

3654-00 4W Universal SF (USF) Channel Unit

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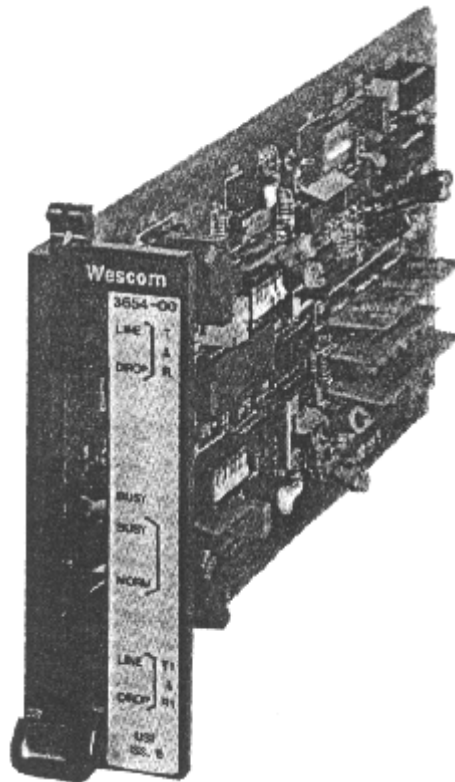


Figure 1. 3654-00 (Issue 5) 4W Universal SF (USF) Channel Unit

1. GENERAL

1.1 Document Purpose

This document provides general and installation information for the Charles Industries 3654–00 (Issue 5) 4W Universal SF (USF) Channel Unit, shown in Figure 1.

1.2 Document Status

This document is reprinted to include a general editorial update.

1.3 Equipment Function

The 3654–00 USF channel unit is used in the 360/363 D4 Digital Carrier Terminals to terminate a PCM channel and convert the A and B highway signaling states of the channel to inband tone (2600Hz) signaling states for transmission via the voice paths of an SF signaling facility.

1.4 Equipment Location/Mounting

The 3654–00 occupies one channel unit slot of a Charles Industries 360/363 D4 Channel Bank.

1.5 Equipment Features

The 3654–00 (Issue 5) USF includes the following features:

- SF signaling complies with AT&T publication 43201, Appendix A
- SF port optioning for FXO, FXS or E&M signaling compatibility
- Far-end compatible with any D4 voice frequency channel unit, such as:

2/4W E&M	2/4W FXO/GT	2/4W DPO
4W PLR	2/4W FXS/GT	2/4W DPT
2/4W FXO	4W TDM	2/4W DX
2/4W FXS	4W USF	
- Selectable for ground-start or loop-start operation when optioned for the FXS or FXO mode
- Provides up to 24dB of prescription gain in 0.1dB increments in the XMT and RCV paths
- Provides prescription setting of VNL of 6dB in 0.1dB increments
- Front panel BUSY LED indicates busy/idle status
- Selectable for D2 and D3 compatibility
- Front panel BUSY switch is provided to place the unit out of service for testing and alignment
- Provides a 600 ohm terminating impedance at the SF facility interface
- Provides selectable distinctive or 2/4 second ringing when optioned for FXO or FXS mode
- Surge protection for SF facility interface

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 static-conductive wrist straps and a static-dissipative mat, 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.



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

On-board optioning adapts the channel unit's SF facility interface port to function as an FXO (foreign exchange office-end), FXS (foreign exchange subscriber-end), or E&M trunk SF port. The opposite end of the SF facility can be terminated in a standard SF to FXS, FXO, or E&M converter module followed by the required station or switching equipment. The opposite end can also be terminated in a second 3654–00 channel unit to interconnect two PCM channels via an SF link. When the SF port of the 3654–00 interfaces with an SF to FXS, FXO, or E&M converter, the opposite end of the carrier facility is terminated in an FXO-, FXS-, or E&M-type channel unit, respectively.

Figure 2, Figure 3, Figure 4, and Figure 5 illustrate applications of the 3654–00 in the E&M, FXO, and FXS modes of operation. The figures do not represent the only possible applications of the 3654–00 in a given signaling mode.

3.1 E&M Mode

In Figure 2, a tie trunk linking two tandem digital switching centers is implemented by means of an analog radio link. The analog radio does not provide a signaling path, therefore the 3654–00, optioned for the E&M mode, is used to terminate each end of the SF link. The 3654–00 converts PCM A-highway signaling, containing bidirectional supervisory and dialing information, to/from inband SF signaling information that can be transmitted on the voice path of the radio link.

3.2 FXO Mode

In Figure 3, a foreign exchange subscriber's line is implemented using an SF link for signaling extension. This SF link can be a 4-wire cable facility or the voice paths of an analog carrier or microwave link. The 3654–00 is optioned for the FXO mode, and the far end of the SF link is terminated with a 2W To 4W FXS SF W/Gain Signaling Module. Typically, both modules are optioned for ground-start operation in this application, depending on the trunk interface requirements of the PBX.

In Figure 4, an OPX (off-premise extension) connected to an analog PBX via tandem-connected PCM and SF links also illustrates the use of the 3654–00 in FXO mode. The PBX link circuit interfaces the PCM facility through a 360/363 D4 Digital Carrier Terminal and a FXO Channel Unit. The far end of the PCM link is terminated in a 360/363 D4 Digital Carrier Terminal containing a 3654–00 optioned for the FXO mode. The 3654–00 provides the interface between the PCM and SF links. The far end of the SF link is terminated with a 7306–23 2W To 4W FXS SF W/Gain Signaling Module which interfaces the SF link with a 2-wire telephone station. The modules are all optioned in the loop-start mode in this application.

3.3 FXS Mode

Figure 5 illustrates an alternative arrangement of an OPX that is implemented by means of tandem-connected SF and PCM links. A SF FXO signaling module interfaces with the PBX and is optioned for loop-start operation. The signaling module is followed with a 4W to 2W repeater that converts the PBX line to a 4-wire voice path appropriate for the in-band SF signaling transmission. This unit also provides gain as required to compensate for losses on the SF link.

The far end of the SF link is terminated with a 3654-00 that is optioned for the FXS mode. The 3654-00 converts the voice channel and SF signaling information to PCM for transmission on the PCM carrier link. The far end of the PCM link is terminated with a 2W FXS channel unit, which provides proper interface between a PCM terminal and a 2-wire telephone station. The 3654-00 is optioned for loop-start operation, as is required when terminating the line with an individual telephone instrument.

