T1 CSU ACE

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ADTRAN

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To the Holder of the Manual

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P.O. Box 140000
Huntsville, AL 35814-4000
Phone: (256) 963-8000

Notes provide additional useful information.

Cautions signify information that could prevent service interruption.

WARNING

Warnings provide information that could prevent damage to the equipment or endangerment to human life.

Safety Instructions

When using your telephone equipment, please follow these basic safety precautions to reduce the risk of fire, electrical shock, or personal injury:

1. Do not use this product near water, such as a bathtub, wash bowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool.
2. Avoid using a telephone (other than a cordless-type) during an electrical storm. There is a remote risk of shock from lightning.
3. Do not use the telephone to report a gas leak in the vicinity of the leak.
4. Use only the power cord, power supply, and/or batteries indicated in the manual. Do not dispose of batteries in a fire. They may explode. Check with local codes for special disposal instructions.

Save These Important Safety Instructions

Affidavit Requirements for Connection to Digital Services

- An affidavit is required to be given to the telephone company whenever digital terminal equipment without encoded analog content and billing protection is used to transmit digital signals containing encoded analog content which are intended for eventual conversion into voiceband analog signals and transmitted on the network.
- The affidavit shall affirm that either no encoded analog content or billing information is being transmitted or that the output of the device meets Part 68 encoded analog content or billing protection specifications.
- End user/customer will be responsible for filing an affidavit with the local exchange carrier when connecting unprotected customer premise equipment (CPE) to 1.544 Mbps or subrate digital services.

Until such time as subrate digital terminal equipment is registered for voice applications, the affidavit requirement for subrate services is waived.

Affidavit for Connection of Customer Premises Equipment to 1.544 Mbps and/or Subrate Digital Services

For tbe work to be performed in the certified territory of _____ (telco name)

State of _____

County of _____

I, _____ (name), _____ (business address),

_____ (telephone number) being duly sworn, state:

I bave responsibility for the operation and maintenance of the terminal equipment to be connected to 1.544 Mbps and/or _____ subrate digital services. Tbe terminal equipment to be connected complies witb Part 68 of tbe FCC rules except for the encoded analog content and billing protection specifications. Witb 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 analog content and encoded billing protection information continuously complies with Part 68 of the FCC 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 content and billing protection is factory set and is not under the control of the customer.

I attest that the operator(s)/maintainer(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 tbese functions by successfully baving completed one of the following (check appropriate blocks):

( ) 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 (e.g., 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 the control of a supervisor trained in accordance with _____ (circle one) above.

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

_____Signature

_____Title

_____ Date

Transcribed and sworn to before me

This _____ day of _____, _____

_____

Notary Public

My commission expires:_____

FCC regulations require that the following information be provided in this manual:

1. This equipment complies with Part 68 of FCC rules. On the back of the equipment housing is a label showing the FCC registration number and ringer equivalence number (REN). If requested, provide this information to the telephone company.
2. If this equipment causes harm to the telephone network, the telephone company may temporarily discontinue service. If possible, advance notification is given; otherwise, notification is given as soon as possible. The telephone company will advise the customer of the right to file a complaint with the FCC.
3. The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of this equipment. Advance notification and the opportunity to maintain uninterrupted service are given.
4. If experiencing difficulty with this equipment, please contact ADTRAN for repair and warranty information. The telephone company may require this equipment to be disconnected from the network until the problem is corrected or it is certain the equipment is not malfunctioning.
5. This unit contains no user-serviceable parts.
6. An FCC compliant telephone cord with a modular plug is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using an FCC compatible modular jack, which is Part 68 compliant.

7. The following information may be required when applying to the local telephone company for a dial-up line for the V.34 modem:

Service Type	REN/SOC	FIC	USOC
1.544 Mbps - SF	6.0F	04DU9-BN	RJ48C
1.544 Mbps - SF and B8ZS	6.0F	04DU9-DN	RJ48C
1.544 Mbps - ESF	6.0F	04DU9-1KN	RJ48C
1.544 Mbps - ESF and B8ZS	6.0F	04DU9-1SN	RJ48C

8. The REN is useful in determining the quantity of devices you may connect to your telephone line and still have all of those devices ring when your number is called. In most areas, the sum of the RENs of all devices should not exceed five. To be certain of the number of devices you may connect to your line as determined by the REN, call your telephone company to determine the maximum REN for your calling area.

9. This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs. Contact your state public utility commission or corporation commission for information.

Federal Communications Commission Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio frequencies. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Shielded cables must be used with this unit to ensure compliance with Class A FCC limits.

