7350 Loop to E&M Dial Long Line (DLL) Circuit

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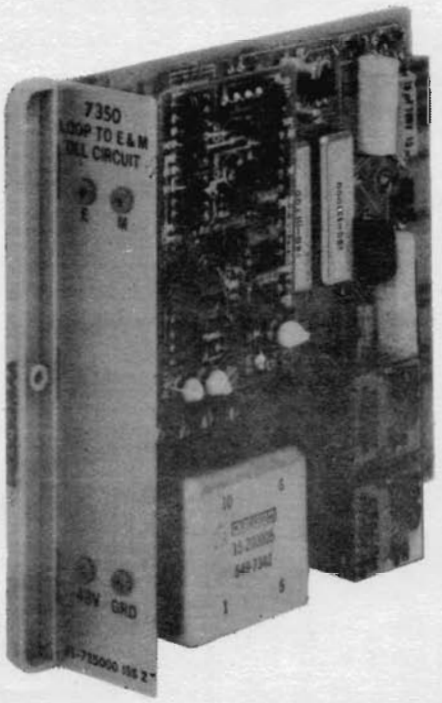


Figure 1. 7350 Loop to E&M DLL Circuit Module

1. GENERAL

1.01 This Practice provides circuit description, installation procedures, and basic testing information for the Wescom® 7350 Loop to E&M Dial Long Line (DLL) Circuit (shown in Figure 1). This Practice has been reprinted to incorporate an editorial update and to make corrections in the earlier printing. Significant editorial changes are indicated by a change bar (▮) in the margin adjacent to the affected copy.

1.02 The 7350 Loop to E&M DLL Circuit Module provides loop to E&M conversion at the Central Office (CO) end of a long subscriber line circuit or PBX trunk. It is also intended for use at a PBX location to provide E&M-lead signaling for an off-premise extension. It is not intended for use with systems that perform station identification (Automatic Numbering Identification) tests.

1.03 The 7350 is constructed as a plug-in, printed circuit module designed to mount in one module position of a Wescom Type 400 Mounting Assembly. It is electrically connected between a CO or PBX switching machine and an E&M signaling system (such as an SF unit or DX set). Its function is to convert E-lead signals to loop supervisory and dialing signals which are received from a distant location via an E&M signaling system. It also converts ringing signals and loop supervisory signals from a CO or PBX switching machine to M-lead signals for transmission via the signaling unit to a distant location.

1.04 Additional features provided by the 7350 are as follows:

(a) The module may be conditioned for ground-start, loop-start, or premonitory busy loop-start operation by means of internal screw and switch options.

(b) An optional 7389 Pulse Corrector plug-in subassembly may be added to the 7350 module to provide the incoming E lead with dial pulse correction.

(c) M-lead states (negative battery, idle; ground, busy) may be reversed (ground, idle; negative battery, busy) by internal slide switch option.

(d) A repeater control lead is provided to turn off an associated voice frequency repeater during idle.

(e) Line termination is provided during idle.

2. APPLICATION GUIDELINES

2.01 The 7350 provides office-end loop to E&M signaling conversion and is designed for use in conjunction with a Wescom 7360 (or equivalent) Loop to E&M DLL Circuit that provides station-end conversion of E&M to loop signaling. If the 7350 is used with an E&M type SF signaling unit, a 6637-(X) Signaling System may be used at the station end of the facility. However, when the 6637-(X) is used with a 7350 module, it can only be utilized in loop-start applications. Although usually installed at the CO or PBX premises, the 7350 may be located anywhere within the loop range of the associated switching machine.

2.02 Refer to Figures 2 and 3 for typical applications of the 7350. The 7350 may be conditioned for one of three modes of operation: ground start, premonitory busy loop start, and loop start. If connection at the station end of the facility is made to a PBX ground-start trunk, office-end and station-end equipment must be arranged for ground-start operation. If the connection at the station end is made to a telephone (or data set), loop-start operation is normally employed.

3. CIRCUIT DESCRIPTION

3.01 The 7350 Loop to E&M DLL Circuit Module provides loop to E&M conversion at the central office end or PBX trunk. It is also intended for use at a PBX location to provide E&M signaling for an off-premise extension. Refer to the block diagram in Figure 6 while reading the following paragraphs.

Loop-Start Operation

3.02 Conditioning the 7350 for loop-start operation consists of verifying that the REV/NORM switch is in the NORM position and of closing screw option F and opening screw option E. The 7350 is arranged such that if the associated switching machine provides tip/ring battery reversal prior to ringing, premonitory busy operation is provided without further module conditioning.

