3651–01/03/61/63 2-Wire E&M Channel Units

® Complies with UL Standard 1459 Second Edition (3651–61/63 Only)*

CONTENTS **PAGE**

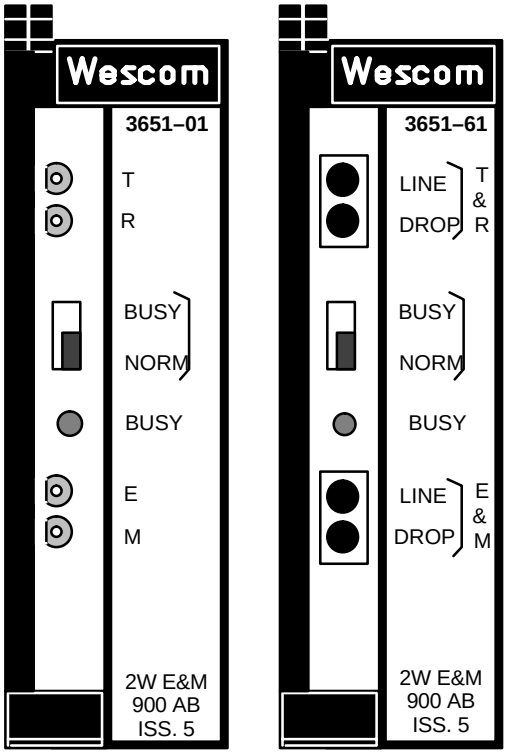

Figure 1. 3651—01 and 3651—61 2-Wire E&M Channel Units

1. GENERAL

1.1 Document Purpose

This document provides a circuit description, testing, and alignment information for the Charles Industries 3651–01/03/61/63 2-Wire E&M channel units (3651–01 & –61 shown in Figure 1).

1.2 Document Status

This document is reprinted to provide a general editorial update.

1.3 Equipment Function

These channel units are used in the Charles Industries 360/363 D4 Digital Carrier Terminal. The 3651–61 and 3651–63 are provided with line (carrier facility) and drop access lifting jacks in the 2-wire voice path and in the E&M signaling path. The 3651–01 and 3651–03 are provided with pin jacks instead of lifting jacks. On these channel units the lifting function is effected by the BUSY position of the NORM/BUSY switch, which disconnects the drop-side voice and signaling paths. The pin jacks allow access toward the line when the NORM/BUSY switch is in BUSY, and allow monitoring access when the NORM/BUSY switch is in NORM.

Table 1 provides a correlation between the Issue 5 channel units and those of a former issue, which they replace.

Table 1. 2-Wire E&M Channel Unit Cross-Reference

Model (Iss. 5)	Description	Models and Issues Being Replaced
3651–01	2W E&M with A&B leads, 900 ohm.	3651–00/01 Issue 1, when optioned for 900 ohm 2W impedance; 3651–01 Issue 4.
3651–03	2W E&M with A&B leads, 600 ohm.	3651–00/01 Issue 1, when optioned for 600 ohm 2W impedance; 3651–03 Issue 4.
3651–61	2W E&M with A&B leads and line-drop access jacks, 900 ohm.	3651–60/61 Issue 3, when optioned for 900 ohm 2W impedance; 3651–61 Issue 4.
3651–63	2W E&M with A&B leads and line-drop access jacks, 600 ohm.	3651–60/61 Issue 3, when optioned for 600 ohm 2W impedance; 3651–63 Issue 4.

1.4 Equipment Location/Mounting

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

1.5 Equipment Features

The 3651–01/03/61/63 features include the following:

- Complies with American Telephone and Telegraph (AT&T) PUB43801 specifications
- Complies with UL Standard 1459 Second Edition and FCC Part 15 Class A limits (3651–61/63 only)
- Front-panel lifting jacks on the 3651–61/63 channel units and front-panel pin jacks on the 3651–01/03 channel units for access to drop-side voice and signaling paths
- Prescription transmit and receive gain controls with incremental control in 0.1dB steps
- Front-panel NORM/BUSY switch
- Front-panel BUSY LED
- Selectable Type I, II, or III E&M signaling interface
- Automatic trunk processing during a carrier failure
- Trunk-processing (lead conditioning) relay (previously provided with 3651–01/61 only) is now a standard feature of the 3651–03/63

Hereafter, in this document the designation 3651–XX will be used when referring collectively to the 3651–01, 03, 61, and 63 channel units.

CAUTION

Field repairs/modifications may void compliance with UL 1459 – Second Edition. 3651–61/63 compliance with UL 1459 – Second Edition is restricted to inside plant wiring.

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.

CAUTION

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

3. APPLICATION GUIDELINES

A typical application is shown in Figure 2. The 3651–XX is used to provide interfacing between a PBX/CO 2-wire E&M port and a channel of a digital carrier facility. (A 3651–01 or 3651–61 would be provided for interfacing with a 900-ohm trunk, whereas a 3651–03 or 3651–63 would be provided for a 600-ohm trunk.) Nominal voice frequency (VF) levels at the 2-wire interface are –3dBm receive (output) and 0dBm transmit (input).

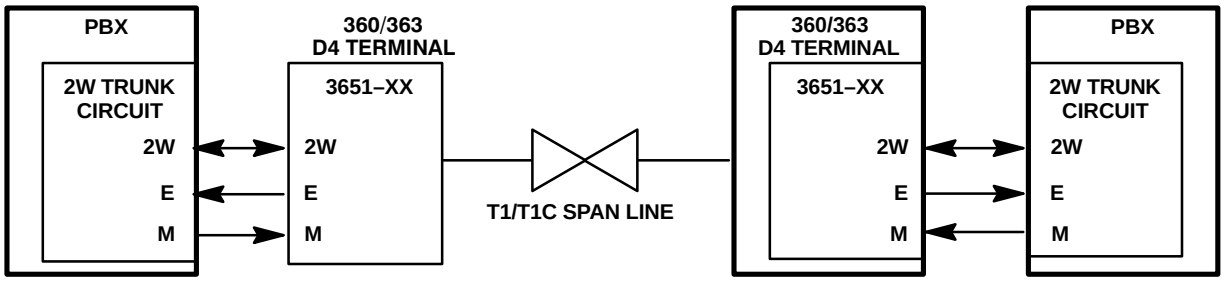

Figure 2. Typical 2-Wire E&M Application

Prescription gain controls are provided for matching the channel unit to a variety of office Transmission Level Points (TLPs) within the range of 0 to –4.5dBm in the transmit (input) direction, and +1.5 to –7dBm in the receive (output) direction. These controls can be used to compensate for up to 4.5dB wiring loss, based on 0dBm transmit and –3dBm receive levels.

