SLC® Series 5 Carrier System AUA94 U-DSL ISDN Channel Unit Installation and Maintenance

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1. Overview

1.01 This practice contains installation and testing procedures for the *SLC*® Series 5 Carrier System AUA94 U interface digital subscriber line (U-DSL) channel unit for integrated services digital network (ISDN). It is divided into the following parts: AUA94 U-DSL channel unit applications, ISDN service prerequisites, transmission equipment preparation, ISDN channel unit installation, test sets, and maintenance procedures. The procedures in this practice tell how to install the AUA94 U-DSL channel unit(s), do acceptance tests or verify certain requirements of the ISDN circuit, and locate and clear trouble at the U-DSL channel unit level. This practice is written for individuals responsible for installing and testing *SLC* Series 5 Carrier System channel units and is easier to understand with a working knowledge of the *SLC* Series 5 Carrier System and ISDN.

1.02 Whenever this practice is reissued, the reason(s) for reissue will be listed in this paragraph.

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1.06 AT&T will provide customer assistance on the *SLC* Series 5 Carrier System including, but not limited to, troubleshooting assistance, technical consultation, operational problem consultation, procedural advice, and emergency recovery assistance from a qualified system support professional from the Regional Technical Assistance Center (RTAC).

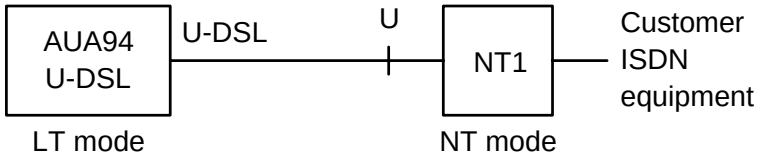
Service is provided from the RTAC at 1-800-225-RTAC. This telephone number is monitored 24 hours a day, 7 days a week. During regular business hours your call will be answered by your local regional RTAC. Outside of normal business hours all calls will be answered at a centralized technical assistance center where service-affecting problems will be dispatched immediately to your local RTAC. All other problems will be referred to your local RTAC on the next regular business day.

1.07 Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

1.08 This document was developed by the AT&T Customer Information Development and Business Translations Organization.

2. Introduction

2.01 The AUA94 U-DSL is a 2-wire channel unit that complies with the *ANSI* * standard TI.601-1988 for the U-DSL. The AUA94 channel unit provides ISDN basic access, in the line terminating mode, to the network termination type 1 (NT1) at the customer location (Figure 1). The DSL is a technology that provides full-duplex service on a single-twisted metallic pair at a rate sufficient to support ISDN basic access and additional framing, timing recovery, and operations functions. The U interface is a reference point on the transmission line between the network termination (NT) (on the customer side) and the line termination (LT) (on the network side, for example, a channel unit). Thus, U-DSL refers to the physical and electrical connection between the LT and the NT. The NT1 is a device that terminates layer 1. [The U-DSL channel units use three layers for ISDN service: layer 1 (physical layer), layer 2 (data link layer), and layer 3 (network layer).]



NT1 - Network termination - layer 1
U-DSL - U interface digital subscriber line
LT Mode - Line termination mode
NT Mode - Network termination mode
— — - Reference point (U interface shown)

tpa 820642/01

Figure 1. U-Interface Digital Subscriber Line (U-DSL)

2.02 The ISDN basic rate interface (BRI) is defined as 2B+D (two 64 kb/s B-channels and one 16 kb/s D-channel). The B-channels communicate digitized voice or data. The D-channel communicates control signaling and low-speed packet-switched data.

* ANSI is a registered trademark of American National Standards Institute, Inc.

3. AUA94 U-DSL Channel Unit Applications

3.01 The AUA94 U-DSL channel unit is a 2-wire circuit that supports ISDN 2B+D service. The AUA94 channel unit provides a U-DSL interface between the NT1 and the TR-303 * switch interface at the far end of the DS1 facility. Figure 2 shows typical applications of U-DSL channel units providing ISDN basic rate service. In the circuit, the AUA94 channel unit functions as a line termination unit. At the far end of the DS1 facility, it interfaces with the TR-303 switch.

