3658–01/04 2-Wire Foreign Exchange Office (2W FXO) Channel Units

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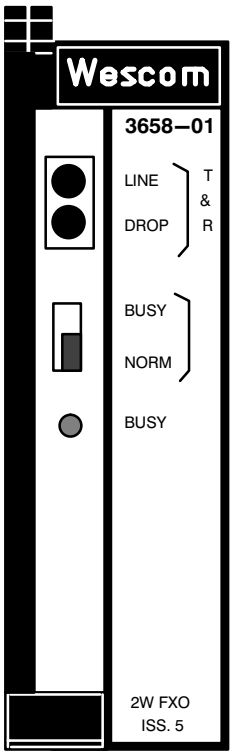

Figure 1. 3658—01 (Issue 5) 2W FXO Channel Unit

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1. GENERAL

1.1 Document Purpose

This document provides information on the Issue 5 versions of the Charles Industries 3658–01/04 2-Wire Foreign Exchange Office (2W FXO) Channel Units. The 3658–01 is shown in Figure 1.

1.2 Document Status

This document is reprinted to provide a general editorial update.

1.3 Equipment Function

The 3658–01/04 2-Wire Foreign Exchange Office (2W FXO) channel units are used in the Charles Industries 360/363 Digital Carrier Terminal to provide an interface to special service circuits.

1.4 Equipment Location/Mounting

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

1.5 Equipment Features

The 3658–01/04 (Issue 5) Channel Units include the following features:

- Compliance with AT&T Publication 43801 specifications
- 900- (3658–01) / 600- (3658–04) ohms plus 2.2μF compromise network and Line Build-Out Capacitors (LBOC), DIP switch-selectable
- Provisions for installing an external precision balance network
- Front-panel-accessible bantam breaking-jacks for accessing the transmit and receive ports
- Prescription attenuation for the transmit and receive levels
- Front-panel BUSY LED indicator
- Front-panel-accessible NORM/BUSY switch
- Loop-start or ground-start mode of operation, switch-selectable
- RING GROUND relay and tip-ground operation controllable by DIP switches H and HC
- End-to-end signaling compatibility, DIP switch-selectable, with D2 or D3, D4, and D1D channel units
- Automatic trunk processing and lead conditioning via optionable RING GROUND, TRUNK PROCESSING, and LOOP CLOSURE relays during carrier failure
- Compatibility with 100-millisecond ringing intervals
- Build-out resistance of 400 ohms for loops less than 1.1k ohms
- Tip-ground transmission optionable when NORM/BUSY switch is in BUSY position

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

CAUTION

Do not ship or store modules near strong electrostatic, electromagnetic, or magnetic fields, or in a highly radioactive environment. Use the original static-protective packaging for shipping or storage.

3. APPLICATION GUIDELINES

The 3658–01 provides a 900-ohm (the 3658–04 a 600-ohm) balanced interface between a 2-wire PBX/CO line (loop-start/ground start) and the common equipment units of the 360/363 D4 terminal. Refer to Figure 2 for typical application.