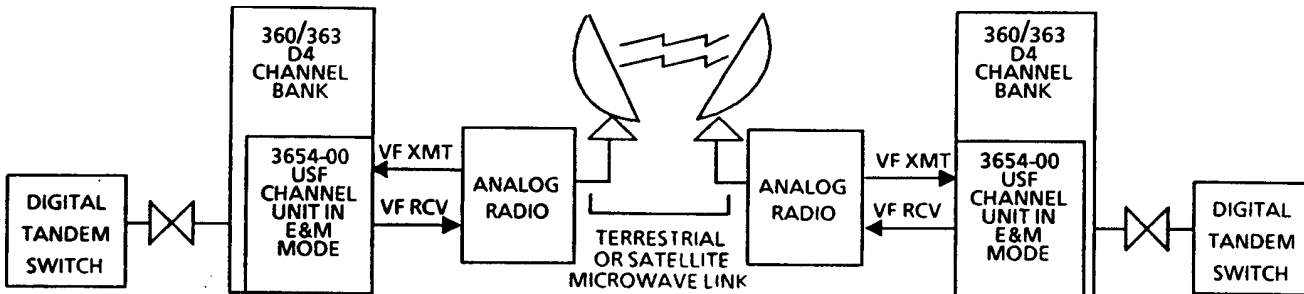


Figure 2. Special Common Carrier Trunk Including An Analog Carrier Link

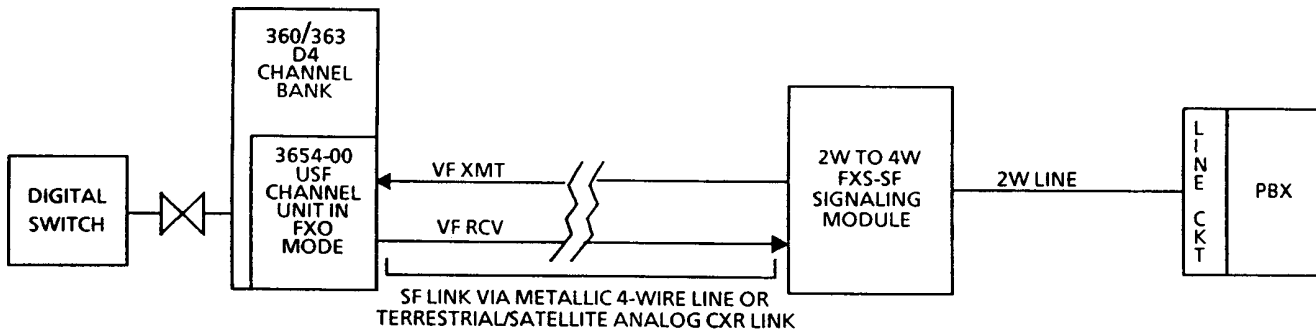


Figure 3. FX Facility Including An SF Signaling Link

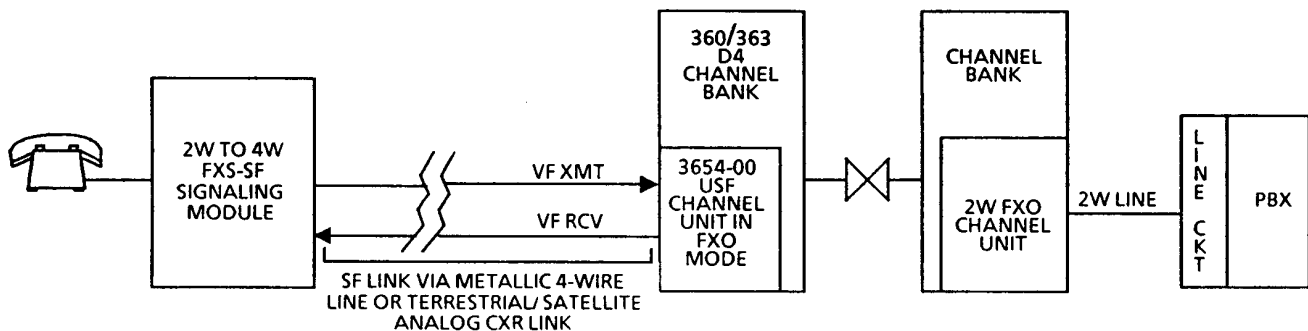


Figure 4. OPX Implemented Using Tandem SF And PCM Links

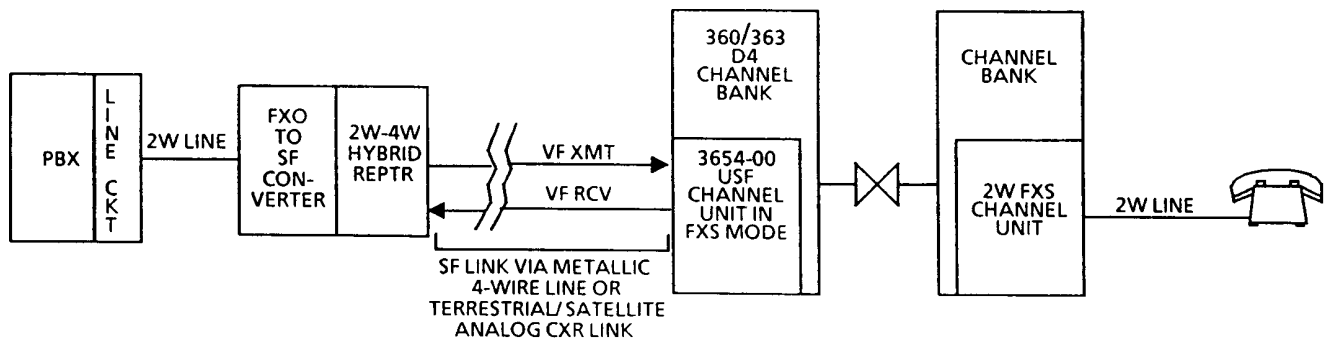


Figure 5. Alternative OPX Implemented Using Tandem SF And PCM Links

4. CIRCUIT DESCRIPTION

Refer to Figure 6, the 3654–00 4W Universal SF Channel Unit (Issue 5) Block Diagram, while reading the following circuit description. Also refer to Table 1 which relates SF tone signaling states to A and B highway signaling states at the PCM facility interface.

4.1 Transmit VF Pat

VF and/or 2600Hz SF tone energy received from the SF facility on T and R (pins 50 and 48) and is passed through XMT XFMR. XMT XFMR circuitry provides surge protection, impedance matching, and dc isolation. The level of voice/tone energy is compensated by the XMT PRESCRIPTION GAIN circuit. The XMT PRESCRIPTION GAIN circuit provides up to 24dB of gain in 0.1dB increments which allows the VF input range to be – 17 to + 7dBm.

In order to provide a constant 5.2 dBm TLP at the input of the ENCODER, the XMT ATTN circuit attenuates the VF signals by a constant 1.8 dB.

The output of the XMT ATTN feeds the 2600Hz FILTER which is enabled and disabled by the SF TIMING & CONTROL circuitry. When disabled, all VF and tone energy is passed through to the XMT FILTER. When enabled, the 2600Hz FILTER rejects the 2600Hz tone energy present on the VF signal and passes all non-SF voice energy to the VNL.