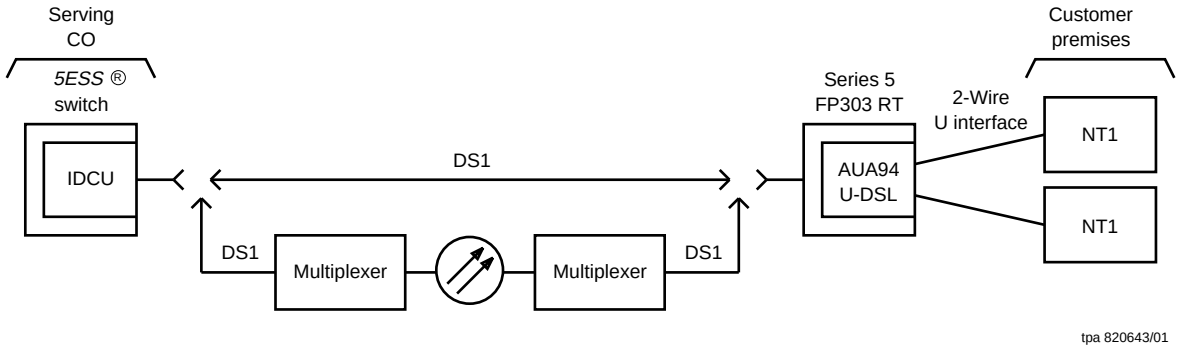


Figure 2. Typical ISDN Applications with AUA94 U-DSL Channel Unit

4. ISDN Service Prerequisites

4.01 Before ISDN service can be provided to a remote location, several prerequisites must be met. The prerequisites are divided into three areas: the serving switch, transmission equipment, and customer-owned equipment.

4.02 The U-DSL channel units can be used only on loops that follow carrier serving area (CSA) design guidelines; thus, no loop qualification is required. The CSA guidelines, summarized in AT&T 915-710-115, *SLC Series 5 Carrier System, Application Engineering*, specify only nonloaded loops. For more information about ISDN customer premises equipment and loop qualification, refer to AT&T 533-700-100, *ISDN Customer Premises Planning Guide*, and AT&T 235-900-341, *5ESS® Switch, ISDN Basic Rate Interface Specification (5E9)*.

* Bellcore Technical Reference TR-TSY-000303 Issue 1, September 1986, and all Revisions and Supplements, *Integrated Digital Loop Carrier System Generic Requirements, Objectives, and Interface.*

Serving Switch

4.03 ISDN service prerequisites at the serving switch are as follows:

- A TR-303 integrated digital carrier unit (IDCU) must be installed in the serving switch and made available for service.
- The DS1 cable from the switch must be connected to the distribution frame where the carrier terminal DS1 cable terminates.
- The proper switch translations for the line must be administered. For the *5ESS* switch, translations are made using the proper switch generic software release (5E9 or later) translations data and the *5ESS* switch translations guide (a set of volumes labeled TG-5).
- The B-channel assignments (voice or data) are made dynamically by the TR-303 switch.

Transmission Equipment

4.04 The transmission equipment provides the connection between the ISDN serving switch and the NT1 and transports ISDN services to remote customers.

4.05 The requirements of the transmission equipment to transport the services are as follows:

- The tip and ring cable from the transmission equipment must be connected to the appropriate distribution frame or cross-connect blocks. (Connection to the serving switch must exist but the tip and ring polarity is not important.)
- Transmission path continuity must exist from the serving switch to the NT1 equipment.
- The AUA94 U-DSL channel unit must be installed in the *SLC* Series 5 Carrier System Feature Package 303 (FP303) remote terminal (RT).

4.06 There are no power consumption limitations associated with AUA94 U-DSL channel units. The AUA94 U-DSL channel unit requires about 2 W of power.

Customer-Owned Equipment

4.07 At the customer location, the *ANSI* NT1 equipment must connect to the tip and ring cable from the transmission equipment for ISDN services. The NT1 equipment provides the 2- to 4-wire interface for ISDN terminals. Some ISDN terminals have a built-in NT1 so that a stand-alone NT1 is not needed.

