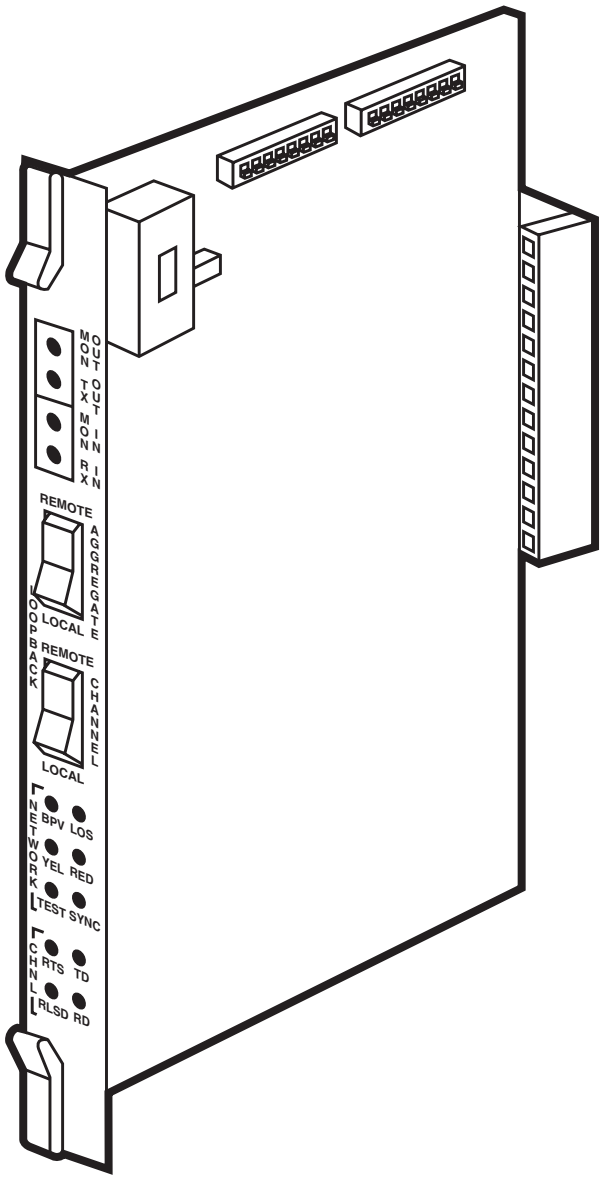
BLACK BOX®
NETWORK SERVICES

JANUARY 1997
MT510A-R2

T1 CSU/DSU Card



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FEDERAL COMMUNICATIONS COMMISSION
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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 B 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.

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.

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1. Specifications

Configuration and Control	(2) 12-switch DIPs
Internal CSU	Local and remote loopback diagnostics; Type I Keep-Alive signal
Clocking Modes	Internally provided; External from the network (loop); External from the DTE (channel)
DTE Channel	Port A (RS-530 physical) selectable for V.35 or RS-449 operations; Density: Alternate DS0 (Fractional T-1), contiguous; Selectable DTE channel rates *n* x 56 Kbps (56, 112, 168, 224, 336, 448, 672, 1344); Selectable DTE channel rates *n* x 64 Kbps (64, 128, 192, 256, 384, 512, 768, 1536)
Compatibility	AT&T® Pub 62411; AT&T Pub 54019A; Carrier T-1 Service Offerings; Carrier Fractional T-1 Service Offerings
Diagnostics	Local Aggregate Loopback, Remote Aggregate Loopback, Local and Remote Channel Loopbacks, Tx Out/Rx In and Mon Out/In Bantam Jacks
Network Indicators	(6) LEDs: Loss Of Signal (LOS), Bipolar Violations (BPV), Synchronization, Red Alarm, Yellow Alarm, Test
DTE Channel Indicators	(4) LEDs: Transmit Data (TD), Receive Data (RD), Request To Send (RTS), Received Line Signal Detector (RLSD)
Operating Temperature	32 to 122°F (0 to 50°C)
Relative Humidity Tolerance	10 to 95%, noncondensing
Maximum Altitude Tolerance	10,000 feet (3048 m)
Voltages	(From mid-plane of the WAN Rack 16) +5 VDC, -5 VDC, +12 VDC, -12 VDC
Size	8.25" x 9" (21 x 22.8 cm)
Weight	1 lb., 5 oz. (595.3 grams)

Network Interface

Recommended Cable	Twisted Shielded Pair (TSP)
Line Rate	1.544 Mbps ±50 bps
Line Encoding Format	AMI or B8ZS
Framing Format	D4 or ESF
Pulse Characteristics	AT&T 62411 compliant
Output Amplitude	2.4 to 3.3 V peak-to-peak
Receiver Sensitivity	0 to -26 dB
Line Build-Out (CSU)	0 dB, -7.5 dB, -15 dB
Line Distance (DSX-1 Mode)	0 to 655 ft. (0 to 200 m)
Line Distance (CSU Mode)	0 to 6000 ft. (0 to 1,829 m) with 22 AWG
Physical Interface	RJ-48C
Density Monitoring	1 of 8, 1 of 16, 1 of 32, 1 of 48, 1 of 64, or None

2. Introduction

2.1 Overview

The T1 CSU/DSU Card is a high speed T-1 and Fractional T-1 CSU/DSU-format processor in modular circuit-board form. See Figure 2-1. The T1 CSU/DSU Card is installed vertically into the front of the WAN Rack 16. For additional WAN Rack 16 information, refer to the WAN Rack 16 manual.

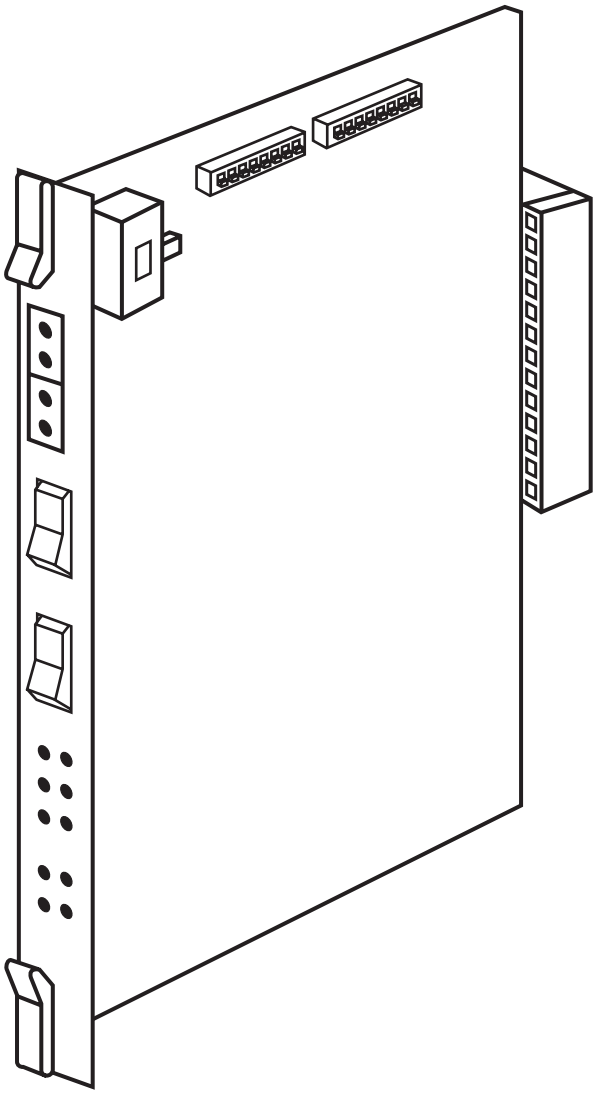

Figure 2-1. T1 CSU/DSU Card.

Functional features of the T1 CSU/DSU Card are:

- Single port CSU/DSU for T-1 and Fractional T-1 applications.
- Provides WAN (Wide Area Network) access to LAN internetworking, CAD/CAM, video conferencing, computer and PBX equipment.
- DIP-switch configuration and control.
- RS-530 physical interface applications port. Configured to support V.35 or RS-449.
- Compatible with carrier service offerings and standards-based T-1 equipment.
- On-board switch-selected diagnostics.
- Ability to drive T-1 signals (using shielded twisted-pair cabling) up to 6000 feet (1,829 m).

The T1 CSU/DSU Card can process digital information from a single high-density DB26, software-selectable DCE port supporting V.35 or RS-449 applications at speeds of either *n* x 56 Kbps (56, 112, 168, 224, 336, 448, 672, 1344) or *n* x 64 Kbps (64, 128, 192, 256, 384, 512, 768, 1536), depending on the format and density requirements of the application.

The DTE port (Port A) is on a separate I/O interface module, which installs vertically in the rear of the WAN Rack 16 chassis. The I/O interface module is illustrated in Figure 2-2.

NOTE

The second DTE Port (Port B) on the I/O interface module is not supported by the T1 CSU/DSU Card and should not be cabled.

