SLC® -2000 Access System

SPQ®444 4-Wire Current Sink Special Services Channel Unit — SAC1BF0

Features/Functions

- Four-wire special service applications:
  - — FX or OPS
  - — Loop-start, ground-start or tandem signaling.
- On-hook transmission performance same as off-hook
- Reverse battery capability for LSAS applications
- Fast forward disconnect
- Faceplate test access to tip and ring pairs
- BUSY LED on faceplate
- Enhanced inventory read-out
- Conforms to appropriate industry standards
- Compatible with *CLASS** services.

Description

This data sheet describes the *SPQ*444 4-Wire Current Sink channel unit (CU) (COMCODE 107226730) and is intended for use in non-locally-switched ground-start and loop-start special services. The *SPQ*444 CU provides a single channel of service; it uses the odd-numbered channel associated with a physical plug-in slot. The *SPQ*444 CU can be used in a *SLC*®-2000 Access System equipped with Release 3.2 (or later) in a central office terminal (COT) or remote terminal (RT). (Where a 4-wire current sink channel unit is needed for use in a Multi-Services Distant Terminal (MDST) in a *SLC*-2000 system, the AUA44 *SLC*®Series 5

* Service Mark of Bell Communication Research, Inc.

System channel unit must be used instead, for backplane compatibility.) Typical services are foreign exchange trunks and lines and off premises station lines. The unit may interface with other transmission equipment or cable.The *SPQ*444 CU can be connected to a distant D-bank via an integrated network access facility (INA_Facility) arrangement.

The *SPQ* 444 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

The *SPQ*444 CU provides one channel of service which can function in one of two modes.

4FXO: The foreign exchange-office end (4FXO) function is used in non-locally-switched loop-start and ground-start (LS/GS) circuits where the current sink unit must be four-wire. For foreign exchange applications, the unit is always located at the central office terminal (COT). For off-premises station applications, the unit can be at the COT or the station (RT) end of the circuit. These applications are generally 2-wire at the customer end. Therefore, when the *SPQ*444 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 at the far end. The *SPQ*444 in the 4FXO mode can directly interface another carrier channel unit such as a D4 type 4FXS CU, or connect to a PBX or foreign exchange switch using a maximum of 15 dB of cable.

4TDM: The tandem function is used in providing a back-to-back carrier interface for loop-start and ground-start circuits. The *SPQ*444 can also be used for 2-state circuits such as tie trunks, but in those cases the *SPQ*454 CU is preferred.

Transmission Treatment

The *SPQ*444 channel unit provides wide ranges of transmission level point, structural impedance, and equalization capability — see Table 3 for a listing of corresponding options and their ranges. For loaded cable, equalization is limited to the transmit direction (post-equalization only). Transmission treatment is independent of the busy/idle condition.

* COMMON LANGUAGE is a registered trademark and CLEI, CLFI are trademarks of Bell Communications Research, Inc.

Distribution Cable

The *SPQ*444 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 network channel terminating equipment (NCTE). 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).

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 are compatible with the *SPQ*444 CU provided they conform to the construction rules in those standards. Such cables do not exceed 18 kft nor do any exceed the 2800 ohm resistance, 15 dB loss capability of the *SPQ*444 unit.

Loaded Cable: Loops longer than 18 kft should be H88 loaded. Such loops are compatible with the *SPQ*444 CU provided the service does not require the most stringent equalization* called out in TR-NWT-000057, and provided the resistance does not exceed 2800 ohms. Attenuation can range to the crosstalk limit which is usually 12 dB for loaded cable, but not more than15 dB.

Options

The *SPQ*444 CU has options (Table 1) that must be set before service can be provided. All options for the CU are set by entering commands into the craft interface terminal (CIT, *SLC*-2000 System provisioning tool), which transmits the settings to the system controller where they are stored in nonvolatile memory. The controller then writes the settings into memory registers on the CU

* 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 *SPQ*444 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.

immediately, or when a CU is later installed or replaced. Option settings for the *SPQ*444 CU should not be specified for an even-numbered channel. The procedures for setting options with the CIT are described in AT&T 363-208-001, *SLC-2000 Access System User/Service Manual*.

The options for each of the *SPQ*444 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. Use the guidelines for the AUA44 provided in AT&T 915-710-116 *SLC*® Series 5 *Channel Unit Application and Prescription Setting* to select option settings for the *SPQ*444 channel unit.

Facility Failure:

When the system controller notifies the channel unit that a facility failure has occurred, the *SPQ*444 carries out the following actions:

- Adopts the LS or GS idle condition for 2.5 seconds, then busy out the service for the remainder of the failure
- Sends idle signaling to the far end
- Disables the test relay and transmission in the receive direction. During the failure the BUSY LED can still be tested.