The signaling port can be optioned for Type I, Type II, or Type III E&M interface toward the PBX/CO signaling port. See Figure 3 through Figure 5. The Type 1 interface can be used when no potential difference exists between the trunk circuit ground and the carrier terminal ground. The Type II interface allows operation in the presence of a difference in ground potentials by providing balanced signaling pairs for both the E- and the M-signaling paths. The Type III interface uses 3-wire balanced signaling leads for the M-lead path. However, it relies upon a return from the channel unit through ground for operating the E RELAY (or equivalent) in the trunk circuit. Therefore, only partial isolation is provided in this mode. During operation, a 3651–XX channel unit receives an input signal on the M-lead from the PBX/CO trunk, which it retransmits on the A and B signaling highways of the asso-

ciated digital carrier channel. Signaling in the opposite direction is received on the A signaling highway of the digital carrier channel and is passed by the 3651–XX channel unit to the PBX/CO trunk on the E-lead.

4. CIRCUIT DESCRIPTION

Refer to Figure 6 and Figure 7, the block diagrams of the 3651–01/03 and 3651–61/63, as needed while reading the following circuit description. Table 2 provides notes for these block diagrams.

4.1 Transmit Voice Path

Voice energy received from the PBX/CO 2-wire trunk circuit enters the 3651–XX on pins 50 (tip) and 48 (ring). In 3651–01/03 channel units, it passes directly into line transformer T1; in 3651–61/63 channel units, it passes through LINE and DROP lifting jacks before entering T1. Transformer T1 provides DC isolation and a balanced input to the 2W/4W HYBRID circuit. It also derives A and B leads from the 2-wire pair for the transmission of sealing current or DC signaling levels toward the PBX/CO trunk circuit.