The VNL circuit allows attenuation of the signal to facilitate inter-connection loss. The signal from the VNL circuit is applied to the XMT FILTER which provides the proper voice channel bandpass characteristics and eliminates unwanted harmonics.

The output of the XMT FILTER is applied to the ENCODER which converts the VF signal from an analog to a digital signal and applies it, through the common equipment, to the PCM facility.

4.2 Transmit Signaling Path

The output of the XMT ATTN branches to the SF DETECTOR. In the high guard mode, the SF DETECTOR recognizes SF tones when the SF tone energy exceeds the non-tone energy by 10dB (the nominal signal-to-guard ratio). In the low guard mode, the SF DETECTOR will recognize any SF tone greater –31dB0. The output of the SF DETECTOR is applied to the SF TIMING AND CONTROL circuit.

The signal at the SF DETECTOR output reflects the state of the signaling tone entering the 3654–00 from the SF facility and corresponds to supervisory signaling or dial pulsing originating at the far end of the SF facility. SF high tone is received at –8dBm0 for 400 milliseconds, and then reduced to low tone at –20dBm0.

The SF TIMING AND CONTROL provides the necessary timing and control for the E&M, FXO, and FXS operating modes with the following specific functions:

- Conditions the SF DETECTOR for either high-guard or low-guard. Maintains the high-guard mode for 225 milliseconds to improve the talk-off performance and prevent false disconnects. Prevents false seizures due to carrier fades by maintaining the low-guard mode for 50 milliseconds.
- Rejects any pulse tone having a duration of 30 milliseconds or less.

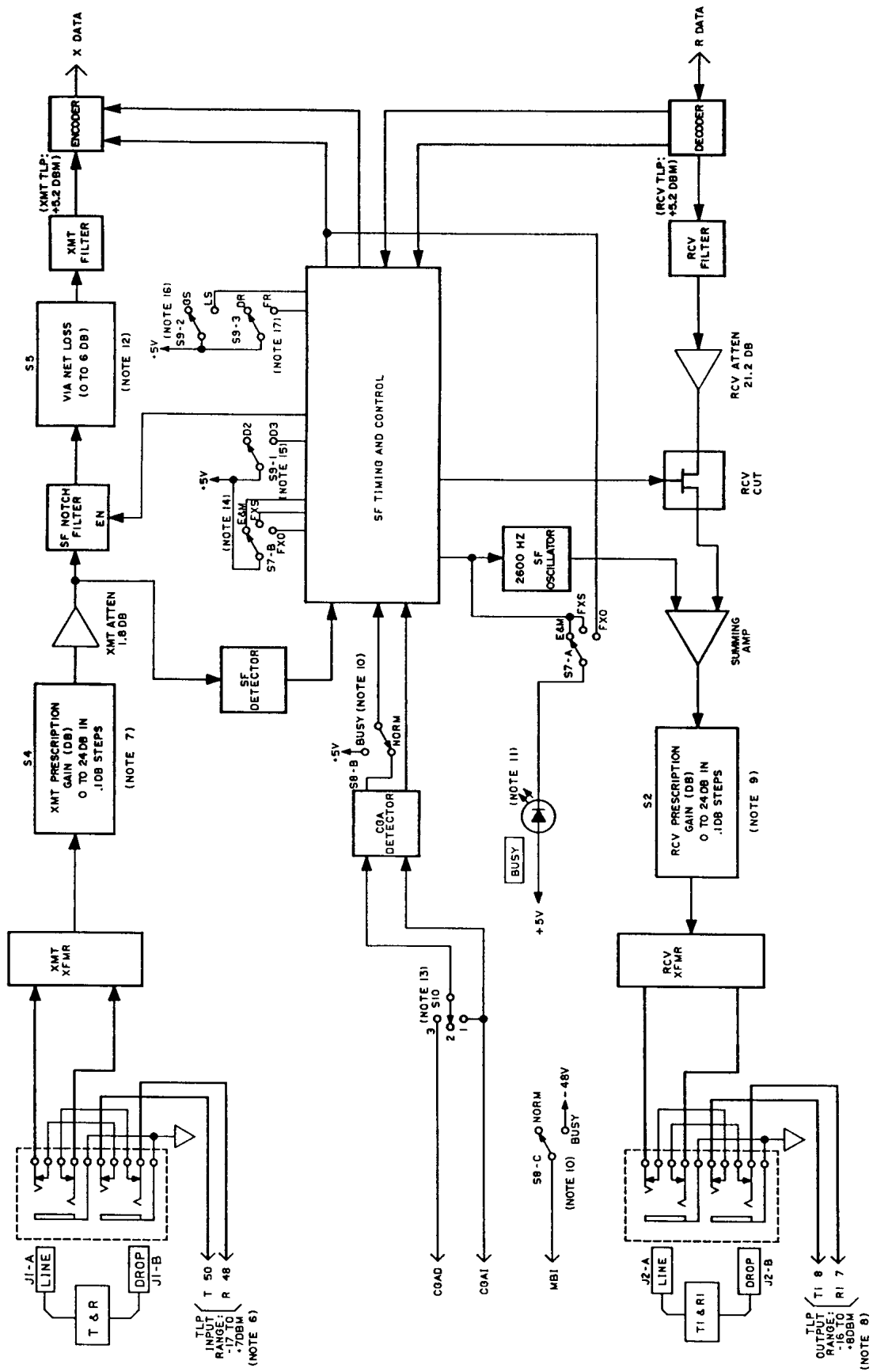


Figure 6. 3654-00 (Issue 5) Block Diagram

NOTES

1. P.C. BOARD CONNECTOR PIN.
2. FRONT PANEL MARKING.
3. PRIMARY TRANSMISSION PATH.
 SIGNAL FLOW DIRECTION.
4. GANGED SWITCHES ARE INDICATED BY ALPHABETICALLY SUFFIXED REF. DESIGNATIONS; NUMERICAL SUFFIX DENOTES DISCRETE SWITCH WITHIN A PACKAGE.
5. PC MOUNT TEST JACKS:

MARKING	FUNCTION
T & R LINE J1-A	ACCESS TOWARDS CHANNEL UNIT
T & R DROP J1-B	ACCESS TOWARDS OFFICE EQUIPMENT
T1 & R1 LINE J2-A	ACCESS TOWARDS CHANNEL UNIT
T1 & R1 DROP J2-B	ACCESS TOWARDS OFFICE EQUIPMENT

6. THE XMT INPUT RANGE AT T & R: -17 DBM TO +7 DBM. THE UNIT IS FACTORY ADJUSTED FOR -16 DBM INPUT. THE XMT GAIN IS SET TO 23 DB.
7. THE XMT PRESCRIPTION CIRCUIT PROVIDES 24 DB GAIN IN 0.1 DB STEPS TO COMPENSATE FOR OFFICE WIRING LOSS AND INPUT LEVEL VARIATIONS. REFER TO THE FOLLOWING TABLE FOR SETTING PRESCRIPTION GAIN.