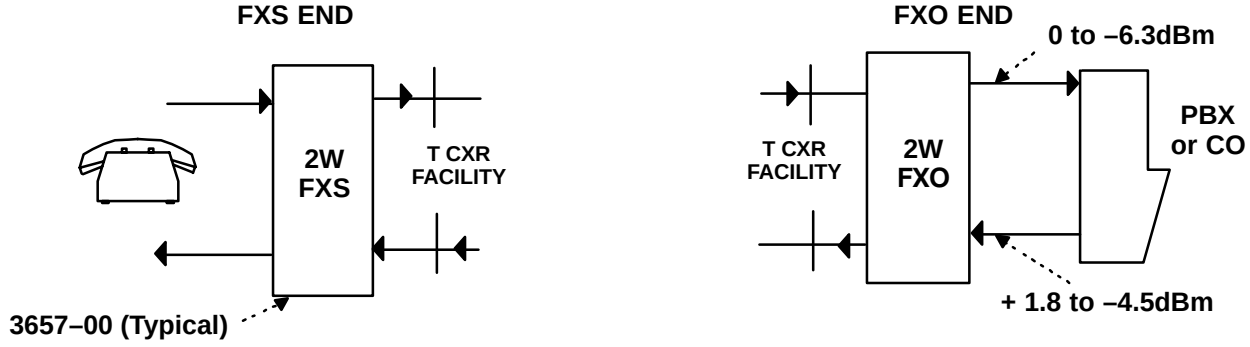

Figure 2. 3658–01/04 2W FXO Typical Application

4. CIRCUIT DESCRIPTION

Refer to Figure 3, the 3658–01/04 (Issue 5) Block Diagram, as needed while reading the following circuit description. Differences between the channel units are indicated as required.

4.1 Transmit VF Path

Voice Frequency(VF) signals applied to the input T&R (pins 48 and 50) are routed through the DROP and LINE breaking-jacks to the 2W/4W HYBRID circuit. The 2W/4W HYBRID circuit converts the balanced 2-wire input to an unbalanced 4-wire interface.

Voice energy from the 2W/4W HYBRID is routed into the XMT GAIN and XMT ATTEN 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 ATTEN allows finely controlled adjustment for a range of office TLPs from –4.5 to +1.8dBm.

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

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.