WARNING

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

Industry Canada Compliance Information

Notice: The Industry Canada label applied to the product (identified by the Industry Canada logo or the "IC:" in front of the certification/ registration number) signifies that the Industry Canada technical specifications were met.

Notice: The Ringer Equivalence Number (REN) for this terminal equipment is supplied in the documentation or on the product labeling/ markings. The REN assigned to each terminal device indicates the maximum number of terminals that can be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the RENs of all the devices should not exceed five (5).

Canadian Emissions Requirements

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus," ICES-003 of the Department of Communications.

Cet appareil numérique respecte les limites de bruits radioelectriques applicables aux appareils numériques de Class A prescrites dans la norme sur le materiel brouilleur: "Appareils Numériques," NMB-003 edictee par le ministre des Communications.

Warranty and Customer Service

ADTRAN will repair and return this product within 5 years from the date of shipment if it does not meet its published specifications or fails while in service. For detailed warranty, repair, and return information refer to the ADTRAN Equipment Warranty and Repair and Return Policy Procedure.

Return Material Authorization (RMA) is required prior to returning equipment to ADTRAN.

For service, RMA requests, or further information, contact one of the numbers listed at the end of this section.

LIMITED PRODUCT WARRANTY

ADTRAN warrants that for 5 years from the date of shipment to Customer, all products manufactured by ADTRAN will be free from defects in materials and workmanship. ADTRAN also warrants that products will conform to the applicable specifications and drawings for such products, as contained in the Product Manual or in ADTRAN's internal specifications and drawings for such products (which may or may not be reflected in the Product Manual). This warranty only applies if Customer gives ADTRAN written notice of defects during the warranty period. Upon such notice, ADTRAN will, at its option, either repair or replace the defective item. If ADTRAN is unable, in a reasonable time, to repair or replace any equipment to a condition as warranted, Customer is entitled to a full refund of the purchase price upon return of the equipment to ADTRAN. This warranty applies only to the original purchaser and is not transferable without ADTRAN's express written permission. This warranty becomes null and void if Customer modifies or alters the equipment in any way, other than as specifically authorized by ADTRAN.

EXCEPT FOR THE LIMITED WARRANTY DESCRIBED ABOVE, THE FOREGOING CONSTITUTES THE SOLE AND EXCLUSIVE REMEDY OF THE CUSTOMER AND THE EXCLUSIVE LIABILITY OF ADTRAN AND IS IN LIEU OF ANY AND ALL OTHER WARRANTIES (EXPRESSED OR IMPLIED). ADTRAN SPECIFICALLY DISCLAIMS ALL OTHER

WARRANTIES, INCLUDING (WITHOUT LIMITATION), ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. SOME STATES DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO THIS EXCLUSION MAY NOT APPLY TO CUSTOMER.

In no event will ADTRAN or its suppliers be liable to the Customer for any incidental, special, punitive, exemplary or consequential damages experienced by either the Customer or a third party (including, but not limited to, loss of data or information, loss of profits, or loss of use). ADTRAN is not liable for damages for any cause whatsoever (whether based in contract, tort, or otherwise) in excess of the amount paid for the item. Some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to the Customer.

Customer Service, Product Support Information, and Training

ADTRAN will repair and return this product if within 5 years from the date of shipment the product does not meet its published specification or the product fails while in service.

A return material authorization (RMA) is required prior to returning equipment to ADTRAN. For service, RMA requests, training, or more information, use the contact information given below.

Repair and Return

If you determine that a repair is needed, please contact our Customer and Product Service (CAPS) department to have an RMA number issued. CAPS should also be contacted to obtain information regarding equipment currently in house or possible fees associated with repair.

CAPS Department (256) 963-8722

Identify the RMA number clearly on the package (below address), and return to the following address:

ADTRAN Customer and Product Service
901 Explorer Blvd. (East Tower)
Huntsville, Alabama 35806

RMA # _____

Pre-Sales Inquiries and Applications Support

Your reseller should serve as the first point of contact for support. If additional pre-sales support is needed, the ADTRAN Support web site provides a variety of support services such as a searchable knowledge base, latest product documentation, application briefs, case studies, and a link to submit a question to an Applications Engineer. All of this, and more, is available at:

http://support.adtran.com

When needed, further pre-sales assistance is available by calling our Applications Engineering Department.

Applications Engineering (800) 615-1176

Post-Sale Support

Your reseller should serve as the first point of contact for support. If additional support is needed, the ADTRAN Support web site provides a variety of support services such as a searchable knowledge base, updated firmware releases, latest product documentation, service request ticket generation and trouble-shooting tools. All of this, and more, is available at:

http://support.adtran.com

When needed, further post-sales assistance is available by calling our Technical Support Center. Please have your unit serial number available when you call.