3.03 Relay TS, which must be operated to complete the loop, is held operated at all times when the loop-start mode of operation is used. Relay TS is controlled through a timing and logic circuit which causes it to remain operated whenever the tip lead (pin 47) is at ground potential. It also causes relay TS to be held operated by a ring lead (pin 53) ground condition either through contact set B-4, when relay B is released, or through holding contacts TS-2.

3.04 Incoming Call – A request for service by the distant (station) end of the FX, OPX, or long subscriber line causes the local signaling equipment to change the state of the E lead from open to ground. This ground signal, applied to the 7350 on pin 43, operates relay B via the slow release circuit and relay B driver.

3.05 Relay B, operated, prepares a path for operating relay A by opening one of the two inputs to the driver circuit via contact set B-6. However, relay A remains released because

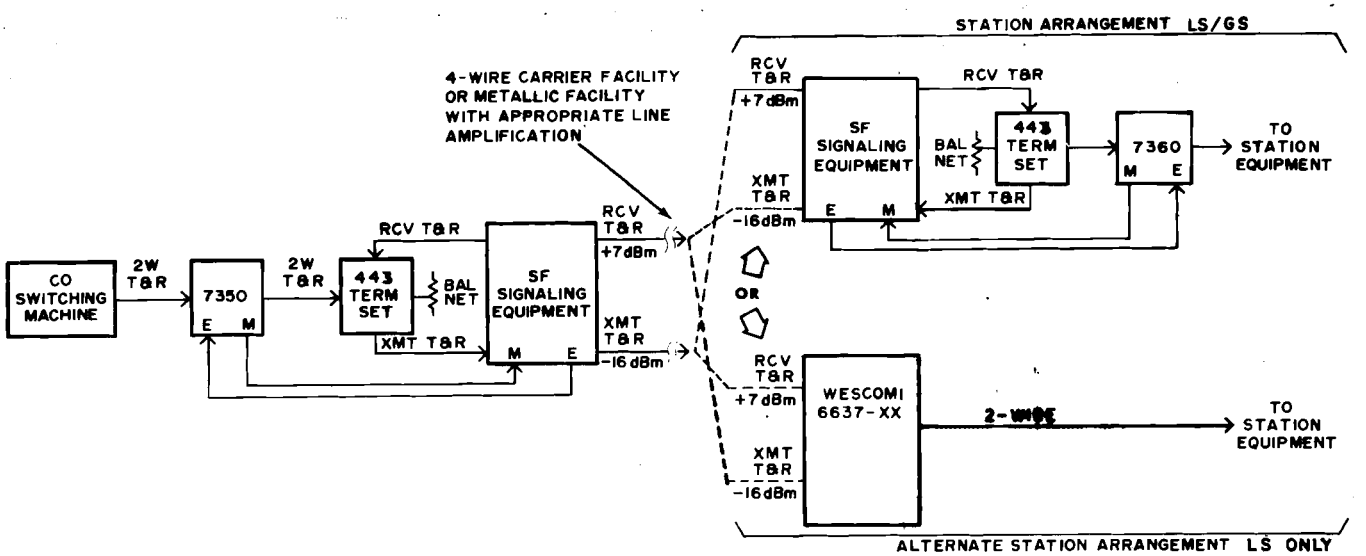


Figure 2. 7350 Used in Conjunction With an E&M SF Signaling System

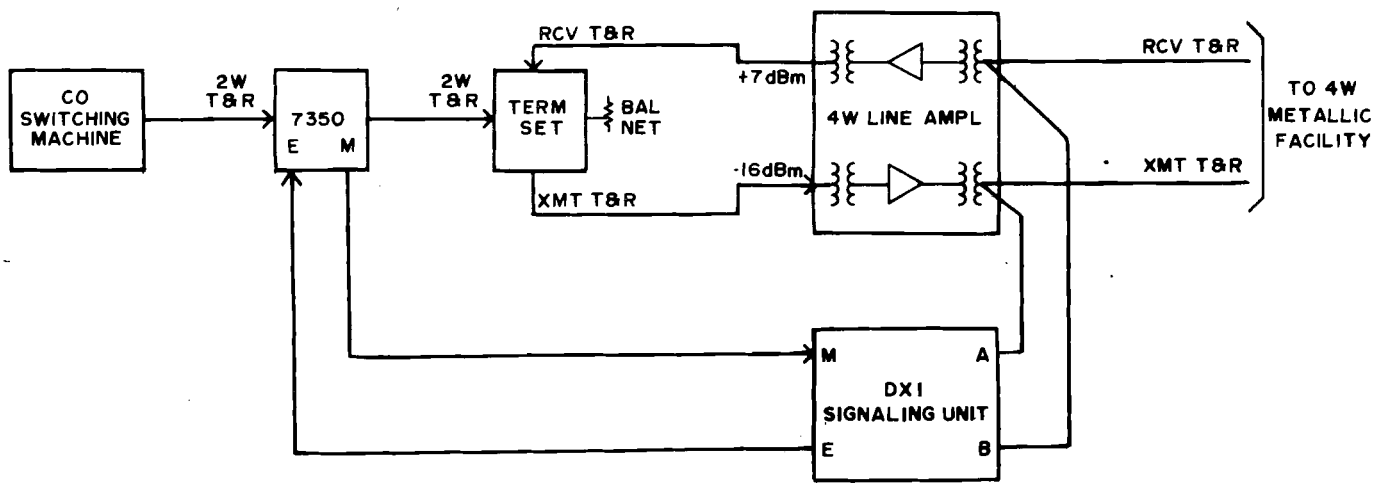


Figure 3. 7350 Used With a DX Signaling System

the second requirement of the driver circuit (the E-lead open state) is not met.

3.06 Relay B (operated) and relay A (released) seizes the loop toward the office switching equipment which returns dial tone toward the distant end. During this time, loop current flows from the ring lead (pin 53) through relay contact A-1 (released), contact TS-1 (operated), contact B-1 (operated), 150- and 300-ohm resistors and retard coil L1 to the tip lead (pin 47). Contacts TS-4 and B-2 are also closed at this time to pass dial tone through the 7350 toward the distant end.

3.07 When the party at the station end receives dial tone and begins dialing, these dial pulses are received and decoded by the local signaling equipment which causes them to appear as E-lead "open" pulses on pin 43 of the 7350. Relay B remains operated during the entire dial pulse train due to its associated release delay circuit which holds it energized during the "break" (E-lead open) portion of each dial pulse. The driver circuit, having its second requirement met by the E-lead open portion of each dial pulse, causes relay A to follow the dial pulses. Relay A becomes operated during the "break" portion of

each dial pulse to open the loop via contact set A-1 in the ring lead circuit to pin 53.