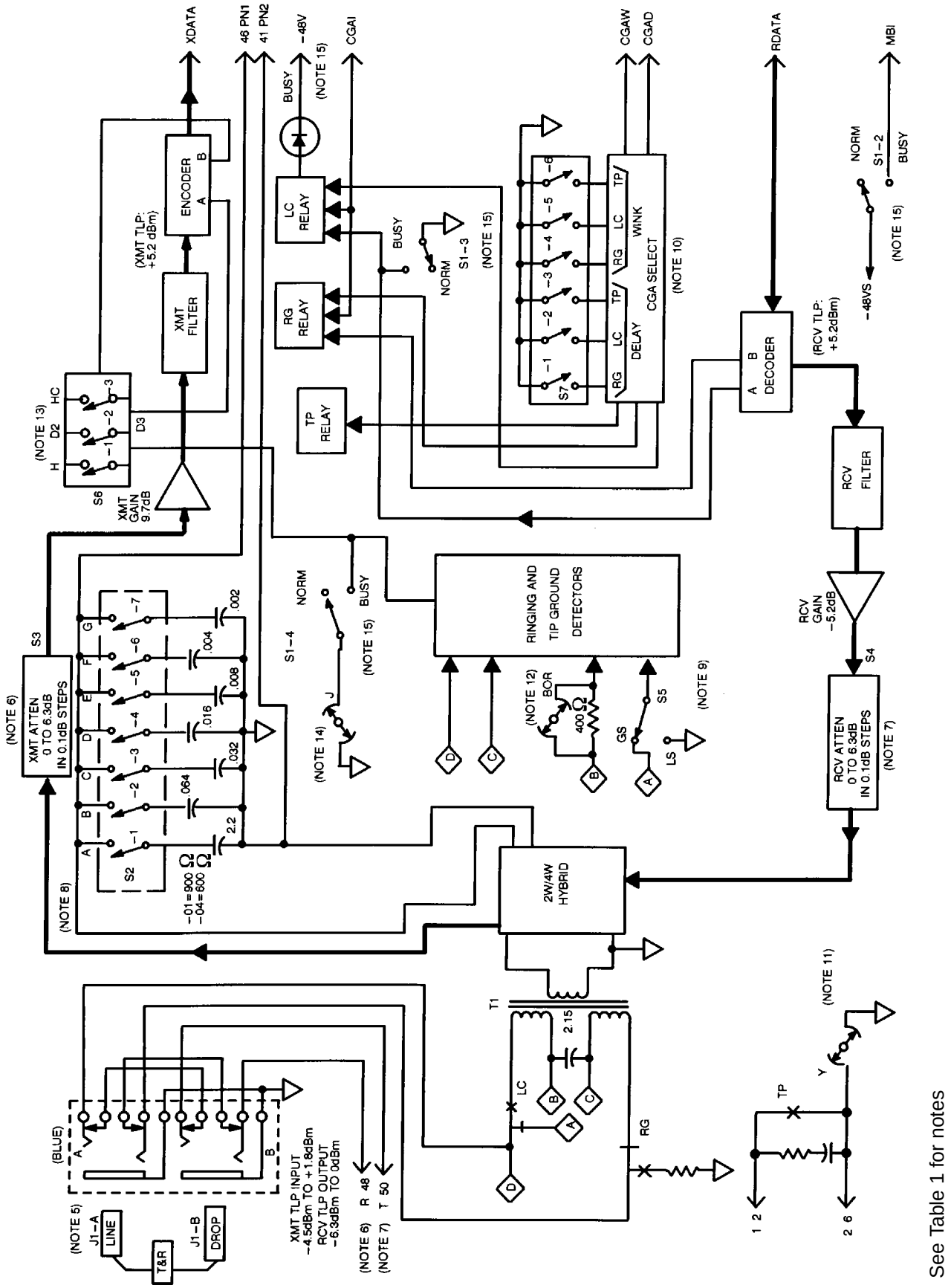

Figure 3. 3658–01/04 2W FXO (Issue 5) Block Diagram

Table 1. Table 1. Notes For Figure 3

#	Note	#	Note
1.	← PC board connector pin	9.	For loop start operation, place LS/GS (S5) in the LS position. For ground start operation, place in the GS position.
2.	[XXXX] Front panel marking	10.	During a carrier group alarm, the unit shall force no RG and no LC. Approximately 2 seconds later: With only RGDLY (S7-1) closed, RG relay closes With only LCDLY (S7-2) closed, LC relay closes With only TPDLY (S7-3) closed, TP relay closes With only RGWNK (S7-4) closed, RG relay winks With only LCWNK (S7-5) closed, LC relay winks With only TPWNK (S7-6) closed, TP relay winks
3.	◄— Signal flow direction	11.	When the Y screw option is closed, pins 2 and 6 go to ground upon carrier failure. When Y is open, pin 2 is connected by relay to pin 6 upon carrier failure.
4.	—✕— —| |— N.O., N.C. relay contact	12.	BOR screw option open adds an additional 400 ohms for short loops. If total loop resistance is greater than 1.1K Ω, then remove BOR by closing screw.
5.	PC mount test jacks: **Marking** / **Function** T&R LINE, J1–A: Access toward channel unit T&R DROP, J1–B: Access toward office equipment	13.	Switch S6 contains three signaling options. When "H" (S6-1) is closed, the ring ground relay is automatically released when a tip ground is received. The D2/D3 switch (S6-2) provides compatibility for D2 and D3 signaling formats. When the HC switch (S6-3) is closed, ringing is sent on both the "A" and "B" highways, and the tip ground detector is disconnected from the "A" highway.
6.	The XMT INPUT range at T&R: –4.5dBm to +1.8dBm. The XMT ATTEN (S3) is adjustable for 0 to 6.3dB in 0.1dB increments. For 0.0dBm input at T&R, the XMT ATTEN should be set for 4.5dB of attenuation.	14.	When screw option "J" is closed, a tip ground is sent to the far end when the NORM/BUSY switch is in the "BUSY" position.
7.	The RCV OUTPUT range at T&R is –6.3 to 0.0dBm. The RCV ATTEN (S4) is adjustable for 0 to 6.3dB in 0.1dB increments. For –2.0dBm output at T&R, the RCV ATTEN should be set for 2.0dB of attenuation.	15.	A BUSY switch is provided on the front panel. When in the "BUSY" position: A BUSY LED is illuminated on the front panel, a tip ground is sent to the far end (if "J" is closed), the MAKE BUSY lead (pin 12) goes to –48V, and the loop closure relay is closed.
8.	Close switch "A" to provide a 900 ohm on the 3658-01; 600 ohm on the 3658-04, plus 2.15uF balance network. Switches B through G provide additional capacitance for hybrid balancing.		

