



SLC[®] Series 5 Carrier System

AUA41() 4-Wire Current Feed Special Services Channel Unit — 5SCU7D1 (AUA41), 5SC3HJE (AUA41B)

Features/Functions

- Four-wire special service applications:
 - Loop- or ground-start signaling
 - PBX tie trunks (DX signaling)
 - Private line, voice or data (TO signaling).
- Fixed sealing current (AUA41), optional sealing current (AUA41B)
- On-hook transmission performance same as off-hook
- Fast forward disconnect
- Faceplate test access to tip and ring pairs (AUA41B)
- BUSY and Sealing Current LEDs on faceplate (AUA41B)
- Enhanced Inventory read-out (AUA41B)
- Conforms to appropriate industry standards
- Supports *CLASS** services including Calling Name/Number Delivery (CND).

Description

This data sheet describes the AUA41() 4-Wire Current Feed Special Services channel unit (CU) (COMCODE 106064876, AUA41; 106988082, AUA41B) which is intended for use in non-locally-switched ground-start and loop-start special services, nonswitched private lines, and PBX tie trunks. It may interface with other transmission equipment, data equipment, or cable. The AUA41() is used in the SLC[®] Series 5 Carrier System but can also be used in the SLC[®]-2000 Access

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System. This data sheet has been reissued to add information about the AUA41B CU.

The AUA41() CU provides one channel of service; it uses only the odd-numbered channel associated with a physical slot. This unit can function in any of the following modes: Foreign Exchange - Station End (4FXS), Duplex (4DX), Transmission Only (4TO), Equalized Transmission Only (4ETO), and may be used in the central office terminal (COT), remote terminal (RT) or multi-services distant terminal (MSDT), depending on the application.

Figure 1 is the functional block diagram, Figure 2 shows the faceplate diagram, and Figure 3 shows the AUA41B option switch.

The AUA41B CU includes capability for plug-in inventory. The unit stores in its nonvolatile memory an inventory record that includes its 10-character CLEI* code, readable by the system controller.

Functions

4FXS: The FXS function is used in non-locally-switched loop-start or ground-start applications. Typical applications are foreign exchange trunks and lines (RT/MSDT) and off-premises PBX stations (COT). These applications are generally 2-wire at the customer end; therefore, when the AUA41() CU is used in the circuit (to provide transmission capabilities not available in a 2-wire CU), the cable it faces is usually terminated in a 4-wire to 2-wire converter.

4DX: The primary application of the 4DX function is a PBX tie trunk. For this application, the unit is used at an RT or MSDT facing cable. (Additional equipment at the network interface (NI) at the customer location provides DX to E&M conversion.) When the AUA41() CU is used at the COT in a tie trunk, it can face cable or a 4DX unit in an interoffice carrier or loop carrier system.

4TO/4ETO: Both the 4TO and 4ETO functions are used in private lines (voice or data or tie trunk). The 4ETO function is used when equalization of cable transmission characteristics is required. In the 4TO mode, the CU is operating with a "terminal interface" which means the unit faces short metallic extensions within the confines of a central office or customer location; equalization is not provided, and transmission quality is essentially determined by the termination and characteristics of the metallic extension. Sealing current is provided for both the 4TO and 4ETO functions, but sealing current can be switched off in the AUA41B unit.

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Within the Bell Operating Companies, few loops served by digital carrier systems are so long that 4-wire channel units are required to achieve satisfactory transmission performance. Therefore, applications of the AUA41() channel unit are dominated by tie trunks (4DX function) and private line data (4TO, 4ETO functions) since their circuit design standards call for 4-wire transmission end-to-end.

Transmission Treatment

The AUA41() channel unit provides a wide range of transmission level point, structural impedance, and equalization capability — see Table 3 for a listing of corresponding options and their ranges. The ranges depend on the function type, although the equalization selections are identical for the 4FXS, 4DX, and 4ETO functions. For loaded cable, equalization is limited to the transmit direction (post-equalization only). Transmission treatment is independent of the busy/idle condition.

Distribution Cable

The AUA41() CU is designed to deliver trunk quality service over loaded or nonloaded cables defined in Table 4. The various types of cables are categorized below.