The T1 CSU/DSU Card provides framing and density requirements for transmission across predefined network facilities. Timing (clock) may be derived from either the T-1 line (loop-slave), an internal Stratum Level IV crystal oscillator (internal-master), or externally from the DTE (external channel).

All application configurations are switch-selected through two 12-switch DIPs (S1 and S3) mounted on the T1 CSU/DSU Card. See Figure 2-1.

The T1 CSU/DSU Card also provides continuous network and channel (DTE) signal monitoring. When the LED display shows network degradation, you can use a series of loopback tests to troubleshoot the unit and its network quickly and accurately.

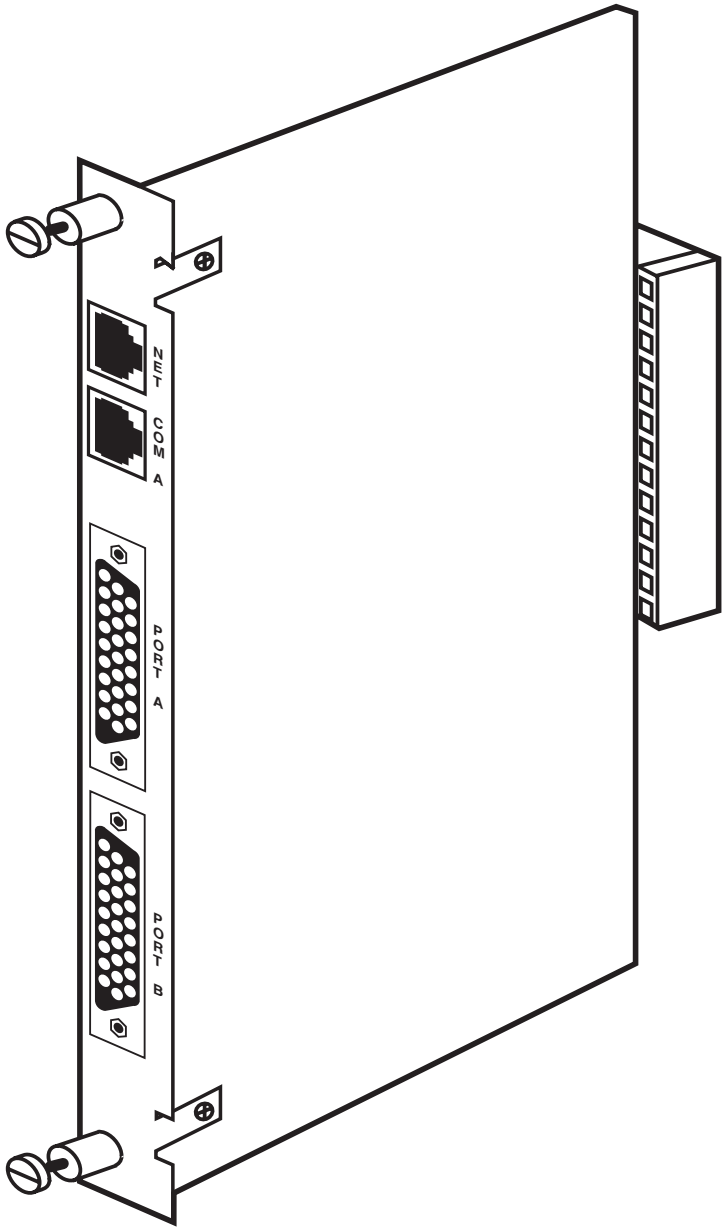

Figure 2-2. I/O Interface Module.

2.2 Controls and Indicators

2.2.1 Network Bantam Jacks

The four network Bantam jacks, located on the front of the T1 CSU/DSU Card, provide access to the network aggregate for either monitoring or testing (signal injection) purposes. See Figure 2-1.

- The MON OUT jack passively monitors the aggregate signal, on the T-1 network side, generated by your unit.
- The TX OUT jack allows you to inject a DS-1 test signal toward the T-1 line.
- The MON IN jack passively monitors the aggregate signal, on the T-1 network side, received from the carrier.
- The RX IN jack allows you to interrupt the aggregate signal, on the T-1 network side, and replace your unit's network receiver with the test set's receiver.

To monitor (without interrupting aggregate application data) the T-1 carrier service, connect a T-1 test set between the MON OUT jack and the MON IN jack.

To inject and receive a test signal (application data will be interrupted) across the T-1 network, first connect a T-1 test set between the TX OUT jack and the RX IN jack. Then put the T1 CSU/DSU Card diagnostic CHNL loopback switch in the REMOTE position.

NOTE

Using the TX OUT and RX IN Bantam jacks will disrupt your application data.

2.2.2 Diagnostic Loopback Switches

The two diagnostic loopback switches, located on the front of the T1 CSU/DSU Card, provide manual control over the execution of four diagnostic loopbacks: Local Aggregate, Remote Aggregate, Local Channel, and Remote Channel. See Figure 2-1.

Refer to **Chapter 5** for additional information on the diagnostic loopbacks.

2.2.3 Network LEDs

The six network LEDs, located on the front of the T1 CSU/DSU Card, provide a visual status of network conditions. See Figure 2-1. The information conveyed by each network LED is described in Table 2-1.

Table 2-1. Network LED Information

LED Name	LED Color	Description
Bipolar Violation (BPV)	Red	When lit, indicates that a pulse was received that is of the same polarity as the preceding pulse (excluding B8ZS codewords). This is in violation of the Alternative Mark Inversion (AMI) rule.
Loss of Sync (LOS)	Red	When lit, indicates a lack of sufficient signal pulses (marks) at the network receiver to maintain synchronization.
Yellow Alarm (YEL)	Yellow	When lit, indicates that the remote transmitter is in a Red-Alarm condition and is transmitting the Yellow-Alarm signal.
Red Alarm (RED)	Red	When lit, indicates that the local T1 CSU/DSU Card has lost frame synchronization for 2 to 2.5 seconds. The LED will go out after frame synchronization is acquired and maintained for at least 8 consecutive seconds.
Test (TEST)	Red	When lit, indicates that the local T1 CSU/DSU Card is either conducting a diagnostic loopback operation, or the network is experiencing diagnostic testing.
Synchronization (SYNC)	Red	When lit, indicates that the local T1 CSU/DSU Card is synchronized with the remote unit. Synchronization is achieved following the receipt of 10 consecutive framing bits. Synchronization is lost if 2 out of 4 consecutive frame words are in error.

2.2.4 CHANNEL LEDS

The four channel LEDs, located on the front of the T1 CSU/DSU Card, provide a visual status of channel (DTE) conditions. See Figure 2-1. The information conveyed by each channel LED is described in Table 2-2.

Table 2-2. Channel LED Information

LED Name	LED Color	Description
Ready to Send (RTS)	Green	When lit, indicates that the DTE channel port's RTS function has been activated.
Transmit Data (TD)	Green	When lit, indicates that the DTE channel port is transmitting data across the T-1 network.
Received Line Signal Detector (RLSD)	Green	When lit, indicates that the DTE channel port's RLSD function has been activated.
Receive Data (RD)	Green	When lit, indicates that the DTE channel port is receiving data from the T-1 network.

2.2.5 LBO Switch

The Line Build-Out (LBO) switch, located on the T1 CSU/DSU Card behind the top ejector tab, regulates the transmitted dB line level strength. This 3-position switch (0 dB, -7.5 dB, and -15 dB) slide switch is set according to the T-1 carrier requirements. See Figure 2-3.

NOTE

Make sure that the LBO switch is in its proper dB position before the T1 CSU/DSU Card is installed in the WAN Rack 16.

2.2.6 Configuration DIP Switches

The T1 CSU/DSU Card is controlled by switches S1 and S3. These switches, located at the top of the T1 CSU/DSU Card, are set to match specific application requirements. See Figure 2-1.

Refer to **Chapter 4** for detailed information about configuring the T1 CSU/DSU Card using these DIP switches.

NOTE

Make sure that the configuration DIP switches are set before the T1 CSU/DSU Card is installed in the WAN Rack 16.