5. Transmission Equipment Preparation

5.01 This part contains general information needed to prepare the *SLC* Series 5 Carrier System FP303 RT for ISDN service.

SLC Series 5 Carrier System FP303 RT Preparation

5.02 The line interface units (LIUs) installed in the *SLC* Series 5 Carrier System FP303 RT provide loop timing derived from the DS1 facility. The loop timing is automatic and no special action is needed at the RT to activate it. The MC97777A1 bank control unit (BCU) and an AUB27B alarm display unit (ADU) must be installed in the *SLC* Series 5 Carrier System FP303 RT to use the AUA94 channel unit.

6. AUA94 U-DSL Channel Unit Installation and Verification Tests

6.01 This part contains the procedures to install the AUA94 U-DSL channel unit in the *SLC* Series 5 Carrier System FP303 RT and test the circuit to make sure it works. These procedures assume that the ISDN circuit is complete except for installing the RT channel unit.

NOTE:
To verify that the circuit is synchronized, verify continuity between the *5ESS* switch and the transmission equipment.

6.02 Procedure 1 may be used to install the AUA94 U-DSL channel unit in the *SLC* Series 5 Carrier System FP303 RT. Procedure 2 checks the complete ISDN circuit for proper operation. Test equipment required for Procedure 2 is an ISDN terminal. The ISDN terminal should include an ISDN telephone, an NT1 termination (*ANSI* standard), power supply, and connecting cables.

6.03 An electrostatic discharge (ESD) wrist strap should be worn when handling *SLC* Series 5 Carrier System circuit packs to prevent possible damage to the circuit packs.

Procedure 1 — Install AUA94 U-DSL Channel Unit in *SLC* Series 5 Carrier System FP303 RT

A. Application

6.04 This procedure may be used to install and verify placement of the AUA94 U-DSL channel unit in the *SLC* Series 5 Carrier System FP303 RT.

B. Summary

6.05 Verify that the channel unit slot number is correct. Install the AUA94 U-DSL channel unit.

Step	Procedure

1. **CAUTION:**
An electrostatic discharge wrist strap, with a minimum resistance of 250K ohms, should be worn when handling SLC Series 5 Carrier System circuit packs to prevent possible damage to the circuit packs. Before using the wrist strap, check it for opens, shorts, and minimum resistance value. If the strap does not pass these checks, it should not be used. To avoid possible personal injury while using the wrist strap, connect only to the ESD GRD jack on the fan unit.

   An AUA94 U-DSL channel unit will serve two ISDN lines specified in the circuit/service order or work order record detail (WORD) document.

2. Install the AUA94 channel unit into the specified channel slot.

   Response: Channel unit FAIL LED indicator lights for about 2 seconds (channel unit self test), then goes off.

3. Did the channel unit FAIL LED indicator light and go off as specified in the response?

   If **YES,** then proceed to Step **5.**

   If **NO,** then continue with Step **4.**

NOTE:
The purpose of the light-emitting diode (LED) test is to verify the FAIL LED indication.

Step	Procedure
4.	Channel unit is failed. Replace channel unit; if FAIL LED indicator remains lighted, refer trouble to installation and maintenance. Otherwise, continue with Step **5.**
5.	Perform Procedure 2 as required to verify U-DSL circuit operation after the AUA94 channel unit is installed.
	STOP. YOU HAVE COMPLETED THIS PROCEDURE.

Procedure 2 — Test U-DSL Circuit for Operation

A. Application

6.06 This procedure verifies that the U-DSL circuit is operational and error-free from the *SLC* Series 5 Carrier System FP303 RT to the ISDN serving switch. The tests should be done after the serving switch translations are complete.

B. Summary

6.07 Data transmission may be verified with a loopback test of the NT1 from the serving switch. (*5ESS* switch commands are given.) Voice transmission is verified using the basic rate interface test line (BRITL) number (*5ESS* switch) and an ISDN terminal at the RT cross-connection.

C. Test Equipment Required at RT

- 353A power unit.
- AT&T NT1U-200 NT1 unit.
- ISDN telephone.
- Modified telephone cord (8-pin) about 8 feet long or long enough to reach the protector block or cross-connect terminals at the top shelf of a 7-foot RT bay. The T and R leads (pins 4 and 5) of the 8-pin modular telephone plug must have clip leads at the other end of the cable for connecting to tip and ring. The polarity of tip and ring does not matter with U-DSL channel units.
- Two D8W-87 cords.

