T200/T400 TRI-R
Total Reach® ISDN Remote Card
Installation and Maintenance

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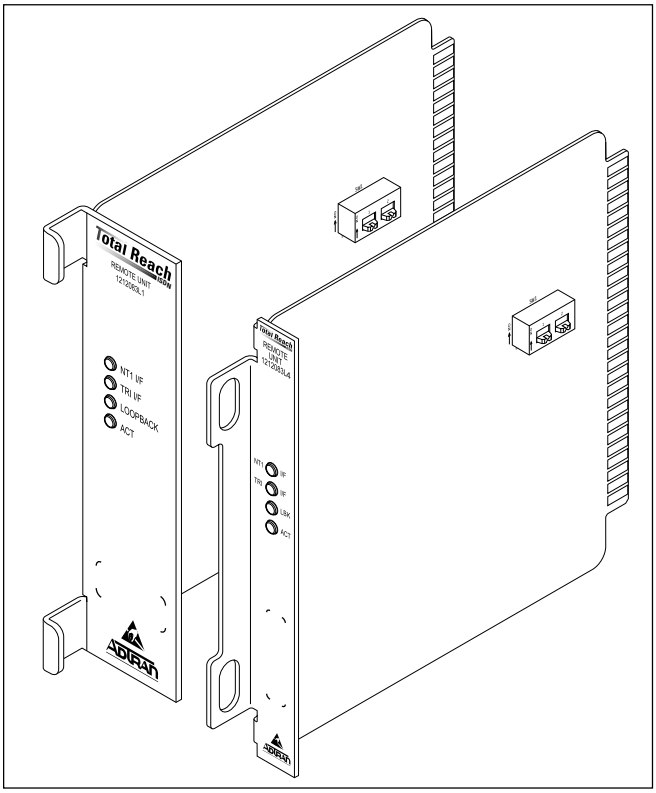

Figure 1. T200/T400 Total Reach ISDN-R

1. GENERAL

This practice provides installation and maintenance procedures for the ADTRAN Low Voltage Total Reach ISDN - circuit card (TRI-R). **Figure 1** is an illustration of the T200/T400 Total Reach ISDN-R.

Revision History

This Installation and Maintenance Practice has been reissued to include the following information and changes:

- Addition of Figure 2. 1st Generation to 2nd Generation Compatibility
- Clarification of the LOOPBACK LED in Table 4. Front Panel Indicators
- Minor format change to Tables 6 and 8
- Added note to Table 7. Cable Loss Constants (PIC @ 70°F)
- Clarification of the Deployment Guidelines section
- Addition of Table 8.
- Addition of Type 200 TRI-R, part numbers 1212083L4 and 1212083L5.

Features

Total Reach ISDN-R, part numbers 1212083L1, L1#A, L4, and L5 features include:

- ISDN 2B1Q U-interface meets all Layer 1 requirements as specified in ANSI T1.601-1992
- U-interface provides 18 kft nominal range on mixed gauge wire

- Total Reach (TR) interface provides 30.5 kft nominal range on mixed wire gauge
- Performance monitoring of the Layer 1 facility as specified in TR-NWT-000397 and TR-TSY-000829
- Eight hours of performance history, per TR-NWT-000829
- Eight ISDN BRA National Standard *eoc* messages responded to, including B1, B2, and 2B+D loopbacks
- Lightning and power cross protection in compliance with GR-1089-CORE
- Span powered by the Total Reach ISDN-Central Office Unit
- Compatible with -130 VDC and -190 VDC Central Office Units

General Descriptions

The TRI-R is a Type 200/400 mount circuit card that occupies a single slot on a standard Network Communication Termination Equipment housing, such as the ADTRAN T400 19" and T400 23" shelves, single mount stand-alone housing, and T400 Environmental Housings.

The T200/T400 TRI-R, in conjunction with the Central Office card (TRI-C), allows the transparent transport of Basic Rate ISDN (BRI) service to the customer premises at distances up to 30.5 kft over a single twisted pair of mixed gauge wire.

