

3657-01 4-Wire Foreign Exchange Subscriber (4W FXS) Channel Unit

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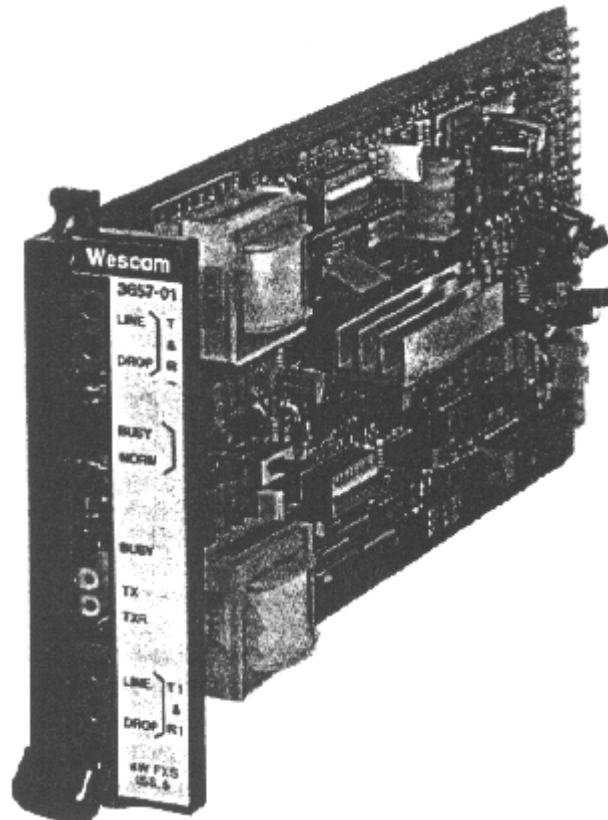


Figure 1. 3657-01 (Issue 5) 4W FXS Channel Unit

1. GENERAL

1.1 Document Purpose

This document provides information on the Issue 5 version of the Charles Industries 3657–01 4-Wire Foreign Exchange Subscriber (4W FXS) Channel Unit.

1.2 Document Status

This document is reprinted to include a general editorial update.

1.3 Equipment Function

The 3657–01, shown in Figure 1, is used in the Charles Industries 360/363 D4 Digital Carrier Terminal to provide an interface to special service circuits

1.4 Equipment Location/Mounting

Occupies one channel unit slot of a Charles 360/363 D4 Digital Carrier Channel Bank Assembly.

1.5 Equipment Features

The 3657–01 (Issue 5) 4W FXS Channel Unit includes the following features:

- Compliance with the specifications in AT&T Publication 43801
- Front-panel-accessible bantam breaking-jacks for accessing the transmit and receive ports
- Front-panel-accessible pin-jack test points (TX and TXR) for monitoring the transmit level
- Selectable termination impedance of 150, 600, or 1200 ohms for matching the impedance at the 4-wire port interface
- Transmit and receive prescription attenuation of 16.5dB in 0.1dB increments
- Built-in jack to mount an optional 3691–00 Nonloaded Cable Equalizer or 3691–01 H88 Loaded Cable Equalizer Subassembly for post-equalization
- Front-panel NORM/BUSY switch
- Front-panel BUSY LED indicator
- Selectable normal or reversed simplex-signaling leads for tandem operation with a 4W FXO channel unit in an intermediate office
- Selectable loop-start or ground-start mode of operation
- Selectable Build-Out Resistors (BOR) for a 300-ohm or less Short Loop (SL)
- Compatibility with 100-millisecond ringing intervals
- Ring tripping during the ringing or silent intervals
- Selectable immediate-idle or delayed-busy trunk processing during carrier failure
- Five-year warranty

2. INSPECTION

2.1 Inspect for Damages

Inspect the equipment thoroughly upon delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

2.2 Equipment Identification

Charles Industries' equipment is identified by a model and issue number imprinted on the front panel or located elsewhere on the equipment. Each time a major engineering design change is made on the equipment, the issue number is advanced by 1 and imprinted on subsequent units manufactured. Therefore, be sure to include both the model number and its issue number when making inquiries about the equipment.

2.3 Static Concerns

Each unit is shipped in static-protective packaging to prevent electrostatic charges from damaging static-sensitive devices. Use approved static-preventive measures, such as static-conductive wrist straps and a static-dissipative mat, when handling units outside of their protective packaging. A unit intended for future use should be tested as soon as possible and returned to its original protective packaging for storage.