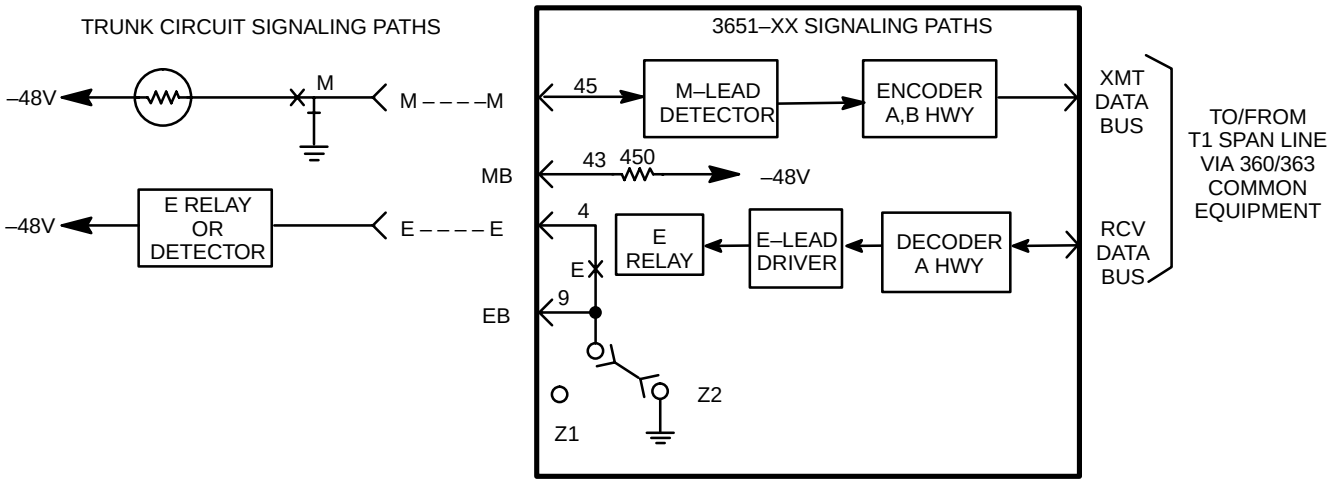

Figure 3. Signaling Path Configuration for Type I E&M Signaling Interface

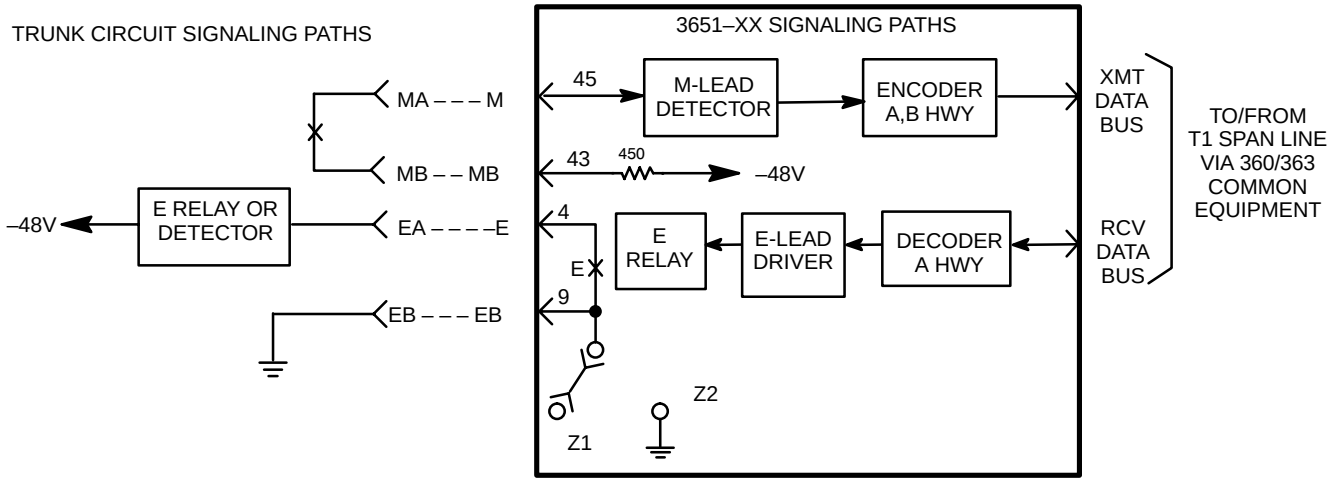

Figure 4. Signaling Path Configuration for Type II E&M Signaling Interface

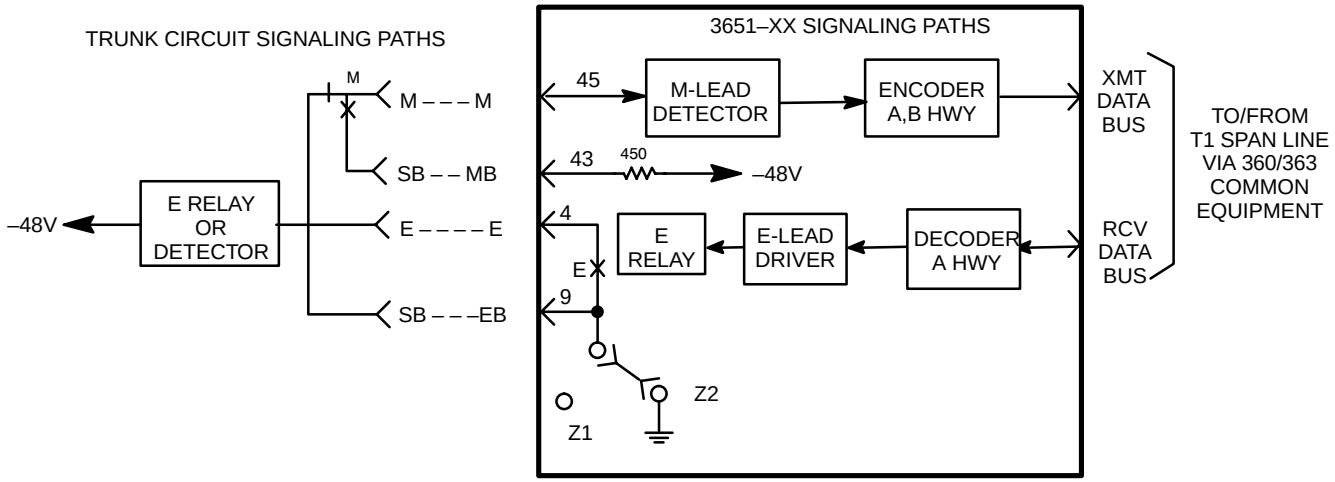

Figure 5. Signaling Path Configuration for Type III E&M Signaling Interface

Voice energy that enters the 2W/4W HYBRID via T1 is routed by the hybrid into the XMT GAIN and XMT PRESCRIPTION GAIN circuits. These circuits, acting together, set the transmit path gain to the level required to drive the XMT FILTER and ENCODER circuits. The use of the XMT PRESCRIPTION GAIN control allows finely controlled adjustment (0.1dB increments) for input office TLPs from 0.0 to –4.5dBm.

In the XMT FILTER, the voice energy is filtered so that energy outside the bandwidth of a standard voice channel is prevented from passing into the encoder. Voice energy within the pass band of the filter is subsequently converted to a PCM bit stream by the ENCODER.

4.2 Receive Voice Path

The DECODER converts the PCM information from the RDATA bus back to analog form. The recovered signal is filtered by the RCV filter to remove PCM switching transients, which are outside of the standard voice channel pass band. The output of the RCV FILTER circuit is then fed to the RCV GAIN circuit.

The RCV GAIN and RCV PRESCRIPTION GAIN circuits, acting together, set the receive path gain to the level required for interfacing with office TLPs from +1.5 to –7.0dBm. The use of the RCV PRESCRIPTION GAIN control allows adjustment (0.1dB increments) for the output level. The voice signal at the output of the attenuator is passed into the 2W/4W HYBRID circuit, which routes it through transformer T1 toward the trunk circuit.

The 2W/4W HYBRID circuit is provided with an internal compromise balance network and Building-Out Capacitors (BOC) for balancing the hybrid relative to the capacitance of the cable connected to the 2-wire port of the 3651–XX. Such balancing is required to prevent a portion of the received signal from returning through the transmit path. The internal compensation provided is sufficient for up to 0.126uF of shunt capacitance on the 2-wire port. Provision has been made for connecting an external Precision Balance Network (PBN) to the hybrid for balancing external plant cable. These PBN connections are pins 41 (PN2) and 46 (PN1) on the module connector.

4.3 E&M Lead Signaling Path

Push-on jumper options and signal leads are provided for arranging the 3651–XX to function in a Type I, Type II, or Type III E&M signaling interface. These interfaces are diagramed in Figure 3 through Figure 5, which show the internal arrangement of the 3651–XX together with a typical mating trunk circuit configuration.

For the following description, it will be assumed that the channel unit is arranged for a Type I E&M interface. The 3651–XX channel unit signaling path interfaces with the trunk circuit signaling path via E- and M-leads on pins 4 and 45 of the channel unit's module connector. The M signal output by the trunk passes through the E&M LINE and DROP lifting jacks (3651–61/63 only) and through the NORM/BUSY switch into the M-LEAD DETECTOR. An off-hook (–48V) condition of the M-lead applied to the M-LEAD DETECTOR results in the output of a logic 1 state on the A and B signaling highways of the associated PCM carrier channel. An on-hook (ground) condition of the M-LEAD results in the output of a logic 0 state on the A and B signaling highways. The A and B highway logic 1 and logic 0 states subsequently will be converted to E-lead ground and open states when they are received by the channel unit at the opposite end of the digital carrier facility.

Signaling information received via the digital carrier facility appears in the bit stream on the RDATA bus as logic 1 state (off-hook) and logic 0 state (on-hook) signals on the A highway. This information is recovered by the DECODER circuit and passed into the E-LEAD DRIVER. A logic 1 state on the A highway causes the E RELAY to operate and the BUSY LED to illuminate. In the operated state, the E RELAY closes a contact set that grounds

the E-lead (pin 4) toward the trunk via the path through the NORM/BUSY switch and, in the 3651–61/63, the E&M LINE and DROP lifting jacks. A logic 0 state on the A highway causes the release of the E RELAY, thereby removing the ground from the E-lead and extinguishing the BUSY LED.

4.4 NORM/BUSY Switch

In the NORM position, the NORM/BUSY switch located on the front of the 3651–XX connects the E&M signaling interface to signaling circuitry within the 3651–XX. In the BUSY position, this switch open-circuits the E and M signaling path from/to the trunk interface. Simultaneously it connects a –48V potential to the M-LEAD DETECTOR via screw option M, causing an off-hook signal to be sent to the opposite end of the carrier facility. It also sends an E-lead ground (off-hook state) toward the trunk directly (i.e., without operating the E RELAY), illuminates the BUSY LED, and provides an output signal on the Make Busy Indicator (MBI) lead to the carrier terminal's common equipment.