Short (CSA) Cable: Cables considered short generally do not extend beyond the range defined by the carrier serving area (CSA). The CSA cable design rules have been established by Bellcore to facilitate the deployment of digital loop carrier (DLC) equipment that does not require outside plant repeaters or NCTE nor, in most cases, circuit design. To accomplish this end, the CSA rules regulate the range and structure of RT-to-customer cable. The CSA design rules are listed in Section 2.2 of TR-NWT-000057. CSA cables must be nonloaded and no longer than 12 kilofeet (kft). CSA cable applications are usually limited to 4DX and 4ETO functions; where the 4FXS function is to be provided over CSA cable, the AUA41() CU is almost never deployed because cost-effective 2-wire units (that is, E SPOTS[®] channel unit) are available with loop-start/ground-start signaling capability. Cables within the CSA range are compatible with the AUA41() CU for all service applications.

Extended Range, NonLoaded Cable: Nonloaded cables that extend beyond the limits of the carrier serving area are intended to conform with one of several sets of rules that have been promulgated by AT&T and Bellcore, such as Modified Resistance Design rules. At the time of divestiture, the most current AT&T guidance was contained in Recommendation Letter RL 83-04-013. The rules also were documented in the 902-xxx-xxx layer of Bell System Practices.

Nonloaded loops longer than CSA range that conform to the construction rules in those standards are compatible with the AUA41() CU. Such cables do not exceed 18 kft nor do any exceed the 2800 ohm resistance, 15 dB loss capability of the AUA41() unit.

Loaded Cable: Loops longer than 18 kft should be H88 loaded. Such loops are compatible with the AUA41() CU provided the service does not require the most stringent equalization* called out in TR-NWT-00057, and provided the resistance does not exceed 2800 ohms in the 4FXS mode or 5000 ohms in a 4DX application. Attenuation can range to the crosstalk limit which is usually 12 dB for loaded cable, but not more than 15 dB.

Options

The AUA41() CU has options that must be set before service can be provided. Except for sealing current, which is controlled manually, all options for the CU are set by entering commands into the *SLC Series 5* craft interface unit (CIU, J99404TA-1), Special Channel Administration Tool (SCAT, COMCODE 107040347) or craft interface terminal (CIT, *SLC-2000* System provisioning tool) which transmits the settings to the bank where they are stored in nonvolatile memory. The BCU then writes the settings into memory registers on the CU immediately, or when a CU is later installed or replaced. The CIU is also used during manual testing of the transmission performance of the AUA41() CU. The procedures for setting options and performing tests with the CIU are described in AT&T 363-205-402, *SLC Series 5 Carrier System Channel Unit Installation and Testing*. The CIU is described in AT&T 363-205-101, *SLC Series 5 Carrier System Craft Interface Unit, Description*. Instructions for provisioning the AUA41() using the CIT are given in the *SLC-2000 System User/Service Manual*, AT&T 363-208-001.



NOTE:

The CLEI code for the AUA41, 5SCU7D, must be used when provisioning the AUA41B CU in *SLC Series 5* (unless the SCAT tool is used) and *SLC-2000* Systems.

The options for each of the AUA41 CU functions are shown in Table 1. The option labeled FUNCTION CODE is used to specify the CU function and signaling mode; Table 2 lists them all. Table 3 describes the range of settings for each of the other options. AT&T 915-710-116 *SLC Series 5 Channel Unit*

* Certain sections of TR-NWT-000057 require that the equalized attenuation of cable plus channel unit be no less than -0.2 dB (gain of +0.2 dB) at any frequency from 400 Hz to 2800 Hz, relative to the attenuation at 1000 Hz. The AUA41B equalization of the above loaded cables allows the relative attenuation to be as negative as -0.7 dB, with the most negative value occurring at about 1.8 kHz.

Application and Prescription Setting provides guidelines on selecting option settings for the AUA41() channel unit.

**NOTE:**

The AUA41B has an on/off sealing current switch that takes effect only when the TO4 or ETO4 function code is selected. The switch must be set manually.

Facility Failure

When the bank controller notifies the channel unit that a facility failure has occurred, the AUA41() will carry out the following actions:

- 4FXS function — remove battery for 2.5 seconds, then applies battery for the duration of the failure; sends idle signaling to the far end; disables transmission in the receive direction
- 4DX function — applies on-hook to the cable and sends idle signaling to the far end for 2.5 seconds, then applies off-hook and sends busy signaling for the duration of the failure; disables transmission in the receive direction
- 4TO, 4ETO functions — disables transmission in the receive direction.

Remote Test Access

Local or remote test access to the AUA41() CU is available when the unit's test relay is operated. Access is via a relay with full splitting contacts (Figure 1).