4.2 Receive VF Path

The PCM digital signal transmitted from the far-end is received by the 360/363 D4 terminal common equipment and routed to the 3658–01/04 via the RDATA lead. The DECODER and RCV FILTER then 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 ATTEN circuits which, acting together, set the receive path gain to the exact level required to interface with a range of office TLPs. The use of the RCV ATTEN allows finely controlled adjustment for the output level from –6.3 to 0dBm.

4.3 Transmit Signaling

Ringing, loop-current, or tip-ground information is multiplexed onto the T1 line by the ENCODER.

A ground signal applied to the tip lead of the 3658–01/04, when switch S5 is set for GS, is detected by the RINGING AND TIP GROUND DETECTORS circuit. The 3658–01/04 will then transmit this tip-ground condition to the ENCODER where it will be multiplexed onto the A highway of the T1 line.

When the RINGING AND TIP GROUND DETECTORS circuit senses ringing on the T&R leads, this ringing condition will be multiplexed onto the B highway of the T1 line.

The RINGING AND TIP GROUND DETECTORS circuit senses an on-hook or off-hook condition by detecting the presence of loop current. This status is sent along the A highway.

4.4 Receive Signaling

In the receive direction, signaling information is sent through the DECODER from the T1 line and transmitted to the RG RELAY and the LC RELAY.

A ring-ground signal from the far-end is output by the DECODER, causing the RG RELAY to operate, thereby grounding the ring lead (pin 48).

A loop closure signal, sent along the A highway, is output from the DECODER into the LC RELAY. Closure of this relay completes the circuit on the loop side. The BUSY LED is illuminated when the LC RELAY is operated to indicate that the channel unit is busy.

4.5 Trunk Processing During a Carrier Group Alarm (CGA)

3.15 When a carrier failure occurs, the CGAI bus goes to ground, causing the LC RELAY to open and the RG RELAY to be disconnected. Approximately 2.5 seconds after a carrier failure, the TP, RG, or LC RELAYS can wink open and return to closure or just close, depending on how the CGA options (S7-1-6) are set.

5. MOUNTING

The 3658–01/04 mounts in one channel unit slot of a 360/363 D4 terminal. The 3658–01/04 is equipped with an insert/eject lever mechanism in the form of a hinged front panel. The mechanism ensures a positive connection between the channel unit's card-edge connector and the backplane connector when the unit is installed. The insert/eject lever also facilitates removal of the unit.

CAUTION

Installation and removal of channel units should be done with care. Do not force a unit into place. If excessive resistance is encountered while installing a unit, remove it, and check the card guides 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.
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 used. Electrical connections are made when the unit is installed.

7. OPTIONS

The following paragraphs describe the screw and switch options that are used to condition the 3658–01/04 for proper application and operation. Refer to Figure 4 for a drawing showing the option locations and a summary of the option functions.

Note: When opening a screw option, rotate the screw counterclockwise two full turns to ensure that the connection is open. When closing a screw option, rotate the screw counterclockwise until it seats.

7.1 Switch S1 – NORM/BUSY

Place switch S1 to the NORM (down) position to condition the 3658–01/04 for normal (in-service) operation. Place S1 to the BUSY (up) position to create an out-of-service condition for looped or single channel tests. When S1 is in the BUSY position, it performs the following functions.

- Closes the loop to the local office (LC relay operates).
- Sends a busy condition to the far end if screw option J is in the closed position.
- Illuminates the BUSY LED on the front panel of the 3658–01/04 and lights the BUSY LED on the front panel of the local Alarm Logic Unit (ALU) via the Message Buffer Interface (MBI).