In the 3651–01 and 3651–03, which are provided with pin jacks in lieu of lifting jacks, the NORM/BUSY switch has one additional function: In the BUSY position it disconnects the 2-wire trunk from the 2-wire port. This permits the use of the 2-wire T&R pin jacks for accessing the channel unit during testing. While the switch is in BUSY, the E output of the 3651–01/03 is available for testing at the E pin jack. At the same time, an M input signal can be connected to the M pin jack for testing, provided that the M screw option is opened.

4.5 Trunk Processing During Carrier Failure

When an alarm condition is detected by the PCM terminal's Alarm Logic Unit (ALU), the ALU immediately sends an output signal on the CGAI Lead to the 3651–XX. After 2.5 seconds have elapsed, the ALU sends a signal to the 3651–XX on the CGAD lead. These signals can be used to control the state of the E-lead sent toward the trunk during a carrier failure. One of three available processing modes can be selected by the appropriate positioning of push-on jumper P.

A dry contact closure is also provided between pins 2 and 6 of the module connector (the 1 and 2 leads) for use in trunk processing during carrier failure. This contact set is controlled by the Trunk Processing (TP) RELAY, which is operated by a signal on the CGAW lead from the digroup's ALU.

Note: The above-mentioned feature was called lead conditioning on former Issues of the 3651—XX channel units.

5. MOUNTING

The 3651–XX mounts in one channel unit slot of a 360/363 D4 Terminal and is equipped with an insert/eject lever in the form of a hinged front panel. The insert/eject lever ensures positive connection of a channel unit's card-edge connector to the backplane connector when the unit is installed and also provides easy removal of the unit.

Align the channel unit with the appropriate card guide slot of the terminal. Slide the channel 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 (down) position and apply light pressure until the channel unit snaps into place.

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 guides and connector to verify proper alignment and the absence of foreign material.