STATIC-SENSITIVE

This equipment contains static-sensitive electronic devices. To prevent electrostatic charges from damaging static-sensitive units:

- Use approved static preventive measures (such as a static-conductive wrist strap and a static-dissipative mat) at all times whenever touching units outside of their original, shipped static-protective packaging.
- Do not ship or store units near strong electrostatic, electromagnetic, or magnetic fields.
- Use static-protective packaging for shipping or storage.

3. APPLICATION GUIDELINES

The 3657–01 channel unit provides the interface between the 4-wire VF extensions of foreign exchange lines, off-premise extensions, PBX/CO trunks (loop start/ground start), and the common equipment units of a 360/363 D4 terminal. Refer to Figure 2 for a typical application.

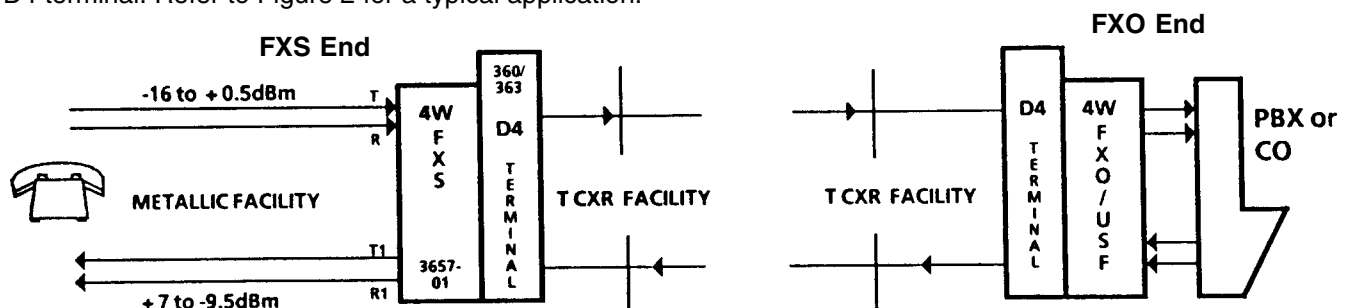


Figure 2. 3657–01 4W FXS Typical Application

4. CIRCUIT DESCRIPTION

Refer to Figure 3, the 3657–01 block diagram, as needed, while reading the following circuit description.

4.1 Transmit VF Path

Voice Frequency (VF) signals applied to the input T&R are routed through the LINE and DROP breaking-jacks to the XMT TRANSFORMER via switch S6. Switch S6 selects a terminating impedance of 150, 600, or 1200 ohms for both the transmit and receive paths, to match the impedance of the metallic facility and to provide a balanced input to the XMT TRANSFORMER. The XMT TRANSFORMER provides dc isolation from the metallic facility.

Voice energy from the XMT TRANSFORMER is routed into the XMT PRESCRIPTION ATTN and XMT GAIN circuits. These circuits, acting together, set the transmit path gain to the exact level required to drive the XMT FILTER and ENCODER circuits. The use of the XMT PRESCRIPTION ATTN allows adjustment for a range of office TLPs from –6 to +0.5dBm in 0.1dB increments.

The adjusted VF signal is then applied to the XMT FILTER for suppression of frequencies that are outside the bandwidth of the standard voice frequency and prevents them from entering the ENCODER.