Technical Support (888) 4ADTRAN

Installation and Maintenance Support

The ADTRAN Custom Extended Services (ACES) program offers multiple types and levels of installation and maintenance services which allow you to choose the kind of assistance you need. This support is available at:

http://www.adtran.com/aces

For questions, call the ACES Help Desk.

ACES Help Desk (888) 874-ACES (2237)

Training

The Enterprise Network (EN) Technical Training Department offers training on our most popular products. These courses include overviews on product features and functions while covering

applications of ADTRAN's product lines. ADTRAN provides a variety of training options, including customized training and courses taught at our facilities or at your site. For more information about training, please contact your Territory Manager or the Enterprise Training Coordinator.

Training Phone	(800) 615-1176, ext. 7500
Training Fax	(256) 963-6700
Training Email	training@adtran.com

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Chapter 1 General

UNIT OVERVIEW

The ADTRAN T1 Channel Service Unit (CSU) Advanced Communications Equipment (ACE) provides the T1 interface between customer premises equipment (CPE) such as channel banks, T1 multiplexers, and the carrier network as shown in Figure 1. The unit complies with Part 68 of FCC Rules and with applicable sections of AT&T 62411, ANSI T1.102 and ANSI T1. 403.

The unit provides functions such as surge protection, signal regeneration, alarms, loopbacks necessary for circuit operation and fault isolation as illustrated in Figure 2 on page 22. The unit is transparent to ESF or SF framing formats and AMI or B8ZS line coding.

