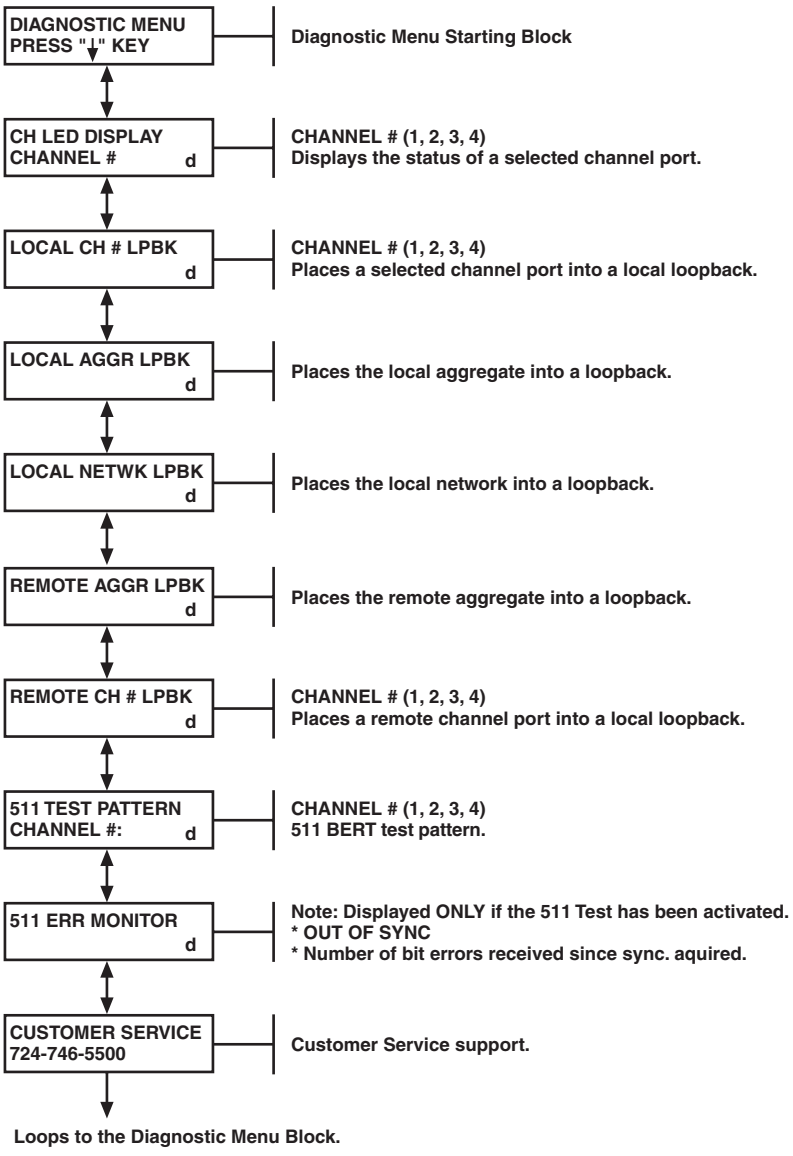


Figure 3-11. The Diagnostics Menu.

3.11.2 Local Aggregate Loopback

This loopback occurs on the network side of the local transmit and receive logic. The unit continues to transmit data across the network but also loops the data back to its own receiver circuitry. To access this loopback, scroll down through the diagnostic function until the LOCAL AGGREGATE LOOPBACK function is displayed on the LCD. To activate this loopback, press the ENTER key. To disable this loopback, press the ENTER key again. When in this Loopback Mode and the unit is in Loop Timing, it will default to Internal Timing until the loopback is disabled.

3.11.3 Local Network Loopback

This loopback allows the operator to disconnect the local side of the network by transmitting the data recovered from the network. To activate this loopback at the LOCAL NETWORK LOOPBACK function, press the ENTER key. When complete, press the ENTER key again and the loopback is disabled.

NOTE

When locally activating Local Network Loopback, the unit must not be the unit supplying timing to the network.

3.11.4 Remote Aggregate Loopback

The Remote Aggregate Loopback allows the operator to test the entire system from the local unit through the network to the remote E1 MUX-2/4 transmit and receive front end. To activate this test, scroll through the diagnostic function until the REMOTE AGGREGATE LOOPBACK function appears on the LCD. Then press the ENTER key. The system displays the message ACTIVATING for 8 seconds. Then the message ON is displayed. Pressing the ENTER key again clears this loopback. Activating this test from a loop timed unit causes the unit to default to Internal Timing.