CAUTION:
The standard cord for ISDN applications is the D8W-87 (RJ-45, 8-pin connector). Forcing another type of connector into the AUA94 faceplate socket can result in damage to the socket pins.

Step	Procedure

1. Is the *5ESS* switch trunk/line work station available for testing?

   If **YES,** then continue with Step **2.**

   If **NO,** then proceed to Step **5.**

2. At the *5ESS* switch trunk/line work station, run the basic rate interface (BRI) integrity tests to the NT1 on the channels assigned for service according to the work order or WORD document.

Step	Procedure

3. Did the tests result in no errors or in a bit error rate (BER) better than 10^{-7}

   If **YES,** then proceed to Step **5.**

   If **NO,** then continue with Step **4.**

4. At the trunk/line work station, run the TST:DSL command with the argument TEST=SECT until a passing result is obtained. This test should isolate the failed section. If the results show possible failure at the RT, replace the AUA94 channel unit and repeat the BRI integrity test. If the test then passes, continue with Step **5.** If the test still fails, refer the trouble to the appropriate repair forces.

5. Obtain the following test equipment (shown in Figure 3):

   - 353A power unit.
   - AT&T NT1U-200 NT1 unit.
   - ISDN telephone.
   - Modified telephone cord (8-pin) about 8 feet long or long enough to reach the top shelf of a 7-foot RT bay. The T and R leads (pins 4 and 5) of the 8-pin modular telephone plug must have clip leads at the other end of the cable for connecting to tip and ring. The polarity of tip and ring does not matter with U-DSL channel units. See Figure 3.
   - Two D8W-87 cords.

6. **NOTE:**
   The test setup of Figure 3 is a temporary arrangement and should be disconnected as soon as the test is finished.

   Disconnect the loop at the protector block and connect the test equipment (Figure 3) to the RT cross-connect or protector block.

7. From the ISDN terminal, dial the *5ESS* switch BRITL access code [the directory number (DN) assigned through recent change/verify (RC/V)]. Do you hear dial tone (indicating successful origination)?

   If **YES,** then circuit is complete and working; continue with Step **8.**

   If **NO,** then **STOP.** Circuit is not working: problem may be in test connections, AUA94, RT wiring, or elsewhere in the circuit. The problem may be *5ESS* switch translations that are not correct. Refer trouble to switching control center (SCC) or to appropriate organization according to local procedures. Refer to section 8, "Maintenance on U-DSL Circuits," for trouble clearing independent of the switch.

Step	Procedure

8. If desired, further tests may be run as specified in the DSL BRI dial up test in AT&T 235-105-220, *5ESS Switch, Corrective Maintenance Procedures*. When testing is finished or if no further tests are required, disconnect test equipment from RT cross-connect and reconnect loop.

STOP. YOU HAVE COMPLETED THIS PROCEDURE.

7. Test Equipment

Test Sets

7.01 Test sets may be used in U-DSL circuits to verify trouble or to isolate trouble independent of the serving switch. The faceplate switch controls access to either the odd (O) or even (E) channel.

Using an ISDN Terminal for Testing

7.02 Testing for dial tone, ringing, ring trip, and voice transmission on a U-DSL circuit requires an ISDN terminal or ISDN telephone. For testing purposes, the ISDN terminal is equivalent to the customer premises equipment connected to the digital interface (for example, the U interface or T interface) for an ISDN application. It usually includes an ISDN telephone, which may be a digital telephone set or an integrated voice/data terminal. Depending on the interface, an NT1 termination may be required for 2- to 4-wire conversion. Some terminals have a built-in NT1 so that a separate NT1 is not needed.

7.03 For testing on a U-DSL circuit, the ISDN terminal should include an ISDN telephone, an NT1 termination (*ANSI* standard), power supply (for the NT1 and phone), and connecting cables. At the RT site, the ISDN terminal can be connected directly to the channel unit interface using a D8W-87 cord.