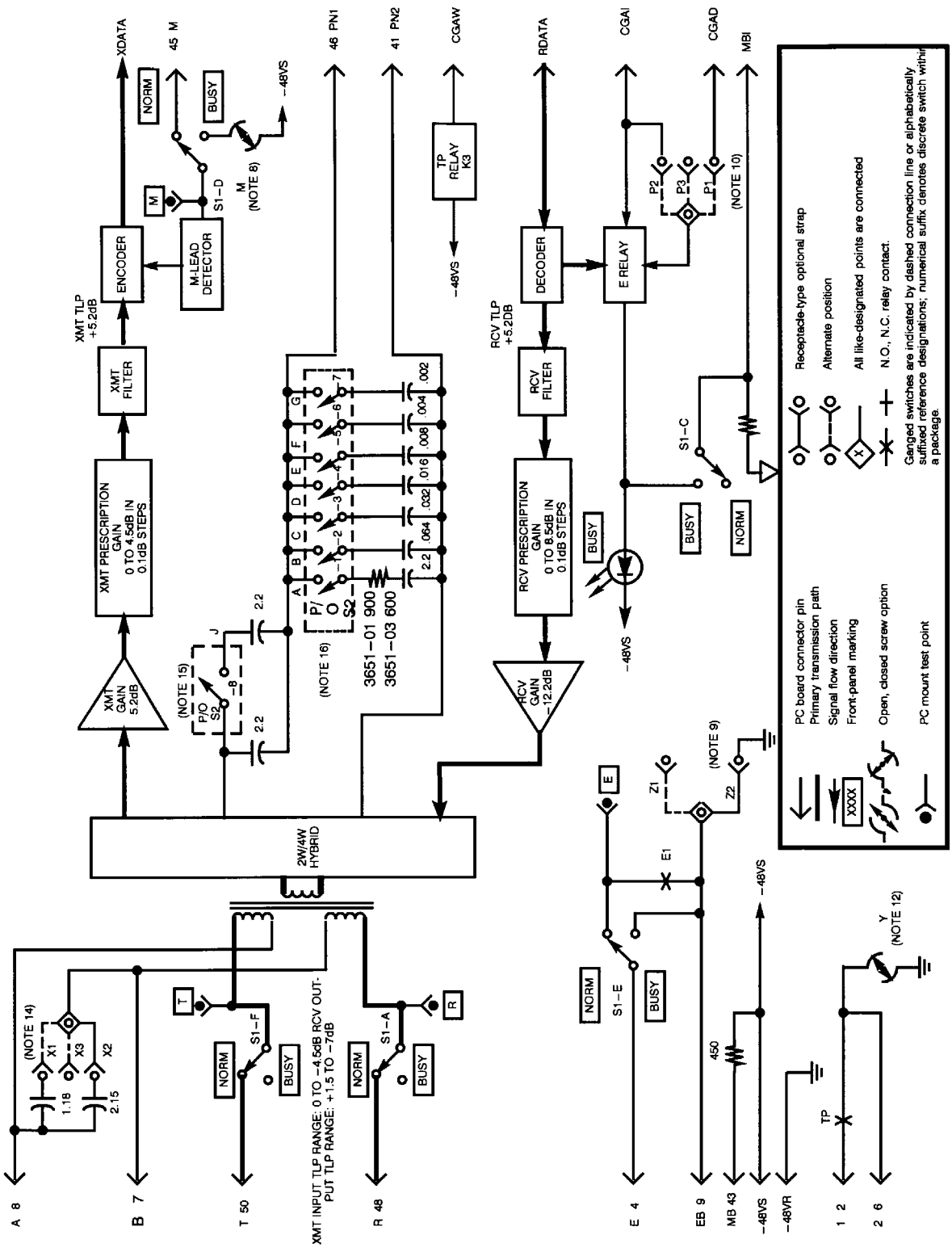

Figure 6. 3651—01/03 2-Wire E&M Channel Units (Issue 5) Block Diagram

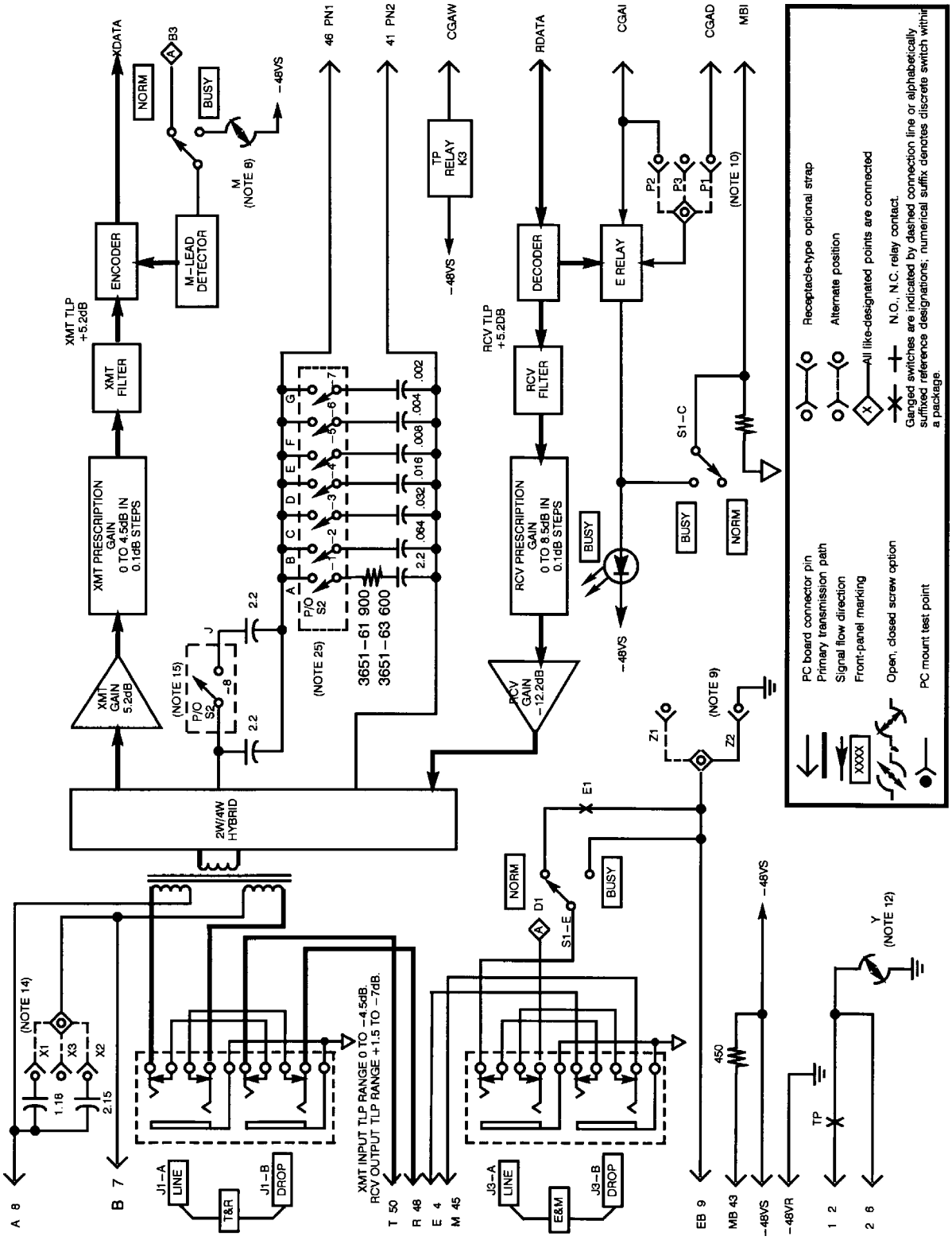

Figure 7. 3651—61/63 2-Wire E&M Channel Units (Issue 5) Block Diagram

Table 2. Notes for Figure 6 and Figure 7

<table>
<tr><th>#</th><th>Note</th><th>#</th><th>Note</th></tr>
<tr><td>1a.</td><td>For 3651–01/03 PC mount test jacks
Marking | Function
T | Tip and ring (EQIP) monitor and direct access
R
E | E-lead (EQIP) monitor
M | M-lead (EQIP) monitor</td><td>9.</td><td>E-lead condition:
BUSY: Leads E & EB shorted
IDLE: Leads E & EB open
For Types I & III trunk, connect Z to Z2 (EB grounded)
For Type II trunk, connect Z to Z1 (E & EB dry contact)</td></tr>
<tr><td>1b.</td><td>For 3651–61/63 PC mount test jacks
Marking | Function
T&R line J1–A | Access toward channel unit
T&R drop J1–B | Access toward office equipment
E&M line J3–A | Access toward channel unit
E&M drop J3–B | Access toward office equipment</td><td>10.</td><td>Option P is used to select the proper idle out/busy out sequence of the E-lead when Carrier Group Alarm (CGA) is activated due to an alarm condition in the channel bank.
E-Lead Sequence | Option Condition
E-lead idled out immediately upon CGA | Connect P to P3
E-lead busied out immediately upon CGA. | Connect P to P2
E-lead idled out immediately upon CGA and busied out after 2.5 seconds. | Connect P to P1</td></tr>
<tr><td>2.</td><td>The XMT INPUT range at T&R: –4.5dBm to 0dBm. The unit is factory adjusted for 0dBm input with the XMT GAIN set to 0dB.</td><td>11.</td><td>When the channel unit is removed from its mounting slot, the E-lead (pin 4) is grounded through a shorting contact in the backplane connector. A busy condition is transmitted to the far-end E-lead.</td></tr>
<tr><td>3.</td><td>The XMT PRESCRIPTION circuit provides 4.5dB gain in 0.1dB steps to compensate for input level variations. Refer to the following table for details:
Input (dBm) | XMT Gain (dB)
0 | 0
–2 | 2
–4.5 | 4.5</td><td>12.</td><td>Trunk process relay is activated immediately due to an alarm condition in the channel bank. Two seconds later it is deactivated for 70 milliseconds and again activated. During the activated mode, leads designated as 1 and 2 are shorted:
Lead 2 Ground: Close Y
Lead 2 Open: Open Y</td></tr>
<tr><td>4.</td><td>The RCV OUTPUT range at T1&R1: –7dBm to +1.5dBm. The unit is factory adjusted for –3dBm output with the RCV GAIN set to 4dB.</td><td>13.</td><td>When the channel unit is removed from its mounting slot, the lead designated as 1 (pin 2) is grounded through a shorting contact in the card connector.</td></tr>
<tr><td>5.</td><td>The RCV PRESCRIPTION circuit provides 8.5dB gain in 0.1dB steps to compensate for output level variations. Refer to the following table for details:
Output (dBm) | RCV Gain (dB)
+1.5 | 8.5
0 | 7.0
–3 | 4.0
–7 | 0</td><td>14.</td><td>Option X provides the optimum midpoint capacitance (MPC):
Option X to X1, MPC=1uF
Option X to X2, MPC=2uF
Option X to X3, MPC is provided by trunk.</td></tr>
<tr><td>6.</td><td>Busy switch:
Switch handle down is normal NORM position.
Switch handle up is busy BUSY position.
Busy switch performs the following functions:
Disconnect E- & M-leads from the office equipment.
Turn on busy lamp on front edge of units.
Apply a busy condition on the E-lead to the office equipment.
Send a busy condition to the far end. This function can be disabled by option M.
Provide a manual busy indication to the alarm and logic units.</td><td>15.</td><td>If mutual pair capacitance is 2uF, open switch S2-J.
If mutual pair capacitance is 4uF, close switch S2-J.</td></tr>
<tr><td>7.</td><td>M–lead condition. The M–lead will accept battery for busy, ground or open for idle. The MB-lead (pin 43) provides resistance battery, which may be returned to the M-lead through an office contact for a Type II interface.</td><td>16.</td><td rowspan="2">Switch S2-A through G provides compromise network and build-out capacitance (BOC) for hybrid balance. Open S2-A when external PBN is used. S2-B through G provides a total of 0.13uF BOC in 0.002uF steps. The total BOC is set equal to cable capacitance at T&R.</td></tr>
<tr><td>8.</td><td>Close option M when using the busy switch to send a busy condition to the far end. This function is disabled by opening option M. The second condition is selected when performing signaling tests on a looped channel bank or when performing single channel maintenance routines on an operating system.</td><td></td></tr>
</table>