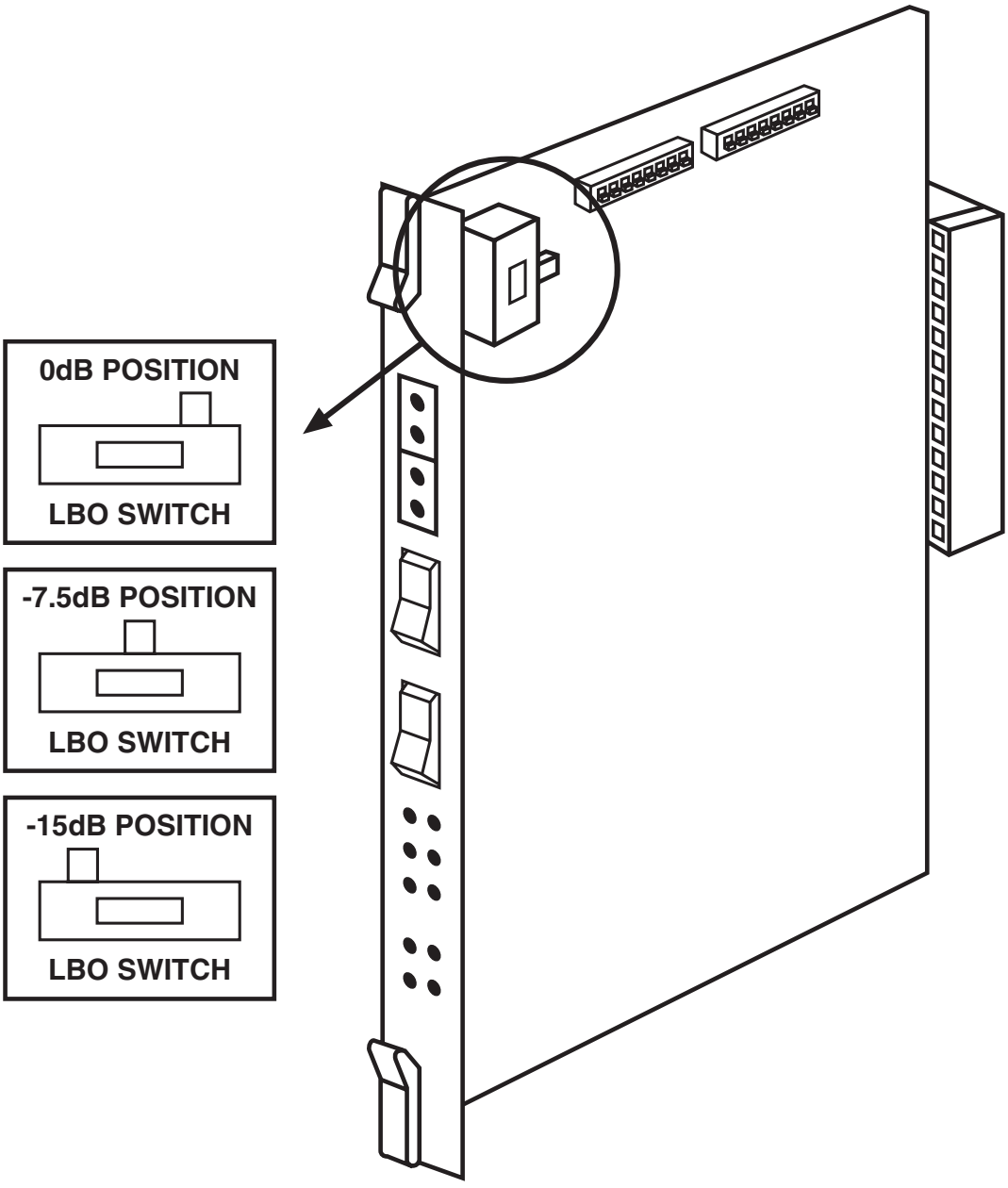

Figure 2-3. LBO Switch Positions.

2.2.7 NET Interface

The NET (Network) interface, located on the I/O interface module, provides for the transmission and receipt of the T-1 aggregate. Cables attach to this interface through an 8-pin RJ-48 connector. The pinouts for the NET interface connector are illustrated in Figure 2-4.

The NET interface may be configured to support various aggregate configurations using the DIP switches located on the T1 CSU/DSU Card. To configure the NET interface, refer to **Chapter 4**.

This interface connector may be cabled to accommodate several different types of configurations. For information on these configurations, refer to **Appendix C**.

An RJ-48 loopback plug or cable (not provided) can be plugged into the NET interface connector. This connector, when plugged in during troubleshooting, is used to isolate the unit from the T-1 line. The pin-out for this plug (cable) is illustrated in Figure 2-4.

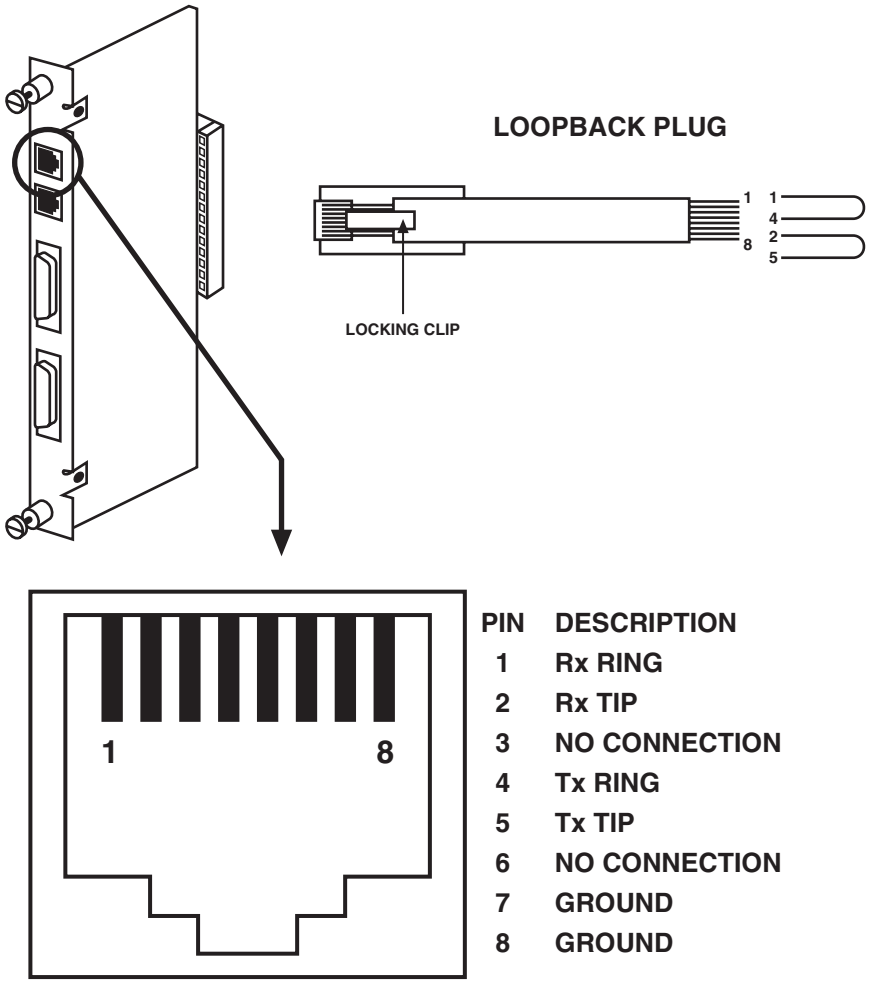

Figure 2-4. NET Interface Pinout.

2.2.8 COM A Interface

The COM A interface port, located on the I/O interface module, is not used.

2.2.9 Port A Interface

The Port A interface, located on the I/O interface module, is designed as a DCE interface and provides for the electrical transmission/reception of serial digital information. For ease of cabling, the pinouts (signal names) associated with this port match the pinouts found on a DTE port.

This interface port, based on the EIA RS-530 specification, uses a high-density DB26 connector, and may be configured to support either V.35 or RS-449 applications. You'll also need to get an HD26M-to-M34 adapter cable, part number EHN069. The pinouts for the HD DB26 connector are shown in Figure 2-5.

To configure the Port A interface for DTE channel operations, refer to **Chapter 4**.

Figure 2-5. High-Density DB26 (Port A) Pinout.

Pin	Signal
1	FRAME
2	TD (A)
3	RD (A)
4	RTS (A)
5	CTS (A)
6	DSR (A)
7	SG
8	DCD (A)
9	RT (B)
11	TT (B)
12	ST (B)
14	TD (B)
15	ST (A)
16	RD (B)
17	RT (A)
19	RTS (B)
20	DTR (A)
22	DSR (B)
24	TT (A)

Three cabling configurations exist for the Port A interface (refer to **Appendix C**). Each cabling configuration is based on the type of connector on the DTE:

- DTE running V.35 applications equipped with a 34-pin connector block. Attachment to the I/O interface module's Port A interface is through a 34-pin-to-HD DB26 adapter cable (part number EHN069).
- DTE running RS-530 applications equipped with a 25-pin connector. Attachment to the I/O interface module's Port A interface is through an HD 26-pin-to-25-pin RS-530 cable.
- DTE running RS-449 applications equipped with a 37-pin connector. Attachment to the I/O interface module's Port A interface is through a 37-pin-to-25-pin adapter cable.

2.2.10 Port B Interface

The Port B interface port, located on the I/O interface module, is not used by the T1 CSU/DSU Card.

3. Installation

3.1 Unpacking the Card

The T1 CSU/DSU Card communication module is shipped in a carton designed to ensure that it arrives at your location safely and undamaged.