CAUTION:
The standard cord for ISDN applications is the D8W-87 (RJ-45, 8-pin connector). Forcing another type of connector into the AUA94 faceplate socket can result in damage to the socket pins.

7.04 The BRITL number is a feature of the *5ESS* switch (generic 5E5 and later) that allows digital testing of a channel (B1 or B2) from an ISDN terminal. Refer to AT&T 235-105-220, *5ESS Switch, Corrective Maintenance Procedures (5E9 generic)*, Part 2 — "Hardware Maintenance Procedures," in the section on line maintenance using the trunk/line work station.

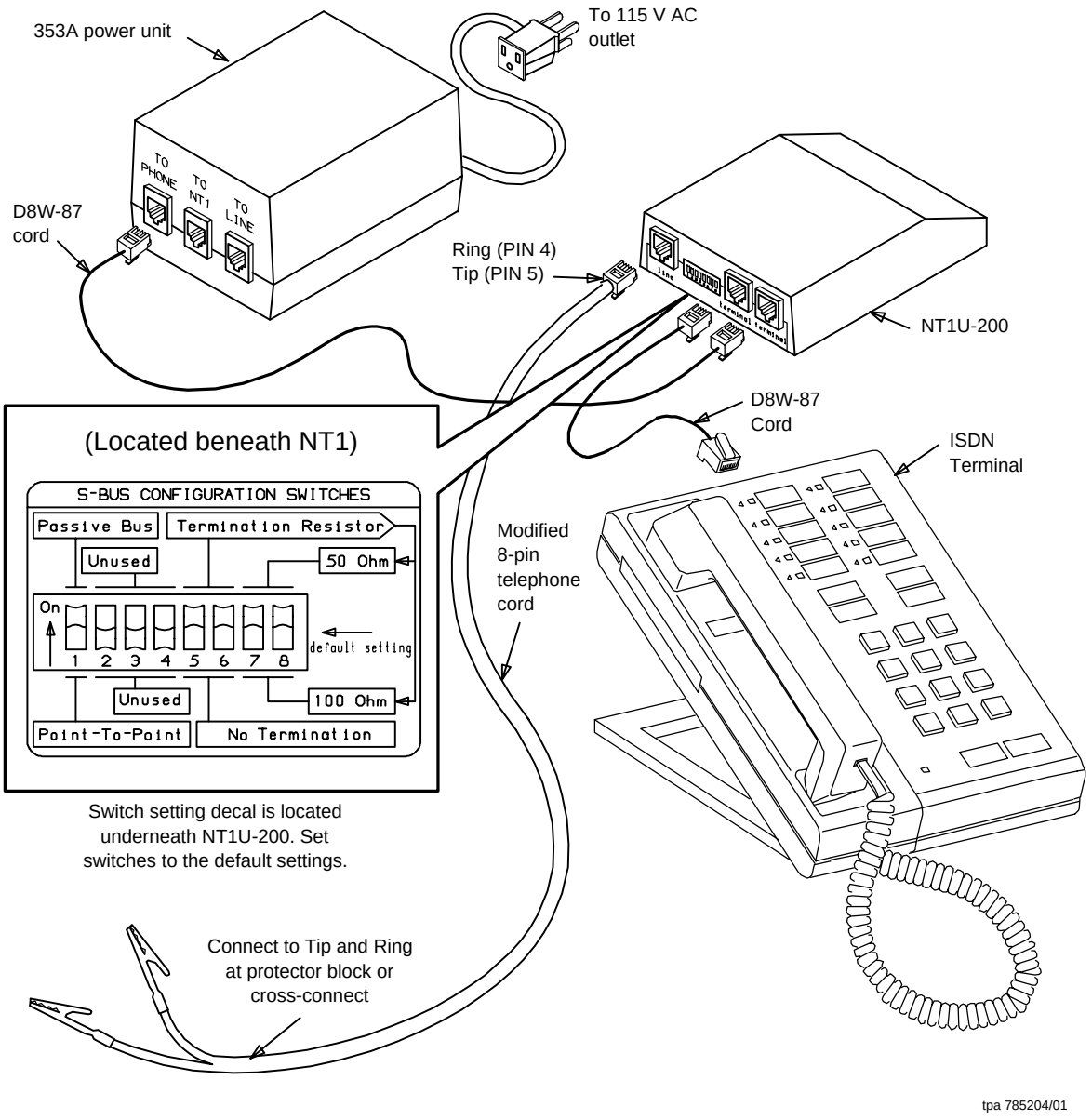


Figure 3. Test Connections at the *SLC* Series 5 Carrier System RT Cross-Connect

8. Maintenance on U-DSL Circuits

Overview

8.01 This part provides maintenance information for the AUA94 U-DSL channel unit.

General Information

8.02 Maintenance on U-DSL channel units is normally a reaction to a customer complaint. The goal for ISDN circuits is to use existing procedures for plain old telephone service (POTS) to handle trouble. The ISDN customer may dial 611 to report trouble or may have to call the telephone center in charge of maintaining the U-DSL circuit in that area.

8.03 The telephone company's response varies. Some companies have the maintenance center handle the problem; other companies may dispatch a technician to clear the trouble and get the circuit working. Depending on local procedures, maintenance may require coordination of several groups (switching, central office, and outside plant forces).

8.04 The first step in maintenance of an ISDN circuit is to isolate the trouble to the following:

(a) switch equipment