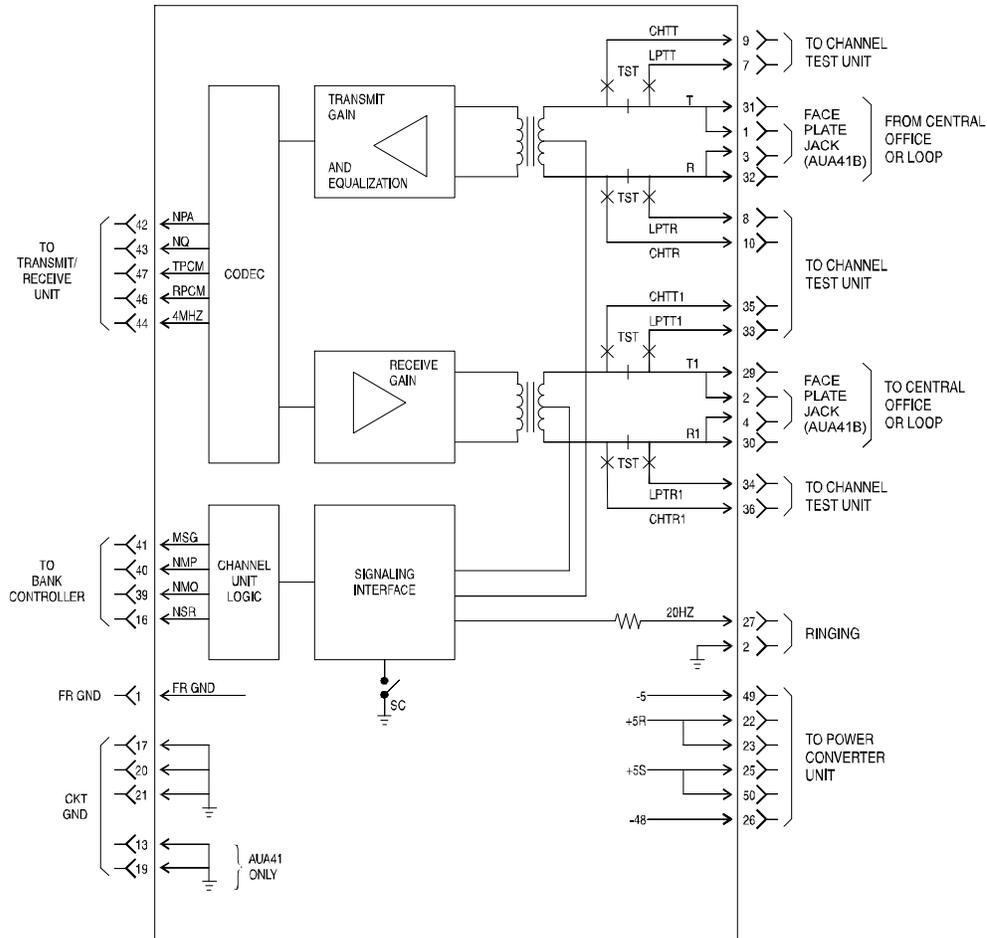


Figure 1. AUA41() Functional Block Diagram

Table 1. AUA41() Channel Unit Options.

Options For Each AUA41() Channel Unit Function				
Option	CU Function			
	4FXS	4DX	4TO	4ETO
Function Code	X	X	X	X
Transmit Attenuator	X	X	X	X
Receive Attenuator	X	X	X	X
Equalizer Nonloaded/Loaded*	X	X		X
Equalizer Slope*	X	X		X
Equalizer Bandwidth*	X	X		X
Equalizer Height*	X	X		X
Transmit and Receive Impedance	X	X		X
-7 dB (J3)				X
-7 dB Transmit			X	
-7 dB Receive			X	
Sealing Current (AUA41B)†			X	X

* Adjustable equalization is provided for the transmit direction only for post-equalization of the cable transmission characteristics.

† Controlled by a physical switch, which has no effect when either of the 4FXS or 4DX functions is selected.

Table 2. AUA41() Channel Unit Function Codes.