To unpack and inspect the T1 CSU/DSU Card and its I/O interface module:

1. Carefully remove all packing material from the carton. The carton should contain:
    - T1 CSU/DSU Card communication module,
    - I/O interface module,
    - This manual.
2. Inspect the items for damage that may have occurred during shipment. If any damage is noted or if items are missing, contact your supplier.

NOTE

Save the packing material and carton in case you need to store or return the unit.

3.2 Site Preparation

Power—The T1 CSU/DSU Card operates in a Direct Current (DC) environment provided by the WAN Rack 16's mid-plane chassis. This mid-plane supplies voltages of +5 VDC, -5 VDC, +12 VDC, and -12 VDC.

Environmental—The T1 CSU/DSU Card is designed to operate effectively under a wide range of environmental conditions, as listed in **Chapter 1**.

CAUTION

To make sure that environmental factors do not hinder the T1 CSU/DSU Card's performance, do not exceed the recommended ranges.

3.3 T-1 Network

Before you install the T1 CSU/DSU Card, here are a few things to consider:

- Consult your network designer to determine specifications for your T-1 line. Your local carrier will have configured the T-1 line based on your requirements.
- T-1 network specifications include such parameters as encoding methods (AMI or B8ZS) and framing (D4 or ESF). This information will be used when configuring your T1 CSU/DSU Card.
- The T-1 line should be Local (non-powered) or "DRY."
- The T-1 line should be thoroughly tested end-to-end before your T1 CSU/DSU Card is connected.
- We recommend installing lightning-protection equipment on the T-1 line. It discharges electrical surges, so that your equipment (including the T1 CSU/DSU Card) won't be damaged.
- Make sure that the wiring and installation of network-support equipment, such as the Smart Jack, is complete.

3.4 Installing the T1 CSU/DSU Card Module

To install the T1 CSU/DSU Card module, complete the steps listed in Table 3-1.

NOTE

1. **For detailed information on the WAN Rack 16, refer to the WAN Rack 16's manual.**
2. **The WAN Rack 16's design allows for the removal and insertion of communication and I/O modules without powering down the chassis.**

Table 3-1. Installing the T1 CSU/DSU Card and its I/O Interface Module

Step	Action
1	If the T1 CSU/DSU Card module has been pre-installed, complete steps a through c. If the T1 CSU/DSU Card module has not been pre-installed, complete step c. **CAUTION:** To decrease the possibility of damage from a discharge of static electricity, use a grounding kit whenever you handle the T1 CSU/DSU Card module. a) Release the T1 CSU/DSU Card module's top and bottom ejector tabs. See Figure 3-1. b) Gently pull the module toward you until it's removed from the WAN Rack 16 chassis. c) Set the Line Build-Out (LBO) switch according to your T-1 carrier requirements. For LBO switch information, refer to **Chapter 2**. **NOTE:** Place the LBO switch into the 0-dB position if the network mode is DSX-1.

Table 3-1. Installing the T1 CSU/DSU Card and its I/O Interface Module (continued)

Step	Action
2	Configure the two 12-switch DIPs (S1 and S3), located on the T1 CSU/DSU Card module, to support data application and T-1 network requirements. Refer to **Chapter 4**.
3	Select an unused front chassis slot. All slots have equal access to the chassis's tri-bus mid-plane. Install the T1 CSU/DSU Card module into the chassis: a) Align the module with the chassis slot's top and bottom card rails. See Figure 3-1. b) Hold each of the module's ejector tabs in its open position. Gently push the T1 CSU/DSU Card module forward along its card rails until it is seated in the mid-plane. c) Lock the top and bottom ejector tabs. These tabs secure the module to the chassis. d) With power applied to the WAN Rack 16 chassis, observe the Card's front panel for LED activity. If no LED activity is present, select another chassis slot and re-install the module card. If there is still no LED activity, there may be a power problem. Refer to **Chapter 5**.
4	If the I/O interface module has been pre-installed, go to step 5. If the I/O interface module has not been pre-installed, complete steps a through d. **CAUTION:** To decrease the possibility of damage from static-electricity discharge, use a grounding kit whenever you handle the I/O interface module. a) Locate the rear WAN Rack 16 chassis slot that physically matches (mirror image) the front slot that houses the T1 CSU/DSU Card module. b) Align the I/O module with the chassis slot's top and bottom card rails. See Figure 3-2. c) Push the I/O module forward along its card rails until it's seated in the mid-plane. d) Hand tighten the top and bottom captive screws. These screws secure the I/O module to the chassis.
5	Make sure that the two diagnostic loopback switches, located on the front of the T1 CSU/DSU Card module, are in the center positions. See Figure 3-1.
6	Cable the I/O interface module (DTE Port A and NET) to support data application and network requirements. Refer to **Appendix C**.

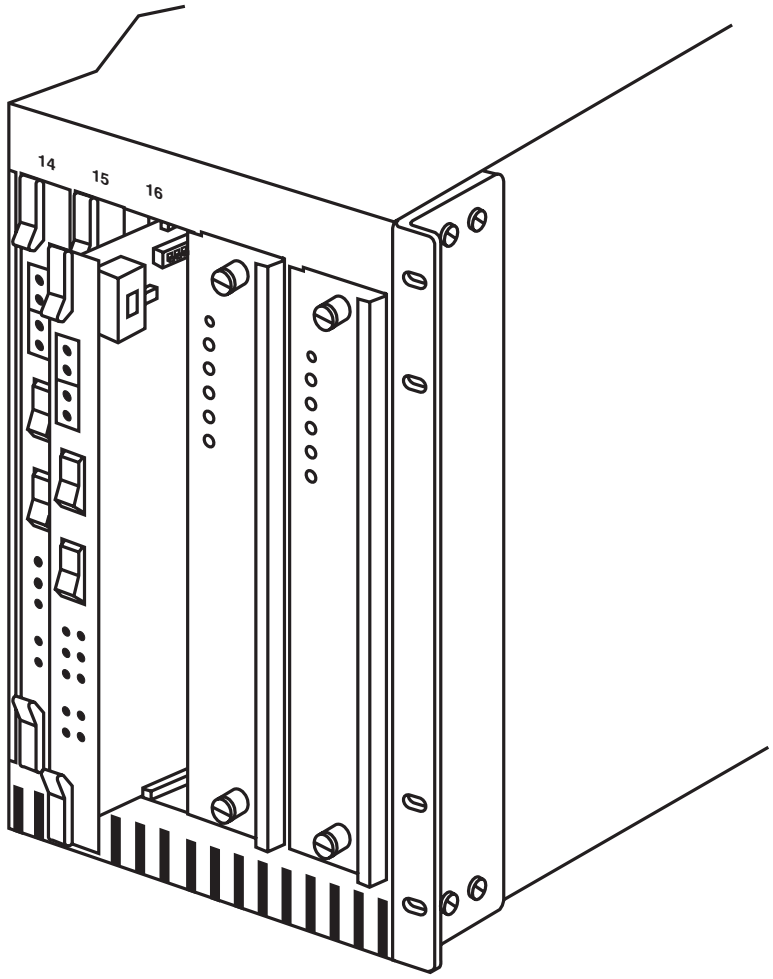

Figure 3-1. Installing the T1 CSU/DSU Card Module.

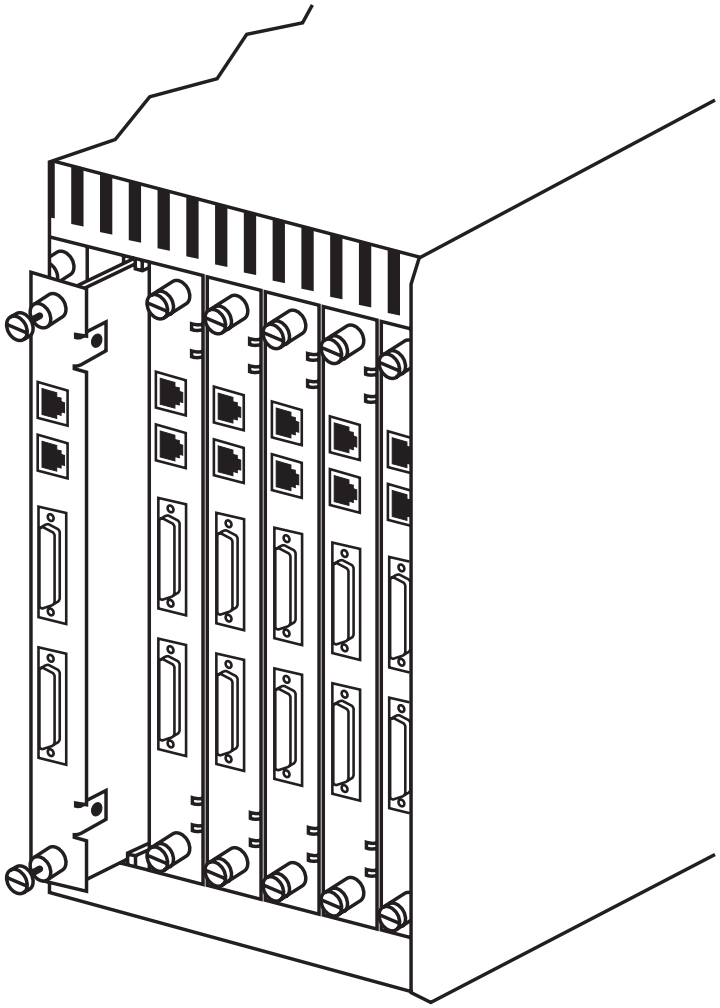

Figure 3-2. Installing the I/O Interface Module.