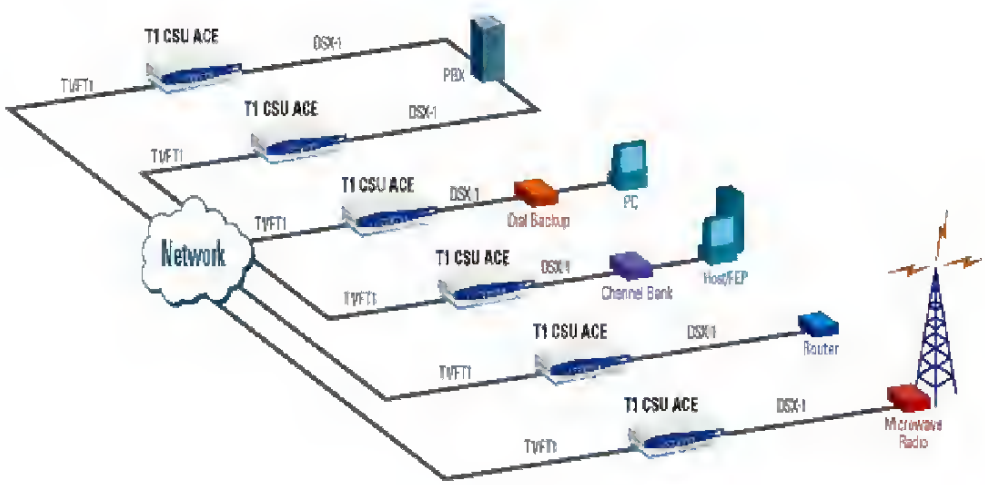

Figure 1. T1 CSU ACE Applications

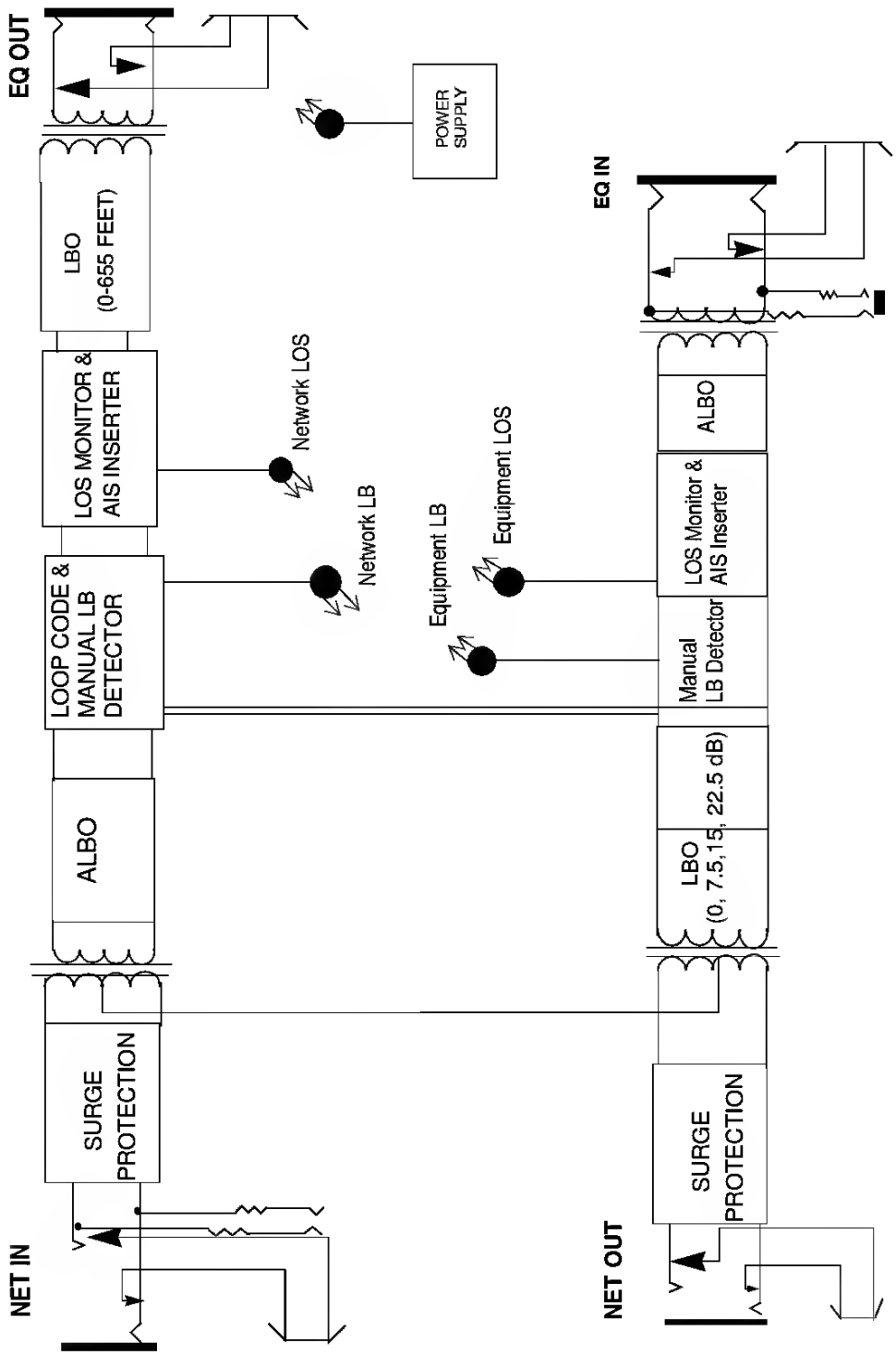

Figure 2. T1 CSU ACE Block Diagram

POWER OPTIONS

The T1 CSU ACE may receive power from a local power supply located on the customer's premises. Local power can be supplied by the customer's own 12 to 48 volt supply, or by the wallmount power supply shipped with the unit (see Figure 3). The wall mount power supply is an NEC class 2 device.

WARNING See *Powering the Unit* on page 30 for details on connecting the power to the unit.