AUA41() Channel Unit Function Codes		
Function Code	CU Function	Signaling Mode
FXS1	4FXS	Loop-Start Signaling Signaling Leads Normal* No Toll Diversion Capability†
FXT1	4FXS	Loop-Start Signaling Signaling Leads Normal* Toll Diversion Capability†
FXS2	4FXS	Loop-Start Signaling Signaling Leads Reversed‡ No Toll Diversion Capability†
FXT2	4FXS	Loop-Start Signaling Signaling Leads Reversed‡ Toll Diversion Capability†
FXS3	4FXS	Ground-Start Signaling Signaling Leads Normal* No Toll Diversion Capability†
FXT3	4FXS	Ground-Start Signaling Signaling Leads Normal* Toll Diversion Capability†
FXS5	4FXS	Ground-Start Signaling Signaling Leads Reversed‡ No Toll Diversion Capability†
FXT5	4FXS	Ground-Start Signaling Signaling Leads Reversed‡ Toll Diversion Capability†
DX4N	4DX	Duplex Signaling Signaling Leads Normal
DX4R	4DX	Duplex Signaling Signaling Leads Reversed
TO4	4TO	Transmission Only with Sealing Current (optional, AUA41B)
ETO4	4ETO	Equalized Transmission Only with Sealing Current (optional, AUA41B)

* Tip signaling lead connected to T-R, ring signaling lead connected to T1-R1.

† Toll Diversion means that the AUA41() reverses the polarity of its battery feed upon receipt of a Toll Diversion ABCD signaling code from the CO end. This function enables the line side answer supervision (LSAS) feature, but only in FPC or INA-RT modes.

‡ Ring signaling lead connected to T-R, tip signaling lead connected to T1-R1.

Table 3. Range of Settings For AUA41() Channel Unit Options

Range of Settings For AUA41() Channel Unit Options		
Option	Range	
Function Code	Transmit Gain* (dB)	Receive Gain* (dB)
FXS () & FXT ()	-1.5 to 15.0	-10.5 to 6.0
DX4 ()	-1.5 to 15.0	-10.5 to 6.0
TO4	-7.5 to 16.0	-16.5 to 7.0
ETO4	-8.0 to 15.0	-9.5 to 7.0
	in steps of 0.1 dB	
Equalizer Nonloaded/Loaded	N or L	
Equalizer Slope	0 to 15 in steps of 1	
Equalizer Bandwidth	0 to 15 in steps of 1	
Equalizer Height	0 to 15 in steps of 1	
Transmit and Receive Impedance†	150, 600, or 1200 Ohms	
-7 dB (J3)‡	White or Black	
-7 dB Transmit**	White or Black	
-7 dB Receive††	White or Black	
Sealing Current	On or Off (AUA41B)	

* Gain values listed result from combination of fixed gain and variable attenuation; see also Table AJ of AT&T 915-710-116, Issue 4, SLC Series 5 Carrier System Channel Unit Application and Prescription Setting.

† Selecting 150 ohms produces slope equalization equivalent to 150/600 ohm impedance mismatch. This option is automatically set to 600 ohms for the 4TO function of the channel unit.

‡ This option is used only for the 4ETO function of the channel unit. Changing the setting from Black to White increases the attenuation in the transmit direction by 7 dB.

** This option is used only for the 4TO function of the channel unit. Changing the setting from White to Black increases the attenuation in the transmit direction by 7 dB.

†† This option is used only for the 4TO function of the channel unit. Changing the setting from White to Black increases the attenuation in the receive direction by 7 dB.

Table 4. Recommended Cables for 4-Wire Designed Special Services

Recommended Cables for 4-Wire Designed Special Services
<p>A. LOSS/RESISTANCE RANGE</p> <ol style="list-style-type: none"> 1. Loss—15 dB* 2. Resistance is limited by signaling: <ul style="list-style-type: none"> • 2800 ohms, FXS mode • 5000 ohms, DX mode
<p>B. NONLOADED CABLE</p> <p>Compliant with Resistance Design, Modified Resistance Design (MRD), or Revised Resistance Design (RRD) rules as were promulgated in Bell System practices and AT&T Recommendation Letter RL 83-04-013, with the RT playing the role of a CO. For nonloaded cable, the most significant rule was that bridged tap is limited to 6 kft.</p>
<p>C. LOADED CABLE</p> <p>Loops greater than 18 kft (total length including bridged tap) require standard H88 loading, which for use with AUA41() should conform to:</p> <ol style="list-style-type: none"> 1. Maximum cable: 15 dB, 2800 ohms 2. Bridged tap <ul style="list-style-type: none"> • 6 kft. maximum • No loaded bridged tap and no bridged tap between loads 3. COT/RT end section length <ul style="list-style-type: none"> • Resistance 900 ohms or less: 1.5 kft to 7.5 kft, provided voiceband frequency response meets transmission requirements • Resistance greater than 900 ohms: 3000 ft. ± 120 ft. (build-out permitted) 4. Customer end section: main section plus bridged tap, 3 kft to 9 kft.