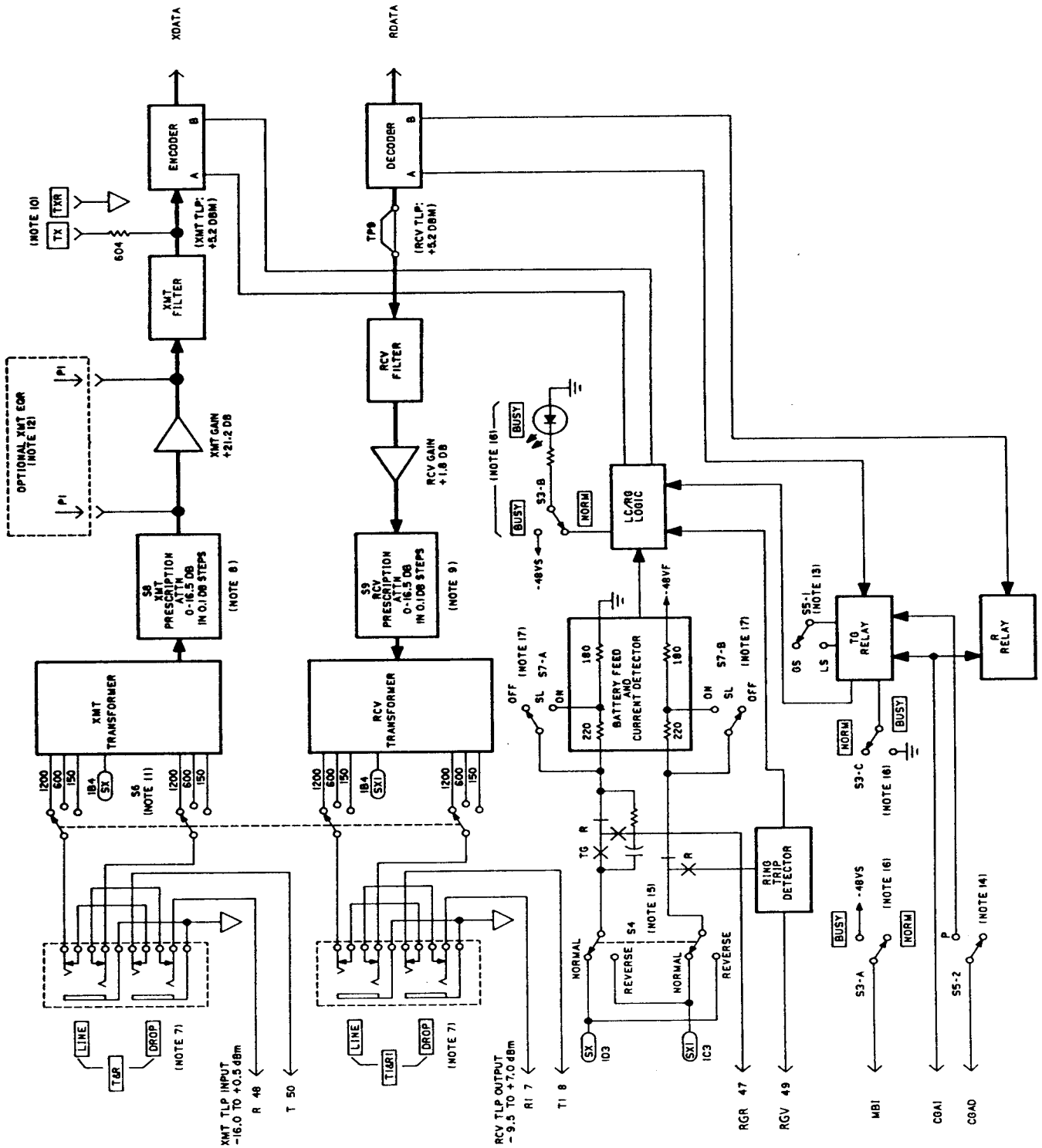







Figure 3. 3657-01 4W FXS Block Diagram

Table 1. Notes for Figure 3

#	Note													
1.		PC board connector pin.												
2.		Front panel marking.												
3.		Signal flow direction.												
4.		N.O., N.C. relay contact												
5.		Test point												
6.	Ganged switches are indicated by dashed connection lines or alphabetically-suffixed reference designations. A numerical suffix denotes discrete switch within a package.													
7.	PC mount test jacks: <table border="1" data-bbox="219 598 787 787"> <thead> <tr> <th>Marking</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>T&R Line</td> <td>Access toward channel unit</td> </tr> <tr> <td>T&R Drop</td> <td>Access toward office equipment</td> </tr> <tr> <td>T1&R1 Line</td> <td>Access toward channel unit</td> </tr> <tr> <td>T1&R1 Drop</td> <td>Access toward office equipment</td> </tr> <tr> <td>TX&TXR</td> <td>XMT monitor points</td> </tr> </tbody> </table>		Marking	Function	T&R Line	Access toward channel unit	T&R Drop	Access toward office equipment	T1&R1 Line	Access toward channel unit	T1&R1 Drop	Access toward office equipment	TX&TXR	XMT monitor points
Marking	Function													
T&R Line	Access toward channel unit													
T&R Drop	Access toward office equipment													
T1&R1 Line	Access toward channel unit													
T1&R1 Drop	Access toward office equipment													
TX&TXR	XMT monitor points													
8.	The XMT input range at T&R is –16 to 0.5 dBm. The XMT ATTN is adjustable for 0 to 16.5 dB in 0.1 dB increments. For +0.5 dBm input at T&R, S8 (XMT ATTN) should be set for 16.5 dB of attenuation.													
9.	The RCV output range at T1&R1 is –9.8 to +7 dBm. The RCV ATTN is adjustable for 0 to 16.5 dB in 0.1 dB increments. For +7 dBm input at T1&R1, S9 (RCV ATTN) should be set for 0 dB of attenuation.													
10.	The level at the transmit test point, TX and TXR, measured with a 600 Ohm bridged meter, should be +5.2 dBm.													
11.	Switch S6 provides T&R and T1&R1 with an impedance of 150/600/1200 Ohms.													
12.	369100 non-loaded cable equalizer or 369101 loaded cable equalizer is ordered separately to provide post-equalization when inserted in connector J3.													
13.	For loop start operation place S5–1 (LS/GS) in the LS position. For ground start operation place S5–1 in the GS position.													
14.	During a carrier group alarm, S5–2 (option P) can be configured for continuous idle—S5–2 open (CGAI)—or 2 seconds idle, followed by continuous busy for the duration of the carrier failure—S5–2 to P (CGAD).													
15.	Use switch S4 to switch SX–SX1 leads from NORM to REV. This allows the 4W drop of the FXS to be tandemed to a 4W FXO.													
16.	S3 (BUSY/NORM) performs the following functions: 1. Sends a busy signal to the 360 common equipment 2. Applies a tip ground to the unit 3. Lights the BUSY LED on the front panel of the unit													
17.	For loop lengths less than 300 Ohms, set S7 (SL option) to OFF)													