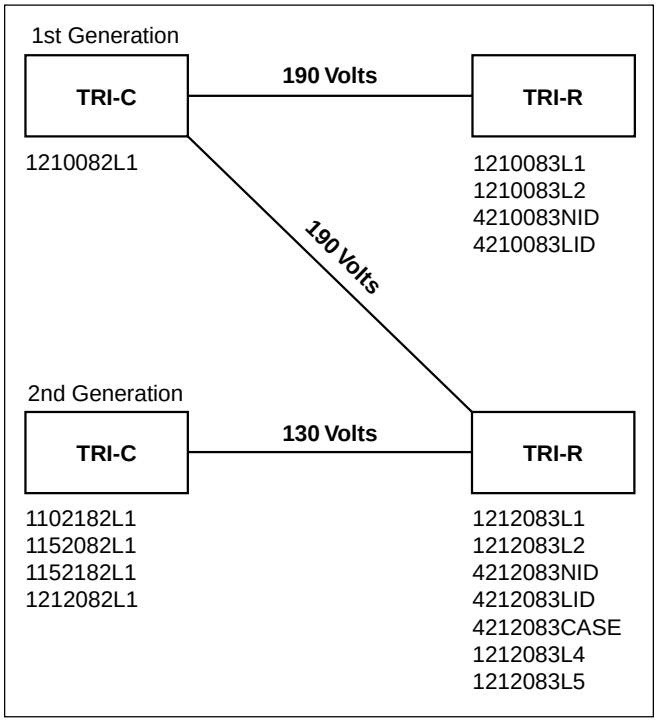

Figure 2. 1st to 2nd Generation Compatibility

The TRI-R restores the 2B+D data and Layer 1 embedded operations channel (eoc) information from the Total Reach ISDN interface, converting it to standard U-interface 2B1Q line code for transport to the customer's NT1/TA.

TRI-R makes use of ADTRAN's Simple Coded-Pulse Amplitude Modulation (SC PAM) line coding technology to extend the service range of ISDN without requiring the use of current mid-span U-Repeater technology. SC PAM is a full-duplex, multilevel encoding scheme that utilizes bandwidth reduction and improved adaptive equalization to transparently extend the ISDN Digital Subscriber Line (DSL) well beyond the current serving range of ISDN.

The Total Reach ISDN system extends the DSL serving range up to 52 dB when measured at 20 kHz@ 135 ohms termination. This is based on -44.2 dBm of 2B1Q Near End Crosstalk (NEXT) as defined in ANSI T1.601 (typically referred to as 0 dB margin). Refer to *Deployment Guidelines* for additional information.

The Low Power T200/T400 TRI-R is span powered by -130 VDC maximum from the multiple Low Power TRI-C products, or by -190 VDC maximum from the T400 TRI-C, P/N 1210082L1, CLEI DDRPLKC1AA (see **Figure 2**). This allows the TRI-R to be located near or at the customer's premises. The TRI-R converts the span-power input to provide operation voltages for the TRI-R and provide sealing current for the customer's NT1/TA.

2. INSTALLATION

CAUTION!
SUBJECT TO ELECTROSTATIC DAMAGE OR DECREASE IN RELIABILITY.
HANDLING PRECAUTIONS REQUIRED.

After unpacking the unit, inspect it for damage. If damage is discovered, file a claim with the carrier, then contact ADTRAN. See *Warranty and Customer Service*.

Optioning

The TRI-R has a two-position Dual In-Line Package (DIP) switch SW1 that is used to option the unit. See **Table 1** for a description of optioning.

Table 1. SW1 Option Settings

Switch	Label	Description	
SW1-1	NO SX	ON	Default and normal position. Provides between 4 to 10 mA of sealing current toward the customer's NT1/TA
		OFF	Disables sealing current to the customer's NT1/TA.
SW1-2	TEST	ON	(**TEST**) Factory Test only.
		OFF	Default and operational mode.