3.11.5 Remote Channel Loopback

This test verifies the operation of the local channel, the aggregate/network, and the remote aggregate section (including the interface to the remote channel card). To activate this test, scroll through the diagnostic function until the REMOTE CHANNEL LOOPBACK function appears on the LCD. The entire remote unit is tested except for the DTE transceivers. If this test is successful, but end-to-end data transmission is unsuccessful, then the remote channel card may be defective.

3.11.6 Test Pattern

NOTES

1. BERT can only be run on one channel at a time.

2. This test operates on a Timeslot or Timeslot Bundle basis. RS-232 channels enable the multiplexing of two channels into one TS. Therefore, when invoking this test on a RS-232 channel, the second channel's data is overwritten.

To activate this test, scroll through the diagnostic function until the TEST PATTERN function appears on the LCD. When this function is activated, the local unit transmits and expects to receive a 511test pattern. There are two displays associated with this test. They are: OUT OF SYNC, and a numerical display that counts the number of bit errors since sync acquisition (32 consecutive correct bits). When this count reaches 65,536, the counter freezes. To clear the counter, press the ENTER key and the system restarts the counter. The OUT OF SYNC display indicates the local unit is not receiving the generated 511 pattern or that the unit is receiving the pattern but that it contains more than 25% errors.

Excessive bit errors implies that there is a problem in the data path. Use the Internal BERT, in conjunction with the other diagnostics tests, to isolate the problem.

Errors can be injected into the 511 pattern generated by the E1 MUX-2/4 by pressing the right or left function keys while in the Bit Error Monitor display.

3.11.7 Customer Service

If at the end of the diagnostic procedure the fault is not found, you may want to call 724-746-5500 for Technical Support.

Appendix A. Performance Display Overview

This appendix describes the front-panel interactive displays you may encounter within the PERFORMANCE menu. All categories within the menu structure are in compliance with CCITT specifications G.703 and G.704.

A full understanding of the following basic terms allows for better isolation of problems at the aggregate level.

Table A-1. Performance Display Terminology.

Term	Definition
CRC4 Errors	Occurs when the CRC4 summation, generated by the local device and based on the incoming CEPT signal, does not match the CRC4 field contained in Bit 1 of TIMESLOT 0.
Frame Word Error	Occurs when any of the bit positions of the frame alignment signal or bit positions 2 through 8 of any other framing is incorrect.
Errored Seconds (ES)	A second with one or more errored events. These may be either CRC4 error events or Frame Word Error events.
Severely Errored Seconds (SES)	A second with greater than or equal to 915 CRC4 errors or at least one Sync Loss Error.
Failed Signal State	Declared after a sequence of ten consecutive severely errored seconds. Return to service is declared after receipt of ten consecutive seconds without a severely errored second.
Bipolar Violation (BPV)	Indicates the presence, in the CEPT signal, of two consecutive bits with the same polarity. This is a violation to the Alternate Mark Inversion.

The flow of the PERFORMANCE menu is such that an operator can check seven basic types of events:

- Errored Events
- CRC4 Errors
- Frame Word Errors
- Errored Seconds
- Severely Errored Seconds
- Failed Seconds
- Bipolar Violations

Within each type of event, three areas may be accessed: CURRENT, HISTORY, and TOTAL. These are defined on the next page.

CURRENT Provides counts of seconds and events which occur in the current 15-minute interval. Resets at the end of the 900-second time interval.

HISTORY Provides a count of events which occurred in the past 96 time intervals contained within the unit's history map.

TOTAL Provides a count of events which occurred in the past 24-hour cycle. This will only be cleared when the user clears all registers.

The user may access any of the above areas for each of the event types: Errored Seconds, Severely Errored Seconds, Failed Seconds, and Bipolar Violations. The explanations below are applicable regardless of event type.

CURRENT

xxx yyy mu/mn

xxx The number of events which occurred within the current 15-minute interval.

yyy Time (in seconds) which has elapsed in the current 15-minute interval. At 900, the whole display resets and the next interval commences.

mu/mn Indicates whether the values being monitored are on the user (mu) or network (mn) side of the unit.

HISTORY

xxx yy/zz mu/mn

xxx Number of events which were present during the interval which is currently specified by yy. For example, if xxx reads 22, there were 22 events which were recorded at the interval specified by yy.

yy This is the number of the interval which the operator is currently viewing. By pressing either the right or left cursor keys, you may view all past 96 intervals and each interval's event record.

zz Indicates the current number of intervals in the history. The maximum number of periods which may accrue is 96.

mu/mn The operator may toggle between user registers and network registers.