6. INSTALLER CONNECTIONS

Electrical connections to a non–connectorized 360/363 D4 Terminal are made by wire-wrapping leads onto the channel unit connector located on the backplane of the 360/363 D4 Terminal. These connections are listed in Table 3. Connections to connectorized 360/363 D4 Terminals (360–10, 360–11, etc.) are made via 25-pair cables terminated in CINCH 222–22–50–023, or equivalent, female 25-pair connectors. Wiring diagrams of the terminal's male mating connectors are provided in Section 360–000–200 for use in identifying cable pairs.

Table 3. 3651—XX Installer Connections

360/363 Terminal channel slot connectors J1B through J24B, as equipped with 3651–XX channel units.

Lead Designations		Pin
Transmit/Receive 2-wire trunk pair	T R	50 48
Signaling lead output to trunk	E/EA EB	4 9
Signaling lead input from the trunk	M/MA MB	45 43
CGA make busy contact to trunk	1 2	2 6
DC signaling lead derived from 2-wire tip lead	A	8
DC signaling lead derived from 2-wire ring lead	B	7

7. OPTIONS

The 3651–XX Channel Units are equipped with push-on jumpers, DIP switches, slide switches, and screw options that are used to condition the module for proper application and operation. Refer to Figure 8 for the locations of these options while reading the following optioning instructions.

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 clockwise until it seats.

7.1 Hybrid Balance Network (Switch 2-A through S2-G)

Switch S2 is an 8-section DIP switch in which section A (S2-A) is provided for connecting a compromise balance network (600- or 900-ohm resistor in series with a 2.2uF capacitor). Slide A to ON when use of the internal CBN is desired. Alternatively, an external Precision Balance Network (PBN) may be connected across pins 41 and 46 with S2-A in the OFF position. Follow standard procedure or use the instructions provided with the PBN.

Sections S2-B through S2-G provide Line Build-Out Capacitance (LBOC) in amounts of 0.064, 0.032, 0.016, 0.008, 0.004, and 0.002uF respectively. Add LBOC capacitance by switching ON the appropriate sections of S2B-G for a total capacitance equal to that of the trunk cable plus any switchtrain capacitance, to within the nearest 0.002uF. (Switch OFF all unused sections of S2B-G.) If an external PBN is used in lieu of the internal compromise balance network, add LBOC via sections B through G of S2 according to instructions provided with the PBN.