The filtered VF signal is then applied to the ENCODER. The ENCODER performs an Analog-To-Digital (A/D) conversion of the VF signal and sends the resulting Pulse Code Modulation (PCM) signal to the 360/363 D4 terminal common equipment via the XDATA lead.

4.2 Receive VF Path

The PCM digital signal transmitted from the FXO end is received by the 360/363 D4 terminal common equipment and routed to the 3657–01 via the RDATA lead. The DECODER and RCV FILTER then, in turn, perform a digital-to-analog (D/A) conversion of the signal and suppression of frequencies that are outside the bandwidth of the standard voice frequency.

The output of the RCV FILTER is applied to the RCV GAIN and RCV PRESCRIPTION ATTN circuits which, acting together, set the receive path gain to the level required to interface with a range of output TLPs. The use of the RCV PRESCRIPTION ATTN allows adjustment for the output level from –9.5 to +7.0dBm in 0.1dB increments.

The output of the RCV PRESCRIPTION ATTN circuit is coupled through the RCV TRANSFORMER, switch 56, and the LINE and DROP breaking-jacks to T1&R1. S6 selects a terminating impedance of 150, 600, or 1200 ohms for both the transmit and receive paths, to match the impedance of the metallic facility and to provide a balanced output for the RCV TRANSFORMER. The RCV TRANSFORMER provides dc isolation from the metallic facility.

4.3 Transmit Signaling

Loop-Closure (LC), Ring-Ground (RG), or open loop conditions of the simplex leads are detected by the BATTERY FEED AND CURRENT DETECTOR. The output of the BATTERY FEED AND CURRENT DETECTOR goes to the LC/RG LOGIC circuit which, in turn, outputs this information to the ENCODER. If current is detected and no tip ground is present, the ENCODER sends a signal out on the B signaling highway indicating a ring ground. If a tip-ground signal is present when current is detected, the LC/RG LOGIC circuit will then transmit a signal on the A signaling highway indicating loop closure. If the tip-ground signal is then removed, the LC/RG LOGIC circuit will hold the detected current as loop closure and not as ring ground. This prevents false ring-ground requests from being transmitted. Whenever loop closure is being transmitted, the R RELAY will be disabled.

4.4 Receive Signaling

In the receive direction, signaling information received by the DECODER via the RDATA lead is converted to tip-ground and ringing information for controlling the TG and R RELAYS.

A tip-ground signal from the far-end is output by the DECODER on its A lead causing the TG RELAY to activate. When the TG RELAY is activated, filtered battery-ground is applied to the tip lead.

A ringing signal from the far-end is output by the DECODER on its B lead causing the R RELAY to activate which allows ringing to be applied to the ring lead. The RING TRIP DETECTOR will be connected into the loop, and the BATTERY FEED AND CURRENT DETECTOR will be disconnected from the circuit. The RING TRIP DETECTOR detects the dc loop signal during ringing cycles.