7.2 Screw J – CLOSED/OPEN

CLOSE screw J to send a tip-ground signal to the far-end when switch S1 is in BUSY position. When screw J is OPEN, the ground is removed.

7.3 Switch S2 – Hybrid Balance Impedance

Switch S2 is a seven-section DIP switch used for selecting the appropriate amount of capacitance required for balancing the 2W/4W hybrid circuit. Hybrid balance can also be provided by an external compromise network, or PBN, via pins 46 and 41 (PN1 and PN2, respectively). In these cases, set S2-A to the OFF position. Refer to Paragraphs 7.05 and 7.06 below for further information on switch S2.

7.3.1. Switch S2-A – Compromise Balance Network

Switch S2-A is used to select a compromise balance network of 900- (3658–01) / 600- (3658–04) ohms in series with a 2.2μF capacitor. To select this option, set switch S2-A to ON.

7.3.2. Switches S2-B-G (LBOC)

Switches S2-B through S2-G provide up to 0.1303μF build-out capacitance for balancing the hybrid circuitry relative to the line connected to the 2-wire port of the 3658–01/04. By placing the individual switches to the ON position, the required amount of capacitance can be added in approximately 0.002μF increments.

7.4 Switch S3 – XMT Prescription Attenuation

S3 is a six-section DIP switch that selects the appropriate amount of attenuation between 0 and 6.3dB in 0.1dB increments for adjusting the transmit path to the proper operating level. By placing the individual switches of S3 (3.2, 1.6, 0.8, 0.4, 0.2, 0.1dB) to the ON position as required, the desired level of +5.2dBm at the input to the ENCODER can be achieved.

7.5 Switch S4 – RCV Prescription Attenuation

S4 is a six-section DIP switch that selects the appropriate amount of attenuation between 0 and 6.3dB in 0.1dB increments for adjusting the receive path to the proper operating level. By placing the individual switches of S4 (3.2, 1.6, 0.8, 0.4, 0.2, 0.1dB) to the ON position as required, the level at the output of the DECODER can be varied to obtain the desired output level (between –6.3 and 0dBm) at T&R.

7.6 Switch S5 – Loop-Start/Ground-Start

The LS/GS option selects the proper mode of operation. To operate in the loop-start mode, place switch S5 in the LS position. To operate in the ground-start mode, place switch S5 in the GS position.

7.7 Switch S6-1 (H) Ring Ground Control

When a digital switch or an FXS channel unit is used at the far-end, the H option should normally be ON. This will cause the 3658–01/04 to remove ring ground after tip ground is detected at the near-end and loop closure is received from the far-end. This permits both loop closure and ring ground information from the far-end to be received simultaneously. With option H in the OFF position, a loop closure signal from the far-end will remove ring ground independent of the tip ground detector.

7.8 Switch S6-2 (D2/D3)

The D2/D3 option selects the signaling mode in which the 3658–01/04 operates. If the far-end channel bank is a D3 or D4 type, set S6-2 to D3. If the far-end channel bank is a D2 type, set S6-2 to D2 in order to invert the tip ground and ring ground information on the PCM signaling highways.

