TRUNK AND LINE TEST PANEL AND ASSOCIATED EQUIPMENT DESCRIPTION AND THEORY OF OPERATION 3"ESS*" SWITCH

CONTENTS PAGE

1. GENERAL 2
INTRODUCTION 2
PURPOSE 2
CHARACTERISTICS 2
2. EQUIPMENT DESCRIPTION 3
3. FUNCTIONAL DESCRIPTION 3
4. THEORY OF OPERATION 4
SETUP PROCEDURE 4
TESTING 5
A. VM (Voltmeter) Tests 5
Voltmeter Test Voltage Supply Test . 5
Resistance to Ground Test 5
Foreign Battery Test 5
Test for Voltage Between Tip and Ring 5
Test for Short Circuit Between Tip and Ring 6
Capacitance Test 6
Breakdown Test 6
+STA and −STA Test 6

CONTENTS PAGE

CDF Testing 6
B. Coin Collect and Return Tests . . . 7
C. Transmission Tests 7
Milliwatt Receiving Test 7
Milliwatt Transmitting Test 8
Looparound Test 8
Balance Test 8
D. Talk and Monitor Tests 8
E. Circuit State Control Tests 8
F. Lamp Test 9
TAKING EQUIPMENT OUT OF SERVICE . . 9
5. POWER 9
−48 VOLT POWER 9
±130 VOLT POWER 9
TEST VOLTAGES 9
6. MAINTENANCE 10

Figures

1. Connection of TLTP to Test Circuit Multiple 23
2. Test Frame 24

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CONTENTS PAGE

3. Trunk and Line Test Panel (Lower Panel) 25
4. Peripheral Test Unit 26
5. Trunk and Line Test Panel Interface . . 27
6. Voltmeter 28
7. Voltmeter Circuit 28
8. Voltmeter Test Voltage Supply Test . . . 29
9. Resistance to Ground Test 29
10. Foreign Battery Test 29
11. Voltage Between Tip and Ring Lead Test 29
12. Loop Resistance Between Tip and Ring Lead Test 29
13. Capacitance Test 29
14. Breakdown Test 29
15. +STA and −STA Test 30
16. Coin Collect and Return Test 30
17. Transmission Measuring Set (Optional) . 31
18. Transmission Test Paths Using Transmission Facilities at Distant Office 32
19. Transmission Test Path Using Looparound Circuit at Distant Office 33
20. Balance Test 33
21. Network Configuration (During Ringing) 34
22. Trunk and Line Test Panel Schematic . 35

CONTENTS PAGE

Tables

A. Trunk and Line Test Panel and Keys . . 11
B. Assigned Dialing Codes 19
C. Meter Resistance 20

1. GENERAL

INTRODUCTION

1.01 This practice provides a description and theory of operation of the TLTP (trunk and line test panel) and associated equipment used in the 3ESS switch.

1.02 This practice is being reissued to provide information on the connections between the TLTP and the mini—RTTU (mini-remote trunk test unit). Revision arrows are used to denote significant changes in this practice.

PURPOSE

1.03 ▶The TLTP provides facilities for the manual or remote testing of trunks, lines, junctors, and service circuits in the office.◀

CHARACTERISTICS

1.04 The TLTP is part of the periphery of the 3ESS switch. Interface to the switching network is made via two dedicated access trunks and a communication line. Access trunks provide switched access through the switching network to circuits for testing. System test verticals are used for network access when performing junctor tests (Fig. 1). Circuit states can be controlled and tested using the state control keys connected to master scanner ferrods.

▶1.05 Communications from the trunk and line test panel to the system is accomplished with scanner ferrods located in the scanner. These scanner ferrods are controlled by keys in the access trunk control area, keys in the state change control area, keys in the associated junctor control area, and sta-

tus change control area. Scanner ferrod can also be read or controlled remotely by the mini-RTTU.◀

1.06 The communication line serves as a telephone line circuit. A P1A ringer provides audible indications for incoming calls.

▶1.07 The TLTP also connects to the mini-RTTU to allow remote operation of test functions.◀

2. EQUIPMENT DESCRIPTION

2.01 The TLTP and associated circuits are two panels mounted on the test frame (Fig. 2). The upper panel contains:

- Telephone handset and touch-tone dial
- Voltmeter
- Transmission measuring set (optional).