Loop current is detected by either the BATTERY FEED AND CURRENT DETECTOR or the RING TRIP DETECTOR. With the TG RELAY activated, detection of loop current causes the R RELAY to be disabled allowing loop-closure information to be transmitted onto the A signaling highway.

4.5 Trunk Processing During A Carrier Group Alarm (CGA)

When a carrier failure occurs, the CGAI bus goes to ground, causing the TG and R RELAYS to be disabled. If the DIP switch S5–2 (P) position is set to ON, a tip ground will be forced by the CGAD bus approximately 2 seconds after the carrier failure.

5. MOUNTING

The 3657–01 is equipped with an insert/eject lever in the form of a hinged front panel which ensures a positive connection of the channel unit’s card-edge connector to the backplane connector when the unit is installed. The insert/eject lever also facilitates removal of the unit.

CAUTION

Installation and removal of modules should be done with care. Do not force a module into place. If excessive resistance is encountered while installing a module, remove the module and check the card guide and connector to verify proper alignment and the absence of foreign material.

Step	Action
1.	Align the channel unit with the appropriate card-guided slot of the terminal.
2.	Slide the unit into the slot with the front panel in a horizontal (up) position.

Step	Action
3.	When the top portion of the hinged front panel is under the front lip of the terminal, push down on the front panel until it is in the vertical position. The channel unit's card-edge connector will begin to make contact with the inner portion of the backplane connector.
4.	Continue applying light pressure onto the bottom edge of the front panel until the unit snaps into place.

6. INSTALLER CONNECTIONS

Installer connections are made to the channel unit by wire-wrapping leads onto the associated 50-pin connectors located on the backplane assembly of the 360/363 D4 terminal. On connectorized 360/363 D4 terminals (360–10,–11, etc.) connections are made via 25-pair female connectors (CINCH 222–22–50–023 or equivalent) to the appropriate 25-pair male connectors of the 360/363 D4 terminal. Refer to Section 360–000–200 for the wiring diagrams of the female connectors with respect to the 360/363 D4 terminal being utilized. Electrical connections are made when the unit is installed.

7. OPTIONS

The following paragraphs describe the options that are used to condition the 3657–01 for proper application and operation. Also refer to Figure 4 for a drawing showing the option locations and a brief summary of the option conditioning requirements.

7.1 Switch S3 — NORM/BUSY

Place switch S3 to the NORM (down) position to condition the 3657–01 for normal (in-service) operation. Place S3 to the BUSY (up) position to create an out-of-service condition for testing or troubleshooting purposes (this will also light the BUSY LEDs [front panel and Alarm Logic Unit (ALU)] and busy the channel unit on the far end).

7.2 Switch S4 — NORM/REV — Simplex Leads

The NORM/REV switch S4, when placed in the REV position, reverses the simplex lead connections to T&R and T1&R1. This lead reversal allows the 3657–01 4W FXS Channel Unit to be tandemed (on the 4-wire metallic facility) to a 4W FXO unit in an intermediate office. Caution must be exercised when the 4W FXS channel unit is operating into a 4W FXO circuit with a similar reversing option to ensure that only one unit has its simplex signaling leads reversed.

7.3 Switch S5 — LS/GS — Carrier Failure

7.3.1. Switch S5-1 — Loop Start/Ground Start

The LS/GS option selects the proper mode of operation. To operate in the loop-start mode, place S5–1 in the LS position which permanently operates the TG RELAY. Thus, when the subscriber goes off-hook, a loop-closure indication is sent to the far-end. To operate in the ground-start mode, place S5–1 in the GS position.

7.3.2. Switch S5–2 (P) — Carrier Failure (CGA)

S5–2 (P) provides the capability to respond to a carrier failure alarm by immediately releasing a call (P to OFF), or by activating the TG RELAY which simulates a busy condition (P to ON) during a carrier failure. When S5–2 (P) is in the ON position, the tip lead will release immediately upon an alarm, then reapply a tip ground signal after about 2 seconds which causes the TG RELAY to activate and forces the trunk busy. This prevents the 3657–01 from being seized.

7.4 Switch S6 — Impedance Selection

Switch S6 selects a transmit and receive impedance of either 150, 600, or 1200 ohms for matching the impedance of the 4-wire metallic facility. See Table 3.

7.5 Switch S7 — Short Loop (BOR)

Set switch S7 to the ON position to short-out build-out resistance for loops greater than 300 ohms. To reduce power dissipation on shorter loops, set switch S7 to the OFF (open) position thereby adding in the resistance.