INPUT LEVEL (DBM)	XMT GAIN SETTING (DB)
+7	0
0	7
-16	23
-17	24

8. THE RCY OUTPUT RANGE AT T1 & R1: -16DBM TO +8DBM. THE UNIT IS FACTORY ADJUSTED FOR +7DBM OUTPUT. THE RCY GAIN IS SET TO 23 DB.
9. THE RCY PRESCRIPTION CIRCUIT PROVIDES 24 DB GAIN IN 0.1 DB STEPS TO COMPENSATE FOR OFFICE WIRING LOSS AND OUTPUT LEVEL VARIATIONS. REFER TO THE FOLLOWING TABLE FOR SETTING PRESCRIPTION GAIN.

OUTPUT LEVEL (DBM)	RCY GAIN SETTING (DB)
+8	24
+7	23
0	16
-16	0

10. BUSY SWITCH:
SWITCH HANDLE UP IS POSITION
SWITCH HANDLE DOWN IS POSITION
BUSY SWITCH PERFORMS THE FOLLOWING FUNCTIONS:
A. ILLUMINATES LED ON FRONT PANEL
B. REMOVES SF TONE FROM RCY PATH (T1 AND R1)
C. SENDS A BUSY SIGNAL TO FAR END
D. PROVIDES A MANUAL BUSY INDICATION TO THE ALARM AND LOGIC UNITS

11. THE LED ILLUMINATES WHEN:
A. THE BUSY SWITCH IS IN THE POSITION.
B. SF-E&M: A BUSY SIGNAL IS DECODED ON THE RCY PATH.
C. SF-FXS: LOOP CLOSURE IS DECODED ON THE RCY PATH
D. SF-FXO: RING GROUND OR LOOP CLOSURE IS SIGNALLED ON THE XMT PATH.
12. THE VIA NET LOSS (VNL) CIRCUIT PROVIDES 6DB ATTENUATION IN 0.1 DB STEPS IN THE XMT PATH TO FACILITATE INTER-CONNECT LOSS.
13. TRUNK PROCESSING DURING A CGA ALARM CAN BE SELECTED VIA SWITCH S10 FOR THE FOLLOWING OPERATING MODE.

POSITION	CGA MODE
1	IMMEDIATE BUSY
2	IMMEDIATE IDLE
3	IMMEDIATE IDLE FOR APPROXIMATELY 2.5 SECONDS, FOLLOWED BY CONTINUOUS BUSY.

14. MODE SELECTION E&M/FXO/FXS IS OPTIONAL VIA SWITCH S7. E&M MODE ALSO FUNCTIONS AS DP/DX SIGNALING. THE OPERATING MODE OF THE 3654-00 MUST ALWAYS BE SET TO THE SAME MODE AS THE FAR END PCM CHANNEL UNIT.
15. D2/D3 SIGNALING COMPATIBILITY IS PROVIDED BY OPTION SWITCH S9-1.
16. LOOP START/GROUND START OPTIONING FOR FXS AND FXO MODE IS SELECTABLE VIA SWITCH S9-2.
17. D-SPEC/F-SPEC RINGING OPTIONING FOR FXS AND FXO MODE IS SELECTABLE VIA SWITCH S9-3. F-SPEC RINGING (FR) CAN BE USED FOR BOTH LOOP START AND GROUND START OPERATIONS. D-SPEC RINGING (DR) IS USED ONLY ON LOOP START OPERATION.

Figure 7. 3654-00 (Issue 5) Block Diagram (Notes for Figure 6)

- Controls the insertion and removal of the 2600HZ NOTCH FILTER in the transmit path. The filter is inserted in 13 milliseconds to minimize encoding of the SF tone. The filter remains in the transmit path for a minimum of 225 milliseconds or 50 milliseconds after SF tone ceases.
- In the E&M mode, idle and busy signals are applied to a pulse corrector and then to the A highway of the ENCODER.
- In the FXO mode, ring-ground signals are applied to the transmit B highway. The ring-ground signal is disabled by tip-ground signaling decoded from the receive A highway.
- In the FXO mode the loop-closure signals are pulse corrected and then to the A highway of the ENCODER. Note that the loop closure signals are inhibited until a tip ground signal is present on the A highway of the DECODER.
- in the FXS mode and switch S9-2 in the GS (ground-start) position, absence of SF tone will be detected as a tip-ground detection and be applied to the A highway of the ENCODER. Modulated SF tones (18 to 30pps) will be detected as ringing and be applied to the B highway of the ENCODER.

- In the FXS mode and switch S9–2 in the LS (loop-start) position, 20pps-modulated SF tone is not used for ringing. The far end transmits SF tone for ringing and no SF tone for idle. The ringing signal is applied to the transmit B highway, bypassing the 20pps demodulator. The tip-ground signaling is forced internally and then applied to the transmit A highway.

Table 1. Signaling Correspondence Between SF Interface States and PCM A and B Signaling Highway States— E&M MODE

SF Tone Signaling State Received from the SF Facility	PCM Signaling State Transmitted		SF Tone Signaling State Transmitted to the SF Facility	PCM Signaling State Received	
	A HIGHWAY	B HIGHWAY		A HIGHWAY	B HIGHWAY
Tone on	0 (Idle)	0 (Idle)	Tone on	0 (Idle)	*
Tone Off	1 (Busy)	1 (Busy)	Tone Off	1 (Busy)	*
Tone-Burst Dial Pulsing	0/1 Pulsing	0/1 Pulsing	Tone-Burst Dial Pulsing	0/1 Pulsing	*

Table 2. Signaling Correspondence Between SF Interface States and PCM A and B Signaling Highway States— FXO LOOP-START MODE

SF Tone Signaling State Received from the SF Facility	PCM Signaling State Transmitted		SF Tone Signaling State Transmitted to the Sf Facility	PCM Signaling State Received	
	A HIGHWAY	±B HIGHWAY		±A HIGHWAY	B HIGHWAY
Tone on	0 (\overline{LC})	0 (\overline{RG})	Tone on	0 (TG)	0 (R)
Tone Off	1 (LC)	1 (\overline{RG})	Tone Off	0 (TG)	1 (\overline{R})
Tone-Burst Dial Pulsing	1/0 Pulsing	1 (\overline{RG})			

Table 3. Signaling Correspondence Between SF Interface States and PCM A and B Signaling Highway States— FXO GROUND-START MODE