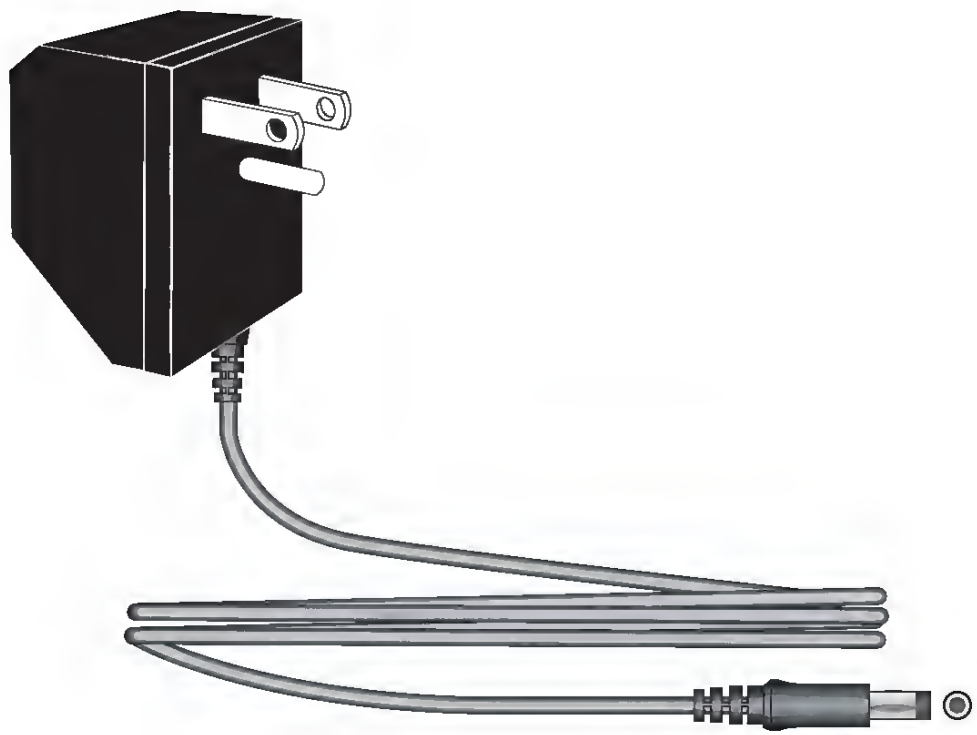

Figure 3. T1 CSU ACE Power Supply

ALARMS

The T1 CSU ACE provides five LED alarms on the front of the unit to help troubleshoot the communication channel. See Figure 4.
The alarm descriptions are as follows:

- The **POWER** LED shows that the unit is receiving power.
- The **SYNC** LED indicates signal is present on both the Network and the Equipment interface.
- **NET LOS** indicates loss of signal (LOS) from the network.
- **NET MAN LB** indicates a network loopback has been activated manually from the rear panel.
- **NET RMT LB** indicates a network loopback has been activated over the network.
- **EQ LOS** is illuminated when there is a loss of signal on the equipment side.
- **EQ MAN LB** indicates a loopback on the equipment side has been activated manually from the rear panel.
- **EQ RMT LB** indicates a loopback sequence has been detected from the equipment side.

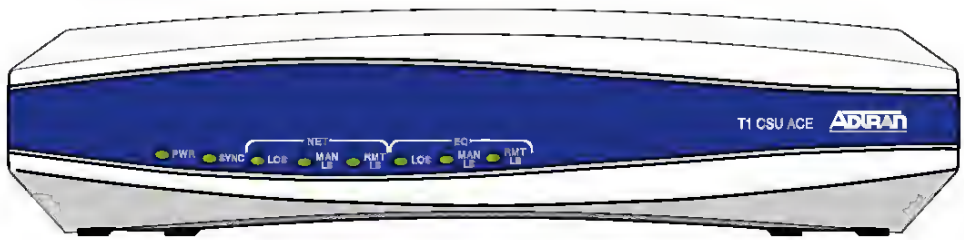

Figure 4. T1 CSU ACE LED Alarms

LOOPBACK

The T1 CSU ACE supports four types of loopbacks. With the first two, the unit loops the signal received from the network back to the network and transmits an unframed **all 1s** pattern to the CPE. The signal received from the CPE is ignored.

The first type of loopback, **Manual Network Loopback** (see Table 1), is initiated by switching on the **NET LB** switch on the back of the unit. The **NET MAN LB** LED will turn **On** and the loopback will continue until it is switched off. See Figure 5 on page 26.

The second type of loopback, **Network LB,** is activated by sending the unit a **1-in-5** pattern (10000) from the network side for five seconds. The **NET RMT LB** LED will turn **On** until it is cleared by sending a **1-in-3 pattern** (100) for five seconds. The patterns may be **Unframed** or **Framed** (SF or ESF).

The third type of loopback, **Manual Equipment Loopback** (see Table 1), is initiated by the **Equip LB** switch on the back of the unit. It will continue until **Equip LB** is switched off. With the **Equip LB**, the unit loops the signal received from the CPE equipment back to the CPE equipment, and transmits an unframed **all 1s** pattern to the network. The signal received from the network is ignored. The **EQ MAN LB** LED will illuminate when the loopback is in progress. See Figure 5 on page 26.

The fourth type of loopback, Equipment Remote Loopback, is activated by sending the unit a 1-in-5 pattern (10000) from the CPE side for five seconds. The **EQ RMT LB** will illuminate until it is cleared by sending a **1-in-3** pattern (100) for five seconds. The patterns may be **Unframed** or **Framed** (SF or ESF).

