ADTRAN

PRACTICES

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

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SINGLE-WIDE FT1 REPEATER INSTALLATION/MAINTENANCE

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1. GENERAL

This practice provides installation and maintenance procedures for the ADTRAN Single-Wide Fractional T1 (FT1) Repeater, (ADTRAN P/N 1245211L1), illustrated in Figure 1.

The ADTRAN Single-Wide FT1 Repeater is a device used to extend the effective range of an ADTRAN FT1 circuit. It is capable of doubling the deployment range of standard HDSL, providing a carrier service area (CSA) compliant loop on both sides of the Single-Wide FT1 Repeater.

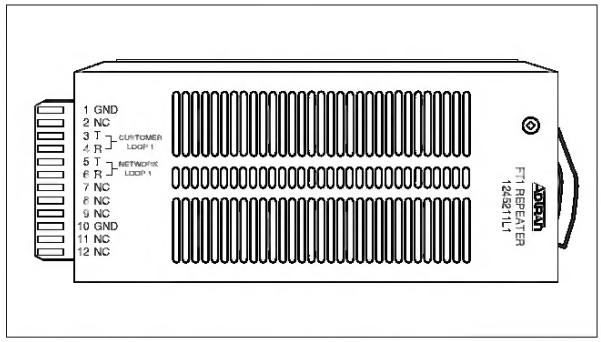

Figure 1. ADTRAN Single-Wide FT1 Repeater

Features of tbe Single-Wide FT1 Repeater include:

- 2B1Q line coding
- Range up to 12 kft of 24-gauge wire each direction from FT1 Repeater
- Lightning protection
- Remote loopback control
- Coexists with DDS and ISDN repeaters in same apparatus case
- Remote performance monitoring capability

This unit is used in conjunction with any span powering FT1 DP for tbe central office and span powered FNID remote end as follows:

Part Number	Unit Name
1245206L1	Siemens FT1 DP
1245207L1	Northern Telecom FT1 DP
1245208L1	ALCATEL FT1 DP
1245205L1	WECO D4 FT1 DP
1245201L1	FNID (T400)
1242046L2	Siemens FT1 DP
1242047L2	Northern Telecom FT1 DP
1242048L2	Alcatel FT1 DP
1242040L2	AT&T FT1 DP
1242041L2	FNID (T400)
1242042L2	FNID (standalone)

The ADTRAN Single-Wide FT1 Repeater provides a means of extending the digital subscriber loop serving range using a centrally-located unit. There are no manual option settings on the Single-Wide FT1 Repeater.

The ADTRAN Single-Wide FT1 Repeater provides three faceplate LEDs which indicate signal quality, error conditions, and loopback status. See Table A for a description of tbe LED indicators.

Operating power is derived from an ADTRAN FT1 DP, independent of line impedance or wire gauge. The repeater uses some current, then passes the span power on to the FN1D.

The Single-Wide FT1 Repeater operates at line losses up to 35.25 dB at 200 kHz, in botb directions from the repeater and regenerates the 2B1Q signals to meet tbe transmitted power spectrum of Bellcore TA-NWT-0001210. For deployment guidelines, refer to subsection 5 of this practice.

The Single-Wide FT1 Repeater is housed in an environmental apparatus case.

NOTE

Do not remove the metal shell enclosing the circuit packs.

Table A. LED Indications

LED	Description and Indications
NET	This LED indicates the FT1 signal quality and errors on the Network-side loop. The NET LED will flash once when an errored second is detected on NET side loop. If the NET LED flashes yellow rapidly (six times per second), sealing current is present and the FT1 Repeater is attempting to synchronize with the other FT1 circuit elements. Off ..... No synchronization with the FT1 DP. Green .... Synchronized with good signal quality on NET loop (> 2dB margin above 10^{-7} BER) Yellow .. Synchronized with marginal signal quality on NET loop (< 2 dB margin ahove 10^{-7} BER) Red..... Synchronized with poor signal quality on NET loop (>10^{-7} BER)
CUST	This LED indicates the FT1 signal quality and errors on the Customer-side loop. The CUST LED will flash once when an errored second is detected on CUST side loop. Off ..... No synchronization with the FNID. Green .... Synchronized with good signal quality on CUST loop (> 2dB margin ahove 10^{-7} BER) Yellow .. Synchronized with marginal signal quality on CUST loop (< 2 dB margin above 10^{-7} BER) Red..... Synchronized with poor signal quality on CUST loop (>10^{-7} BER)
LBK	This LED indicates the status of a loophack detected at the FT1 Repeater. Off ..... No loopback detected at the FT1 Repeater. Yellow .. Loopback detected toward NET.