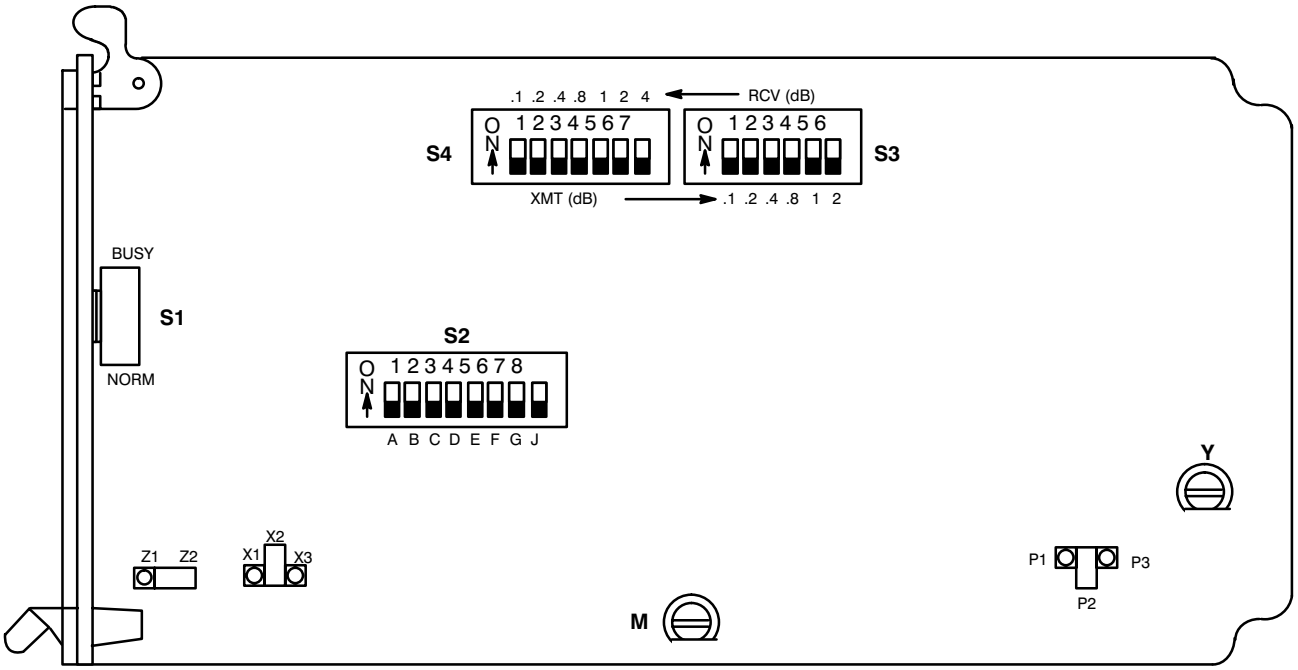

Figure 8. 3651–01/03/61/63 Option Locations

Table 4. 3651–01/03/61/63 Option Settings

Option	Type	Position	Use to...
S1	Slide switch	NORM	Condition channel unit for normal operation.
		BUSY	Busy out channel unit for testing.
S2-A	Slide switch	ON	Add internal compromise hybrid balancing network (CBN)
		OFF	Delete CBN for use with external PBN
S2–B through S2–G	Slide switch	ON	Add line build-out capacitance to hybrid balancing port in increments of 0.002uF. All switches (S2B–S2G) are additive. S2B ON=0.064uF S2C ON=0.032 uF S2D ON=0.016uF S2E ON=0.008uF S2F ON=0.004uF S2G ON=0.002uF
S2–J	Slide switch	ON	Add 2.2 uF
		OFF	Value of CBN or PBN
S3 (XMT dB)	Slide switch	ON	Provide transmit level gain adjustment (0 to +4.5 dB) in increments of 0.1 dB. Switches S3–1 through S3–6 are additive.
S4 (RCV dB)	Slide switch	ON	Provide receive level gain adjustment (0 to +8.5 dB) in increments of 0.1 dB. Switches S4–1 through S4–7 are additive.
M	Screw option	Closed	Send M-busy signal toward far carrier terminal while NORM/BUSY switch is in BUSY.
		Open	Send M-idle signal toward far carrier terminal while NORM/BUSY switch is in BUSY.

Option	Type	Position	Use to...
P	3-way push-on jumper	P1	Condition the E-lead to send the idle state at onset of a CGA, changing to the busy state in 2.5 seconds.
		P2	Condition the E-lead to send the busy state for duration of a CGA.
		P3	Condition the E-lead to send the idle state for duration of a CGA.
X	3-way push-on jumper	X1	Add 1.18uF between A and B leads.
		X2	Add 2.15uF between A and B leads.
		X3	Add 0.00uF between A and B leads.
Y	Screw option	Open	Provide isolated contact closure between the 1 lead and 2 lead upon carrier group alarm.
		Closed	Provide switched ground output on the 1 lead, and ground on the 2 lead upon carrier group alarm.
Z	2-way push-on jumper	Z2	Provide a Type I or Type III interface (switched ground output on E-lead).
		Z1	Provide a Type II interface (isolated contacts between E and EB leads.

7.2 Trunk Interface (A- and B-Lead) Capacitance Option (X1, X2, X3 and S2-8)

A VF bypass (midpoint) capacitance is required between the A and B leads (pins 8 and 7) to complete the voice path. This capacitance can be provided by the 3651–XX or by an external signaling circuit connected between the A and B leads. Use the following procedure for selecting A and B lead capacitance:

Step	Action
1.	If a signaling circuit is not used or does not contain A and B lead capacitance, place push-on jumper X in the X2 position to connect a 2.15uF capacitance within the 3651–XX.
2.	If an associated signaling circuit contains approximately 1uF, place X in the X1 position to connect a 1.18uF capacitance within the 3651–XX.
3.	If a signaling circuit contains 2uF or more, place X in the X3 position, in which case the 3651–XX adds no capacitance.
4.	If the total capacitance added by the external signaling circuit and the 3651–XX is approximately 2uF, switch OFF section J of S2 (S2-8) for proper hybrid balance; if it is 4uF or greater, switch ON S2-8.

If sealing current is to be provided, it can be applied to the A- and B-lead path either at the 3651–XX or at the opposite end of the 2-wire drop. When sealing current is applied to the A and B leads of the 3651–XX, this unit should be optioned for a midpoint capacitance of 2.15uF by placing push-on jumper X in the X2 position, and by placing S2-8 in the OFF position. Alternately, when sealing current is applied at the far end of the 2-wire drop, the A and B leads of the 3651–XX should be terminated to complete the loop.

7.3 E-Lead Optioning for Types I, II, and III Interface (Z1 and Z2)

To arrange the E-lead for either a Type I or a Type II interface, place the Z push-on jumper in the Z2 position. This arrangement grounds the EB lead (pin 9) and provides open-idle/ground-busy switched ground states on the E-lead (pin 4). To arrange the E-lead for a Type II interface, place Z in the Z1 position to remove the ground from the EB lead. This arrangement provides balanced switched dry contact state between the EA (E) and EB leads. (Types I, II, and III interfaces are illustrated in Figure 3 through Figure 5.)

Note: The E-lead terminal, pin 4, of the channel unit connector automatically becomes grounded upon removal of the 3651–XX from its channel slot, regardless of E-lead conditioning of the 3651–XX. This feature sends an E-lead-busy signal toward the trunk when the unit is removed.

7.4 NORM/BUSY Switch (S1)

Place the NORM/BUSY switch to the NORM position to condition the channel unit for normal operation. Place the NORM/BUSY switch to the BUSY position when testing or aligning the channel unit.

7.5 NORM/BUSY Switch Control of M Signaling State (M)

To transmit an M-lead-idle condition while the NORM/BUSY switch is in the BUSY position, open option screw M. (Use this conditioning also to arrange the M pin jack of the 3651–01/03 for accepting an M test signal while the NORM/BUSY switch is in the BUSY position.) Conversely, to transmit an M-lead-busy condition, close option screw M.

7.6 E-Lead Optioning for Trunk Processing During CGA (P1/P2/P3)

The E-lead can be arranged to output one of three signaling formats for processing the drop side trunk terminal during a CGA condition. These formats are described in Table 5, including optioning instructions involving push-on jumper P.

Table 5. Format Selection for E-Lead Processing During a CGA Condition

E-Lead Sequence Provided During a CGA	Instruction
E-lead is idled out immediately upon receiving a CGA, and busied out 2.5 seconds later. Subsequently, it remains busy until the CGA is cleared.	Place P to P1
E-lead is busied out immediately upon receiving a CGA. Subsequently, it remains busy until the CGA is cleared.	Place P to P2
E-lead is idled out immediately upon receiving a CGA. Subsequently, it remains idle until the CGA is cleared.	Place P to P3

7.7 Auxiliary Trunk Processing During CGA(Y)

Auxiliary trunk control contacts between pins 2 and 6 (the 1 and 2 leads) are closed upon the activation of a CGA, but are provided with a 70-millisecond momentary open at two seconds following initial closure. To provide a dry floating contact closure between the 1 and 2 leads, open option screw Y. Conversely, to provide a switched ground output on pin 2 (the 1-lead) during a CGA, close option screw Y. Option Y is closed for sleeve-lead control of a step-by-step office and for similar applications.

Note: The 1-lead, pin 2 of the channel unit connector, automatically becomes grounded upon removal of the 3651–XX from its channel slot, regardless of the conditioning of the Y option on the 3651–XX. This feature sends an out-of-service signal on the 1-lead toward the trunk when the unit is removed.