(b) synchronization equipment

(c) transmission equipment (including the loop), and/or

(d) customer-owned equipment.

8.05 If the problem is isolated to the serving switch, the responsible organization (for example, the SCC) usually makes arrangements to fix the problem. For customer-owned equipment trouble, the customer should be informed about the problem so that equipment can be repaired or replaced. If trouble is diagnosed in the transmission or synchronization equipment, further tests must be run to isolate the trouble.

U-DSL Channel Unit Maintenance Features

8.06 The U-DSL channel units contain counters for recording cyclic redundancy check (CRC) block errors (which are transmission errors), errored seconds, and severely errored seconds in each direction. These statistics are recorded during specified time periods under control of the serving switch. The serving switch also can control the interval for reading and resetting the counters. The switch requests the performance monitoring statistics and resets the counters by means of the embedded operations channel (eoc). (The eoc abbreviation is lower case to distinguish it from the EOC on the carrier facility.) The eoc is an additional out-of-band maintenance channel specified by the *ANSI* standard (TI.601-1988).

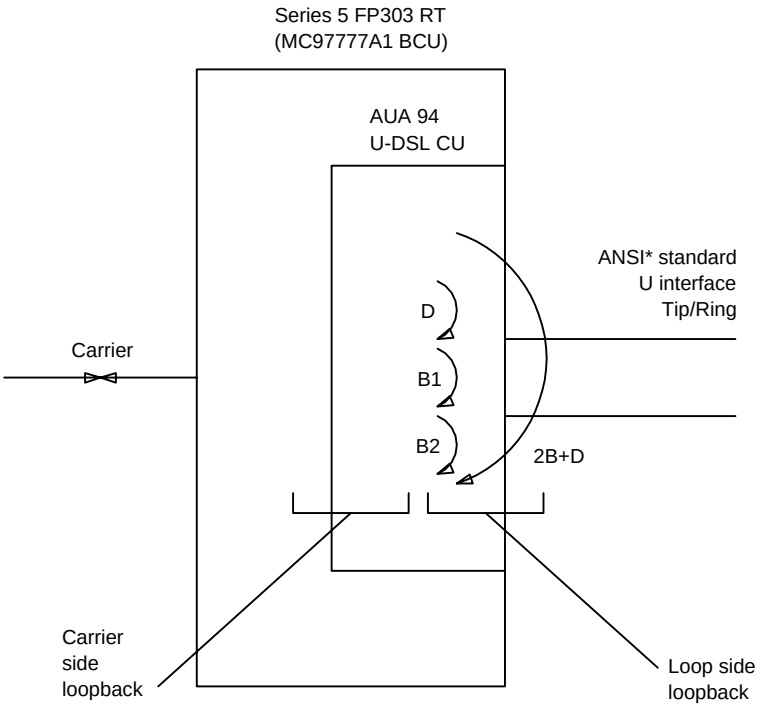


Figure 4. U-DSL Channel Unit Loopbacks

8.07 For testing and trouble isolation, the U-DSL channel units provide four different loopbacks (Figure 4) as follows:

- Transparent B1, B2, or D loopbacks toward the carrier side (line or facility interface).
- A nontransparent 2B+D loopback toward the carrier side (line or facility interface).