3.08 Answer Supervision Toward Distant Terminal – After dialing is completed, the office equipment selects the called party and applies ring signaling to his line. When the called party goes off-hook in response to ringing, the path is completed for two-way voice communication. If the office switching equipment is such that it applies reverse battery supervision across tip and ring (pins 47 and 53) after the called party goes off-hook, relay RU becomes operated. Relay RU operated, changes the M lead to the ground state causing the local signaling equipment to send the answer signal toward the distant end. If answer supervision at the subscriber location is not required, the 7360 Loop to E&M DLL Module, (except Issue 1) which is normally provided as the station-end counterpart to the 7350 can be conditioned to disregard this signal.

3.09 Outgoing Call – At the beginning of a call originating through the central office or PBX, the associated switching equipment applies ringing voltage across the tip and ring (pins 47 and 53) which operates relay RU. Premonitory busy operation can be accommodated in the loop-start mode. In this mode of operation, switching equipment applies a negative potential to the tip lead on incoming calls, causing the RU relay to operate immediately during the silent ringing interval. Relay RU operated, changes the M lead to the ground state causing the local signaling equipment to send a signal toward the distant end that starts ringing at the station equipment.

3.10 The called party, going off-hook in response to ringing, causes the transmission of a signal that changes the E lead at the local signaling equipment to the ground state. The resulting ground on pin 43 of the 7350 causes relay B to operate. Relay B operated, completes the path for loop current from the tip lead (pin 47) through L1, 150- and 300-ohm resistors, B-1, TS-1 and A-1 to the ring lead (pin 53) causing ring trip. After ringing has been tripped, the absence of ringing voltage, ring generator bias or reverse battery between the tip and ring leads results in releasing relay RU. Relay RU released, changes the M lead (pin 15) to the negative battery state. The path for two-way voice communication is now complete.

3.11 Release at End of Call – At the end of a call, the 7350 does not release the loop to the office equipment until the station end returns to the on-hook condition, regardless of whether the call is incoming or outgoing. When the station end goes on-hook, the corresponding change in the state of the E lead (from ground to open), received on pin 43 of the 7350, releases relay B which breaks the path for loop current via contact set B-1, thereby releasing the office switching machine.

Ground-Start Operation

3.12 Conditioning the 7350 for ground-start operation consists of closing screw option E, opening screw option F and verifying that the REV/NORM switch (S1) is in the REV position.