8. ALIGNMENT

8.1 Transmit Alignment

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

[XMT GAIN = 0 – TLP]

For an input TLP of –2dBm, the XMT GAIN = 0 – (–2) = 2dB. Set the sum of the switch settings on S3 to 2.

8.2 Receive Alignment

The RCV GAIN switch group S4 is a prescription control that provides gain from 0 to 8.5dB in increments of 0.1dB to accommodate an output TLP range from –7 to +1.5dB. To adjust the receive path to the proper operation level, the difference between –7 and the receive TLP at T&R must be obtained:

[RCV GAIN = TLP – (–7)]

For an output TLP of –1.0dBm, the XMT GAIN = –1 – (–7) = 6dB. Set the sum of the switch settings on S4 to 6.

9. TESTING

After completing Parts 4 through 8, place a call end-to-end through the trunk and carrier facility to verify proper operation. If trouble is encountered, recheck the installer connections, option conditioning, and alignment adjustments. Some signaling problems can be isolated by observing the state of the BUSY LED on the front of the

3651–XX. This LED, when illuminated, indicates that the E-lead is in the busy (off-hook) state. Additionally, the 3651–61 and 63 are provided with E&M jacks (E on tip, M on ring) for accessing the signaling leads toward the DROP (trunk) and toward the LINE (digital carrier facility). These jacks can be used in conjunction with a standard E&M pulse test set for testing the signaling function.

The 3651–61 and 63 are also provided with test jacks for accessing the 2-wire trunk voice path toward the DROP (trunk) and toward the LINE (digital carrier facility). These jacks can be used for level testing of the voice path using a standard VF Transmission Measuring Set. Similar voice and signaling tests can be performed with the 3651–01/03 by placing the NORM/BUSY switch in the BUSY position. This disconnects the voice and signaling paths at the trunk interface, permitting voice-frequency and signaling access toward the line via the front panel pin jacks. (Option M must be open to disable the internal M-busy state whenever a pulse test set is connected to the M pin jack.) For additional testing information, refer to the Looped Terminal Tests and End-to-End System Tests provided in Section 360–001–205.

10. TECHNICAL ASSISTANCE

10.1 Technical Assistance — U.S.

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)

10.2 Technical Assistance — Canada

Canadian customers contact:

905–821–7673 (Main Office)
905–821–3280 (FAX)

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
   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

12.1 Electrical

The electrical characteristics of the 3651–XX Channel Unit are as follows:

(a) PERMISSIBLE MODES (3651–01 and 3651–61): 2T9-4T, 4T-2T9.

(b) PERMISSIBLE MODES (3651–03 AND 3651–63): 2T6-4T, 4T-2T6.

(c) 2-WIRE IMPEDANCE: 900 ohms (3651–01 and 3651–61); 600 ohms (3651–03 and 3651–63).

(d) LINE SIDE LEVELS: Transmit (fixed), + 5.2 TLP; receive (fixed), +5.2 TLP.

(e) DROP SIDE LEVELS: Transmit, –4.5dB minimum, 0.0dB maximum; receive, –7.0dB minimum, +1.5dB maximum.

(f) 1000Hz GAIN/LOSS: Transmit (fixed), +5.2dB; receive (fixed), –12.2dB.

(g) ADJUSTMENT GAIN/LOSS: Transmit, 0.0dB minimum, +4.5dB maximum in increments of 0.1dB; receive, 0.0dB minimum, +8.5dB maximum in increments of 0.1dB.

(h) OPERATION: E&M

12.1.1. Voice Frequency Transmission

(a) IMPEDANCE: 3651–01 and 3651–61, 900 ohm +2.15uF; 3651–03 and 3651–63, 600 ohm +2.15uF.

(b) TRANSMIT INPUT LEVEL RANGE: –4.5 to 0dBm in 0.1dB increments.

(c) RECEIVE OUTPUT LEVEL RANGE: –7.0 to 1.5dBm in 0.1dB increments.

(d) LOSS STABILITY: ±0.5dB maximum of reference loss.

(e) RETURN LOSS: At nominal impedance plus 25 ohms loop resistance: echo 33dB minimum; singing, 20dB minimum.

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

(g) NBO CAPACITANCE: 0.126uF in steps of 0.002uF.

(h) FREQUENCY RESPONSE:

Frequency (Hz)	XMT (dB)	RCV (dB)
60	–20 maximum	—
200	–3 to 0.0	–2 to 0.0
300	–0.5 to +0.25	–0.5 to +2.5
1000	0 (ref)	0 (ref)
3000	–0.5 to +0.25	–0.5 to +0.25
3200	–0.75 to +0.25	–0.75 to +0.25
3400	–1.5 to 0.0	–1.5 to 0.0
4000	–14 maximum	–14 maximum
4600	–32 maximum	–28 maximum

(i) LEVEL TRACKING:

Level (dBm0)	XMT (dB Max.)	RCV (dB Max.)
+3 to –37	+/–0.25	+/–0.25
–37 to –50	+/–0.50	+/–0.50

(j) LONGITUDINAL BALANCE:

Frequency (Hz)	AT&T Method (dB Min.)	IEEE Method (dB Min.)
200	66	58
1000	60	58
3000	58	53

(k) IDLE CHANNEL NOISE:

XMT	RCV
20dBrnC0 max.	20dBrnC0 max.

(l) IMPULSE NOISE:

Threshold Level	Counts in 30 Minutes
41dBrnC0	10 maximum
51dBrnC0	1 maximum
58dBrnC0	0.1 maximum

(m) SIGNAL-TO-DISTORTION RATIO:

Level (dBm0)	XMT (dB Min.)	RCV (dB Min.)
0 to –30	35	35
–40	29	29
–45	25	25

(n) SINGLE-FREQUENCY DISTORTION:

Input	Output
0 to 12kHz	–28dBm0 max. at any other frequency
1020Hz	–40dBm0 max. at any frequency 0 to 4kHz

(o) PEAK-TO-AVERAGE RATIO (P/AR): Transmit, 97 (minimum); Receive, 97 (minimum).

12.1.2. Signaling

(p) DIAL PULSE DISTORTION: ±4 percent maximum at 12pps and 60 percent break.

12.1.3. Operational

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

(r) CURRENT DRAIN: Typical from –48Vdc: idle, 20mA; busy, 25mA.

12.2 Physical

The physical characteristics of the 3651–XX Channel Unit are shown in Table 6.

Table 6. 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	16 ounces	255 grams