Table 1. Manual Loopbacks Switch Position Settings

LOOPBACK Type	POSITION 6	POSITION 7
Network	Up	Down
Equipment	Down	Up

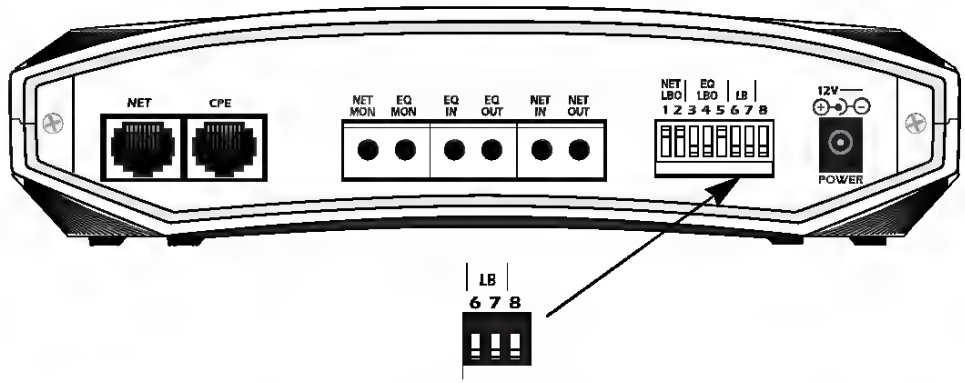

Figure 5. T1 CSU ACE Loopback Switch and LED

LINE BUILD OUT

The first five positions of the switch on the back of T1 CSU ACE selects **Line Build Out** (LBO). See Figure 6. Separate LBOs set the transmit levels for the network and CPE sides of the T1 CSU ACE. The receivers on both sides of the CSU ACE contain **Automatic Line Build Out** (ALBO) circuitry to compensate for loss.

On the **Network side**, the amount of attenuation in decibels (dB) specified by the carrier can be selected as shown in Table 2 on page 27.

On the **CPE side**, the amount of attenuation is determined by the maximum length of cable between the T1 CSU ACE and the CPE, as shown in Table 3 on page 27.

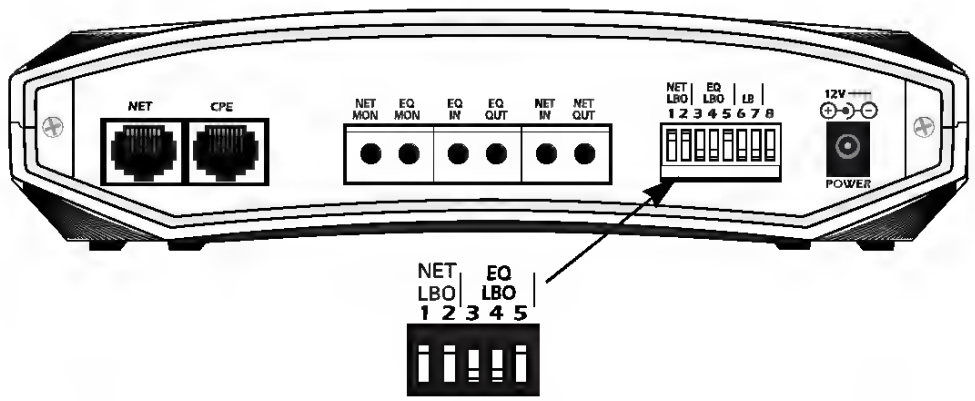

Figure 6. Line Build Out Switch

SETTING THE LBO SWITCH POSITIONS

Network and customer LBO switch position settings are defined in Table 2 and Table 3.

Table 2. Network LBO Switch Position Settings

POSITION 1	POSITION 2	ATTENUATION (dB)
Up	Up	0
Up	Down	7.5
Down	Up	15
Down	Down	22.5

Table 3. Customer LBO Switch Position Settings

POSITION 3	POSITION 4	POSITION 5	CABLE LENGTH (feet)
Down	Down	Up	0-133
Up	Up	Down	134-265
Down	Up	Down	266-399
Up	Down	Down	400-533
Down	Down	Down	534-655

WALLMOUNTING THE UNIT

The T1 CSU ACE may be installed in a wallmount or tabletop configuration. The following section provides step-by-step instructions for wallmounting the unit.

Instructions for Wallmounting	
Step	**Action**
1.	Decide on a location for the T1 CSU ACE. Mount the unit at or below eye-level so that the LEDs are viewable.
2.	Prepare the mounting surface by attaching a board (typically plywood, 3/ 4" to 1" thick) to a wall stud, using 3" wood screws. *Important! Mounting to a stud ensures stability. Using sheetrock anchors may not provide sufficient long-term stability.*
3.	Install two #8 (1 1/ 2" or greater in length) wood screws into the mounted board following these guidelines and referring to Figure 7: • Screws should be spaced horizontally, approximately 5" apart. Find exact positioning by using the location of the two eyed insets on the bottom of the unit as a guide. • Screws should be horizontally level with each other. • Leave approximately 1/4" of the screws protruding from the board to allow the heads of the screws to slide into place in the unit's keyed insets.
4.	Slide the keyed insets on the bottom of the T1 CSU ACE chassis securely onto the screws.
5.	Proceed to the steps given in *Powering the Unit* on page 30.