SF Tone Signaling State Received from the SF Facility	PCM Signaling State Received ±A Highway	PCM Signaling State Transmitted	
		A HIGHWAY	±B HIGHWAY
Tone On	1 (\overline{TG})	0 (\overline{LC})	1 (\overline{RG})
Tone On → Off (Seizure)	1 (\overline{TG})	0 (\overline{LG})	1 (\overline{RG}) → 0 (RG)
Tone Off (Busy)	0 (TG)	1 (LC)	1 (\overline{RG})
Tone-Interrupted Dial Pulsing	0 (TG)	1/0 Pulsing	1 (\overline{RG})
Tone Off (T-CXR Side Disconnects First)	0 (TG) → 1 (\overline{TG})	1 (LC)	1 (\overline{RG})
SF Tone Signaling State Transmitted to SF Facility		PCM Signaling State Received	
		±A HIGHWAY	B HIGHWAY
Tone On		1 (\overline{TG})	1 (\overline{R})
Tone Off		0 (TG)	1 (\overline{R})
20 PPS-Modulated SF Tone		0 (TG)	0 (\overline{R})

Table 4. Signaling Correspondence Between SF Interface States and PCM A and B Signaling Highway States— FXS LOOP-START MODE

SF Tone Signaling State Received from the SF Facility	PCM Signaling State Transmitted		SF Tone Signaling State Transmitted to the SF Facility	PCM Signaling State Received	
	‡A HIGHWAY	B HIGHWAY		A HIGHWAY	‡B HIGHWAY
Tone on	0 (TG)	0 (R)	Tone on	0 (\overline{LC})	1 (\overline{RG})
Tone Off	0 (TG)	1 (\overline{R})	Tone Off	1 (LC)	1 (\overline{RG})
			Tone-Interrupted Dial Pulsing	1/0 Pulsing	1 (\overline{RG})
			Tone Off (Abnormal Condition)	*	0 (RG)

Table 5. Signaling Correspondence Between SF Interface States and PCM A and B Signaling Highway States— FXS GROUND-START MODE

SF Tone Signaling State Received from the SF Facility	PCM Signaling State Transmitted		SF Tone Signaling State Transmitted to the SF Facility	PCM Signaling State Received	
	‡A HIGHWAY	B HIGHWAY		A HIGHWAY	‡B HIGHWAY
Tone on	1 (\overline{TG})	1 (\overline{R})	Tone on	0 (\overline{LC})	1 (\overline{RG})
Tone Off	0 (TG)	1 (\overline{R})	Tone Off	0 (\overline{LC}) 1 (LC) (See Note)	0 (RG) 1 (RG) (See Note)
20 PPS-Modulated SF Tone	0 (TG)	0 (R)	Tone-Interrupted Dial Pulsing	1/0 Pulsing	1 (\overline{RG})

Note: Tone Off can be caused by either RG or LC depending upon the presence of TG at the PCM far-end terminal FXS channel unit: TG forces LC and disables RG.

Table 6. Key for Table 1 through Table 5

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
LC	Loop closure	RG	Ring lead ground	→	Changes to
\overline{LC}	No loop closure	\overline{RG}	No ring lead ground	*	Signal path is not used
R	Ringing	TG	Tip lead ground	‡	State is inverted in D2 mode
\overline{R}	No ringing	\overline{TG}	No tip lead ground		

4.3 Receive VF Path

Digital signals, received from the common equipment, are applied to the DECODER circuit. The DECODER converts the digital signal to an analog signal which is applied to the RCV FILTER. The DECODER also recovers the signaling information from the digital signal and outputs this information as A and B highways to the SF TIMING & CONTROL circuit.

The RCV filter reconstructs the analog signal suppressing frequencies above 4KHz. The VF signal is then applied to the RCV ATTN which attenuates the 5.2dBm signal from the RCV FILTER by 21.2dB. This attenuated signal is then applied to the SUMMING AMP through the RCV CUT circuit. The RCV CUT circuit, under control of the SF TIMING & CONTROL circuit, can inhibit the VF signal from being applied to the SUMMING AMP.

The SUMMING AMP combines the VF signals from the RCV CUT and the SF tone enabled from the SF TIMING & CONTROL circuit. This combined signal is then applied to the RCV PRESCRIPTION GAIN circuit which is adjustable from 0 to 24dB of gain in 0.1dB increments. This provides adjustment of the RCV output range from –16 to + 8dBm.

The VF/tone signal is then applied to the RCV XFMR which provides dc isolation, surge protection, and impedance matching (with option S1). The RCV XFMR then applies the signals to T1 and R1 (pins 8 & 7).

4.4 Receive Signaling Path

At the appropriate channel time, signaling on the A and B highways is applied to the SF TIMING AND CONTROL which responds, as required, to the E&M, FXO, and FXS operating modes with the following specific functions:

- Controls the level of SF tone that is transmitted on the receive path toward the SF facility such that when tone transmission is initiated, a high level of -8dBm0 is applied for 400 milliseconds. This high level tone insures detection at the far end of the SF link. The timing circuit then reduces the tone level to -20dBm0. The HL/LL output of the SF TIMING AND CONTROL is applied to the TONE LEVEL CONTROL.
- Controls the RCV CUT to prevent VF energy from interfering with 2600Hz signaling tone on the receive path. In the E&M mode, the CUT is described in Table 7. In the FXO mode, incoming SF tone on the transmit pair T, R (pins 50 and 48) inserts the CUT (removal of the SF tone disconnects the CUT after a 50 millisecond delay). In the FXS mode, the CUT is inserted while a loop-open signal is received on highway A (the CUT is removed 125 milliseconds after a loop closure signal is received).
- In the E&M mode, signaling received on the A highway is converted to SF tone signaling; idle (tone), busy (no tone).
- In the FXO mode, tip-ground signaling is received on the A highway. In the groundstart mode, the absence of tip ground enables SF-tone transmission toward the SF facility. Tip ground decoded on the received A highway inhibits the ringground signal on the transmit B highway and the SF-tone transmission toward the SF facility. In the loop-start mode, the tip ground signal is internally forced to inhibit ring ground and SF tone, representing the idle condition.

Table 7. Receive Path Voice Cut Operation in the E&M Mode

SF Facility XMT Pair	RCV Path A Highway	Cut
Idle (Tone On) to Busy (Tone Off)	Idle (0)	Removed in 625msec
Idle (Tone On)	Busy (1) to Idle (0)	Inserted in 9msec
Idle (Tone On)	Idle (0) to Busy (1)	Removed in 125msec

- In the FXO mode, the ringing signal is received on the B highway. In the groundstart mode, the ringing signal is applied to a 20pps modulator to generate 20pps-modulated SF ringing tone toward the SF facility. In the loop-start mode, 20pps SF tone is not required. Continuous SF tone is transmitted for ringing and no SF tone for idle condition.
- In the FXS mode, ring-ground signaling is received on the receive B highway. Ring ground inhibits SF tone toward the SF facility representing the busy condition.
- In the FXS mode, loop-closure signaling is received on the A highway. Loop closure inhibits SF tone transmission toward the SF facility.
- All signaling states for the different modes of operations are D1D, D2, D3, and D4 compatible.