4. Configuration

4.1 Configuration DIP Switches

The T1 CSU/DSU Card is controlled by a series of DIP-switch settings contained on two 12-switch DIPs located next to the LBO switch. These DIP switches (S1 and S3) are configured to match specific network and application requirements. Refer to Figure 4-1 for a description of each switch position.

Fill in this checklist before you set the DIP switches.

Configuration Parameters

Aggregate Timing	Internal ____	External ____	Loop ____
Line Encoding	B8ZS ____	AMI ____	
Line Framing	D4 _____	ESF (Fe) _____	
Network Mode	CSU _____	DSX-1 _____	
Density Monitoring	000–133 ft. _____	133–266 ft. _____	
(DSX-1 Mode only)	266–399 ft. _____	399–533 ft. _____	533–655 ft. _____
DTE Channel Timing	Loop 1 ____	Loop 2 ____	
DTE Channel Multiple	*n* x 56 Kbps _____	*n* x 64 Kbps _____	
Data Rate	_____ Kbps		
DTE Port A Support	V.35 _____	RS-449 _____	
Request to Send (RTS)	RTS constant On _____	RTS Controlled _____	
DTE Channel Data	Normal _____	Invert _____	
DTE Channel Timing	Normal _____	Invert _____	
Zero Byte Suppression	Enable _____	Disable _____	
DS0 Mapping	Contiguous _____	Alternate _____	

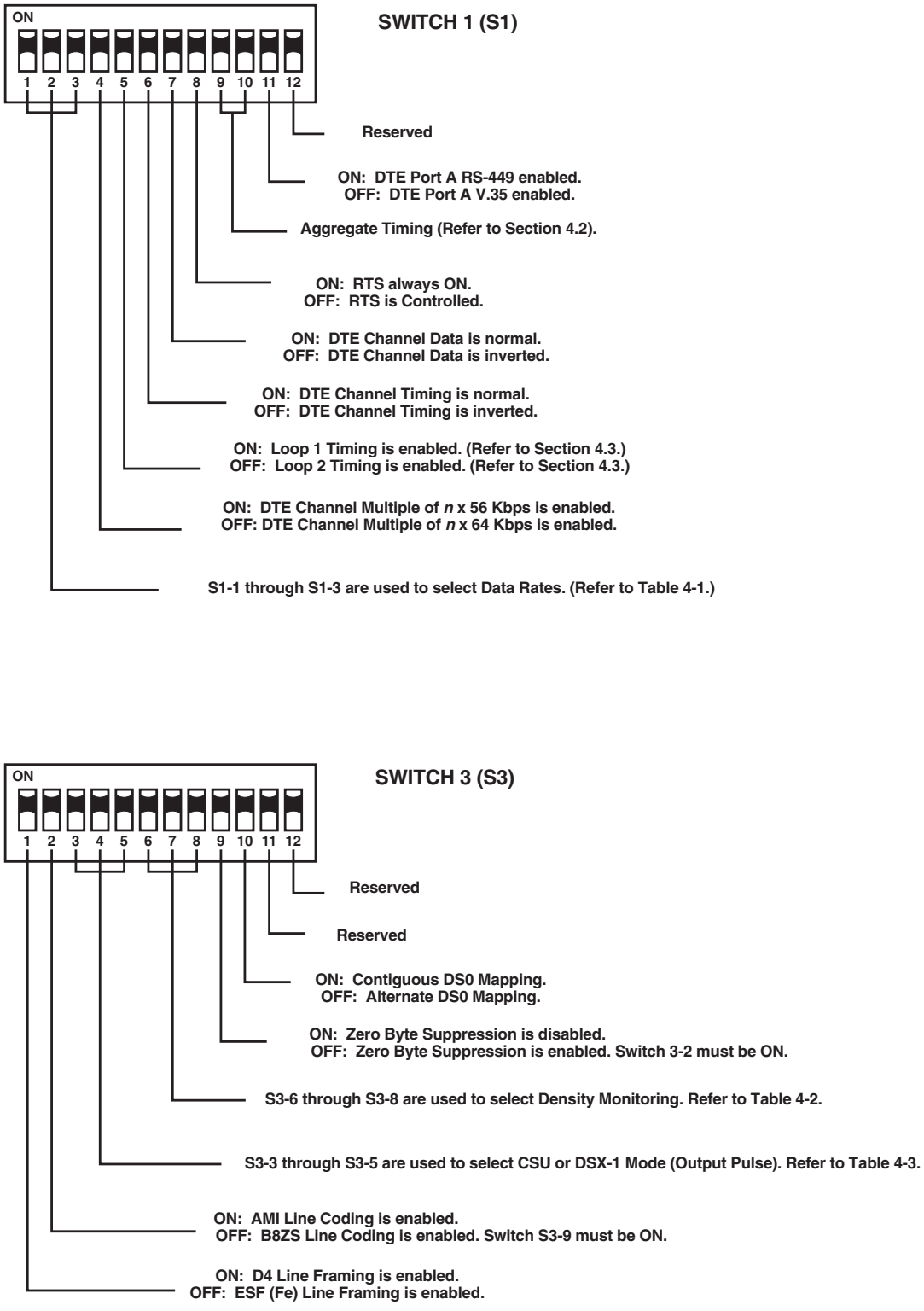

Figure 4-1. Configuration DIP Switches.

Table 4-1 describes the DIP settings that must be made to support the various *n* x 56 Kbps and *n* x 64 Kbps data rates.

Table 4-1. Setting Data Rates

Data Rate (Kbps)		Data Rate Settings			DSOs Used	
S1-4 On	S1-4 Off	S1-1	S1-2	S1-3	S3-10 On	S3-10 Off
56	64	On	On	On	1	1 - 2
112	128	Off	On	On	1 - 2	1 - 4
168	192	On	Off	On	1 - 3	1 - 6
224	256	Off	Off	On	1 - 4	1 - 8
336	384	On	On	Off	1 - 6	1 - 12
448	512	Off	On	Off	1 - 8	1 - 16
672	768	On	Off	Off	1 - 12	1 - 24
1344	1536	Off	Off	Off	1 - 24	N/A

Table 4-2 describes the DIP settings that must be made to support density monitoring.

Table 4-2. Setting Density Monitoring

Density Ratio	DIP Switch S3-6 Position	DIP Switch S3-7 Position	DIP Switch S3-8 Position
1 in 16	Off	On	On
1 in 32	Off	Off	On
1 in 48	Off	On	Off
1 in 64	Off	Off	Off
None	On	N/A	N/A

Table 4-3 describes the DIP settings that must be made to support either the CSU mode or the DSX-1 mode (output pulse distance required).

Table 4-3. Setting Network Mode

Network Mode (CSU/DSX-1)	DIP Switch S3-3 Position	DIP Switch S3-4 Position	DIP Switch S3-5 Position
CSU	On	Off	On
DSX-1 (000–133 ft.)	Off	Off	On
DSX-1 (133–266 ft.)	On	On	Off
DSX-1 (266–399 ft.)	Off	On	Off
DSX-1 (399–533 ft.)	On	Off	Off
DSX-1 (533–655 ft.)	Off	Off	Off

4.2 Network Timing

The T1 CSU/DSU Card uses three types (modes) of aggregate timing: Internal (Master) Crystal Timing, Loop (Slave) Timing, and External Channel Timing. Table 4-4 describes the DIP settings that must be made to support the various network timing modes.

Table 4-4. Setting Network Timing

Network Timing Mode	DIP Switch S1-9 Position	DIP Switch S1-10 Position
Internal (Master) Crystal	On	On
Loop (Slave)	Off	On
External Channel	On	Off

Internal (Master) Crystal Timing—Data is transmitted (clocked) to the network with a signal provided by the crystal in the T1 CSU/DSU Card. Timing for the data transmission from the DTE to the T1 CSU/DSU Card is also clocked using this same signal. See Figure 4-2.