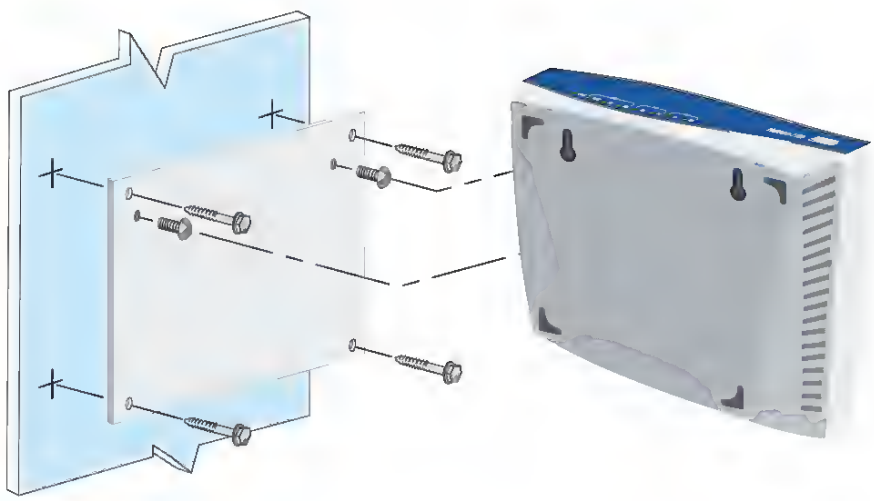

Figure 7. Wallmounting the T1 CSU ACE

POWERING THE UNIT

The unit may be powered by using the supplied NEC Class 2, 12V wall mount power supply. It may also be locally powered by own 12 to 48 V power supply. Once power has been applied to the unit, the **POWER** LED will be illuminated.

The unit can be powered by either of the following methods:

Method 1
• Use the included NEC Class 2, 12V at 800 mA wall mount power supply. *Note: The wall outlet shall be near the equipment and readily accessible.*

OR

Method 2
• Connect to a reliably-grounded 12-48 Vdc source which is electrically isolated from the AC source. *Note: The branch circuit overcurrent protection shall be a fuse or circuit breaker rated 48 V, minimum to 10A, maximum.* *A readily accessible disconnect device that is suitably approved and rated, shall be incorporated in the field wiring.* *The unit shall be installed in accordance with the requirements of NEC NFPA 70, where applicable.*

CONNECTING TO THE NETWORK AND CPE

Two 8-pin modular connectors are located on the back of the T1 CSU ACE (see Figure 8 on page 32). **NET** connects the unit to the network via the network cable. The connector marked **CPE** connects the cable from the customer equipment to the T1 CSU ACE.

Notify the carrier before connecting the T1 CSU ACE to the carrier network. Connect the T1 CSU ACE to the network demarcation before connecting to the **CPE**. Connector pin assignments for the Net RJ48C are listed in Table 4. Connector pin assignments for the CPE 8-Pin modular jack are listed in Table 5.

Table 4. Network RJ48C Connector Pin Assignments

PIN	NET
1	R1 (Receive from Network)
2	T1 (Receive from Network)
3	Not Used
4	R (Transmit to Network)
5	T (Transmit to Network)
6	Not Used
7	Not Used
8	Not Used

Table 5. CPE Connector Pin Assignments

PIN	CPE
1	R (Transmit to CPE)
2	T (Transmit to CPE)
3	Not Used
4	R1 (Receive from CPE)
5	T1 (Receive from CPE)
6	Not Used
7	Not Used
8	Not Used

TEST AND MONITOR ACCESS

The six Bantam jacks located on the back of the T1 CSU ACE provide test and monitor access for the network and equipment side of the T1 CSU ACE. The diagram on the face of the unit shows each jack's function, as seen in Figure 8.