The connector pinout for the Single-Wide FT1 Repeater is sbown in Figure 2.

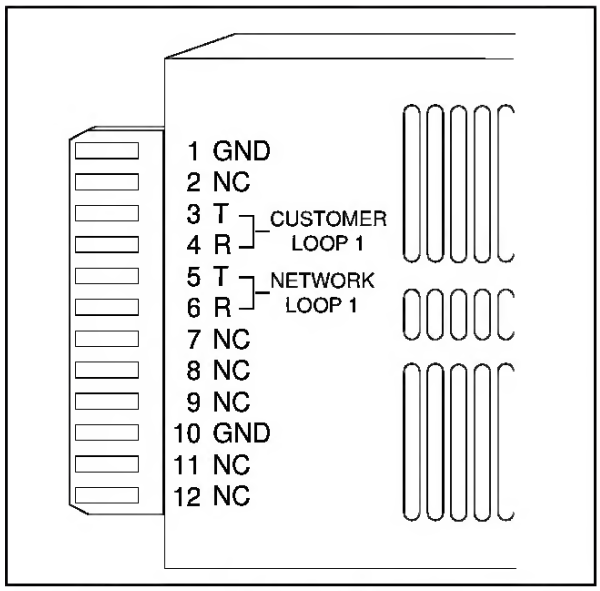

Figure 2. ADTRAN Single-Wide FT1 Repeater Connector Pinout

Revision History

This is the first issue of this practice. In subsequent issues, revisions will be summarized in this paragraph.

2. INSTALLATION

CAUTION

This equipment contains static-sensitive components. Be sure to follow proper electrostatic discharge procedures before handling or installing the equipment.

The Single-Wide FT1 Repeater circuit pack is shipped in a separate carton and must be installed in an environmental apparatus case.

Remove the Single-Wide FT1 Repeater circuit pack from the carton and visually ensure tbat damage has not occurred during shipping or bandling. 1f damage has occurred, file a claim immediately with the carrier, then contact ADTRAN customer service.

The Single-Wide FT1 Repeater circuit pack is designed for installation in a pre-wired apparatus case. These are described in Table B.

Table B. FT1 Repeater Apparatus Cases

ADTRAN Part Number	Description	FT1 Repeaters
1150027L1	4-Slot, Dual T1 form, air	4
1150027L2	4-slot, Dual T1 form, gel	4
1152010L3	2-slot, Dual T1 form, gel	2
1152010L4	2-slot, Dual T1 form, air	2
1150057L1	4-slot, Universal, air	4
1150057L2	4-slot, Universal, gel	4
1150058L1	8-slot, Universal, air	6
1150058L2	8-slot, Universal, gel	6

3. INSTALLATION OF SINGLE-WIDE FT1 REPEATERS IN ADTRAN APPARATUS CASES

When installing tbe Single-Wide FT1 Repeater in an ADTRAN apparatus case, refer to the ADTRAN Installation/Maintenance practice for the apparatus case being used.

CAUTION

The housing must he considered to he under pressure and should he handled accordingly. The Single-Wide FT1 Repeater dissipates a maximum of 3 watts.

4. MAINTENANCE

The ADTRAN Single-Wide FT1 Repeater requires no routine maintenance. In case of equipment malfunction, perform an in-band loopback from the central office (CO), as described in Appendix A of this practice. If a malfunction is confirmed, replace the Single-Wide FT1 Repeater.