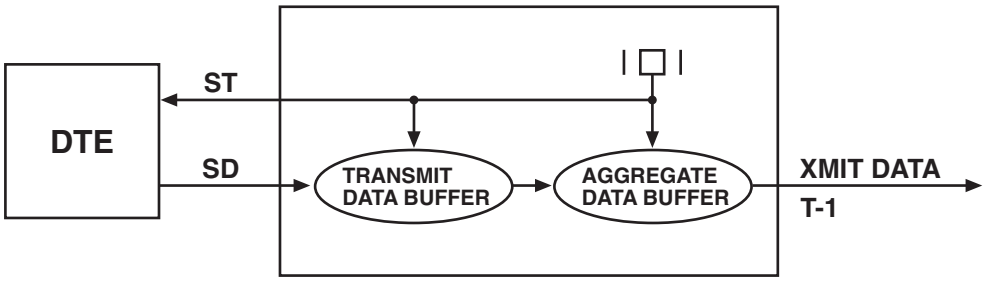

Figure 4-2. Internal (Master) Crystal Timing Diagram.

Loop (Slave) Timing—Receive data from the network, when received, is passed through a Phase Lock Loop (PLL) circuit. The function of the PLL circuitry is to create a clock based on the line transmissions (marks) that is in phase with the incoming data. This clock is then used for both the receiver and the attached DTE equipment.

The PLL clock signal is also used as a reference for Send Timing (ST) to the DTE and also as the clock for transmitting data to the network. In this timing scheme, both network and port timing are slaved to the same clock source. A single clock source ensures synchronization between all data transmissions. See Figure 4-3.

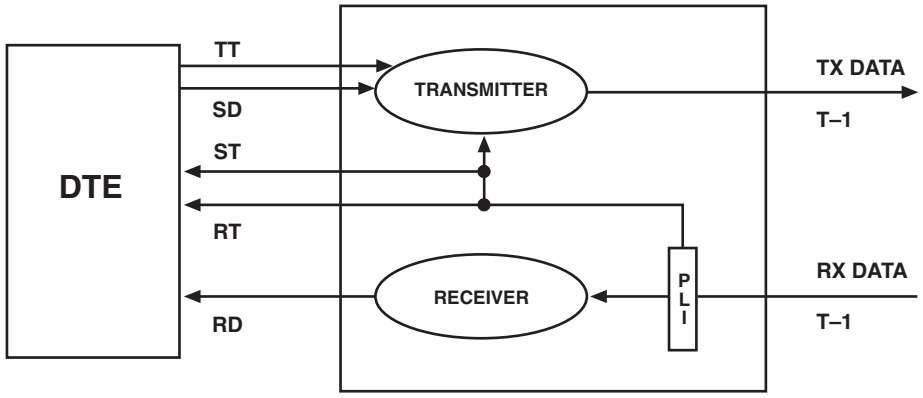

Figure 4-3. Loop (Slave) Timing Diagram.

External Channel Timing—Data is transmitted (clocked) to the network with a signal provided by the DTE. The DTE passes this clock signal to the T1 CSU/DSU Card via Terminal Timing (TT). Timing for the data transmission from the DTE to the T1 CSU/DSU Card is also clocked using this same signal. DTE Channel Timing must be configured for Loop 1 if this timing mode is selected. See Figure 4-4.

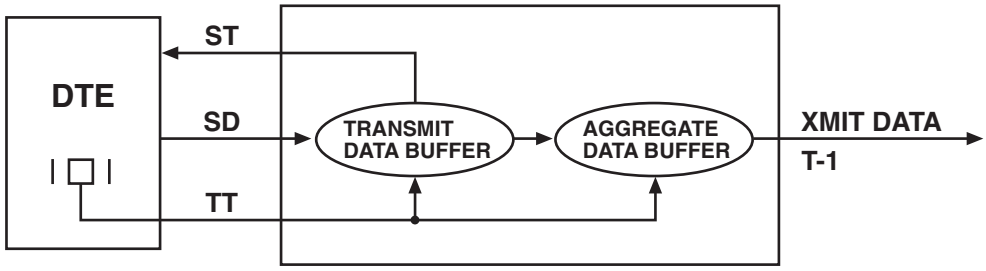

Figure 4-4. External Channel Timing Diagram.

4.3 DTE Channel Timing

The T1 CSU/DSU Card uses two types (modes) of DTE channel timing: Loop 1 Timing and Loop 2 Timing.

Loop 1 Timing—This timing mode is used when Data Terminal Equipment (DTE), attached to Port A on the I/O interface module (Port B is not used), will return (loop) a Terminal Timing (TT) clock signal in response to receiving the Send Timing (ST) signal from the T1 CSU/DSU Card. See Figure 4-5.

When using Loop 1 Timing, the T1 CSU/DSU Card uses the TT clock signal to gate the Send Data (SD) Function (DTE data) into the network transmit data buffer. Clock function and data are subject to the same delays and attenuation inherent in data transmission. Therefore, both the data and the clocking function should be in sync. As long as the interface specifications for distance versus speed have been met, the sampling of the incoming data should never lead or lag more than a few degrees.

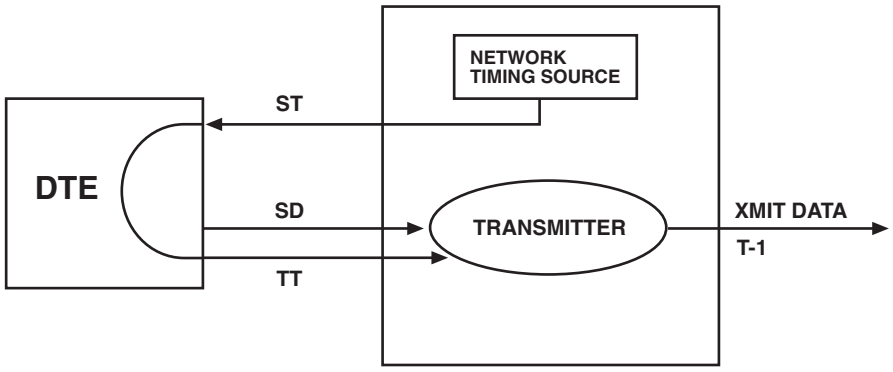

Figure 4-5. Loop 1 Timing Diagram.

Loop 2 Timing—This timing mode is used when the Data Terminal Equipment (DTE), attached to Port A on the I/O interface module (Port B is not used), will not return (loop) a Terminal Timing (TT) clock signal in response to receiving the Send Timing (ST) signal from the T1 CSU/DSU Card. See Figure 4-6.

When using Loop 2 Timing, the T1 CSU/DSU Card uses its own Send Timing (ST) clock signal to gate the Send Data (SD) Function (DTE data) into the network transmit data buffer.

NOTE

Transmission delays (an out-of-sync condition between the data and timing functions) may result from using this form of port timing. When using the Loop 2 Timing mode, adhere to all interface specifications.

When using this timing mode, 100% throughput cannot always be guaranteed. If problems arise that seem to be the result of using this timing mode, select DTE Channel Timing Invert (S1-6) when configuring the T1 CSU/DSU Card. This causes the sampling of the Send Data to occur on the opposite edge of the clock, which should allow for a more acceptable data transfer.

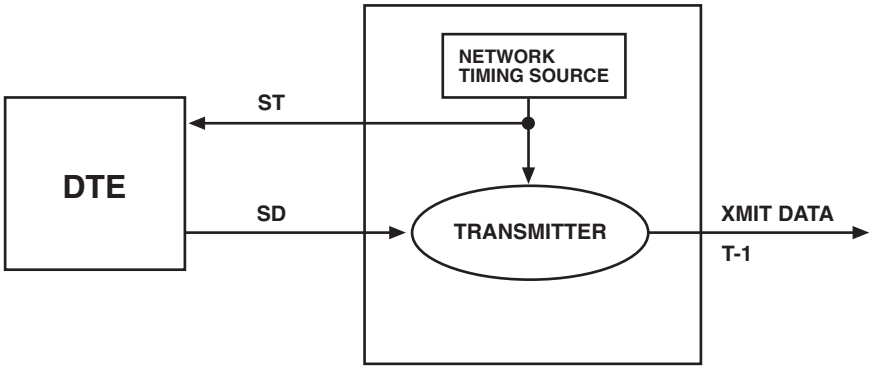

Figure 4-6. Loop 2 Timing Diagram.

5. Troubleshooting

Before you start any troubleshooting routine, evaluate the problem:

- Check system messages and LEDs. Use all available system messages and LED indicators to help pinpoint where there's a problem.
- Gather as much information as possible about the problem, such as configuration information and operator action.

5.1 Power Problems

The T1 CSU/DSU Card gets its power entirely from the WAN Rack 16 chassis mid-plane. The loss of mid-plane power will cause a lack of front-panel LED activity (network and channel port).

If there is more than one communication module in the chassis, see if each module is experiencing the same symptoms. If so, there's probably a chassis power loss.

To troubleshoot a power-related problem, refer to the WAN Rack 16 manual.

5.2 Network or Port Problems

Troubleshooting a network or port interface problem involves collecting information about the problem and performing preliminary corrective actions.

Some of the information you should collect:

- LED conditions that may indicate a problem with the DTE, local T1 CSU/DSU Card, T-1 line, or the remote unit. (Refer to **Chapter 2** for descriptions of the network and DTE channel LEDs.)