2.02 The lower panel is the main control area (Fig. 3). It contains various switches and lamps. Jacks are located on the front edge of the writing shelf for portable test equipment connection.

2.03 Located behind the lower TLTP panel is the peripheral test unit (Fig. 4). Each test circuit consists of one or more plug-in circuit packs. The peripheral test unit consists of:

- Continuity and polarity test circuit
- Transmission test termination
- Milliwatt and transmission environment test circuit
- Dial pulse receiver test circuit
- Touch-tone receiver test circuit
- Tone presence detector
- Loop environment test circuit
- Station ringer test circuit
- Line insulation test circuit
- Incoming local test desk trunk
- Remainder of TLTP circuitry
- Teletypewriter line circuit.

2.04 With the exception of five toggle-type STATE CONTROL keys and a peripheral decoder group PD TRIPLET rotary switch, all TLTP keys are either locking or nonlocking pushbutton types. All locking keys contain lamps which are lighted when the key is operated. Some nonlocking keys contain lamps which are lighted when the key is operated and extinguished after appropriate system action is complete. See Table A for a list of TLTP lamp and key controls.

3. FUNCTIONAL DESCRIPTION

3.01 The following test capabilities are provided by the TLTP:

- Operational and transmission tests of trunks, junctors, and service circuits
- Leakage and continuity checks on lines and trunks
- Complete functional tests of subscriber lines
- Transmission checks on subscriber lines and PBX (private branch exchange) trunks
- Removal of trunks and service circuits, lines, and junctors from service and restoral to service
- Voice communications via private lines and regular telephone channels to other points within offices of the 3ESS switch and to distant offices
- Removal of PD (peripheral decoder) groups from service under key control and restoral to service.

3.02 The TLTP program is nonresident and must be loaded into the system from the tape data controller unit. Testing cannot be performed until the program is loaded.

3.03 Operating the ON key sends "setup" information to the 3A CO (3A central control) via the scanner. Connection of circuits to the TLTP is accom-

plished by dialing assigned dialing codes (Table B) and by using the panel-mounted touch-tone dial.

3.04 Test paths which connect the circuit under test to the selected access trunk (Fig. 5) are established through the switching network.

3.05 Once the path to a line, trunk, service, or junctor circuit is established, proper operation of TLTP keys provides the capability for connection of test equipment within the TLTP to the circuit under test. If the test equipment is external to the TLTP, access trunk jacks located on the edge of the writing shelf provide a means of connecting portable test equipment to the circuit under test.

4. THEORY OF OPERATION

4.01 The TLTP is used to perform many tests; however, all of the TLTP circuitry is not required for every test. Accordingly, this part will explain the test requirements first and then the circuits required for the test.

SETUP PROCEDURE

4.02 The ON key on the TLTP is used to indicate to the system a request to load the TLTP software program. The same key is used to request unloading of the testing program to deactivate the TLTP. The TLTP software program provides the necessary interface between the TLTP and the circuit to be tested.

4.03 When the ON key is depressed to request loading of the TLTP program, the ON lamp indicates the program loading status according to the following lamp states:

(a) ***60 ipm (Interruptions per Minute):*** Loading request is accepted by multiscan function control, and program is being loaded.

(b) ***120 ipm:*** Loading request is denied by multiscan function control because system is too busy or a higher priority program is being run at the time of request.

(c) ***Lighted Steady:*** Program has been loaded.

4.04 After the program has been loaded, the desired access trunk is connected to the network by depressing the ACCESS TRUNK 1 or ACCESS TRUNK 2 key.

4.05 An origination is entered into the system by lifting the handset off-hook. The system recognizes an origination by providing dial tone on the selected access trunk. The touch-tone dial is then used to access the desired trunk, service, junctor, or line circuit by dialing assigned codes (Table B).

4.06 The PROGRESS OR ERROR lamp indicates whether a connection is made. The following lamp conditions show progress of the call.

(a) ***Lighted Steady:*** Request is successfully completed.

(b) ***Momentarily Off:*** New request is recognized.

(c) ***60 ipm:*** There is an error in attempting to perform a valid request.

(d) ***120 ipm:*** There is an error in input information.

4.07 The EQUIPMENT STATUS (1 or 2) lamp indicates the state of a selected circuit when initial connection is made between the circuit and the TLTP. The lamp indications are:

(a) ***Lighted Steady:*** Selected circuit is in idle state.