FT1 Repeater Loopbacks

The Single-Wide FT1 Repeater has looping capability through the channel which allows for digital loopback to help isolate faults. The looping is accomplished remotely from the CO switch as described in Appendix A.

The FT1 Repeater network loopback is a digital loopback toward the CO, as illustrated in Figure 3.

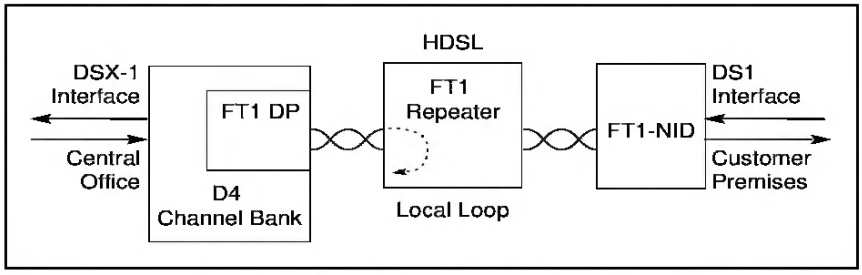

Figure 3. FT1 Repeater Network Loopback

This loopback is initiated by the DDS latching loopback code for NEI Position 1 (N1000001). The NEI Position 1 latching loopback is detected in the primary DS0 of tbe FT1 circuit (the channel in wbicb the FT1-DP is physically installed) to control the looping of the FT1 circuit. When tbe FT1 circuit is looped, all DS0s in use will be looped. The DS0s in use will also be transmitted on to the customer. This loopback is also initiated from the craft interface or the LB push-button at the FT1-DP.

FT1 Self-Test

When a self-test is initiated at the FT1-DP, a repeater failure will be indicated as an FN1D failure on the craft interface screens. Likewise, if a self-test is initiated at the FN1D, a repeater failure will be indicated as an FT1-DP failure on the craft interface screens.

Replacement of Circuit Packs

When testing indicates a faulty circuit pack, refer to the apparatus case installation/maintenance practice for the entry and pressurization control. Replace tbe faulty circuit pack. Request a loopback test from the CO, per Appendix A.

ADTRAN does not recommend field repair of the circuit pack. Repair services may be obtained by returning the defective unit to the ADTRAN Repair Department.

Testing the FT1 Repeater at the CO

The ADTRAN Single-Wide FT1 Repeater performs the loopback described in Appendix A.

5. CSA DEPLOYMENT GUIDELINES

The ADTRAN FT1 DSL system including the ADTRAN Single-Wide FT1 Repeater is designed to provide Fractional DS1 based services over loops designed to comply with Carrier Service Area (CSA) guidelines. CSA deployment guidelines are given below.

1. All loops are non-loaded only.
2. For loops with 26-AWG cable, the maximum loop length including bridged tap lengths is 9 kft.
3. For loops with 24-AWG cable, the maximum loop length including bridged tap lengths is 12 kft.
4. Any single bridged tap is limited to 2 kft.
5. Total bridged tap length is limited to 2.5 kft.
6. The total length of multi-gauge cable containing 26-AWG cable must not exceed:

   $12 - \{(3*L^{26})/9\} - L^{BTAP}$ (in kft)

   L^{26} = Total length of 26-AWG cable excluding bridged taps (in kft)

   L^{BTAP} = Total length of all bridged taps (in kft)

This deployment criteria is summarized in the chart shown in Figure 4.