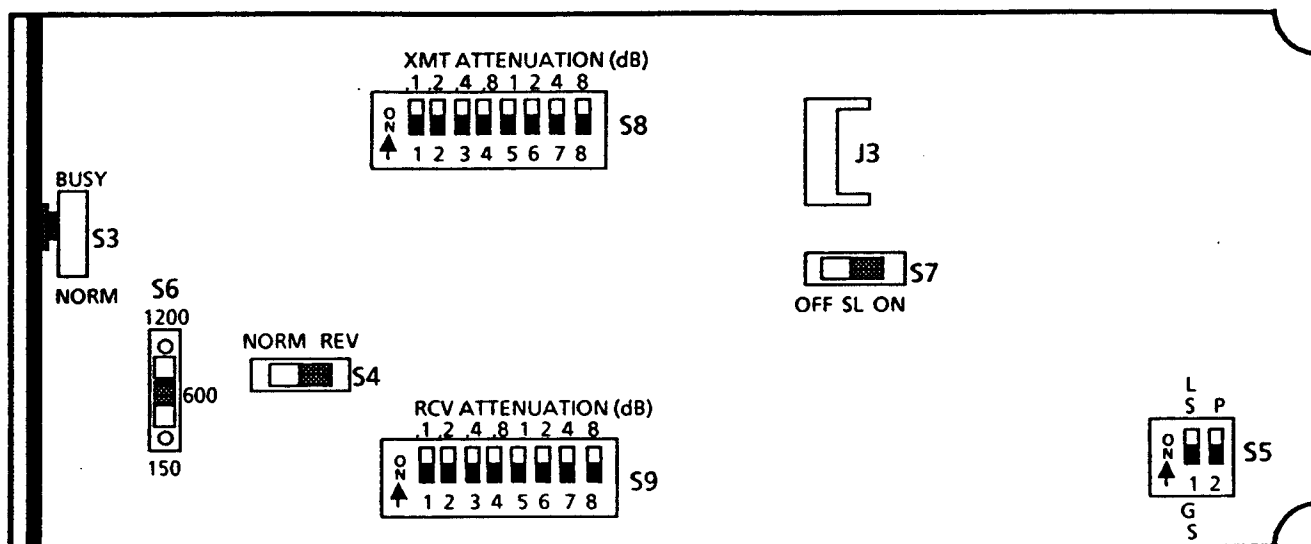


Figure 4. 3657-01 4W FXS (issue 5) Option Locations

Table 2. 3657-01 4W FXS Option Description

Option	Function/Remarks	Position
J3	Jack for mounting an optional transmit post-equalizer 3691- 00/01.	See Section 369 -100-201
S3	For in-service operation.	NORM
	For testing or network troubleshooting.	BUSY
S4	For normal operation.	NORM
	For tandem operation (on the 4-wire metallic facility) with a 4W FXO, set to REV position if the 4W FXO's simplex leads are set to normal, and vice versa.	NORM/REV as required
S5-1	To select loop-start mode of operation.	LS
	To select ground-start mode of operation.	GS
S5-2	During carrier failure: To select 2 seconds idle followed by continuous busy.	ON(P)
	To select continuous idle.	OFF
S6	Selects the required termination impedance of the 3657-01 for matching the impedance of the 4-wire metallic facility. (See Table 3)	150/600/1200 as required
S7	To remove BOR for loops greater than 300 ohms.	ON
	To include BOR for shorter loops.	OFF
S8	8 sections (0.1,0.2,0.4,0.8,1,2,4,8) total 16.5dB of transmit attenuation when all are ON.	See page 9
S9	8 sections (0.1,0.2,0.4,0.8,1,2,4,8) total 16.5dB of receive attenuation when all are ON.	See page 9

Table 3. 4-Wire Facility Impedance Selection

4-Wire Cable	Impedance Selection S6 Position (Ohms)
Nonloaded	600
	150 for long, nonloaded loops where onboard equalization is not required
H99 Loaded	1200

4-Wire Cable	Impedance Selection S6 Position (Ohms)
Mixed Loaded and Nonloaded	600 if distance between 3657– 01 and the first load coil is greater than 9kft.
	1200 if distance between 3657– 01 and the first load coil is less than 9kft.