4.5 Norm/Busy Switch (S8)

In the NORM position, switch S8 provides continuity between the E&M, FXO, and FXS signaling leads and the signaling interface circuitry within the 3654–00. In the BUSY position, S8 performs the following functions:

- Buses the receive path by removing outgoing SF.
- Sends an off-hook busy signal to the opposite end of the carrier facility.
- Illuminates the BUSY LED.

- Provides a signal on the MBI (Make Busy Indicator) lead to illuminate the BUSY LED on the Alarm Logic Unit (ALU) to indicate that a channel unit within the digroup has been manually busied.

4.6 Carrier Group Alarm

The 3654–00 Channel Unit can be optioned to process a Carrier Group Alarm in one of the following three methods:

- With S10 in the 1 position, a busy condition is sent immediately upon detection of a CGA signal.
- With S10 in the 2 position, an idle condition is sent immediately upon detection of a CGA signal.
- With S10 in the 3 position, an idle condition is sent immediately upon detection of a CGA signal, and a busy condition is sent 2.5 seconds later.

5. MOUNTING

The 3654–00 mounts in one channel unit slot of a 360/363 D4 terminal and is equipped with an insert/eject lever which facilitates removal and installation of the unit.

CAUTION

Removal and installation 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.

Align the channel unit with the appropriate card-guided slot of the terminal. Slide the unit into the slot with the front panel in a horizontal (up) position. 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 cardedge connector will begin to make contact with the inner portion of the backplane connector. Continue applying light pressure to the bottom edge of the front panel until the unit snaps into place.

6. INSTALLER CONNECTIONS

Installer connections are made to the T,R and T1,R1 leads at the 3654–00 card-edge connector on the backplane of the 360/363 D4 terminal. The 3654–00 pinout assignments are shown in Table 8.

Table 8. 3654–00 Installer Connections

LEAD DESIGNATION		PIN
T	[Transmit Pair From SF Facility]	50
R		48
T1	[Transmit Pair To SF Facility]	8
R1		7

7. OPTIONS

The 3654–00 is equipped with DIP switches and slide switches that are used to condition the module for proper application and operation. Refer to Figure 8 for the location and description of the options.

The 3654–00 option switches are provided for mode selection (FXO, FXS, or E&M), loop-start or ground-start operation in the FXO or FXS mode, CGA alarm signaling selection, and prescription gain adjustments for the transmit and receive paths to facilitate interconnect loss in the transmit path.

7.1 XMT And RCV Prescription Gain Adjustment (S2 And S4)

DIP switches S2 (receive) and S4 (transmit) are eight-section DIP switches that provide gain (from 0 to 24dB) in 0.1dB increments for setting the transmit and receive paths to the proper operating level.

If the input level, from the SF facility to the transmit path (T&R), of the 3654–00 is + 7.0dBm set the switches on S4 to 0dB. Increasing the gain setting of S4 reduces the input level requirement of +7.0dBm in proportion to the amount of gain provided. Similarly, if the output of the 3654–00 (T1 &R1) is to be + 7.0dBm to the SF facility, set the switches of S2 to 23dB. Decreasing the setting of S2 decreases the output level (up to a minimum of – 16dBm). The transmit path (T&R) will accept a TLP range between – 17 to + 7dBm. The receive path (T1 &R1) will provide an output TLP range between + 8 to – 16dBm.

7.2 Via Net Loss [(VNL) (SS)]

The VNL circuit provides up to 6dB of attenuation in 0.1dB steps in the transmit path to facilitate interconnection loss.

7.3 Mode Selection (S7)

Option switch S7 is used to set the operating mode of the 3654–00 as follows:

Set to...	If...
FXO	The far end of the 4-wire SF facility is provided with an SF-FXS converter unit and the respective channel PCM carrier facility is provided with a 2/4FXO channel unit.
FXS	The far end of the 4-wire SF facility is provided with an SF-FXO converter unit and the respective channel the PCM carrier facility is provided with a 2/4FXS channel unit.
E&M	The far end of the 4-wire SF facility is terminated by an SF-E&M converter unit and the end of the PCM carrier facility is terminated with a 2/4 E&M channel unit.
USF (Tandem Connect)	The far end of the SF facility is terminated by a second 3654–00 for tandem-connecting two PCM Carrier facilities. For FX applications, the unit at one end of the facility can be used in the FXO mode (S7 to FXO) while the unit at the other end is used in the FXS mode (S7 to FXS).
DPO, PLR, DPT, DX	If the far end of the PCM Carrier facility is terminated with a 4PLR, 2DPO, 2DPT, or 2/4DX channel unit, set S7 to the E&M position.
4TDM	For 4TDM applications, set S7 to match the unit which connects to the TDM channel unit on the opposite end of the metallic facility.

7.4 Busy/Normal (S8)

The BUSY/NORM switch is operated to the NORM position for normal operation of the channel unit. S8 is operated to the BUSY position when testing or aligning the channel unit.

7.5 D2/D3 PCM Terminal Compatibility (S9–1)

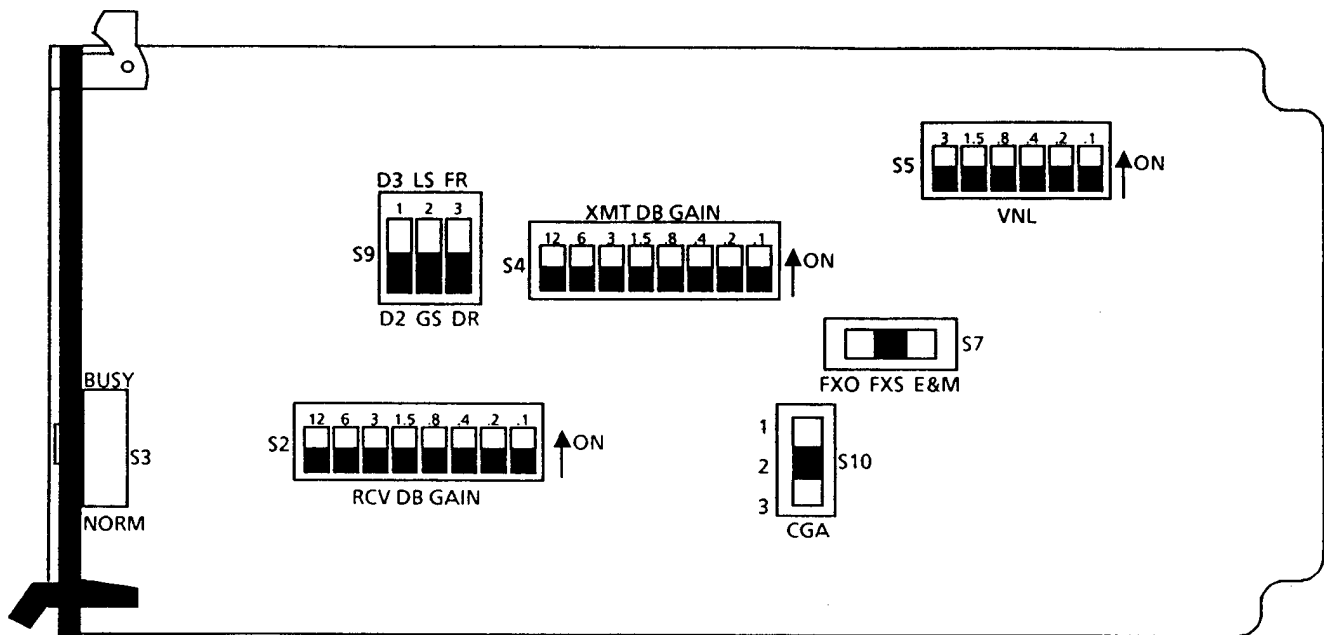
Switch S9–1 is operated to the D2 or D3 position as required to conform with the A and B highway signaling format used on the PCM facility.