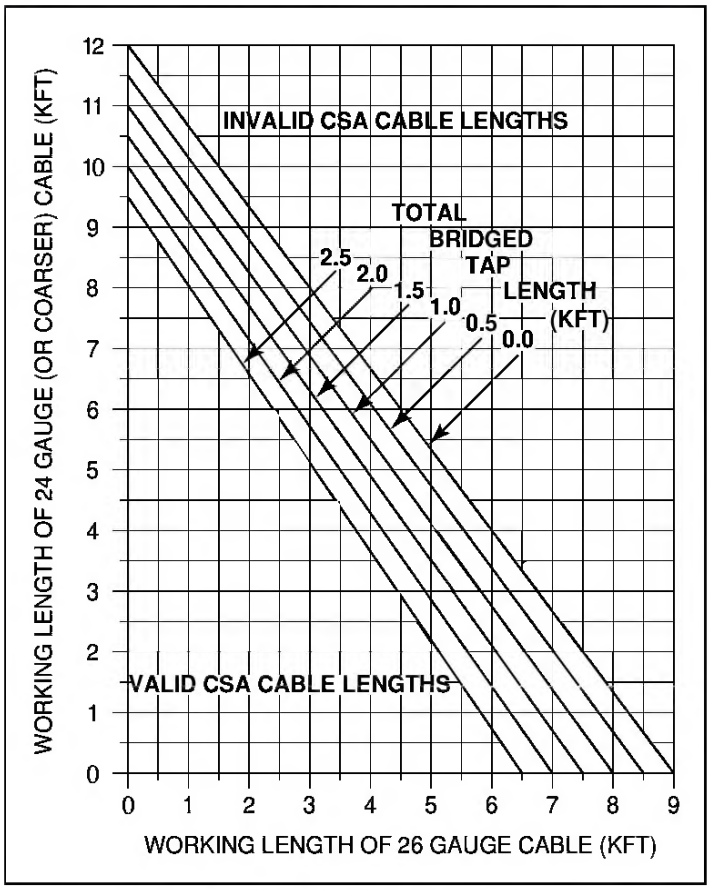

Figure 4. CSA Deployment Guidelines

Recommended maximum local loop loss information for PIC cable at 70°F, 135Ω, resistive termination is provided in Table C.

Table C. Loop Insertion Loss Data

Frequency (Hz)	Maximum Loss (dB)
3000	12.0
10,000	15.0
50,000	25.5
100,000	30.0
150,000	32.75
200,000	35.25

An approximation for the maximum amount of wideband noise on a DSL local loop as measured by a 50 kbps filter is ≤ 31 dBrn.

An approximation for the maximum level of impulse noise as measured using a 50 kbps filter on an DSL loop is ≤ 50 dBrn.

NOTE

These approximations are to be used as guidelines only and may vary slightly on different loops. Adhering to the guidelines should produce performance in excess of 10^{-7} BER.

6. SPECIFICATIONS

Specifications for the ADTRAN Single-Wide FT1 Repeater appear in Table D.

7. 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 Equipment Warranty, Repair, and Return Policy and Procedure).

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

For service, RMA requests, or further information, contact one of the following numbers.

ADTRAN Customer Service

ADTRAN Telco Technical Support. (800) 726-8663
Standard support hours ..... Monday-Friday
7 a.m. - 7 p.m. CST
Emergency support ..... 7 days/week, 24 hours/day
Sales ..... (800) 827-0807
RMA (repair service) ..... (256) 963-8722

Repair and Return Address

ADTRAN, Inc.
Customer and Product Support (CAPS) Department
901 Explorer Boulevard
Huntsville, Alabama 35806-2807

Table D. HDSL FT1 Repeater Unit Specifications

Loop Interface	
Modulation Type	2B1Q
Mode	Full Duplex, Echo Cancelling
Number of Pairs	One
Bit Rate	784 kbps per pair
Baud Rate	392K baud per pair
Service Range	Defined by Carrier Service Area Guidelines
Loop Loss	35.25 dB maximum @ 200 kHz
Bridged Taps	Single Taps < 2 kft, Total Taps < 2.5 kft
Performance	Compliant with Bellcore TA-NWT-001210
Return Loss	20 dB (40 kHz to 200 kHz)
HDSL Tx Signal Level	13.5 dBm
Input Impedance	135 Ω
Power	
Input Power	(span-powered by FT1 DP) 3 W maximum
Tests	
Diagnostics	Loopback initiated with DDS latching loopback codes. Self test initiated from FT1-DP or FNID.
Physical	
Dimensions	6.36" long, 2.60" high, 0.7" deep
Weight	12 ounces
Environment	
Temperature	Operating (Standard) ..... -40°C to +50°C Storage ..... -40°C to +85°C
Part Number	
ADTRAN Single-Wide FT1 Repeater	1245211L1

APPENDIX A
FT1 LOOPBACKS

1. GENERAL

This Appendix is an overall reference to the loopback capabilities of the ADTRAN Fractional T1 system. Included in the Appendix is a description of the FT1 loopbacks and tbe methods for activating the FT1 loopbacks.