8.08 The B and D channel loopbacks are transparent. The channel unit maintains normal operation except on the channel (B1, B2 or D) being looped back. The 2B+D loopback is nontransparent. The channel unit is disconnected from the link on the side opposite the loopback. These loopbacks are activated by codes sent over the EOC from the serving switch or test sets.

A. Loopback Test Applications

8.09 All loopback tests are requested by the serving switch. A basic rate interface (BRI) loopback test sets up a 2B+D loopback in the circuit at the addressed U-DSL

channel unit. An NT1 loopback test sets up a 2B+D loopback at the NT1. The serving switch can also request a B1, B2, or D channel loopback on either the U-DSL channel unit or at the NT1.

B. Other Test Applications

8.10 The echo canceler test does not apply to U-DSL channel units (it will always pass), even if the channel unit echo canceler is faulty. The AUA94 channel unit always gives a fail result on channel unit tests by the pair gain test controller (PGTC) or extended test controller (XTC). However, mechanized loop testing (MLT) system access to the loop for testing is allowed through the PGTC or XTC by means of the test pair relays.

Maintenance from the Central Office

8.11 Using the eoc, the *5ESS* switch (with the 5E9 generic) can perform B1, B2, D or 2B+D loopbacks at any U-DSL channel unit or at the NT1 and packet switching tests on the D channel. The switch also collects and records performance monitoring statistics from the U-DSL channel units.

8.12 The MLT system with MLT/ISDN Feature Package Two supports testing of *ANSI* U-DSL circuits. Some changes to the Loop Management Operations System (LMOS) may be required to interface MLT/ISDN Feature Package Two. MLT-2 can perform metallic testing of the loop connected to the AUA94 channel unit and can interface with the *5ESS* switch for its test results. Using these systems, trouble can be isolated and cleared without using the test sets.

8.13 The customer should be notified before any tests are done; most of the tests will interrupt service on the circuit. The easiest way to start sectionalizing the problem is using loopback tests from the *5ESS* switch. Loopbacks can be done at the channel unit or at the NT1. If necessary, drop tests can be done by MLT-2 between the AUA94 channel unit and the NT1 to further isolate the problem. If the problem appears to be in the NT1, a call to the customer to make sure the NT1 has power (green light on) may save a dispatch. Finally, a technician may be dispatched to the suspected location. The problem can then be corrected.

Installation Trouble Clearing

8.14 Most telephone companies have their own procedures for fixing a problem that occurs during installation. Some companies may prefer to let the maintenance center handle the problem like a customer-reported trouble. Other companies may expect the installation technician to clear the trouble and get the circuit working. Since the installation of a U-DSL circuit usually involves coordination of several groups (switching, central office, and outside plant forces), it is difficult to specify a starting point that applies to every case for trouble clearing.

8.15 If an ISDN terminal connected at the *SLC* Series 5 Carrier System RT is not getting dial tone, check first with switching (to verify translations) then verify that equipment has been installed in the rest of the circuit. If the central office equipment appears to be operating properly, a loopback test should show whether a problem exists in the carrier system, the AUA94 U-DSL channel unit, or the NT1. The ability to clear and read performance monitoring (pm) counts from the *5ESS* switch may be helpful in isolating bit error rate problems in one or both directions.

9. Related Documentation

9.01 The following documents provide additional information and details on the AUA94 U-DSL channel unit and related equipment. Also, references to these and other documents are provided in the text as applicable.

Document	Title
AT&T 235-105-220	*5ESS® Switch, Corrective Maintenance Procedures (5E9 generic)*
AT&T 235-900-341	*5ESS Switch, ISDN Basic Rate Interface Specification (5E9 generic)*
AT&T 363-005-135	*AUA94 U-DSL Channel Unit, Data Sheet*
AT&T 533-700-100	*ISDN Customer Premises Planning Guide*

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