Remote Test Access

Local or remote test access to the *SPQ*444 channel unit is available when the unit's test relay is operated. This access includes full splitting access to the transmission leads and splitting access toward the carrier channel on the primary signaling leads (E and EX).

Table 1. *SPQ*444 Channel Unit Options.

Options For Each *SPQ*®444 Channel Unit Function		
	CU Function	
Option	4FXO	4TDM
Function Code	X	X
Transmit Attenuator	X	X
Receive Attenuator	X	
Equalizer Nonloaded/Loaded*	X	
Equalizer Slope*	X	
Equalizer Bandwidth*	X	
Equalizer Height*	X	
Transmit and Receive Impedance	X	

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

Table 2. *SPQ*444 Channel Unit Function Codes.

***SPQ*®444 Channel Unit Function Codes**		
Function Code	CU Function	Signaling Mode
FXO1	4FXO	Loop-Start Signaling Signaling Leads Normal* No Toll Diversion Capability
FXP1	4FXO	Loop-Start Signaling Signaling Leads Normal* Toll Diversion Capability†
FXO2	4FXO	Loop-Start Signaling Signaling Leads Reversed‡ No Toll Diversion Capability
FXP2	4FXO	Loop-Start Signaling Signaling Leads Reversed‡ Toll Diversion Capability†
FXO3	4FXO	Ground-Start Signaling Signaling Leads Normal* No Toll Diversion Capability
FXP3	4FXO	Ground-Start Signaling Signaling Leads Normal* Toll Diversion Capability†
FXO5	4FXO	Ground-Start Signaling Signaling Leads Reversed‡ No Toll Diversion Capability
FXP5	4FXO	Ground-Start Signaling Signaling Leads Reversed‡ Toll Diversion Capability†
TDOA	4TDM	4-State Signaling Signaling Leads looped Through CXR toward Office
TDSA	4TDM	4-State Signaling Signaling Leads looped Through CXR toward Subscriber
TDOB	4TDM	4-State Signaling Signaling Leads nonlooped Through CXR toward Office
TDSB	4TDM	4-State Signaling Signaling Leads nonlooped Through CXR toward Subscriber
TDOC	4TDM	2-State Signaling** Signaling Leads looped

SPQ®444 Channel Unit Function Codes (Continued)		
Function Code	CU Function	Signaling Mode
TDSC	4TDM	2-STATE Signaling** Signaling Leads looped
TDOD	4TDM	2-STATE Signaling†† Signaling Leads nonlooped
TDSD	4TDM	2-STATE Signaling†† Signaling Leads nonlooped

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

† "Toll Diversion" means that a disallowed outgoing address has been dialed through the PBX; this event is signaled as a battery reversal by the switch. The FXP(_) function code enables the *SPQ*444 CU to recognize a battery reversal and to transmit a unique ABCD signaling code, but this feature of the *SPQ*444 CU is not usable for Toll Diversion applications (see Compatibility section).

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

** The choice of either TDOC or TDSC will result in the same signaling mode, 2-state signaling with looped signaling leads.

†† The choice of either TDOD or TDSD will result in the same signaling mode, 2-state signaling with nonlooped signaling leads.

Table 3. Range of Settings For *SPQ*444 Channel Unit Options

Range of Settings For *SPQ*®444 Channel Unit Options	
Option	**Range**
Function Code	Transmit Gain† (dB) / Receive Gain† (dB)
FXO (_) & FXP (_)*	–1.5 to 15.0 / –10.5 to 6.0
TDO (_) & TDS (_)	– 8.0 to 3.6‡ / –2.1
	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

* The function code for toll diversion, FXP(_), must not be selected when the *SPQ*444 is used in a universal configuration.

† 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.

‡ Normal usage: 2.1 to 3.6 dB.

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

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

Recommended Cables for 4-Wire Designed Special Services
A. LOSS/RESISTANCE RANGE 1. Loss — 15 dB* 2. Resistance — 2800 ohms
B. NONLOADED CABLE 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.
C. LOADED CABLE Loops greater than 18 kft (total length including bridged tap) require standard H88 loading, which for use with *SPQ*444 should conform to: 1. Maximum cable: 15 dB, 2800 ohms 2. Bridged tap • 6 kft. maximum • No loaded bridged tap and no bridged tap between loads 3. COT/RT end section length • 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 *SPQ*444 CU is end-to-end compatible in a *SLC*-2000 System equipped with Release 3.2 (or later) with the following channel units providing the noted services:

- AUA41( ), AUA141, AUA43( ), and *SPQ*443 for loop-start/ground-start (LS/GS) applications without line side answer supervision (LSAS) feature
- *SPQ*443 for foreign exchange applications with LSAS
- AUA36, AUA41( ), AUA141, AUA42( ), AUA142, AUA43( ), AUA45( ), AUA56, AUA75, *SPQ*442, *SPQ*443, *SPQ*444, and *SPQ*454, when the *SPQ*444 is provisioned for 4TDM.