7.6 Loop-Start Or Ground-Start (S9–2)

Select either LS (loop-start) or GS (ground-start), as required, by placing switch S9–2 in the appropriate position. If LS is selected, all FXO channel units and FXS/FXO converter units in the signaling path must also be arranged for loopstart operation; if GS is selected, all units in the signaling path must be set for ground-start operation.

7.7 Distinctive Or Normal (2/4 Second) Ringing (S9–3)

Select either DR (distinctive) or FR (normal, 2 seconds ON - 4 seconds OFF) ringing, as required, by placing switch S9–3 in the appropriate position. In the FXO or FXS mode, normal ringing can be used for both loop-start or ground-start operation while distinctive ringing can only be used in the loop-start operation. The distinctive ringing mode provides a symmetrical operate/release delay (70msec delay for FXO and a 55msec delay for FXS).



OPTION	FUNCTION	POSITION
S2 RCV GAIN	8 section DIP switch used to adjust the receive path to the proper operating level. Gain can be selected from 0 to 24dB in 0.1dB increments.	ON(IN)/OFF(Out) as required
S3	Busy out channel during testing.	B (BUSY)
S4 XMT GAIN	8-section DIP switch used to adjust the transmit path to the proper operating level. Gain can be selected from 0 to 24dB in 0.1dB increments.	ON(IN)/OFF(Out) as required
S5	6-Section DIP switch to adjust the VNL circuit which provides up to 6dB of attenuation in 0.1dB steps in the transmit path to facilitate interconnection loss.	ON(IN)/OFF(Out) as required
S7	Selects operation mode of the 3654–00 to interface properly with the far-end channel unit.	E&M/FXO/FXS as required
S9–1	Interfacing a D2 T carrier	D2
S9–1	Interfacing a D1/D3 or D4 carrier	D3
S9–2	FX loop-start operation	LS
S9–2	FX ground-start operation	GS
S9–3	Interfacing distinctive ringing	DR
S9–3	Interfacing 2/4 ringing	FR
S10	Busy immediately upon CGA Idle immediately upon CGA Idle immediately upon CGA and busy 2.5 seconds later	1 2 3

Figure 8. 3654–00 (Issue 5) Option Locations

7.8 CGA Trunk Processing (S10)

The receive path of the 3654–00 can be set for one of three modes to transmit a PCM carrier fail condition toward the SF facility. Condition S10 as follows:

- Setting switch S10 to position 1 sends an immediate busy condition upon detecting a CGA signal.
- Setting switch S10 to position 2 sends an immediate idle condition upon detecting a CGA signal.

- Setting switch S10 to position 3 sends an immediate idle condition followed by a busy condition 2.5 seconds after detecting a CGA signal.

8. ALIGNMENT

Be certain that all the options have been properly conditioned for the application in accordance with Part 7. before beginning the alignment procedure.

8.1 Transmit Alignment

The XMT PRESCRIPTION GAIN switch S4 provides 0.0 to 24.0dB gain in 0.1dB increments to accommodate an input TLP range from –17.0 to +7.0dBm. To adjust the transmit path to the proper operating level, the difference between +7.0dB and the transmit TLP must be maintained.

EXAMPLE: For a transmit TLP of –11dBm;

$$+7.0 - (-11.0) = 18.0$$

Set switches S4–1 (12) and S4–2 (6) to the ON (IN) position.

8.2 Receive Alignment

The RCV PRESCRIPTION GAIN switch S2 provides 0.0 to 24.0dB gain in 0.1dB increments to accommodate an input TLP range from –16.0 to +8dBm. To adjust the receive path to the proper operating level, the difference between –16.0dB and the receive output TLP must be maintained.

EXAMPLE: For a receive output TLP of +8dBm;

$$+8.0 - (-16.0) = 24.0$$

Set all switches on S2 to the ON (IN) position.

Condition S5 (VNL) as required for 0.0 to 6.0dB Via Net Loss in the transmit path.

EXAMPLE: If 5.0dB loss is required, operate sections 3, 1.5, .4, and .1 of S5 to the ON (IN) position.

9. 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)

10. WARRANTY & CUSTOMER SERVICE

10.1 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)

10.2 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.

10.3 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.

10.4 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.

11. SPECIFICATIONS

11.1 Electrical

The electrical characteristics of the 3654–00 (Issue 5) USF Channel Unit are as follows:

11.1.1. VF Transmission Specifications (single-ended)

- (a) PERMISSIBLE MODES: 4N-4T, 4T-4N, and 4T-4T
- (b) XMT INPUT (T&R) TLP RANGE: –17 to +7dBm (adjustable from 0 to 24dB in 0.1dB increments via the XMT GAIN switches).
- (c) RCV OUTPUT (T1 & R1) TLP RANGE: –16 to +8dBm (adjustable from 0 to 24dB in 0.1dB increments via the RCV GAIN switches).
- (d) XMT AND RCV PORT IMPEDANCE: 600 ohms.
- (e) LINE SIDE LEVELS: Transmit (fixed) and receive (fixed), + 5.2dBm.