Connections

The Central-Office-Side Interface and the Customer Side U-interface connections to the TRI-R are made through a 56-pin connector on a T200/T400 shelf, or terminal strip. Some stand-alone housings provide an RJ connector that can be used as the Customer Side connection.

CAUTION

-130 VDC maximum is present on the TRI-R when a low-voltage TRI-C is used and -190 maximum when used with the 1210.082L1

Referring to **Figure 3** and the T200/T400 housing documentation, connect the U-interface and TRI-interface to the appropriate cross-connect. These connections are not sensitive to Tip/Ring reversal.

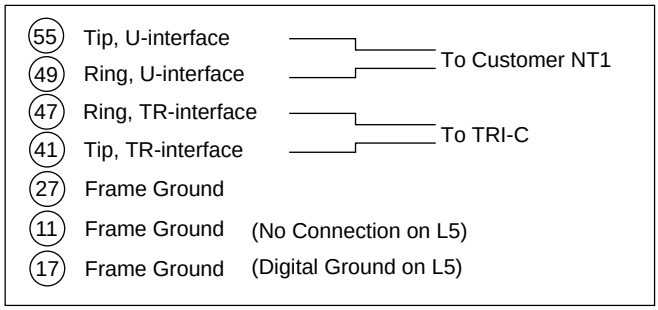

Figure 3. T400 TRI-R Pin Assignments

Pin-out information for ADTRAN environmental housings and other similar housings is provided in **Tables 2 and 3**.

WARNING

The frame ground must be connected to provide lightning and power cross protection for the TRI-R.

To install the T200/T400 TRI-R, grasp the unit by the faceplate and insert it into a shelf slot. Push the T200/T400 TRI-R into the backplane connector until firmly seated. The TRI-C can be installed or powered on at this time. Following power-up, some of the TRI-R faceplate indicators will initially illuminate, and then stabilize with the NT1 I/F and TRI I/F LEDs remaining ON. **Table 4** describes the four front panel status LEDs.

After installation, the TRI-R will initiate the training sequences to the TRI-C. Once synchronization is achieved on the Total Reach interface, the TRI-R will then initiate the training sequences to the customer's terminal equipment. The TRI I/F and NT1 I/F LEDs should go out when synchronization has been achieved on the TRI-interface and U-interface respectively.

After synchronization, if either the TRI I/F or NT1 I/F LED flashes at a rate of once per second, this indicates the receipt of Near End Block Errors (NEBE) on the associated interface. Both LEDs may illuminate immediately following synchronization of each interface, but should go OUT within 1 second. An LED which remains ON, or flashes intermittently, indicates a possible error condition on the associated interface, and should be checked before concluding circuit turn-up.

Once synchronization is complete and all connections are made, the interface indicates activation using the ACT LED. The ACT LED will light after successful exchange of the Activation bit between the customer's terminal equipment and the ISDN Switch.

The ACT LED will flash if the activation bit is received on the U-interface (when NT1 or the customer's terminal equipment is providing the Activation bit) but is not received from the ISDN Switch on the TRI-interface.

During normal operation, the ACT LED will be ON, and all other LEDs will be OFF. See Table 4 for additional LED information.