TOTAL

xxxxx 24HOURS mu/mn

xxxxx Provides an accumulative total of events which occurred in the prior 24-hour period.

mu/mn The operator may toggle between user registers and network registers.

Appendix B. Programming Menu Tree

The main programming menu tree associated with the E1 MUX-2/4 is illustrated in Figure B-1.

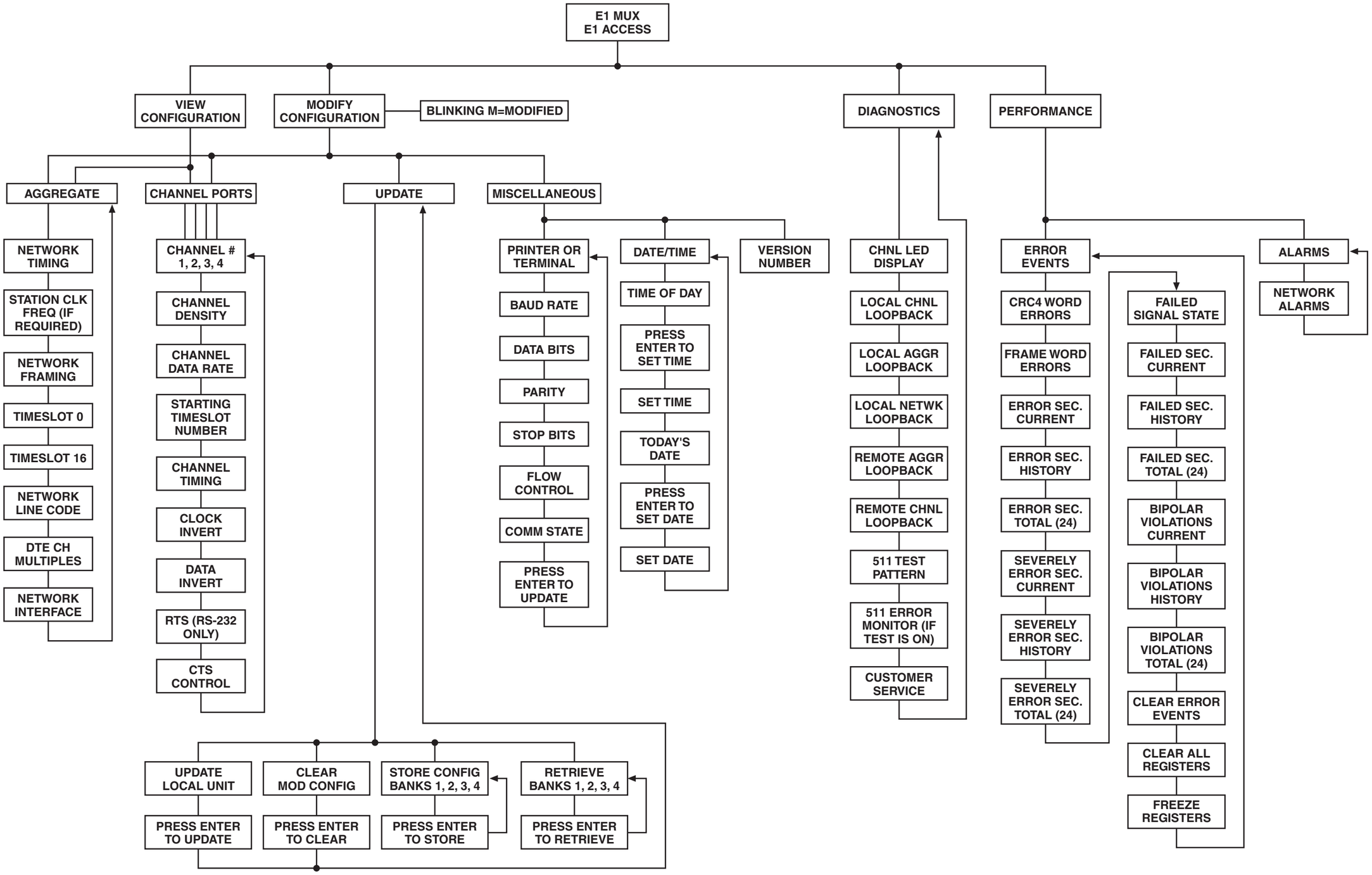


Figure B-1. E1 MUX-2/4 Menu Tree.

OM700671-1 Rev. A

© Copyright 2001. Black Box Corporation. All rights reserved.

1000 Park Drive • Lawrence, PA 15055-1018 • 724-746-5500 • Fax 724-746-0746