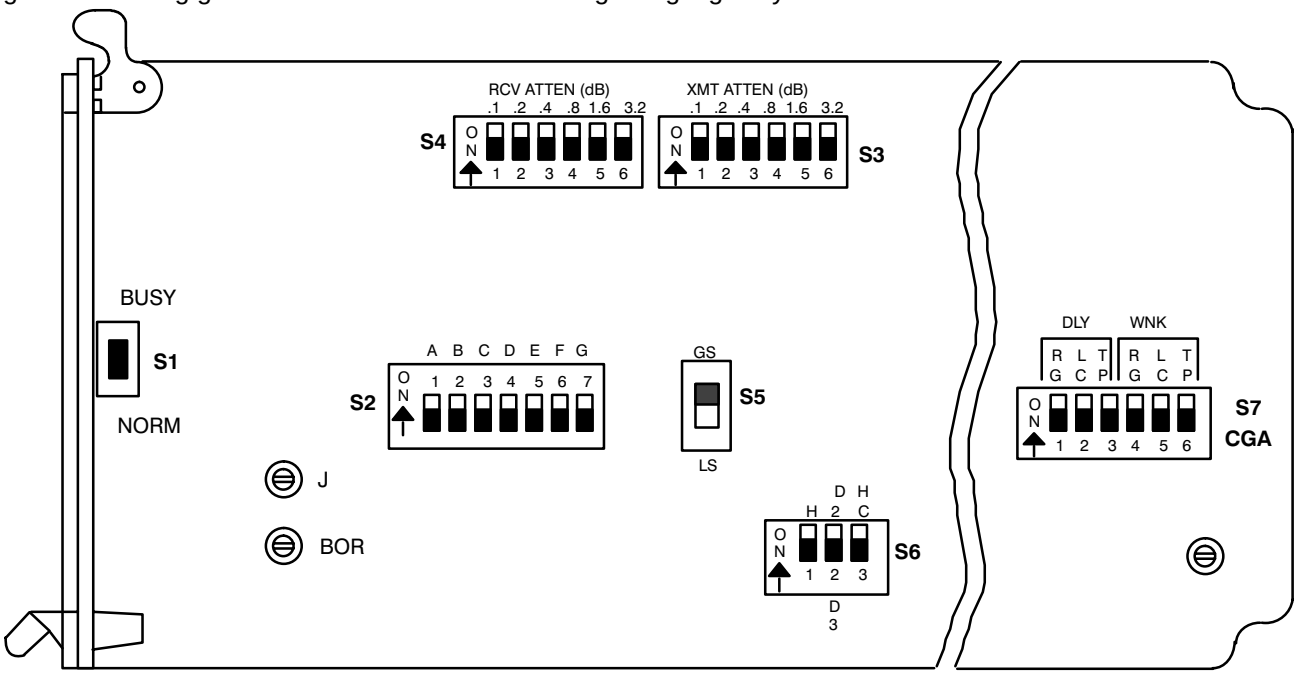

Figure 4. 3658—01/04 2W FXO (Issue 5) Option Locations

Table 2. 3658—01/04 2W FXO (Issue 5) Option Summary

Option	Type	Position	Function/Remarks
S1	Slide switch	NORM	For in-service operation.
		BUSY	For testing or alignment.
J	Screw	OPEN	With S1 in BUSY position, tip ground signal is not sent.
		CLOSED	With S1 in BUSY position, tip ground information is sent normally to the far-end.
S2–A	Slide switch	ON	If a compromise network resistance of 900 ohms plus 2.2mF is desired.
		OFF	If an external PBN is used.
S2–B–G (LBOC)	Slide switch	On/off as required	Provides hybrid balancing of up to 0.13mF in increments of 0.002mF relative to the office cabling connected to the 2-wire port. Place in ON position to add 0.064 S2-B, 0.032 S2-C, 0.016 S2-D, 0.008 S2-E, 0.004 S2-F, and 0.002 S2-G.
S3	Slide switch	ON	Six sections (0.1, 0.2, 0.4, 0.8, 1.6, 3.2) total 6.3dB of XMT ATTEN when all are ON.
S4	Slide switch	ON	Six sections (0.1, 0.2, 0.4, 0.8, 1.6, 3.2) total 6.3dB of RCV ATTEN when all are ON.