3.13 Incoming Call – The distant (station) end of the FX, OPX, or subscriber long line, making a request for service, causes the local signaling equipment to change the state of the E lead from open to ground. As with loop-start operation, this ground signal operates relay B via the release delay circuit and relay B driver. Relay B operated, prepares a path for operating relay A by opening the normally closed contact of B-6. Simultaneously, it places resistance-ground on the ring lead (pin 53) toward the switching machine via the normally open contacts of B-6, the diode, 200-ohm resistor, and contact sets TS-1 and A-1.

3.14 The switching machine, receiving ground on its ring lead through the 7350, responds by placing ground on its tip lead (pin 47) accompanied by dial tone to signal the subscriber that it is ready to receive dial information. The tip lead ground condition is sensed by the timing and logic circuit, which functions through the delay circuit to operate relay TS. Relay TS operated, closes the path for loop current from the ring lead (pin 53) through contact A-1, contact TS-1, contact B-1, 150- and 300-ohm resistors and retard coil L1 to the tip lead (pin 47). Relay TS operated, also completes the path to connect dial tone toward the station end via contact TS-4 and B-2.

In the previous sequence, relay TS becomes operated as the result of seizing the switching equipment, and causes the M lead (pin 15) to change to the negative battery state which sends a supervisory signal back to the station location. This signal, received at the station location, causes the connection of tip lead ground and dial tone to the the station equipment.

3.15 Incoming Call – When the party at the station end receives dial tone and begins dialing, the result of an E lead open on pin 43 causes relay A to pulse the loop toward the switching machine as with loop-start operation.

3.16 After dialing is completed, the switching machine selects and rings the called party. When the called party goes off-hook, the talk path is completed. If the switching machine applies reverse battery supervision across tip and ring (pins 47 and 53) at this time, relay TS does not release because a ground on either tip or ring holds it operated. Therefore, answer supervision is not repeated toward the distant end.

3.17 Outgoing Call – At the beginning of a call originating through the CO or PBX, the switching machine changes the tip lead (pin 47) from open to ground potential and applies ringing voltage to the ring lead (pin 53). The timing and logic circuit senses the tip-lead ground and operates relay TS via the delay circuit. Relay TS operated, changes the M lead (pin 15) to the negative battery state. The local associated signaling equipment responds to this M-lead state by sending a signal that causes a tip lead ground condition and ringing at the station equipment. Due to the timing and logic circuit, relay TS remains operated continuously even in cases where interrupted ringing is applied across tip and ring. Therefore, the M-lead negative battery state remains constant until ringing is tripped. Relay RU follows the ringing portion of an interrupted ringing signal, but its operation is inconsequential during ground-start operation.

3.18 The distant end, going off-hook in response to ringing, causes the local signaling equipment to change the E lead to the ground state. The E-lead ground state operates relay B via the release delay circuit and relay B driver, completing the path for loop current that includes L1, 150- and 300-ohm resistors, and TS-1 via contact set B-1. The resulting loop closure causes the switching machine to trip ringing. Relay B operated, also completes the voice path via contact set B-2. Relay TS remains operated throughout the call until the switching machine releases.

3.19 Release at End of Call – At the end of a call, the party to release first drops the connection. If the distant end releases first, relay B releases, opening the loop through contact set B-1. If the local end releases first (through a switching machine equipped for forward disconnect), relay TS releases and opens the loop through contact set TS-1.

Repeater Control

3.20 The 7350 is provided with a lead (pin 13) which may be used to control an associated voice-frequency repeater. When the station equipment at the distant end is in the off-hook condition, the resulting E-lead ground state from the local signaling equipment holds relay B operated. Relay B operated, places ground on pin 13 through contacts B-6 and diode CR-8 to turn on an associated repeater. When the station equipment at the distant end is in the on-hook condition, the E lead is in the open state, causing relay B to be released. Releasing relay B removes the ground condition from the associated repeater, causing it to turn off.

4. INSPECTION

4.01 Inspect the equipment thoroughly as soon as possible after delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

4.02 Wescom equipment is identified by a model and issue number imprinted on the front panel. Each time a major engineering design change is made on the equipment, the issue number is advanced by one number on any following models that are manufactured. Therefore, be sure to include the issue number along with the model number when making inquiries about the equipment.

5. MOUNTING

5.01 The 7350 mounts in one module position of a Wescom Type 400 Mounting Assembly. Refer to Sections 400-103 and 400-U-101/3 for information on mounting assemblies.

6. INSTALLER CONNECTIONS

6.01 The 7350 makes electrical connection to its associated equipment through a 56-pin, wire-wrapped card connector provided as part of the Type 400 Mounting Assembly. Make all installer connections to this connector in accordance with Table 1.