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- (f) 1000HZ GAIN: Transmit (fixed), –1.8dB; receive (fixed), –21.2dB.
- (g) TRANSMIT AND RECEIVE GAIN: 0 to 24dB, in 0.1dB increments.
- (h) XMT AND RCV PATH FREQUENCY RESPONSE (Referenced at 1 kHz):

Freq. (Hz)	XMT (dB)	RCV (dB)
60	–14 maximum	–
200	–2 TO +0.15	–1 to +0.15
300	Ⓜ	Ⓜ
1000	0(REF)	0(REF)
3000	Ⓜ	Ⓜ
3200	–.75 to +0.15	–.75 to +0.15
3400	–1.5 to 0	–1.5 to 0
4000	–14 maximum	–14 maximum
4200	–23 maximum	–21 maximum
4600	–32 maximum	–28 maximum

- (i) SIGNAL TO DISTORTION RATIO: 35dB minimum at 0 to –30dBm0; 29dB minimum at –40dBm0; 25dB minimum at –45dBm0.
- (j) LONGITUDINAL BALANCE (–16TPL):

Frequency (Hz)	AT&T Method (dB)	IEEE Method (dB)
200	86	74
1000	80	74
3000	78	69

- (k) RETURN LOSS: 28dB minimum at 1kHz; 23dB minimum at 300 to 3000Hz.
- (l) XMT/RCV IDLE NOISE: 20dBmC0, maximum.
- (m) CROSSTALK:

Frequency (Hz)	Single-Ended Level
700	–71dBm0
1000	–71dBm0
3000	–70dBm0

- (n) LEVEL TRACKING: ±0.25dB from +3 to –37dBm0; ±0.5dB from –37 to – 50dBm0.
- (o) INTERMODULATION DISTORTION: With an input power of –13dBm0, R2 is not less than 50dB and R3 is not less than 54dB, [R2 and R3 are defined in American Telephone and Telegraph (AT&T) PUB 41008.]
- (p) XMT AND RCV SINGLE FREQUENCY DISTORTION: Measured end-to-end, –40dB maximum from 0 to 4kHz; –28dB maximum from 4kHz to 12kHz.
- (q) XMT AND RCV ENVELOPE DELAY DISTORTION (Measured single-ended):

Frequency (Hz)	Delay (dB)
800 to 2700	187usec maximum
1000 to 2500	95usec maximum
1150 to 2300	75usec maximum

11.1.2. SF Signaling Receiver Specifications

- (a) SIGNALING FREQUENCY: 2600Hz.
- (b) SIGNALING TONE DETECTION BANDWIDTH: Detection, $2600 \pm 15\text{Hz}$; Rejection, $2600 \pm 50\text{Hz}$.
- (c) SIGNALING TONE THRESHOLD: Detection, $-31 \pm 2\text{dBm0}$.
- (d) SIGNAL TO GUARD RATIO: 10dB, nominal.
- (e) RECEIVER GUARD CIRCUIT: Enable time, $50 \pm 8\text{msec}$; disable time, $225 \pm 60\text{msec}$.
- (f) RECEIVER MINIMUM OPERATE TIMING: SF tone bursts of 30msec or less will not be recognized; SF tone bursts of 35msec or greater will be recognized.
- (g) RECEIVER CARRIER FADE BRIDGING: Following tone intervals of 225msec or more, the receiver will bridge fade intervals of up to 40msec.
- (h) BUSY SWITCH FUNCTION: As stated in the following table:

Mode	XMT Toward PCM Facility	RCV T1 & R1
FXS	Tip ground, no ringing	Tone off
FXO	Open loop, no ground on ring	Tone off
E&M	Busy	Tone off

- (i) SF TONE REJECTION AT 2600HZ: 45dB, minimum.
- (j) DIAL PULSE CORRECTION (SF Signaling Receiver):

Input (pps)	% Break In	% Break Out
8	30	42 to 62
8	80	51 to 68
10	35	47 to 68
10	80	47 to 63
12	45	49 to 65
12	70	49 to 65
13	50	49 to 65
13	70	49 to 65

- (k) SF RECEIVER VOICE PATH FILTER TIMING: SF filter inserted into VF transmit path at $13 \pm 7\text{msec}$; removal time, $50 \pm 8\text{msec}$. Minimum insertion interval, $225 \pm 60\text{msec}$.
- (l) MODULATED SF RINGING TONE DETECTION: 18 to 30pps.

11.1.3. SF Signaling Transmitter Specifications

- (a) SIGNALING FREQUENCY: $2600 \pm 5\text{Hz}$.
- (b) HIGH-LEVEL SIGNALING TONE LEVEL: $-8 \pm 1\text{dBm0}$.
- (c) LOW-LEVEL SIGNALING TONE LEVEL: $-20 \pm 1\text{dBm0}$.

- (d) HIGH-LEVEL SIGNALING TONE TRANSMIT INTERVAL: 400 ± 100 msec.
- (e) SF TONE-OFF LEAKAGE: Less than -70 dBm0.
- (f) MODULATED SF RINGING TONE: 20pps.
- (g) EXTRANEIOUS FREQUENCY COMPONENTS: Less than 35dBm0.

11.1.4. SF Signaling Timing Specifications

- (a) PRE-CUT TIMING: A PCM signaling highway change from busy to idle cuts the channel unit receive path in 9 ± 4 msec. Tone transmission follows this cut in 8 ± 7 msec. The total delay between the start of the idle state and the start of SF tone transmission is 17 ± 3 msec.

- (b) VF PATH CUT TIMING:

E&M Mode

- The receive path of the channel unit is continuously cut while signaling tone is transmitted and received simultaneously.
- During an interval of continuous tone reception, the switching of the PCM signaling highway from idle to busy removes the cut from the channel unit receive path in 120 ± 40 msec.
- During an interval of continuous tone reception, the switching of the PCM signaling highway from busy to idle cuts the channel unit receive path in 9 ± 4 msec.
- Following an interval of continuous tone transmission and reception, the removal of tone from the SF receiver will remove the cut from the channel unit receive path in 625 ± 125 msec.
- Following an interval when no tone is received, the switching of the PCM signaling highway from busy to idle will cut the channel unit receive path for 625 ± 125 msec.

FXO Mode:

- In loop-start and ground-start operation the cut is removed in 50 ± 8 msec after tone is removed from the T&R port (pins 50 and 48, respectively).
- In ground-start operation the cut is removed in 120 ± 40 msec after a tip ground signal is detected on the RCV A signaling highway. Cut is inserted in 75 ± 20 msec after a tip open is detected.

FXS Mode:

- Cut is removed in 120 ± 40 msec after loop closure is detected on the RCV A signaling highway.

11.2 General Specifications

- (a) POWER REQUIREMENTS: Operating range, -44 to -56 Vdc; current drain, 20mA nominal at -48 Vdc.
- (b) TRUNK PROCESSING DURING CGA ALARM: Three operating modes available for selection:
 - Immediate busy (tone OFF toward SF interface), S10 to position 1.
 - Immediate idle (tone ON toward SF interface), S10 to position 2.
 - Immediate idle for 2.5 seconds followed by busy condition, S10 to position 3.

11.3 Physical

The physical characteristics of the 3654–00 (Issue 5) USF Channel Unit are as follows:

Table 9. Physical Specifications

Feature	U.S.	Metric
Height	4.3 inches	10.9 centimeters
Width	1.36 inches	3.5 centimeters
Depth	10.4 inches	26.4 centimeters
Weight	10 ounces	283 grams
Operating Temperature	32° to 122°F	0° to 50°C