NOTE

The front-panel NETWORK LED labeled "TEST" (Red) may occasionally be activated as the result of telco network testing. Contact your carrier if you are not conducting network diagnostics and this LED condition is displayed.

- Alarm conditions associated with any attached DTE equipment.
- Verifying if the problem or condition is unique to the DTE port and its application, or if other communication modules are affected.
- Determining if the problem or condition is related to a specific time of day or other common factors (for example, changes in electrical loads such as the activation of air-conditioning equipment).

Some of the corrective actions you should perform:

- Using the resident diagnostic loopbacks to isolate data paths associated with the problem. (See **Section 5.3.**)
- Confirming that the local T1 CSU/DSU Card and the remote unit's configuration settings are correct. (See **Chapter 4**.)
- Verifying equipment cable types and their connections. (Refer to **Appendix C**.)

5.3 Diagnostic Loopbacks

CAUTION

The diagnostic loopbacks described in this chapter are all disruptive to normal DTE operations.

The T1 CSU/DSU Card communication module contains four resident diagnostic loopbacks that are controlled from two rocker switches on the front of the module:

Local Aggregate Loopback—Placing the AGGREGATE LOOPBACK switch in the LOCAL position causes the local T1 CSU/DSU Card to place a loopback on its aggregate in the direction of the DTE channel interface. This diagnostic loopback tests the local DTE channel interface and aggregate. The local module's front-panel NETWORK LED labeled "TEST" will light. Place the switch in the center position after diagnostic testing is complete. See Figure 5-1.

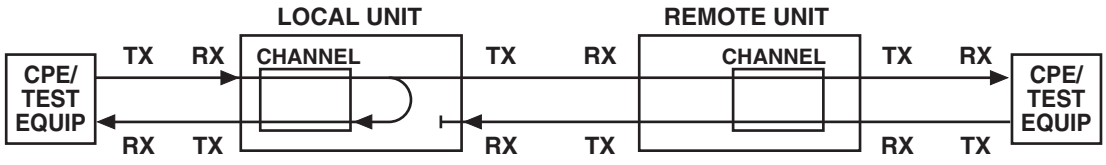

Figure 5-1. Local Aggregate Loopback Diagram.

Remote Aggregate Loopback—Placing the AGGREGATE LOOPBACK switch in the REMOTE position causes the remote T1 CSU/DSU Card to place a loopback on its aggregate in the direction of the network. This diagnostic loopback tests the local DTE channel interface, aggregate, and T-1 network path. The front-panel NETWORK LED labeled "TEST" will light on both the local module and remote unit. Place the switch in the center position after diagnostic testing is complete. See Figure 5-2.

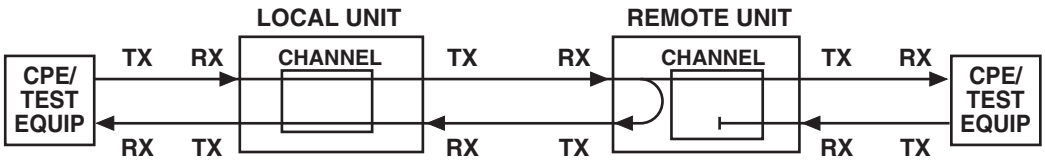

Figure 5-2. Remote Aggregate Loopback Diagram.

Local Channel Loopback—Placing the CHANNEL LOOPBACK switch in the LOCAL position causes the local T1 CSU/DSU Card to place a bidirectional loopback on its DTE channel interface and aggregate. These diagnostic loopbacks test the local DTE channel interface and allow testing of the T-1 network path by the remote unit. The local module's front-panel NETWORK LED labeled "TEST" will light. Place the switch in the center position after diagnostic testing is complete. See Figure 5-3.

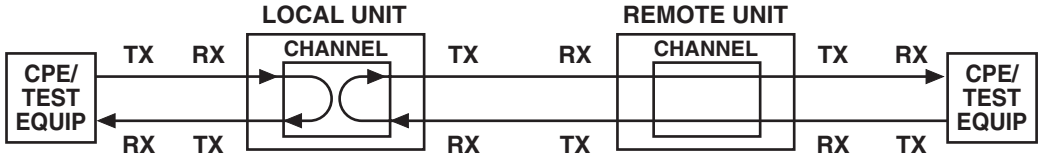

Figure 5-3. Local Channel Loopback Diagram.

Remote Channel Loopback—Placing the CHANNEL LOOPBACK switch in the REMOTE position causes the remote T1 CSU/DSU Card to place a bidirectional loopback on its DTE channel interface and aggregate. These diagnostic loopbacks test the remote DTE channel interface and allow testing of the T-1 network path by the local module. The front-panel NETWORK LED labeled "TEST" will light on both the local module and remote unit. Place the switch in the center position after diagnostic testing is complete. See Figure 5-4.

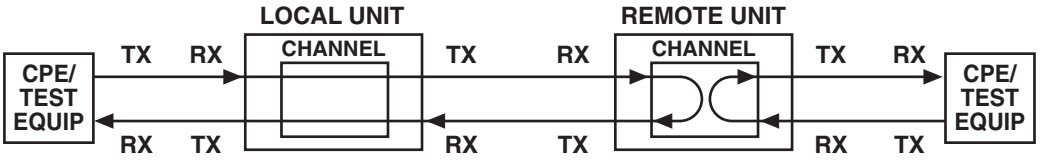

Figure 5-4. Remote Channel Loopback Diagram.

If you have not been able to solve your network or DTE channel port problems after completing these preliminary actions, contact your supplier.

5.4 Calling Your Supplier

If you determine that your T1 CSU/DSU Card is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact your supplier.

Before you do, make a record of the history of the problem. Your supplier will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

5.5 Shipping and Packaging

If you need to transport or ship your Card:

- Package it carefully. We recommend that you use the original container.
- Before you ship, contact your supplier to get a Return Materials Authorization (RMA) number.

Appendix A. FCC Document Requirements

The following information, which informs the user of his rights and obligations in connecting this equipment to the network and in ordering service, is required by FCC Part 68 Rules.

This equipment complies with Part 68 of FCC Rules. Please note the following:

1. When you order service, the telephone company needs to know:

   The Facility Interface Code:

   04DU-B (1.544 MB D4 framing format)

   04DU9-C (1.544 MB ESF format)

   The Service Order Code: 6.0F

   A signal power affidavit (refer to **Appendix B**) will be required to guarantee encoded analog content and billing protection unless this unit is used in combination with an XD-type device or no encoded analog signals and billing information are transmitted. For most uses, the second box is appropriate.

   The USOC Jack Required: RJ48C

   In addition, if requested, inform the telephone company of the make, model, and FCC Registration Number, which are on the label.

2. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

3. If your telephone equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance, but if advance notice is not practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

4. If you experience trouble with the telephone equipment, contact us for information on obtaining service or repairs. Repairs should be performed by us or our authorized agent.

5. You are required to notify the telephone company when this unit is disconnected from the network.

Appendix B. CPE Affidavit

Affidavit for the connection of Customer Premises Equipment (CPE) to 1.544 Mbps and/or Subrate Digital Services (SDS)

For work to be performed in the certified territory of:

_____

(TELCO's Name)

State of: _____ County of: _____

I, _____ , _____

(Name) (Business Address)

Representing _____

Being duly sworn, state:

I have responsibility for the operation and maintenance of the terminal equipment to be connected to _____ 1.544 Mbps and/or _____ Subrate Digital Services. The terminal equipment to be connected complies with Part 68 of the Commission's rules except for the encoded analog content and billing protection specifications.

Continued on the next page

CPE Affidavit, continued

With respect to encoded analog content and billing protection:

I attest that all operations associated with the establishment, maintenance, and adjustment of the digital CPE with respect to encoded analog content and encoded billing information continuously comply with Part 68 of the FCC's Rules and Regulations.

The digital CPE does not transmit digital signals containing encoded analog content or billing information which is intended to be decoded within the telecommunications network. The encoded analog and billing protection is factory-set and is not under the control of the customer.

I attest that the operator(s)/maintenance(s) of the digital CPE responsible for the establishment, maintenance, and adjustment of the encoded analog content and billing information has (have) been trained to perform these functions by successfully completing one of the following (check all appropriate boxes).

☐ a. A training course provided by the manufacturer/grantee of the equipment used to encode analog signals: *or*

☐ b. A training course provided by the customer or authorized representative, using training materials and instructions provided by the manufacturer/grantee of the equipment used to encode analog signals: *or*

☐ c. An independent training course (i.e., trade school or technical institution) recognized by the manufacturer/grantee of the equipment used to encode analog signals: *or*

☐ d. In lieu of the preceding training requirements, the operator(s)/maintainer(s) is (are) under control of a supervisor trained in accordance with ___ above.