2. FT1 LOOPBACKS

Figure A-1 shows the application from the central office (CO) to customer premises. The FT1 Repeater is shown for convenience and not as a necessary part of the FT1 network. Tbe loopbacks shown are as follows:

A. FT1 DP network loopback
B. FT1 DP CPE loopback
C. FT1 Repeater network loopback
D. FNID network loopback
E. FNID CPE loopback

There are two loopbacks available to the FT1 DP. The FT1 DP network loopback loops tbe FT1 signal back to tbe network. The FT1 DP CPE loopback loops the FT1 signal back to the customer.

The FT1 DP network loopback is a digital loopback toward tbe CO (see Figure A-2). Tbis loopback is initiated by the OCU latching loopback command (N1010101), by a push-button when available, or by the craft interface. The OCU latching loopback code is detected in the primary DS0 of the FT1 circuit -- the channel where the FT1 DP is pbysically installed -- to control tbe FT1 circuit looping. When the FT1 circuit is looped, all DS0s in use will be looped back toward the network. Tbe DS0s will be transmitted on to tbe customer.

The FT1 DP CPE loopback is a digital loopback toward customer premises as sbown in Figure A-3. This loopback is initiated by the RLB button on the FNID, or by tbe craft interface. When the FT1 circuit is looped, all DS0s in use will be looped back toward the customer. All DS0s sent toward the network will be filled with all-1s.

