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STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A, OR 35E97
PERMANENT SIGNAL TEST CIRCUIT
FOR USE IN TESTING SUBSCRIBER LINE
FROM LOCAL TEST DESK NO. 12C OR 14

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<u>SECTION I - GENERAL DESCRIPTION</u>	
1. <u>PURPOSE OF CIRCUIT</u>	
1.01 This circuit is designed to provide a means for releasing a first selector or a subscriber line circuit in order to facilitate testing of a subscriber line from the local test desk.	
2. <u>GENERAL DESCRIPTION OF OPERATION</u>	
2.01 A subscriber line circuit can be tested from either the No. 14 local test desk (LTD) or the No. 12C local test	

desk (LTD). The line that is "permanent" is dialed up by the tester at the LTD using a "test chain" consisting of a test trunk, an optional test trunk ringing circuit, a test distributor control circuit, a test distributor, a test connector, and this test circuit. When the PS RLS key at the LTD is operated, it will result in the connection of the permanent signal test circuit. The test circuit will perform its tests and the success or failure will be indicated at the associated "secondary cord supervisory lamp" at the LTD. While attempting to clear the subscriber line of "permanent" the lamp will flash at a 60-ipm rate; if the attempt should fail, the lamp will light steadily and if the test is successful the lamp will be extinguished.

2.02 This circuit is designed to clear most permanent signal conditions not the different step-by-step offices. Since the permanent signal conditions are different, because of the differences of the subscriber line circuits, two arrangements are provided.

- (a) When this circuit is used at a No. 1 or a No. 350A step-by-step office, specify V and T options.
- (b) When this circuit is used at a No. 355A or 35E97 step-by-step type office, specify S option.

SECTION II - DETAILED DESCRIPTION

1. SELECTION OF TEST CIRCUIT

1.01 When the tester at a local test desk (LTD) determines that a permanent condition exists on a line, he will attempt to release the first selector or subscriber line relay connected to the subscriber line in order to make more definite tests to determine the cause of the permanent signal. The tester will make use of the Test Chain, which includes a test connector, a test distributor, an optional test trunk ringing circuit, a test distributor control circuit, and a test trunk circuit. He will dial the subscriber line that is permanent and be connected to that line by the test connector through the subscriber line circuit connector multiple. The permanent signal test circuit is common to a number of test distributor trunk CH relays which are provided so that only one trunk can be connected to the test circuit at one time. The operation of a permanent signal release key, (PS-RLS), at the LTD will cause the test distributor control circuit to connect the

associated CH relay winding through the T and R relay contacts to the G lead. If the permanent signal test circuit is idle, a ground will be present on the G lead which will operate this CH relay and lock. The operated CH relay will operate relay PS which will transfer the tip and ring to the permanent signal test circuit through the test distributor, test connector, and the subscriber line circuit connector multiple appearance and will ground the ST and BC leads which will operate the ST and BC relays, respectively, of the test circuit. Also the EC and FL leads will be connected to the test circuit. (Refer to the test distributor control circuit for more detailed description of its function.)

1.02 The BC, FL, and EC leads of the permanent signal test circuit serve to indicate to the LTD the three stages of the test circuit, test in progress, failure, or success.

1.03 The LTD secondary supervisory lamp will flash while test is in progress, steady for failure of the test, and become extinguished for successful clearing of the permanent signal.

2. POLARITY AND MARGINAL BRIDGE TEST

2.01 Relay ST operates from ground in the test distributor control circuit. Relay FL operates and releases on 60-ipm pulses approximately 1/2 second make and 1/2 second break. The first operation of relay FL will close ground to operate relay W in series with 500-ohm resistance. Relay Z remains shunted as long as this operating ground is connected. The operation of relay W will close the tip and ring of the line through relays PT and PM to make a marginal and polarity test. If the polarity is that of a selector on a direct line, namely, ground on the tip and battery on the ring, relay PT will operate. If the bridge causing the permanent signal is more than about 50 ohms in resistance, relay PM will operate. If reversed polarity is indicated, relay PM will operate but relay PT will not operate and relay SO will operate after a time interval. Relay SO will close a circuit to operate and lock relay R which reverses the tip and ring with respect to the test relays and relay PT should then operate and relay PM reoperate. With either polarity, therefore, both relays PM and PT should operate, closing a circuit to operate relay LR. The release of relay FL will remove the shunt from relay Z which will operate. Relay W remains locked up. The operation of relay FL on the next closure of the interrupter will close ground to shunt and release relay W and maintain relay Z operated as long as ground is closed. Relay W is closed, therefore, for a period of 1/2 second minimum to 1 second maximum and the polarity-marginal test is made during this period.