Where the RT is providing integrated network facility access, the *SPQ*444 is also end-to-end compatible with D4-type channel units with FXS functions, in the 4FXO mode, and with CUs with FX( ), DX, TO, RD, PLAR, and E&M functions, in the 4TDM mode.

There is a restriction in the application of this unit in a *SLC*-2000 System in a universal configuration:

- The *SPQ*444 cannot be provisioned for the function code FXP( ) [(loop-start/ground-start with toll diversion (TD)] when used in a universal configuration. This restriction applies because TD requires use of the extended superframe format, ESF. If TD is provisioned when the *SPQ*444 is used in the universal configuration, which uses the modified superframe format Fs, erratic ringing will occur. Although Release 4 of *SLC*-2000 does use the ESF format between the RT and integrated switch when operating in the TR-303 mode, there is no application for signaling reverse battery from the *SPQ*444 toward the switch in a LS/GS circuit. However, the FX LSAS application of reverse battery is supported in Release 3.2 universal applications by a channel unit pair consisting of an *SPQ*444 CU in the COT provisioned for the normal FXO(_) function code (no TD), and an *SPQ*443 CU in the RT.

Further compatibility and application information can be found in AT&T 915-710-116, *SLC Series 5 Carrier System Channel Unit Application Prescription Setting* where:

a. AUA41 is to be read AUA41( )
b. AUA42 is to be read AUA42( )/*SPQ*442
c. AUA43 is to be read AUA43( )/*SPQ*443
d. AUA44 is to be read AUA44( )/*SPQ*444
e. AUA54 is to be read AUA54( )/*SPQ*454
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 cross-connect equipment, or an INA facility used to connect a *SLC*-2000 RT to a D4-type terminal.

Specifications

The *SPQ*444 CU conforms to the appropriate criteria of ANSI*, Bellcore, FCC, GTE, and UL** standards.

Table 5 gives specifications of salient transmission parameters. For complete transmission specifications consult Chapter 6 of AT&T 363-205-010, *SLC Series 5 Carrier System Application and Planning Guide*, referring to the AUA44 CU. The transmission and signaling ranges of the *SPQ*444 in 4TDM mode are the same —1.5 dB. This range translates to about 3 kft of 26 gauge cable.

Table 5. Salient Transmission Parameters for 4-Wire *SPQ*444 Channel Units

Salient Transmission Parameters for 4-Wire *SPQ*®444 Channel Units		
Parameter	**Condition**	**Value**
Cable Resistance		0-2800 ohms
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 4FXO CU J98726SC. Pre-equalization and post-equalization available by emulating 150-ohm mismatch.
Structural impedance	4FXO	600 or 1200 ohms
	4TDM	600 ohms
Return loss (With reference to structural impedance)	300-3000 Hz 1000 Hz	23 dB 28 dB
Longitudal balance (IEEE Method 455-1976)	200 Hz 500 Hz 1000 Hz 3000 Hz	≥ 67 dB ≥ 67 dB ≥ 67 dB ≥ 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

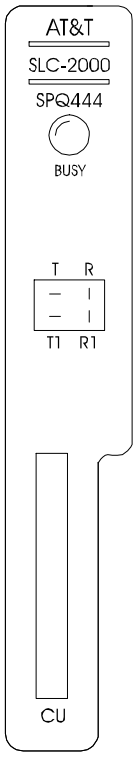
The *SPQ*444 faceplate has one faceplate jack and one red LED indicator. Refer to Figure 1 for faceplate diagram. For FXO/FXP function codes, the BUSY LED will be lit whenever the far-end goes off-hook or when ring-ground is applied in ground-start applications. For tandem function codes, the BUSY LED will be lit whenever the signaling in either direction is off-hook.

In response to an LED TEST command, the BUSY LED will be lit. On power-up, the LED will be lit for 2 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.

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

.



Edge Connections	
Finger	Function
1	Frame Gnd
2	Ringing Gnd
11	SGX
12	EX
13	E
17, 20, 21	Circuit Gnd
22, 23, 25, 50	+5 Volts DC
26	-48 V DC Battery
29	T1
30	R1
31	T
32	R
37	SG
49	-5 Volts DC

Figure 1. *SPQ*444 Faceplate and Edge Connections.

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 363-205-110	*SLC Series 5 - Cable Measurement Method for Determining Provisioning Settings for Special Services Channel Units*
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.*

Bellcore's technical reference for digital loop carrier systems, TR-NWT-000057, Issue 2, January 1993, is one of several telephone company sponsored documents that offer criteria by which to judge such systems.

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

Comments about this document can be directed to:

AT&T Network Systems Customer Education and Training
Documentation Services
2400 Reynolda Road
Winston-Salem, NC 27106-4606

Copyright Information