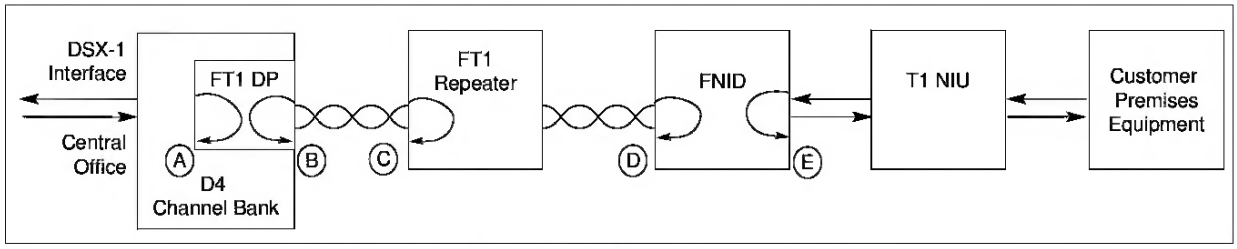

Figure A-1. FT1 Loopbacks

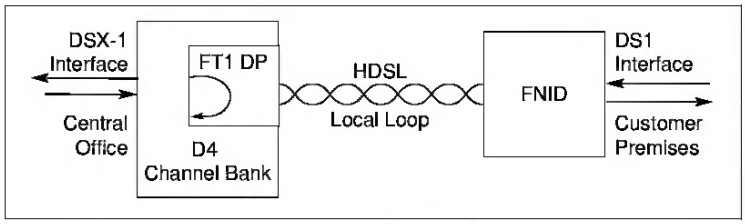

Figure A-2. FT1 DP Network Loopback

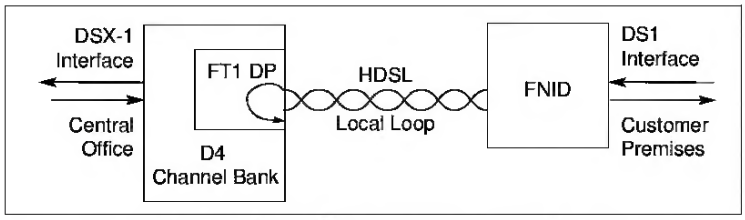

Figure A-3. FT1 DP CPE Loopback

There is one loopback available to the FT1 Repeater. Tbe FT1 Repeater Network loopback is a digital loopback toward the CO as shown in Figure A-4. Tbe loopback is initiated by the DDS latching loopback code for NEI Position 1 (N1000001). The NEI Position 1 latching loopback is detected in the primary DS0 of the FT1 circuit, the channel wbere the FT1 DP is physically installed, to control the looping of the FT1 circuit. When the FT1 circuit is looped, all DS0s in use will be looped. The DS0s in use will also be transmitted on to tbe customer. This loopback is also initiated by the craft interface or by the RLB pusb-button (wben available) at tbe FT1-DP.

There are two loopbacks available to the FNID. The FNID network loopback loops tbe FT1 signal back toward the network. The FNID CPE loopback loops the FT1 signal back toward the customer.

The FNID network loopback is a digital loopback toward tbe CO as illustrated in Figure A-5. This loopback is initiated by the DDS latching loopback code (NEI Position 1 - N1000001 for a non-repeatered loop, or NE1 Position 2 -N1000001 for a repeatered loop), by tbe craft interface, or by the RLB button at the FT1-DP. Tbe NE1 Position 1 latching loopback is detected in the primary DS0 of the FT1 circuit -- the channel in which the FT1 DP is pbysically installed -- to control the looping of the FT1 circuit. When tbe FT1 circuit is looped, all DS0s in use will be looped. The loopback keep alive code will be transmitted to the customer.

The FNID CPE loopback is a digital loopback toward customer premises as sbown in Figure A-6. This loopback is initiated by the craft interface. When the FT1 circuit is looped, all DS0s in use will be looped. The DS0s in use will be filled with all 1s toward the network.

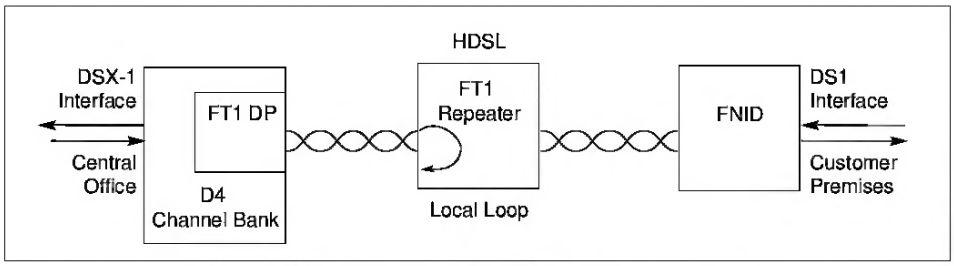

Figure A-4. FT1 Repeater Network Loopback

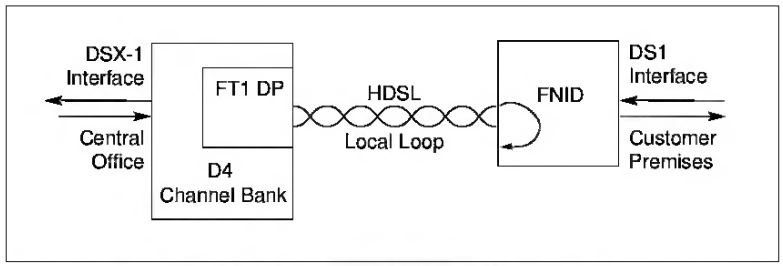

Figure A-5. FNID Network Loopback

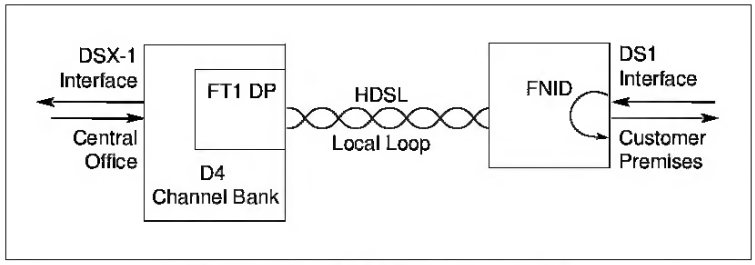

Figure A-6. FNID CPE Loopback

3. LOOPBACK ACTIVATION AND DEACTIVATION

This section describes loopback activation and deactivation methods for the ADTRAN Fractional T1 system. Loopback activation and deactivation is controlled with the push-button located on the front panel, through craft interface, or latching loopback codes.