Table 2. ADTRAN 19" and 23" T400 Shelves Wiring Pinout

	23" T400 Shelf (1150.092L1)		23" and 19" T400 (1150.024L1 & 150.028L1)		HR12 Shelf	
Slot #	Field Side TRI-Interface (Pins 47/41)	Customer Side U-Interface (Pins 49/55)	Field Side TRI-Interface (Pins 47/41)	Customer Side U-Interface (Pins 49/55)	Field Side U-Interface (Pins 47/41)	Customer Side TRI-Interface (Pins 49/55)
1	P1-1/26	P3-1/26	P1-1/26	P2-1/26	P2-14/39	P1-14/39
2	P1-2/27	P3-2/27	P1-3/28	P2-5/30	P2-15/40	P1-15/40
3	P1-3/28	P3-3/28	P1-5/30	P2-9/34	P2-16/41	P1-16/41
4	P1-4/29	P3-4/29	P1-7/32	P2-13/38	P2-17/42	P1-17/42
5	P1-5/30	P3-5/30	P1-9/34	P2-17/42	P2-18/43	P1-18/43
6	P1-6/31	P3-6/31	P1-11/36	P2-21/46	P2-19/44	P1-19/44
7	P1-7/32	P3-7/32	P1-13/38	P3-1/26	P2-20/45	P1-20/45
8	P1-8/33	P3-8/33	P1-15/40	P3-5/30	P2-21/46	P1-21/46
9	P1-9/34	P3-9/34	P1-17/42	P3-9/34	P2-22/47	P1-22/47
10	P1-10/35	P3-10/35	P1-19/44	P3-13/38	P2-23/48	P1-23/48
11	P1-11/36	P3-11/36	P1-21/46	P3-17/42	P2-24/49	P1-24/49
12	P1-12/37	P3-12/37	P1-23/48	P3-21/46	P2-25/50	P1-25/50
13	P1-13/38	P3-13/38	N/A	N/A	N/A	N/A
14	P1-14/39	P3-14/39	N/A	N/A	N/A	N/A

Table 3. Pinout Cross-Reference for TRI-R

TRI-Interface	
Pin 41 (Tip):	TT, T Loop 2 (HDSL-Compatible Housings)
Pin 47 Ring):	TR, R Loop 2 (HDSL-Compatible Housings)
U-Interface	
Pin 55 (Tip):	DTT, T from CPE (HDSL-Compatible Housings)
Pin 49 Ring):	DTR, R from CPE (HDSL-Compatible Housings)

Deployment Guidelines

The Total Reach ISDN system is designed to provide range extension on single twisted-pair, non-loaded loops that exceed the typical ISDN deployment range. The general guidelines require the loop to have an insertion loss of less than 52 dB at 20 kHz, or less than 61 dB at 40 kHz with 135 ohms driving and terminating impedances, see **Table 5**. **Table 6** provides recommended guidelines for the Total Reach ISDN interface. Adherence to these guidelines will allow general deployment of Total Reach ISDN without further qualification. If any of the stated guidelines are exceeded, additional circuit testing will be required to ensure loop loss and noise levels are not exceeded.

Table 4. Front Panel Indicators

Indicator	Color	Description
NT1 I/F	Red	ON solid indicates a loss of signal or synchronization with the 2B1Q BRI interface toward cutomer's NT1. **Flashing** once per second indicates receipt of a Near End Block Error (NEBE) from the 2B1Q BRI interface.
TRI I/F	Red	ON solid indicates a loss of signal or synchronization with the TRI-C unit. **Flashing** once per second indicates receipt of a NEBE from the TRI-C unit.
LOOPBACK	Yellow	Indicates the TRI-R is in a network-commanded loopback; 1 **flash** per second for B1 loopback, 2 **flashes** per second for a B2 loopback, and **solid** for 2B+D loopback.
ACT	Green	**ON** solid indicates that the terminal equipment has exchanged ACT bits with the ISDN switch. **Flashing** once per second indicates that the ACT bit is being sent from only the terminal equipment.

CAUTION

All load coils must be removed from the circuit pairs being deployed. Loading coils, which are used to enhance voice quality on analog circuits, are designed to pass frequencies in the lower bandwidth range. Technologies operating in higher bandwidth ranges such as DDS, HDSL, or in this case ISDN, will not operate properly if all loading coils are not removed from the pair.

Specific loss constant values and DC loop resistance for various wire gauges are provided in Table 5. Loop loss constants (in db/kft) are provided for 20 and 40 kHz and can be used to determine the Estimated Measured Loss (EML) for any local loop. Examples of maximum loop lengths are provided for each wire gauge, and are based on 70°F PIC cable, with -44.2 dBm ANSI NEXT. These constants were derived using *Bell Lab Transmission System for Communications, 1982*, and the method for determining the insertion loss with 135 ohms driving and termination impedances. The total length of multi-gauge cable must yield a loop loss less than or equal to 52 dB @ 20 kHz or 61 dB @ 40 kHz.