7.6 Switch S8 — XMT Prescription Attenuation

S8 is an eight-section DIP switch that selects the appropriate amount of attenuation between 0 and 16.5dB in 0.1dB increments for adjusting the transmit path to the proper operating level. By placing the individual switches of S8 (0.1, 0.2, 0.4, 0.8, 1, 2, 4, and 8dB) to the ON position as required, the desired level of 5.2dBm at the TX and TXR test points can be achieved.

7.7 Switch S9 — RCV Prescription Attenuation

S9 is an eight-section DIP switch that selects the appropriate amount of attenuation between 0 and 16.5dB in 0.1dB increments for adjusting the receive path to the proper operating level. By placing the individual switches of S9 (0.1, 0.2, 0.4, 0.8, 1, 2, 4, and 8dB) to the ON position as required, the 5.2dBm level at the output of the DECODER can be adjusted to obtain the desired output level between – 9.5 and +7dBm at T1&R1.

7.8 Jack J3 — Post-Equalization

A Wescom 3691–00 Nonloaded Cable Equalizer Subassembly or 3691–01 H88 Loaded Cable Equalizer Subassembly can be ordered separately to provide post-equalization (transmit path) when inserted into jack J3. Additional information on the 3691–00/01 is available in Section 369–100–201.

8. ALIGNMENT

8.1 Transmit Alignment

The XMT ATTENUATION DIP switch S8 is a prescription control that provides attenuation from 0 to 16.5dB in increments of 0.1dB to accommodate an input TLP range from –16.0 to +0.5dBm. To adjust the transmit path to the proper operating level, the difference between –16.0 and the transmit TLP at T&R must be obtained.

$$[XMTATTN = TLP - (-16.0)]$$

For an input TLP of –2.0dBm, the XMT ATTN = (–2.0) – (–16.0) = 14dB. Set the sum of the switch settings on S8 to 14.

8.2 Receive Alignment

The RCV ATTENUATION DIP switch S9 is a prescription control that provides attenuation from 0 to 16.5dB in increments of 0.1dB to accommodate an output level TLP range from –9.5 to + 7dBm. To adjust the receive path to the proper operating level, the difference between +7.0 and the receive TLP at T1 & R1 must be obtained.

$$[RCV ATTN = (+7.0) - TLP]$$

For an output TLP of –6.0dBm, the RCV ATTN= (+7.0) – (–6.0) = 13dB. Set the sum of the switch settings on S9 to 13.

9. TESTING

After installation, optioning and alignment, place a call end-to-end through the facility to verify proper operation. If trouble is encountered, recheck all installer connection, options and alignment settings, and verify that the channel unit is making positive connection to the backplane connector. If trouble persists, replace the unit with a similar unit known to be in proper operating order and retest the facility. Channel unit testing for fault diagnosis or verification of circuit operation is provided in Section 360–001–205.

10. TECHNICAL ASSISTANCE

If technical assistance is required, contact Charles Industries' Technical Services Center at:

847–806–8500
847–806–8556 (FAX)
800–607–8500
techserv@charlesindustries.com (e-mail)

11. WARRANTY & CUSTOMER SERVICE

11.1 Warranty

Charles Industries, Ltd. offers an industry-leading, 5-year warranty on products manufactured by Charles Industries. Contact your local Sales Representative at the address or telephone numbers below for warranty details. The warranty provisions are subject to change without notice. The terms and conditions applicable to any specific sale of product shall be defined in the resulting sales contract.

Charles Industries, Ltd.
5600 Apollo Drive
Rolling Meadows, Illinois 60008–4049
847–806–6300 (Main Office)
847–806–6231 (FAX)

11.2 Field Repairs (In-Warranty Units)

Field repairs involving the replacement of components within a unit are not recommended and may void the warranty and compatibility with any applicable regulatory or agency requirements. If a unit needs repair, contact Charles Industries, Ltd. for replacement or repair instructions, or follow the *Repair Service Procedure* below.

11.3 Advanced Replacement Service (In-Warranty Units)

Charles Industries, Ltd. offers an “advanced replacement” service if a replacement unit is required as soon as possible. With this service, the unit will be shipped in the fastest manner consistent with the urgency of the situation. In most cases, there are no charges for in-warranty repairs, except for the transportation charges of the unit and for a testing and handling charge for units returned with no trouble found. Upon receipt of the advanced replacement unit, return the out-of-service unit in the carton in which the replacement was shipped, using the pre-addressed shipping label provided. Call your customer service representative at the telephone number above for more details.