A push-button labeled "LBK," located on the front panel of the FN1D, controls the activation of remote loopback. Pressing this button activates the FT1 DP CPE loopback. Two push-buttons, labeled "LCL" and "REM," respectively, are located on the front panel of the FT1 DP. Press REM on the FT1 DP in order to activate FT1 Repeater loopback (when available) or FN1D network loopback. To deactivate Remote loopback, either press REM or wait for the loopback timeout (if enabled).

Craft interfaces, located on the front panels of the FNID and FT1 DP, allow access to the FT1 device through an RS-232-type interface. All loopbacks for the FNID, FT1 Repeater, and FT1 DP can be controlled from the craft interface. The craft interface located on the FNID faceplate can activate and deactivate FNID network and FNID CPE loopbacks; and remotely activate and deactivate FT1 Repeater network loopback, FT1 DP network loopback, and FT1 DP CPE loopback. The craft interface located on the FT1 DP faceplate can activate and deactivate FT1 DP network loopback and FT1 DP CPE loopbacks; and remotely activate and deactivate the FT1 Repeater networkloopback, FNID network loopback, and FN1D CPE loopback.

FT1 DP, FT1 Repeater, and FN1D network loopbacks can be activated by the DDS latching loopback sequence. The latching loopback sequence is detected in the primary DS0 of the FT1 system. When the loopback is activated on the device, the whole FT1 bandwidth is looped. The FT1 DP, FT1 Repeater, and FN1D each respond to a different loopback select code allowing for sectionalization of the network during testing. Table A-1 is a list of FT1 devices and their loopback select code.

Latching loopbacks for the FT1 system are activated by transmitting the following latching loopback sequence in the primary DS0 of the FT1 system:

A. Minimum of 35 transition in progress (TIP) bytes (N0111010).

B. Minimum of 35 loopback select code (LSC) bytes as defined in Table A-1.

C. Minimum of 100 loopback enable (LBE) bytes (N1010110).

D. Minimum of 35 all 1s bytes (S1111111), plus a minimum of 100 LBE bytes. (*N*-1) iterations, where *N* is the number of channel units of the same type; i.e., same LSC; that lie between the test center and the loopback to be operated. *This step is only used when there are identical channel units in tandem.*

E. Minimum of 32 far end voice (FEV) bytes (N1011010).

A 25-second watchdog timer is activated between the 35 TIP bytes and 35 LSC bytes, between the 35 LSC bytes and 100 LBE bytes, and between the 100 LBE bytes and 32 FEV bytes. The timer requires the correct receipt of the latter sequences less than 25 seconds after receiving the prior sequence. This prevents inadvertent setting of the latching loopbacks.

Latching loopbacks for the FT1 system are deactivated by transmitting the following latching loopback sequence in the primary DS0 of the FT1 system:

Minimum of 25 TIP bytes (N0111010)

Table A-1. FT1 Loopback Select Codes

FT1 Device	Loopback Select Code Name	Loopback Select Code Byte
FT1 DP	OCU loopback	N1010101
FT1 Repeater	NEI Position 1 loopback	N1000001
FNID without repeater	NEI Position 1 loopback	N1000001
FNID with repeater	NEI Position 2 loopback	N1000001

4. LOOP-UP STATE

In the loop-up state, the active FT1 loopback will provide a continuous loop for the FT1 bandwidth. The data flow is continuously monitored for the loop deactivation commands to deactivate the loopbacks. Also, a loopback timeout is checked. If the loopback timeout is enabled, any loopback that is in the loop-up state in excess of the loopback timeout will be deactivated.