Option	Type	Position	Function/Remarks
S5	Slide switch	LS	To select loop-start mode of operation.
		GS	To select ground-start mode of operation.
S6–1 (H)	Slide switch	ON	Digital switch at far-end (tip ground from CO and loop closure from far-end releases ring ground relay).
		OFF	Loop closure from far-end releases ring ground relay.
S6–2 (D2/D3)	Slide switch	D2	Matches 3658–01 to the A and B highway signaling format used on the facility for D2.
		D3	Matches 3658–01 to the A and B highway signaling format used on the facility for D3.
S6–3 (HC)	Slide switch	OFF	#3EAX not at far-end.
		ON	#3EAX at far-end.
S7–1–6	Slide switch	ON	To close RG RELAY during carrier failure.
		ON	To close LC RELAY during carrier failure.
		ON	To close TP RELAY during carrier failure.
		ON	To cause RG RELAY to wink during carrier failure.
		ON	To cause LC RELAY to wink during carrier failure.
		ON	To cause TP RELAY to wink during carrier failure.
Y	Screw	OPEN	To provide isolated contact closure between the 1 lead (pin 2) and the 2 lead (pin 6) during carrier failure (TP RELAY closed).
		CLOSED	To provide switched ground output on the 1 lead (pin 2) and ground on the 2 lead (pin 6) during carrier failure (TP RELAY closed).
BOR	Screw	OPEN	To add 400 ohms to the loop circuit for short loops (less than 1.1k ohms).
		CLOSED	To remove 400-ohm build-out from battery feed.

7.9 Switch S6-3 (HC) Tip Ground Control

The HC option is provided for compatibility with #3EAX. When a #3EAX is not used at the far-end, the HC option should be OFF. When a #3EAX is used at the far-end, the HC option should be ON, and switch S5 (LS/GS) should be in the LS position. In this mode, loop closure and ringing information are exchanged via paralleled A and B highways. This mode may also provide compatibility with some PCM – FDM transmultiplexers.

7.10 Switches S7-1-6 – CGA

Upon carrier failure, an immediate alarm (CGAI) opens the LC RELAY and disconnects the RG RELAY. Approximately 2.5 seconds later, when a Carrier Group Alarm Delay (CGAD) or Carrier Group Alarm Wink (CGAW) arrives, depending on how the CGA switches are set, the following occurs:

- With only S7-1 set to ON, RG RELAY closes
- With only S7-2 set to ON, LC RELAY closes
- With only S7-3 set to ON, TP RELAY closes
- With only S7-4 set to ON, RG RELAY winks
- With only S7-5 set to ON, LC RELAY winks
- With only S7-6 set to ON, TP RELAY winks

Note: Switches S7-1, -2, -3 will override switches S7-4, -5, -6, respectively.

7.11 Screw Y – Trunk Processing Control

Screw option Y determines the state of an auxiliary set of contacts between pins 2 and 6 (1-lead and 2-lead respectively) during trunk processing. To provide a balanced (floating) contact closure between the 1-lead and the 2-lead, OPEN screw option Y. To provide a switched ground output on the 1-lead and a ground on the 2-lead, CLOSE screw option Y.

7.12 Screw BOR – Build-Out Resistance

Set screw BOR to the CLOSED position to short-out 400 ohms resistance for loops greater than 1.1k ohms. To reduce power dissipation, on shorter loops, set screw BOR to the OPEN position, adding in the 400 ohms for shorter loops.

8. ALIGNMENT

8.1 Transmit Alignment

The XMT ATTEN switch S3 is a prescription control that provides attenuation from 0 to 6.3dB in increments of 0.1dB to accommodate an input TLP range from –4.5 to +1.8dBm. To adjust the transmit path to the proper operating level, the difference between –4.5 and the transmit TLP at T&R must be obtained:

[XMT ATTEN = TLP – (–4.5)]

For an input TLP of –2.0dBm, the XMT ATTEN = (–2.0) – (–4.5) = 2.5dB. Set the sum of the switches on S3 to 2.5.