Table 1. 7350 Installer Connections

CONNECT	TO 56-PIN CONNECTOR
CO or PBX 2W line (T)	47
CO or PBX 2W line (R)	53
Term set 2W drop (T1)	49
Term set 2W drop (R1)	51
E lead	43
M lead	15
A lead	23
B lead	25
Repeater enable lead	13
-48Vdc battery	35
Ground	17

7. OPTIONS

Loop-Start Operation

7.01 To condition the 7350 for loop-start operation, close screw switches F and A and open screw switches B, E, and W. If loop start with reverse battery answer supervision or premonitory busy operation is desired, close options F and B and open options A, E, and W. In addition, place switch S1 in the NORM position. Refer to Figure 4 for the relative location of each option.

CAUTION

If positive ringing generator bias is used, option B must be open and option A must be closed. The central office ring generator supply must be checked for type of bias.

Ground-Start Operation

7.02 To condition the 7350 for ground-start operation, close screw switches E and A and open screw switches F and B. If the station-end DLL circuit is such that it must receive an E-lead wink signal before applying ringing voltage to the station equipment, close screw switch W; if otherwise, open screw switch W. In addition, place switch S1 in the REV position.

CO Loop Resistance

7.03 The resistance of the loop closure through the 7350 toward the central office is variable in four increments from 50 to 500 ohms by means of screw switches. Use the highest value provided, subject to the limitation that the total loop resistance does not exceed the signaling limits of the CO or PBX line circuit. Screw switch conditioning for each resistance value is provided in Table 2.

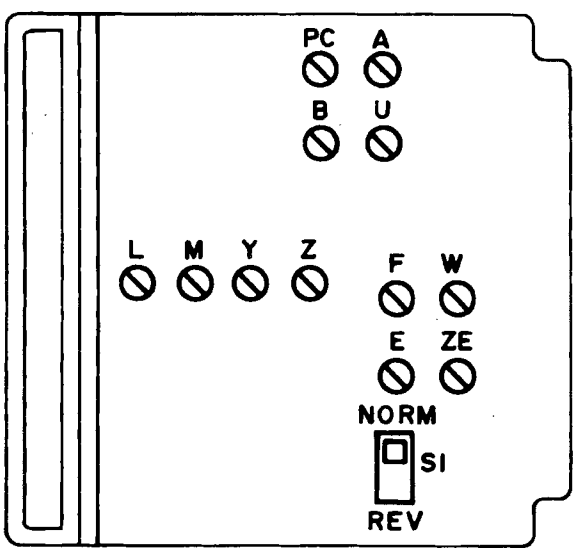


Figure 4. 7350 Switch and Screwdown Option Locations

Table 2. 7350 Loop Closure Resistance

CLOSURE RESISTANCE	CLOSE	OPEN
50 ohms	L & M	
200 ohms	M	L
350 ohms	L	M
500 ohms		L & M

Idle Line Termination

7.04 Condition the 7350 idle line termination resistance to match the 2-wire impedance of the associated 2-wire to 4-wire terminating set according to the instructions given in Table 3.

Table 3. Idle Line Termination Resistance

2-WIRE LINE IMPEDANCE	CLOSE	OPEN
0 to 615 ohms	Z & Y	
615 to 1.6k ohms	Y	Z
Over 1.6k ohms	Z	Y

Pulsing Contact Protection

7.05 Contact protection is provided for the pulsing contacts of relay A by closing screw switch U. For lines in excess of 200 ohms between the CO or PBX and the 7350, this protection is unnecessary and should be removed by opening screw switch U.

Electronic Switching Systems

7.06 If the 7350 is to be used in a circuit with an electronic switching system (No. 1 ESS) at the distant end, close option ZE. With ZE closed, the M-lead ground state is maintained through the switching transition of the associated form C contacts on relays TS and RU. For operation with crossbar or step-by-step switching machines, this conditioning is unnecessary and screw switch ZE should be opened.

Pulse Correction

7.07 If incoming (E lead) pulse correction is desired, open option PC and install the Wescom 7389 Pulse Corrector Subassembly on the 7350 printed circuit board as shown in Figure 5. If pulse correction is not desired, verify that screw switch PC is closed. The subassembly is a separate item and is offered as an option by Wescom.

M-Lead Signaling State Reversal

7.08 With switch S1 in the NORM position, the M-lead states are ground during busy and negative battery during idle. If it is desired to reverse these signaling states to provide ground during idle and negative battery during busy, place switch S1 in the REV position.

NOTE

The M lead is normally at a negative battery potential in a busy state and at a ground potential in an idle state.