* Crosstalk considerations in the loop plant frequently restrict the attenuation to 12 dB for loaded cable.

Compatibility

The AUA41() can be used in a *SLC* Series 5 system equipped for Feature Package (FP) B, C, C with Autocut, 303, or integrated network access (INA-RT) mode, or in a *SLC*-2000 System, Release 3.2 or later.

The AUA41() CU is end-to-end compatible with the following channel units providing the noted services:

- AUA44() 4-wire CU; loop-start/ground-start (LS/GS) applications in FPC, including the line side answer supervision (LSAS) feature. If the distant terminal is a *SLC*-2000 COT or RT the compatible 4-wire CU is *SPQ444* (does not support LSAS).
- AUA41(), AUA141 CUs; tie trunk and private line (TO) applications.
- AUA42(), AUA142, *SPQ442* 2-wire CUs; LS/GS and private line (TO) applications.
- AUA43(), *SPQ443* 2-wire CUs; private line (TO) applications.
- AUA54() CU; tie trunk applications (*SPQ454* if distant terminal is *SLC*-2000 COT or RT).

Where the RT is operating in the integrated network access (INA-RT) mode, the AUA41() is also end-to-end compatible with D4-type channel units with FXO, DX, E&M, and TO functions. This compatibility extends to the LSAS service feature, provided the D-bank channel unit is a D5 unit with FXO signaling and provisioned for Toll Diversion (e.g., AEK24 CU provisioned for FXP() function code) in order to signal battery reversal.

There are several restrictions in the application of this unit in a *SLC*-2000 System universal configuration:

- A circuit using the unit is not testable by MLT using the PGTC; therefore the CU should not be used in a locally-switched circuit unless the circuit can be tested by some other entity (e.g., SARTS).
- Optioning the COT CU for Toll Diversion (LSAS) causes erratic ringing.

Further compatibility and application information can be found in AT&T 915-710-116, where:

- a. AUA41 is to be read AUA41()
- b. AUA42 is to be read AUA42()/*SPQ442*
- c. AUA43 is to be read AUA43()/*SPQ443*
- d. AUA44 is to be read AUA44()/*SPQ444*
- e. AUA54 is to be read AUA54()/*SPQ454*
- f. *SLC*[®] Series 5 is to be read *SLC*[®] Series 5/*SLC*-2000

This practice in several places refers to compatibility of channel units located beyond a digital connectivity unit (DCU). The SLC-2000 System does not support DCUs, but the document can nevertheless be applied if references to DCU-equipped terminals in the text are replaced by digital switch, digital crossconnect equipment, or an INA facility used to connect a *SLC-2000* RT to a D4-type terminal.

Specifications

The AUA41() CU conforms to the appropriate criteria of ANSI* , Bellcore, FCC, GTE, and UL** standards.

Table 5 gives the specifications of salient transmission parameters. For complete transmission specifications consult Chapter 6 of AT&T 363-205-010, *SLC Series 5 Carrier System Applications and Planning Guide*, Issue 3.

Table 5. Salient Transmission Parameters for 4-Wire AUA41() Channel Units

Salient Transmission Parameters for 4-Wire AUA41() Channel Units		
Parameter	Condition	Value
Loop resistance	Excludes telset	0-2800 ohms (loop-start, ground-start) 0-5000 ohms (duplex)
Gain	range	See Table 3
	granularity	0.1 dB
Equalization		Post-equalization of cable less than 15 dB (H88) or 18 kft (NL) is comparable to D4 4FXS CU J98726SB. Pre-equalization and post-equalization available by emulating 150-ohm mismatch.
Structural impedance	4FXS, 4DX, 4ETO	600 or 1200 ohms
	4TO	600 ohms
Return loss (With reference to structural impedance)	300-3000 Hz	23 dB
	1000 Hz	28 dB
Longitudinal balance (IEEE Method 455-1976)	200 Hz	≥ 67 dB
	500 Hz	≥ 67 dB
	1000 Hz	≥ 67 dB
	3000 Hz	≥ 62 dB
Peak-to-average ratio (P/AR) (pulse distortion)		≥ 94

* Registered trademark of American National Standards Institute, Inc.

** Registered trademark of Underwriters Laboratories, Inc.

Faceplate Features

The AUA41 CU has no faceplate features. The AUA41B faceplate has one faceplate jack and two red LED indicators. Refer to Figure 2 for faceplate diagram. When provisioned with TO/ETO function codes, the BUSY LED will continuously be lit indicating that the service is active. The sealing-current (SC) LED is lit whenever there is sealing-current flow on TO/ETO circuits. If the sealing-current switch is in the ON position, but the far-end is not properly terminated, there will be no sealing-current flow and the SC LED will not be lit.