For EML, multiply each section's loop length in kilofeet by the appropriate cable loss constant in **Table 7** to determine the insertion loss of each section. To determine the insertion loss for each bridged tap in the feeder, multiply the length of the bridged tap by 1.32 dB (2.09 for 40 kHz). The maximum loss of each bridged tap is 4.2 dB, (4.7 dB for 40 kHz) regardless of length. Assume 250 feet for Central Office wiring. For total insertion loss for the loop, add each section's insertion loss, the loss due to bridged taps, and loss of Central Office wiring.

Some Loop Deployment Programs provide automatic loop insertion loss predictions based on 40 kHz for ISDN 2B1Q. Table 5 provides a conversion estimate in dB between insertion loss at 40 kHz for 2B1Q ISDN and the recommended 20 kHz for Total Reach ISDN. To use, determine the dB loss at 40 kHz using current methods and the largest component cable size (24 or 22 AWG). If the 22 and 24 AWG components are approximately the same, use the values associated with 22 AWG. This table should only be used to provide a rough estimate of the insertion loss at 20 kHz. A more accurate estimate can be obtained by determining the exact cable make-up of a loop and using the cable loss constants in Table 7. Additional temperature loss data for various wire gauges and cable material is shown in **Table 8**.

The U-Interface follows local deployment guidelines for standard ISDN, as specified in ANSI T1.601 and shown in **Table 9**.

Table 5. 20 kHz vs 40 kHz Loop Loss Conversion

20 kHz (dB)	40 kHz w/majority 22 AWG (dB)	40 kHz w/majority 24 AWG (dB)
1	1	1
5	6	6
10	12	12
15	18	18
20	23	24
25	29	30
30	35	36
31	36	38
32	37	39
33	39	40
34	40	41
35	41	42
36	42	44
37	43	45
38	44	46
39	46	47
40	47	48
41	48	50
42	49	51
43	50	52
44	51	53
45	53	55
46	54	56
47	55	57
48	56	58
49	57	59
50	58	61
51	60	62
52	61	63

Table 6. TRI-Interface Deployment Guidelines

Description	Value
Maximum Loop Loss @ -44.2 dBm ANSI NEXT	52 dB @ 20 kHz or 61 dB @ 40 kHz
Maximum DC resistance	2000 Ω
Maximum single bridged taps	2 kft
Maximum total bridged taps	6 kft
Maximum number bridged taps	3

Table 7. Cable Loss Constants (PIC @ 70°F)

Cable Gauge (mm)	Maximum Loop Length*	Loss @ 20 kHz per kft	Loss @ 40 kHz per kft	Ohms per kft
26/0.40	24 kft	2.159 dB	2.721 dB	83
24/0.51	33 kft	1.586 dB	1.921 dB	52
22/0.61	46 kft	1.134 dB	1.325 dB	32
19/0.91	80 kft	0.655 dB	0.770 dB	16
Bridged Tap	6 kft	1.32 dB	2.09 dB	N/A
*Based on -44.2 dBm ANSI NEXT				

3. TESTING

The TRI-R responds to *eoc* loopbacks, including B1, B2, and 2B+D. Loopback can be initiated from the ISDN switch, or from any other upstream network device that affords test access. The TRI-R also supports performance monitoring as described in TR 829 for fault isolation.

Table 8. dB Loss Over temperature @ 20 kHz.