8. TESTING

8.01 When the installation is completed, place an outgoing call through the facility and verify that ringing is applied to the station equipment at the distant end. As the station equipment at the distant end goes off-hook, verify that ringing is tripped at the switching machine associated with the 7350.

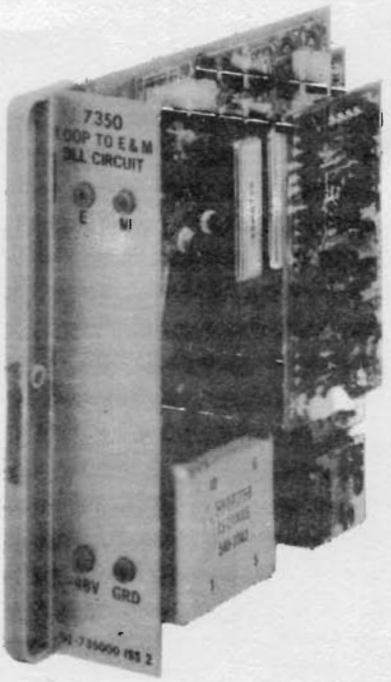


Figure 5. 7389 Pulse Corrector Installation

8.02 Arrange for a call to be originated from the station equipment at the distant end. After the number has been dialed, verify that the proper number has been reached. Perform a talk test to verify that the voice channel is operational.

8.03 If trouble is encountered, determine that all circuit options have been conditioned properly according to part 7 of this Practice. Determine that installer connections have been properly made in accordance with Table 1. If the trouble persists, perform the test procedure in Table 4 to determine whether the cause of the trouble lies in the 7350 or elsewhere in the circuit. If technical assistance is required, contact the Wescom Technical Services Department by calling:

(312) 971-2010,
TWX 910-695-4735, or
DATAPHONE (312) 971-1698

Canadian Customers:
(416) 877-0191 or
TWX 610-492-2646

Table 4. 7350 Test Procedure

STEP	INSTRUCTION	RESULTS
1	Set a multimeter (Simpson 260 or equivalent) to the 50Vdc range and connect it across the -48V and GRD test points on the 7350 front panel.	The potential measured should be 48Vdc ±4V. If the reading is not within these limits, check the power supply, battery wiring, and office fuse.
2	If the 7350 is arranged for loop-start operation (S1 in NORM position, options F and A closed and options B, E and W opened), proceed to Step 3; or if the 7350 is arranged for ground-start operation (S1 in REV position, options E and A closed and options F and B opened), proceed to Step 6.	
3	Connect the negative multimeter lead to the M test point (7350 front panel).	The multimeter should read negative battery during the idle circuit condition.
4	Place a call into the associated telephone or station code for the circuit under test.	When the central office applies ringing voltage, the M lead should switch to ground, indicating 0V on the multimeter.
5	If the CO supplies reverse negative battery answer supervision or premonitory busy operation, verify that option A is open and option B is closed. If the CO does not provide these features, proceed to Step 6.	The multimeter should read a ground potential whenever the CO tip lead is negative with respect to the ring lead. If this condition cannot be met, replace the 7350 with another unit; then retest and proceed to Step 6.
6	Connect the negative multimeter lead on the M test point (7350 front panel).	The multimeter should read 0V during the idle circuit condition.
7	Place a call into the associated telephone or station code for the circuit under test.	This call changes the CO side tip lead from an open to a ground potential, thereby switching the M lead to a negative battery state, indicating -48V on the multimeter. It should continue to read -48V as long as either tip or ring lead is grounded. If these conditions cannot be met, replace the 7350 with another unit; then retest and proceed to Step 8.

TABLE CONTINUED ON NEXT PAGE

Table 4. 7350 Test Procedure (Cont)

STEP	INSTRUCTIONS	RESULTS
8	Connect the negative multimeter lead to the E test point (7350 front panel).	The multimeter should read approximately 48V during idle (distant end on-hook) and 0V during busy. If the multimeter reads 0V during idle, switch the multimeter to a resistance scale to determine whether or not the E lead is grounded. If the E lead is grounded, the fault is in the associated signaling system. If the E lead is not grounded and 0V is indicated on the multimeter, replace the 7350 with a known good operating unit and retest. If the multimeter reads approximately 48V during busy, the fault is in the associated signaling system.
9	Disconnect the multimeter and any test connections to the tip and ring leads. This completes the 7350 Test Procedure	

9. WARRANTY

9.01 STANDARD WARRANTY: Wescom products are warranted to be free from defects in material, workmanship, and design given proper installation and regular maintenance. Wescom's obligations under this warranty are limited to correction and replacement at Wescom's production facility of any defective items received by Wescom, transportation prepaid, for a period of five years from the date of original shipment. Warranty and remedies on products not manufactured by Wescom are in accordance with the warranty of the respective manufacturer. WESCOM MAKES NO OTHER WARRANTY OF ANY KIND WHATEVER, EXPRESSED OR IMPLIED; AND ALL IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEEDS THE AFORESAID OBLIGATIONS IS HEREBY DISCLAIMED BY WESCOM.