11.4 Standard Repair and Replacement Service (Both In-Warranty and Out-Of-Warranty Units)

Charles Industries, Ltd. offers a standard repair or exchange service for units either in- or out-of-warranty. With this service, units may be shipped to Charles Industries for either repair and quality testing or exchanged for a replacement unit, as determined by Charles Industries. Follow the *Repair Service Procedure* below to return units and to secure a repair or replacement. A handling charge applies for equipment returned with no trouble found. To obtain more details of this service and a schedule of prices, contact the CI Service Center at 217–932–5288 (FAX 217–932–2943).

Repair Service Procedure

1. Prepare, complete, and enclose a purchase order in the box with the equipment to be returned.
2. Include the following information:
 - Company name and address
 - Contact name and phone number
 - Inventory of equipment being shipped
 - Particulars as to the nature of the failure
 - Return shipping address

3. Ship the equipment, purchase order, and above-listed information, transportation prepaid, to the service center address shown below.

 CI Service Center
 503 N.E. 15th St., P.O. Box 339
 Casey, IL 62420–2054
4. Most repaired or replaced units will be returned within 30 or 45 days, depending on the product type and availability of repair parts. Repaired units are warranted for either 90 days from the date of repair or for the remaining unexpired portion of the original warranty, whichever is longer.

12. SPECIFICATIONS

12.1 Electrical

The electrical characteristics of the 3657–01 (Issue 5) are as follows:

12.1.1. Transmission

- (a) PERMISSIBLE MODES: 4L –4T, 4N–4T, 4T–4L, 4T–4N, 4T–4T.
- (b) 4-WIRE IMPEDANCE: 150/600/1200 ohms.
- (c) LINE SIDE LEVELS: Transmit (fixed), +5.2dBm TLP; receive (fixed), +5.2dBm TLP.
- (d) DROP SIDE LEVELS: Transmit minimum –16.0dB, maximum +0.5dB; receive minimum –9.5dB, maximum +7.0dB.
- (e) FIXED 1000Hz GAIN: Transmit, +21.2dB; receive, +1.8dB.
- (f) ADJUSTABLE ATTENUATION: Transmit minimum 0.0dB, maximum 16.5dB, in 0.1dB steps; receive minimum 0.0dB, maximum 16.5dB, in 0.1dB steps.
- (g) LONGITUDINAL BALANCE: 74dB minimum at 200Hz to 1kHz; 69dB minimum at 3kHz.
- (h) SIGNAL TO DISTORTION RATIO: 35dB minimum at zero to –30dBm0; 29dB minimum at –40dBm0; 25dB minimum at –45dBm0.
- (i) RETURN LOSS: 23dB minimum at 300Hz and 3kHz; 28dB minimum at 1kHz.
- (j) TRANSMIT AND RECEIVE PATH FREQUENCY RESPONSE (Referenced at 1kHz):

Frequency (Hz)	XMT (dB)	RCV (dB)
60	–14 maximum	--
200	0.15 to –2	0 to –1
300	+0.15 to –0.15	+0.15 to –0.15
1000	0 (REF)	0 (REF)
3000	+0.15 to –0.15	+0.15 to –0.15
3200	+0.15 to –0.75	+0.15 to –0.75
3400	0 to –1.5	0 to –1.5
4000	–14 maximum	–14 maximum
4600	–32 maximum	–28 maximum

- (k) TRANSMIT/RECEIVE IDLE CHANNEL NOISE: 20dBmC0 maximum.
- (l) CROSSTALK: 6dBm0 minimum at 400Hz, 71dBm0 minimum at 700Hz to 1kHz, 70dBm0 minimum at 3kHz.

- (m) LEVEL TRACKING (Measured Single-Ended At 1010Hz): +/-0.25dB from +3 to -37dBm0, +/-0.5dB from -38 to -50dBm0.
- (n) CURRENT DRAW FROM -48VDC: Idle, 20mA; busy, 45mA.

12.1.2. Signaling

- (a) SUPERVISION RANGE: 2000-ohm loop.
- (b) RING TRIP RANGE: 2000-ohm loop.
- (c) 20Hz RINGING RANGE: 2000-ohm loop.
- (d) GROUND START SIGNALING: 1500 ohms.

12.2 Physical

See Table 4 for the physical characteristics of the 3657–01.

Table 4. Physical Specifications

Feature	U.S.	Metric
Height	4.3 in.	10.9 cm
Width	1.36 in.	3.5 cm
Depth	10.4 in.	26.4 cm
Weight	11 oz.	312 g
Operating Temperature	32° to 122°F	0° to 50°C