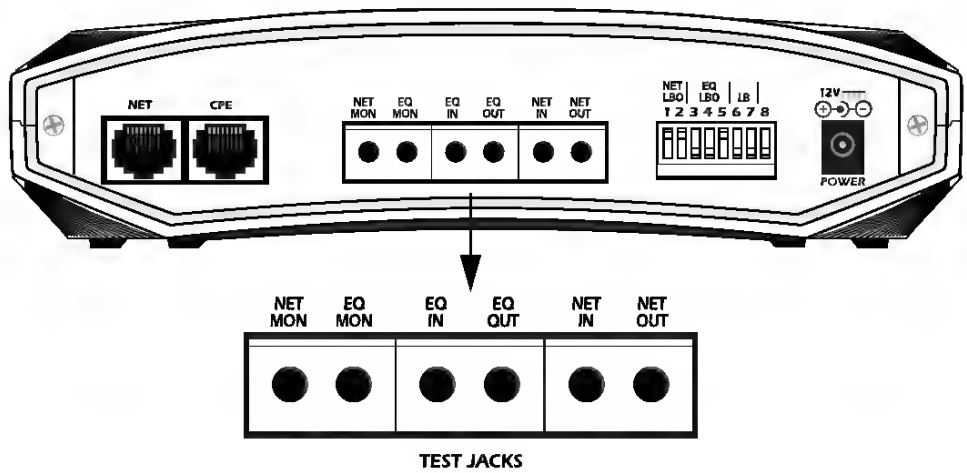

Figure 8. T1 CSU ACE Bantam Jacks

Monitor Jacks

The first two jacks are **monitor jacks** used for monitoring the circuit while in service. **NET MON** monitors the signal received from the network. **EQ MON** monitors the signal received from the CPE.

> **NOTE** *The test set's input impedance must be set for* ***DSX-MON*** *when connected to the monitor jacks.*

Break-and-Test Jacks

The other four jacks are **break-and-test** jacks used for out-of-service testing. These jacks bypass the connections of the modular jacks. **NET IN** and **NET OUT** are used to simulate the network input and output of the T1 CSU ACE. To test the CPE, a T1 Bit Error Rate Test (BERT) test set can be used to simulate the network. **EQ IN** and **EQ OUT** can be used to simulate the CPE with a BERT test set, allowing the network to be tested. The T1 CSU ACE on the other end of the circuit can be looped back to test only the network. Most BERT test sets have the ability to send LB enable and LB clear codes.

*The test set's input impedance must be set for **TERM** when connected to the break-and-test jacks.*

Chapter 3 Troubleshooting and Maintenance

Troubleshooting guidelines and maintenance information are provided in this chapter.

TROUBLESHOOTING

Power

Condition: PWR LED is not illuminated.

1. If locally powered, verify the power cable installation.
2. If the 12 V wall-mount power supply is used, check the supply's cable and the circuit breaker for the 120 V receptacle the supply is plugged into.

Network LOS

Condition: NET LOS LED is illuminated.

1. Verify that the cable from the network demarcation is in **NET** modular jack on the bottom/ end of the T1 CSU ACE.
2. If all connections seem intact, the far end CSU ACE can be looped back (using a BERT test set to send the LB code, or using **MANUAL LB** at the other end) to isolate the problem to the far end customer premises or the network.
3. If the problem persists after the LB has been activated, the problem appears to be within the network or the far end CSU ACE. In this case, notify the carrier.
4. If the problem disappears after loop-up, then the cause must be at the far end customer premises.

Equipment LOS

Condition: EQ LOS LED is illuminated.

1. Verify that the cable from the CPE is in the **CPE** modular jack on the bottom/ end of the CSU ACE.
2. If all connections seem intact, use a BERT test set in the **NET IN** and **NET OUT** jacks to test the CPE.

Power On - Self Check Failure

Condition: NET LOS, EQ LOS, NET LB, and EQ LB all flash in unison, continuously.

- The unit has failed its internal self check. Return the unit to the ADTRAN Customer and Product Service (CAPS) Department as instructed on page 12.

EPROM Checksum Failure

Condition: NET LOS and EQ LOS Flash alternately with NET LB and EQ LB for the first 10 seconds after power up.

- The unit's EPROM has a bad checksum. Return the unit to the ADTRAN CAPs Department as instructed in the Product Support page on the back page of this manual.

MAINTENANCE

The T1 CSU ACE requires no routine maintenance. No repairs should be performed by the customer. Repair services can be obtained by returning the unit to the ADTRAN Customer and Product Service (CAPS) department as instructed on page 12.

Chapter 4 Specifications

NETWORK AND CUSTOMER INTERFACE

Line
4-Wire (T, R, T1, and R1).

Data Rate
1.544 Mbps +/ -50 bps.

Signal Format
Bipolar with B8ZS transparency.

Output Amplitude
6 Volts, peak-to-peak nominal.

Network Connector Type
8-pin modular (RJ48C).

Customer Interface Connector Type
8-pin modular jack.

LED INDICATORS

PWR
Power is On.

SYNC
Signal from network and CPE present.

Net LOS
Loss of Signal from network.

NET MAN LB
Network manual loopback

NET RMT LB
Network Remote Loopback

EQ LOS
Loss of Signal from CPE.

EQ MAN LB
Equipment manual loopback.

EQ RMT LB
Equipment Remote Loopback.

POWER

Local Power
35 *m*A typ. at 48 V.
90 *m*A typ. at 12 V.

ENVIRONMENTAL

Temperature
Operating 0°C to 50°C.

Storage -20°C to 70°C.

Relative Humidity
Up to 95% (non-condensing).

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