(*fill in one*)

Continued on the next page

CPE Affidavit, continued

I agree to provide _____ with proper documentation to demonstrate
(TELCO's) name
compliance with the information as provided in the preceding paragraph, if so requested.

Signature _____

Title _____

Date _____

Subscribed and Sworn to before me

this _____ day of _____ , 19____

_____
Notary Public

My commission expires: _____

Appendix C. Cabling

Read this appendix before cabling the I/O interface module associated with your T1 CSU/DSU Card communication module.

- We recommend using only 100-ohm, 22-AWG individually shielded twisted-pair cables. These cables provide protection from electromagnetic interference (EMI) and crosstalk.
- We recommend using only shielded RJ-48 cables terminated to shielded modular jacks. This will prevent EMI and crosstalk.
- Do not exceed the DTE cabling distances as recommended by the cable's manufacturer. Doing so may result in signal attenuation.
- Make sure that all cable connectors (plug, screw, or clip) are correctly aligned and installed. Misalignment or improperly installed connectors may result in damage to pins, connectors, cables, or the unit.
- Determine if straight-through or crossover cables are required.

Pinouts for some of the common cables used on the I/O interface module are illustrated in Figure C-1.

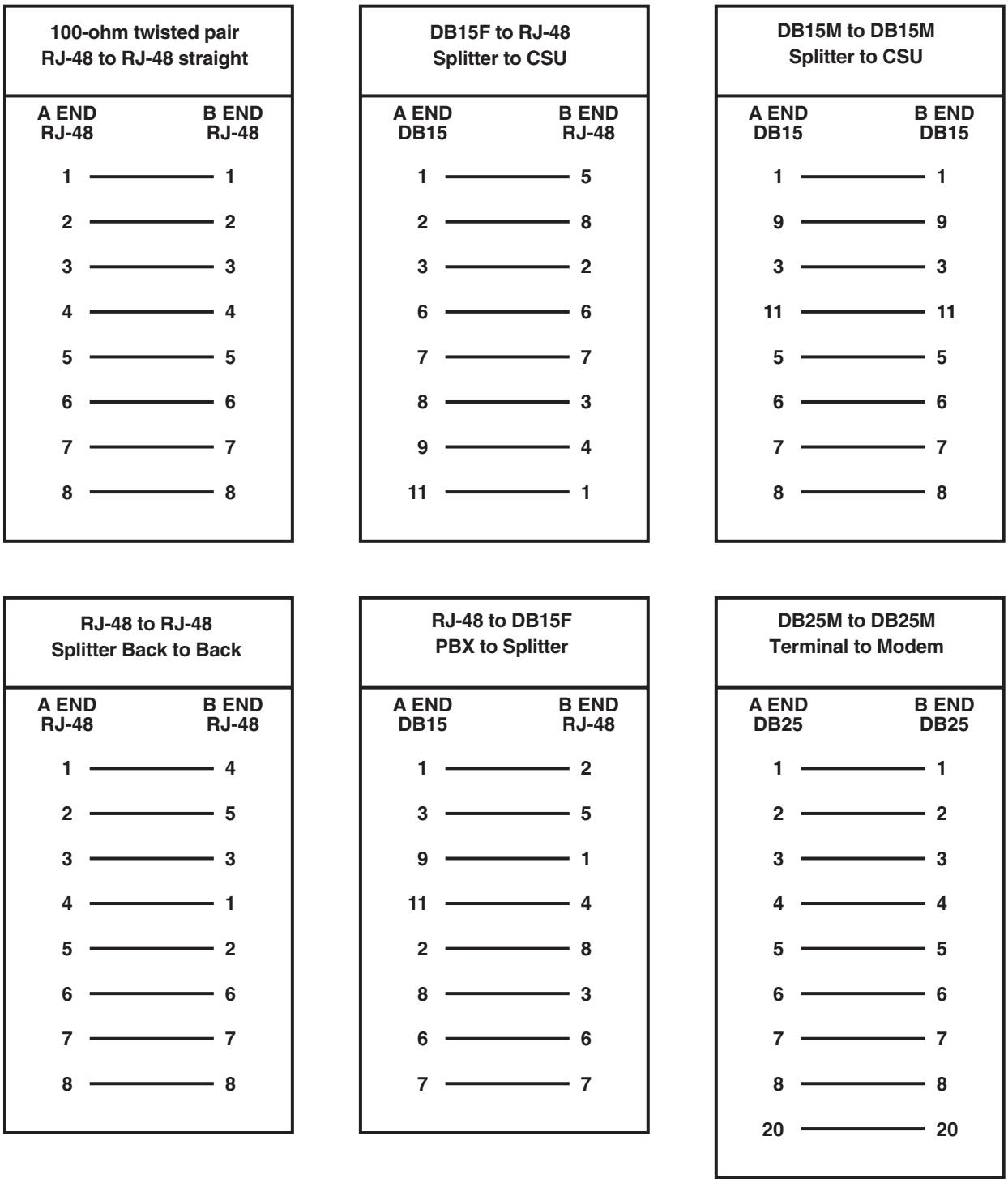

Figure C-1. Common Cable Pinouts.

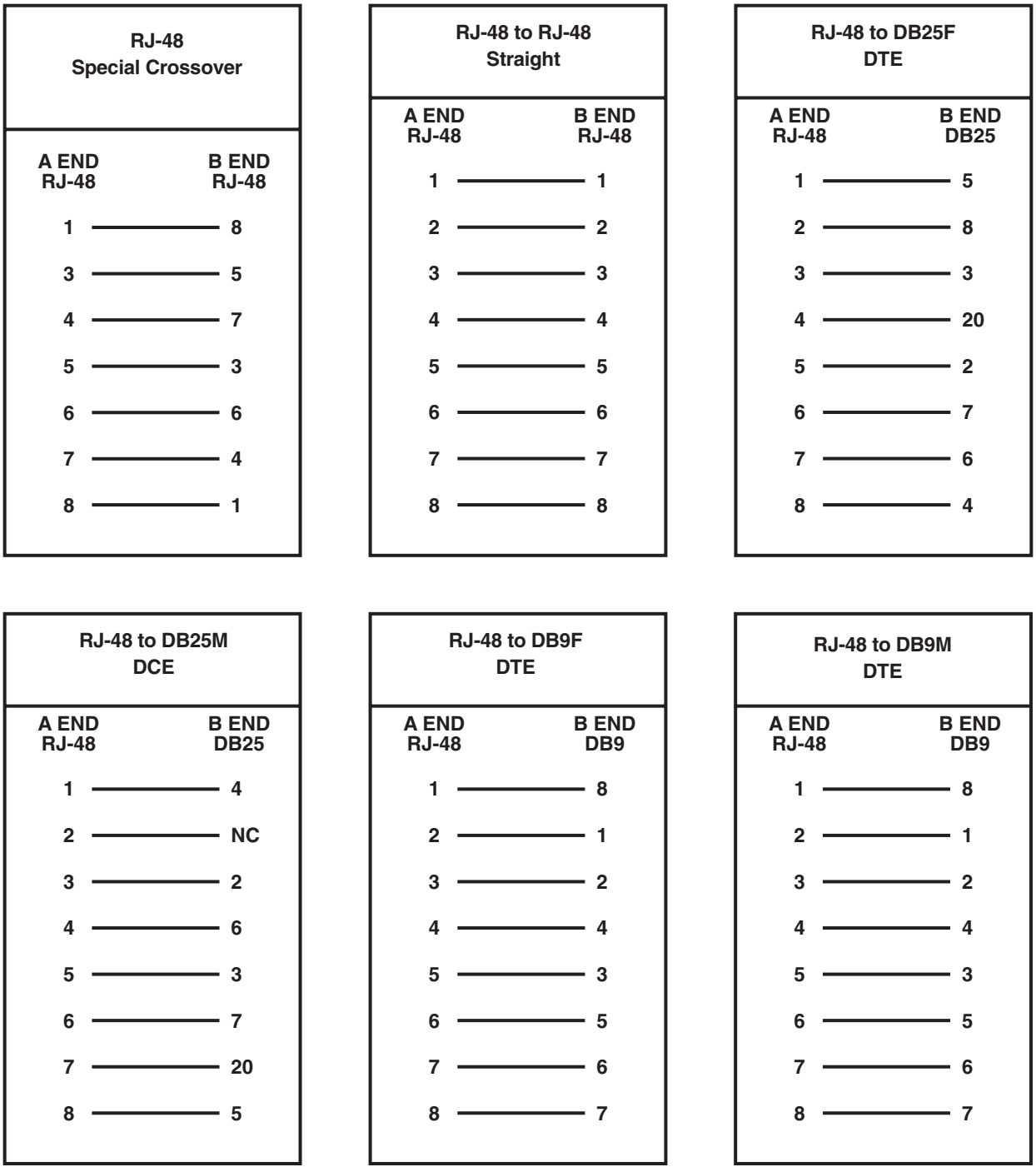

Figure C-1. Common Cable Pinouts (continued).

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