For FXS/FXT function codes, the BUSY LED is lit whenever the near-end goes off-hook or when ring-ground is applied in ground-start applications. The SC LED is not used for these services and will always be dark.

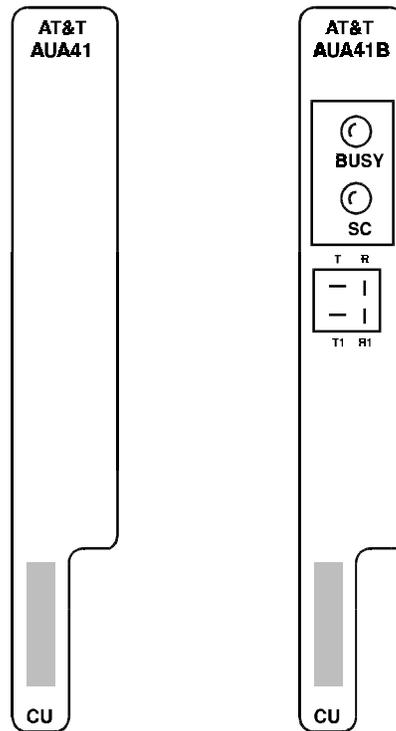
For DX function codes, the BUSY LED is lit whenever the near-end or far-end is off-hook. The SC LED will always be dark.

In response to an LED TEST command in a SLC-2000 Access System, both the BUSY and SC LED will be lit. On power-up, both LED's will be lit for two seconds.

The faceplate test jack provides bridging test access to both tip/ring pairs (T/R, T1/R1) through the ITT RTG16L2H15A channel unit faceplate test cord (COMCODE 405755208). Tip and ring leads provide VF input to the CU; tip1 and ring1 leads connect to the CU output. See Figure 1 for Functional Block Diagram.

BUSY (Red LED): The BUSY LED is lit when service is active, during a TEST command, and on power-up.

SC (Red LED): The SC LED when lit indicates that sealing-current is flowing. This SC LED will also be lit during a TEST command and on power-up.



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Figure 2. AUA41() Faceplate Diagram.

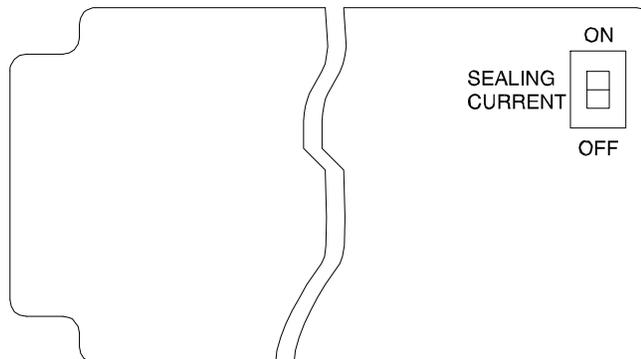


Figure 3. AUA41B Sealing Current Option Switch

References

The following documents provide additional information about the *SLC Series 5 Carrier System* and *SLC-2000 Access System*:

- AT&T 363-205-010 *SLC Series 5 Carrier System Application and Planning Guide*
- AT&T 363-205-101 *Craft Interface Unit, Description*
- AT&T 363-205-110 *SLC Series 5 - Cable Measurement Method for Determining Provisioning Settings for Special Services Channel Units*
- AT&T 363-205-402 *SLC Series 5 Carrier System Channel Unit Installation and Testing*
- AT&T 363-208-000 *SLC-2000 Access System Application, Planning, and Ordering Guide*
- AT&T 363-208-001 *SLC-2000 Access System User/Service Manual*
- AT&T 915-710-115 *SLC Series 5 Carrier System Application Engineering*
- AT&T 915-710-116 *SLC Series 5 Carrier System Channel Unit Application and Prescription Setting.*

Technical Assistance

Follow local procedures for obtaining technical assistance. AT&T also provides in-hours or emergency out-of-hours help for the *SLC Series 5 Carrier System* and the *SLC-2000 Access System*. Call the AT&T Regional Technical Assistance Center at 1-800-225-RTAC.

Ordering Information

Additional copies of this document (AT&T 363-005-105) are available from the Customer Information Center — call 1-800-432-6600.

Comments

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