9.02 Field repairs involving the replacement of components within a unit are not recommended. If an item is found to be defective, contact Wescom, Inc., by telephone or TWX, for instructions regarding replacement or repair.

9.03 If a replacement unit is required, it will be shipped in the fastest manner consistent with the urgency of the situation. Upon receipt of a replacement unit, return the defective unit in the carton in which the replacement was shipped, using the shipping label provided, to:

Wescom, Inc.
8245 Lemont Road
Downers Grove, Illinois 60515

Canadian Customers:
Wescom Canada, Ltd.
45 Sinclair Ave.
Georgetown, Ontario
L7G 4X4

9.04 **Repair or Exchange Services**
In addition to the standard Wescom Warranty Service, Wescom offers a repair or exchange service for those items out of warranty. Under this arrangement, faulty units may be shipped to Wescom for either complete repair and quality testing or exchanged for a replacement unit. To obtain details of this service and a schedule of prices, contact your local Wescom Sales Representative.

10. SPECIFICATIONS

10.01 The electrical and physical characteristics of the 7350 are as follows:

(a) E-LEAD (INPUT) SIGNALING STATES: Idle, open; busy, ground.

(b) M-LEAD (OUTPUT) SIGNALING STATES: Idle, negative battery; busy,

ground. Signaling states may be reversed by internal switch option conditioning.

(c) DIALING SPEED: 8 to 14pps.

(d) E-LEAD DIAL PULSE CORRECTION: Optional, using 7389 plug-in subassembly: For pulsing frequencies of 8 to 12pps, breaks ranging from 25% to 75% will be corrected to 58 ±1%; at 14pps, breaks ranging from 30% to 70% will be corrected to 58 ±3%.

(e) RINGING VOLTAGE: 60 to 130Vac.

(f) RINGING FREQUENCY: 16Hz to 66Hz.

(g) FREQUENCY RESPONSE: ±1dB over the range of 200Hz to 10kHz.

(h) POWER REQUIREMENTS: 48 ±4Vdc at 90mA (busy) and 10mA (idle).

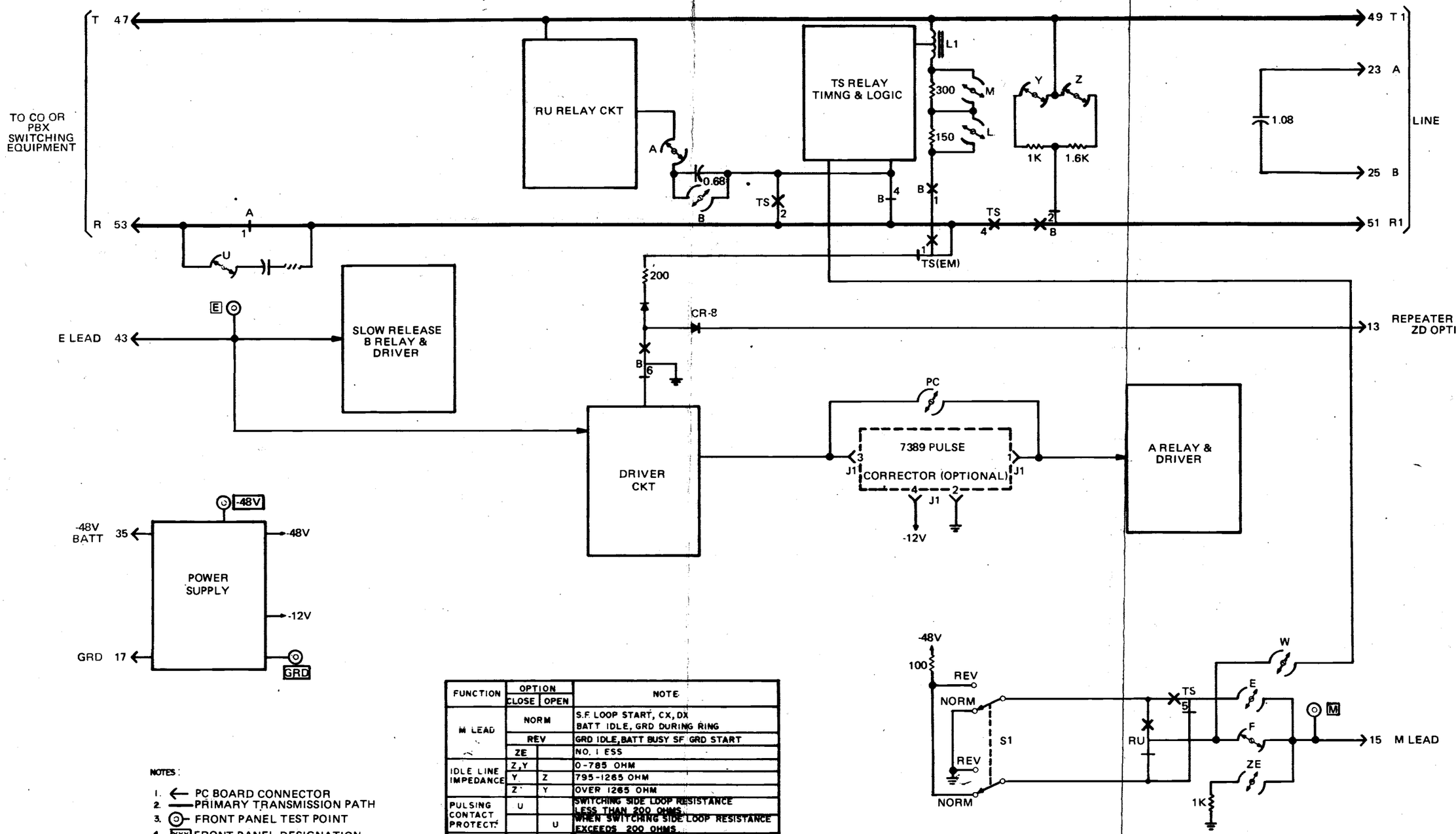
(i) MAXIMUM LOOP LIMITS: 400 ohms for reverse battery sensing; maximum switching equipment (CO or PBX) range for all other functions.