8.2 Receive Alignment

The RCV ATTEN switch S4 is a prescription control that provides attenuation from 0 to 6.3dB in increments of 0.1dB to accommodate an output TLP range from –6.3 to 0dBm. To adjust the receive path to the proper operating level, the difference between 0 and the receive TLP at T&R must be obtained:

[RCV ATTEN = 0 – TLP]

For an output TLP of –6.0dBm, the RCV ATTEN = 0 – (–6.0) = 6dB. Set the sum of the switches on S4 to 6.

9. TESTING

After completing Parts 4 through 8, place a call end-to-end through the facility to verify proper operation. If trouble is encountered, recheck all installer connections, optioning, and alignment settings, and verify that the channel unit is making positive contact with the backplane connector. If the difficulty persists, replace the unit with one known to be good 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 preaddressed 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
   Route 40 East
   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

The electrical and physical characteristics of the 3658–01/04 are as follows:

12.1 Transmission

(a) PERMISSIBLE MODES: 3658–01, 2L-4T, 2N-4T, 2T9-4T, 4T-2L, 4T-2N, 4T-2T9; 3658–04, 2N-4T, 2T6-4T, 4T-2N, 4T-2T6.

(b) 2-WIRE IMPEDANCE: 3658–01, 900 ohms; 3658–04, 600 ohms.

(c) LINE-SIDE LEVELS (XMT And RCV): +5.2 TLP (fixed).

(d) DROP-SIDE LEVELS: Transmit, –4.5dB (min), +1.8dB (max); Receive, –6.3dB (min), 0.0dB (max).

(e) 1000Hz GAIN: Transmit, +9.7dB (fixed); Receive, –5.2dB (fixed).

(f) XMT AND RCV ATTENUATION: 0.0dB to –6.3dB adjustable in 0.1dB steps.

(g) LONGITUDINAL BALANCE: 58dB minimum at 200Hz to 1kHz; 53dB minimum at 3kHz.

(h) SIGNAL TO DISTORTION RATIO: 35dB minimum at 0 to –30dBm0; 29dB minimum at –40dBm0; 25dB minimum at –45dBm0.

FREQUENCY (Hz)	XMT (dB)	RCV (dB)
60	–20 maximum	——
200	0 to –3	0 to –2
300	+0.25 to –0.5	+0.25 to –0.5
1000	0 (Reference)	0 (Reference)
3000	+0.25 to –0.5	+.25 to –0.5
3200	+0.25 to –0.75	+0.25 to –0.75
3400	0 to –1.5	0 to –1.5
4000	–14 maximum	–14 maximum
4600	–32 maximum	–28 maximum

(i) TRANS-HYBRID LOSS: Echo, 34dB minimum; singing, 20dB minimum.

(j) RETURN LOSS: Echo, 28dB minimum; singing, 20dB minimum.

(k) TRANSMIT/RECEIVE IDLE CHANNEL NOISE: 20dBrnC0 maximum.

(l) LEVEL TRACKING: $\pm$0.25dB from +3 to –37dBm0; $\pm$0.5dB from –38 to –50dBm0.

(m) CURRENT DRAW FROM –48Vdc: Idle, 25mA; busy, 40mA.

(n) OPERATING ENVIRONMENT: Temperature, 32 to 122°F (0 to 50°C).

12.2 Signaling

(o) OPERATION: Loop-start or ground-start

(p) MINIMUM OPERATE CURRENT: 20mA.

(q) BUILD-OUT RESISTANCE: BOR in, 800 ohms; BOR out, 360 ohms.

(r) RING LEAD RESISTANCE TO GROUND: 410 ohms nominal.

(s) TIP GROUND DETECTOR SENSITIVITY: 850 ohms must be detected; 10,000 ohms must not be detected.

(t) RINGING SENSITIVITY: 65Vrms at 20Hz.

12.3 Physical

See Table 3 for the physical characteristics of the unit.

Table 3. Physical Specifications

Feature	U.S.	Metric
Height	4.25 inches	10.8 centimeters
Width	1.31 inches	3.3 centimeters
Depth	10.31 inches	26.2 centimeters
Weight	16 ounces	454 grams