3. LOW RESISTANCE BATTERY AND GROUND TEST

3.01 The release of relay W with relay Z operated will close a circuit through a contact of relay D to operate relay W1. The operation of relay W1 will transfer the tip and ring leads from the PT and PM relays to relays MG and MB, respectively, in order to make a test for low resistance battery or ground. This test is applied only if the polarity and marginal test has functioned properly and operated relay LR. The release of relay FL will now cause relay Z to release since relay W is already released. Relay W1, however, locks operated to the control ground on relay ST through a contact of relay D and if relay LR has not operated the release of both relays W and Z will close ground from relay ST, through the locking contact of relay W1, back contact relay W, back contact relay Z, back contact relay LR to operate disconnect relay D which will cancel further test. However, relay LR should be operated, assuming a normal test condition, and the release of relays W and Z will simply count another 1/2 second time interval. The low battery and ground test is applied, therefore, for approximately one second. If a low battery or low ground is encountered during this interval relay MB or MG will operate and close a ground to shunt relay LR which will release and operate relay D which in turn cancels the application of shunting battery.

4. BATTERY TEST FOR LOW RESISTANCE

4.01 The next operation of relay FL will reoperate relay W which will close a circuit to operate relay Z1. This circuit may be traced from ground through make contact of relay ST, make contact of relay LR, back contact relay Z, make contact of relay W, make contact of relay W1, make contact of relay BC to the winding of relay Z1. The operation of relay Z1 will operate relay Z2 which will close the series resistance shunting battery for a low bridge test for approximately 0.2 second during which time if marginal relay M operate in series with the shunting current it will close a circuit to operate relay D and prevent the application of direct shunting battery. Relay M is marginal so that it will operate only if the resistance of the bridge on the line is so low that more than one ampere will flow if direct shunting battery is applied. The operation of relay LR closes a circuit through a back contact of relay Z1 to operate relay SR. The operation of relay Z1 opens the circuit for relay SR which uses a condenser timing scheme to time an interval of approximately 0.2 second for the application of the shunting battery through resistance before applying the direct shunting battery. The

release of relay SR will close a circuit to operate relay W2 provided relay D has not operated.

5. APPLICATION OF SHUNTING BATTERY AND GROUND

5.01 Relay W2 will remain operated while relay Z1 is operated and will close the direct shunting battery and ground to the tip and ring to shunt the A relay of the selector and release the switch. In order to insure the release of the switch this shunting current must be applied for about 1.3 seconds. This time is counted by the operation and release of relay FL. Relay FL will remain operated for about 0.3 second after the operation of relay W2, then its release will operate relay Z. Relay FL will remain nonoperated for 1/2 second then will operate again releasing relay W which now will release relay LR since relay Z1 is operated. Relay FL will be operated for another 1/2 second, making three intervals of a total of 1.3 seconds after relay W2 operates. If the selector releases at any stage during the application of the shunting battery, ground will be removed from lead BC releasing relay BC. The release of relay BC will open the circuit for relays Z1 and W2. Relay W2 in releasing will cut in the 14-ohm resistors in each side of the shunting battery. Relay Z1 will release in turn releasing Z2 which will open the shunting battery circuit. Ground will remain on the ST lead, however, and the timing will continue as above described. A capacitor and resistor are connected across the tip and ring at the No. 2 springs of relay Z2 in order to reduce the click on the line when shunting battery is applied and removed.

6. RELEASE OF TEST CIRCUIT

6.01 The release of relay FL will release relay Z which will close a circuit to operate relay D. This circuit may be traced from ground on a make contact of relay ST, locking make contact of relay W1, back contact relay W, back contact relay Z, back contact relay LR, through relay D to battery. Relay D will operate and lock. The operation of relay D indicates the end of test and subsequent operation is merely to release relays in a certain order to restore the circuit to normal. The operation of relay D opens the circuit for relay W1 which releases and opens the locking circuit for relay Z1 if relay BC is still operated. Relay D in operating also opens the circuit for relay W2 which will release and cut in the 14-ohm resistors in each side of the shunting battery. Relay Z1 releases and opens the holding circuit for relay Z2 which will release opening the circuit of the shunting battery. Relay W2 in releasing will close ground through its back contact through a make contact of relay D to the EC lead. This signals the control circuit that the test is completed and will cause ground to

be opened from the ST lead releasing relay ST. Ground will also be removed from the BC lead if not previously opened by the release of the selector. The release of relay ST opens the locking ground for relay D also for relay R if it has been operated. These relays, releasing, completely restore the test circuit to normal and connect ground to lead G to permit reselection by another control circuit.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 There are limiting conditions in the use of this circuit which may prevent the release of the first selector or subscriber line relay from a permanent line. A signal is provided at the LTD which will indicate the failure to clear the first selector or subscriber line relay. These approximate limits are as follows:

<u>Type of Office</u>	<u>Minimum Sub Line Res Causing Permanent</u>	<u>Max Res in the Tip or Ring Conductor</u>
No. 1 or No. 350A	70 ohms	4 ohms* (T and R from AS Test Ckt Through to Sub Line Conn) (Mult Appearance)
No. 355A or No. 35E97	95 ohms	4 ohms*

1.02 When the resistance of the tip and ring leads from the shunting battery in this circuit through the test chain to the connection to the line at the IDF exceeds 4 ohms per lead, the release of the first selector or line relay of subscribers line circuit cannot be assured. In addition, the exact limits of release will vary for different first selectors due to variation in the adjustment of the A relays, as a result of these limitations there will usually be a small percentage of lines in each office on which it will be impossible to release the first selector but these can be identified only by test.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
BC	Battery Control

* If the tip or ring conductor is less than 2 ohms resistance each, the 2- to 3-volt dry cell booster, KS-6542, may be eliminated. At the No. 355A or No. 35E97 it is of particular importance that the tip or ring conductors be 4 ohms or less each.