(j) OPERATING ENVIRONMENT: Temperature, 32° to 120°F (0° to 49°C); humidity to 95% (no condensation).

(k) WEIGHT: 24 oz (680g).

(l) DIMENSIONS: Height, 5.6 inches (14.2cm); width, 1.5 inches (3.8cm); depth, 6 inches (15.2cm).

(m) MOUNTING: Module occupies one module position in a Wescom Type 400 Mounting Assembly which provides for either KTU apparatus-case or relay-rack mounting.



NOTES:

1. ← PC BOARD CONNECTOR
2. —— PRIMARY TRANSMISSION PATH
3. ⊙ FRONT PANEL TEST POINT
4. [XXX] FRONT PANEL DESIGNATION
5. -x- , -|- NO, NC RELAY CONTACTS
6. OPEN, CLOSED SCREW OPTIONS
7. (EM) EARLY-MAKE, FORM "D" CONTACT

FUNCTION	OPTION CLOSE	OPTION OPEN	NOTE
M LEAD	NORM		S.F. LOOP START, CX, DX BATT IDLE, GRD DURING RING
	REV		GRD IDLE, BATT BUSY SF GRD START
	ZE		NO. 1 ESS
IDLE LINE IMPEDANCE	Z, Y		0-785 OHM
	Y	Z	795-1265 OHM
	Z	Y	OVER 1265 OHM
PULSING CONTACT PROTECT	U		SWITCHING SIDE LOOP RESISTANCE LESS THAN 200 OHMS
		U	WHEN SWITCHING SIDE LOOP RESISTANCE EXCEEDS 200 OHMS
CO LOOP	L, M		50 OHM
	M	L	200 OHM
	L	M	350 OHM
		L. M	500 OHM
			PROVIDE OPTION AS REQUIRED TO MAKE RESISTANCE AS HIGH AS POSSIBLE WITHOUT EXCEEDING LIMIT OF CENTRAL OFFICE LINE & ASSOC. CKT.
FEATURE	F, A	E, B, W	LOOP START
	F, B	E, A, W	LOOP START W/REV BATT OR PREMONITORY BUSY
	E, A	F, B, W	GROUND START
	E, A, W	F, B	GROUND START W/WINK
PULSE CORRECTOR		PC	WITH 7389
	PC		WITHOUT 7389

RELAY REF DESIG	FUNCTIONAL DESIG	FUNCTION
K1	A	PULSING RELAY
K2	RU	RING-UP OR REVERSE BATT
K3	B	SUPERVISORY
K4	TS	TIP (LINE) GRD SENSOR

Figure 6. 7350 Loop to E&M DLL Circuit Block Diagram (Issue 2)