Plastic Cable	dB Loss per kft	Paper Cable	dB Loss per kft
19 Gauge PIC (0º F) 19 Gauge PIC (70º F) 19 Gauge PIC (120º F)	0.568 0.655 0.719	19 Gauge PULP (0º F) 19 Gauge PULP (70º F) 19 Gauge PULP (120º F)	0.611 0.705 0.768
22 Gauge PIC (0º F) 22 Gauge PIC (70º F) 22 Gauge PIC (120º F)	1.006 1.134 1.238	22 Gauge PULP (0º F) 22 Gauge PULP (70º F) 22 Gauge PULP (120º F)	1.054 1.195 1.290
24 Gauge PIC (0º F) 24 Gauge PIC (70º F) 24 Gauge PIC (120º F)	1.429 1.586 1.721	24 Gauge PULP (0º F) 24 Gauge PULP (70º F) 24 Gauge PULP (120º F)	1.475 1.653 1.771
26 Gauge PIC (0º F) 26 Gauge PIC (70º F) 26 Gauge PIC (120º F)	1.961 2.159 2.323	26 Gauge PULP (0º F) 26 Gauge PULP (70º F) 26 Gauge PULP (120º F)	1.955 2.170 2.313

Table 9. U-Interface Deployment Guidelines

Description	Value
Maximum Loop Loss @ -38.2 dBm ANSI NEXT	42 dB @ 40 kHz
Maximum DC resistance	1300 Ω
Maximum single bridged taps	3 kft
Maximum total bridged taps	6 kft
Maximum number bridged taps	3
Max Noise	-57 dBm (135 W termination, 50 kb filter)

4. SPECIFICATIONS

Refer to **Table 10** for unit specifications.

5. MAINTENANCE

The TRI-R does not require routine maintenance for normal operation.

ADTRAN does not recommend that repairs be performed in the field. Repair services are obtained by returning the defective unit to ADTRAN's Customer Service.

6. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within ten years from the date of shipment if it does not meet its published specifications or fails while in service (see *ADTRAN Carrier Network Equipment Warranty, Repair, and Return Policy and Procedure* document 60000087-10A).

Contact Customer and Product Service (CAPS) prior to returning equipment to ADTRAN.

For service, CAPS requests, or further information, contact one of the following numbers:

ADTRAN Sales

Pricing and availability
(800) 827-0807

ADTRAN Technical Support

Presales Applications / Post-sale Technical Assistance
(800) 726-8663

Standard support hours:
Monday-Friday, 7 a.m. - 7 p.m. CST

Emergency support: 7 days/week, 24 hours/day

ADTRAN Repair/CAPS

Return for repair / upgrade
(256) 963-8722

Repair and Return Address:
ADTRAN, Inc.
CAPS
901 Explorer Boulevard
Huntsville, Alabama 35806-2807

Table 10. TRI-R Specifications

2 Wire (Network) Loop Interface	
Line:	2-Wire
Operating Mode:	Full-duplex
Data Rate:	160 kbps total; 144 kbps available to customer
Signal Format:	2B1Q
Transmit Power (rms):	13 dBm to 14 dBm nominal
Tx/Rx Impedance:	135 Ω nominal
Receiver Sensitivity:	42 dB @ 40 kHz with -38.2 dBm ANSI NEXT
Sealing Current:	Optional; when enabled, provides 4 to 10 mA, dependent on loop loss
Total Reach ISDN Interface	
Line:	2-Wire
Operating Mode:	Full-duplex
Signal Format:	SC PAM
Transmit Power (rms):	13 dBm nominal
Tx/Rx Impedance:	135 Ω nominal
Input Power:	1.4 watts nominal, -95 VDC to -130 VDC, dependent on loop loss
Receiver Sensitivity:	52 dB @ 20 kHz with -44.2 dBm of ANSI NEXT
Mechanical	
Size:	1 3/8" wide x 5 5/8" high x 6" long (L1) 3/4" wide x 5 5/8" high x 6" long (L4)
Weight:	13 oz
Mounting:	Type 200/400 compatible
Environmental	
Temperature:	Operating: -40° C to 70° C (-40° F to 158° F) Storage: -40° C to 85° C (-40° F to 185° F)
Relative Humidity:	Up to 95%, non-condensing