<u>Designation</u>	<u>Meaning</u>
D	Disconnect
FL	Flashing
LR	Low Resistance
M	Marginal Current
MB	Marginal Ground Check
MG	Marginal Battery Check
PM	Shunt Current Marginal
PT	Polarity
R	Reversing
SO	Low Operate
SR	Slow Release
ST	Start
W-Z	Traditional Desig for W-Z Ckt
W1	Functional for Low Res Bat and Grd Test
W2, Z ₁ and Z ₂	Functional for Bat Test for Low Res and Application of Full Shunting Bat and Grd Tests

3. FUNCTIONS

3.01 Provides means by the operation of the ST relay for starting a permanent signal test.

3.02 Provides timing means under control of an interrupter and the FL relay to apply various tests, for proper intervals and in definite sequence.

3.03 Provides means for restoring circuit to normal from various test conditions.

3.04 Makes a polarity test of the line.

3.05 Makes a marginal bridge test for low resistance condition on the line.

3.06 Makes a test for low resistance to ground on the battery side of the selected polarity.

3.07 Makes a test for low resistance to battery on the ground side of the selected polarity.

3.08 Makes a marginal battery bridge test for low resistance condition on the line.

3.09 Applies shunting battery and ground of the proper polarity to shunt and release the A relay of the first selector or L relay of the subscriber line circuit.

3.10 Provides means for immediately cutting off the shunting battery after the selector releases.

3.11 Supplies 60-imp interrupter ground to the associated test distributor control circuit or to the test line to test distributor while relay ST is operated

- 3.12 Provides an end of cycle signal to the associated test distributor control circuit or to the test line to test distributor.
- 3.13 Provides a ground signal to the connecting circuits when the test circuit has completely restored to normal and is awaiting reselection.

4. CONNECTING CIRCUITS

- 4.01 When this circuit is listed on a keysheet, the connecting information thereon should be followed.
- (a) Test Distributor Control Circuit for No. 14 Local Test Desk - SD-31401-01.
- (b) Test Line to Test Distributor for No. 12C Local Test Desk - SD-31400-01.
- (c) Test Trunk Circuit from Local Test Desk No. 14 - (typical) - No. 1, 350A, 355A - SD-95737-01.
- (d) Test Distributor - (typical) - No. 1, 350A, 355A - SD-32007-01.
- (e) Subscriber Line Circuits (typical) - No. 1, 350A, 355A or 35E97 - SD-32133-01 No. 355A or 35E97 - SD-32216-01 No. 355A, 35bA or 35E97 - SD-31777-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 This circuit is changed to arrange for its use at a No. 355A or 35E97 Step-by-Step office and provides optional PM and PT relays that will permit the testing of subscriber line relay circuits when permanent. Certain subscriber line relay circuits when "permanent" have their line relay operated and the CO battery and ground connected through the relay winding to the subscriber line. The winding resistance is higher than the first selector A relay previously tested by this circuit and as a result, during the polarity and marginal test, the PM and PT relays do not operate, which is then indicated to the LTD as a failure. In order to clear the "permanent," and permit testing of the subscriber line at the LTD, the line relay must be shunted down. The optional PM and PT relays will permit the application of shunting battery and ground, if the rest of the tests of this circuit are met, at a No. 355A-or 35E97-type office.

B. Changes in Apparatus

- B.1 ADDED
280B PT Relay Fir. 1 Optional Opt. S

B.1 ADDED (Cont)

B-1056 PM Relay Fig. 1 Optional Opt. S

C. Changes in Circuit Requirements Other Than Those Caused by Changes in Apparatus

C.1 Circuit Requirements Table - Relay PM, S512 is designated as option T.

D. Description of Changes

D.1 The title is changed to include No. 355A or 35E97-type Step-by-Step office. The title previously read:

STEP-BY-STEP SYSTEMS
PERMANENT SIGNAL TEST CIRCUIT
FOR USE IN TESTING SUBSCRIBER LINES
FROM LOCAL TEST DESK NO. 12-C OR NO. 14
(PS TST)

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2366-ERL-RMW

D.2 The rating of this drawing is changed to read: AT&TCo STANDARD A&M ONLY FOR 35E97. The previous rating read:

AT&TCo
STANDARD

D.3 In Fig. 1 option T is designated and added.

D.4 In Fig. 1 option S is added.

D.5 In Fig. 1 reference is made to Note 105.

D.6 Circuit Note 105 is added.

D.7 Option T and S are added to the Options Used table.

D.8 The Circuit Note 104 is changed to reflect the use of options T, S, and U.