(b) ***60 ipm:*** Selected circuit was busy (traffic busy). No connection was established.

(c) ***120 ipm:*** Selected circuit is out of service (maintenance busy). Connection to a circuit in this state is attempted.

4.08 Once a successful connection is established, the telephone handset can be placed in the handset holder located near the top of the panel. When the access trunk is connected to the circuit, tests can be performed by operating the appropriate keys on the TLTP.

4.09 If a second port is needed for a test, the HOLD key should be depressed prior to depressing the other ACCESS TRUNK key. The HOLD lamp will light, and the ACCESS TRUNK (on-hold) lamp will

flash at 30 ipm to indicate that an access trunk or communication line is on hold.

TESTING

A. VM (Voltmeter) Tests

4.10 Depressing the VM (1 or 2) key connects the voltmeter (Fig. 6) to the circuit under test. The VM (1 or 2) key used will depend on the access trunk selected. Once connected, the voltmeter can test resistance to ground, resistance between tip and ring, voltage between tip and ring, voltage on either tip or ring, capacitance, short circuits between tip and ring, line insulation for breakdown, and gas tube station ringers.

4.11 Operating the VM key energizes the VM relay. When the VM relay operates, the circuit connected to the corresponding access trunk is disconnected from the telephone circuit and connected to the voltmeter circuit (Fig. 7 and 22).

4.12 Operation of the VM relay also enables MVM (metallic voltmeter), FEMF (foreign electromotive force), 1K, and 20K relays through respective keys. These relays are interlocked so that only one of the relays can be operated at a given time. When the respective key is operated, the holding path for a previously energized relay is interrupted (deenergized). This interlock prevents the use of the 1K and 20K ranges when measuring FEMF.

Voltmeter Test Voltage Supply Test

4.13 With the VMR (voltmeter reverse) key operated, MVM and FEMF keys not operated, the voltmeter test voltage supply can be checked (Fig. 8).

4.14 Ground is connected to the negative meter terminal by operating the VMR key. The test voltage being checked is determined by the position of the 1K and 20K keys. With both keys released, the level of the +100 volt supply is read on the voltmeter. If the 20K key is operated, the level of the +20 volt supply is checked. The ±116 volt test voltage can also be tested by operating the VMR key and the appropriate +STA or −STA key.

Resistance to Ground Test

4.15 This test may be used to analyze troubles on subscriber lines and to determine resistance of coin telephone station ground connections.

4.16 Operation of the VM key connects the ring lead of the access trunk to the voltmeter circuit (Fig. 9). The tip lead is checked for resistance to ground by operating the TRR (tip and ring reverse) key which interchanges the tip and ring connections.

4.17 Connection of the lead (tip or ring) to be tested is made to the negative voltmeter terminal, and +100 volts is connected to the other meter terminal. If the meter deflects, a foreign potential or GRD (ground) is present and the foreign battery test is required. If the meter goes to zero during the foreign battery test, ground is present.

4.18 Operation of the 1K or 20K key on the voltmeter increases meter sensitivity for more accurate resistance readings (Table C) by changing the meter shunt resistance and connecting to a different meter input with +20 volts (Fig. 6).

Foreign Battery Test

4.19 The foreign battery test is used to determine magnitude and polarity of the voltage between ground and one of the leads (tip or ring) of the circuit under test (Fig. 10). Operation of the FEMF key tests the ring lead for a negative potential with respect to ground. Operation of the TRR key at this time tests the tip lead for a negative potential.

4.20 With the FEMF relay energized, the +120 volt side of the meter is grounded and the lead to be tested is connected to the negative side of the meter. With this connection, the meter reads the magnitude of voltage on the lead under test which is negative with respect to ground. If the meter deflection is in the wrong direction, the meter connections are reversed by operation of the VMR key and a positive potential is indicated.

Test for Voltage Between Tip and Ring

4.21 The test for voltage between tip and ring determines the magnitude and polarity of a voltage between the tip and ring (Fig. 11). Operation of the MVM key tests the ring lead for a negative potential with respect to the tip lead. If the VMR key is

operated, the voltmeter tests for a positive potential on the ring with respect to the tip. The tip and ring are thus tested for continuity when battery and ground are supplied by the distant end.

4.22 Operation of the MVM relay connects the tip lead of a circuit under test to the +120 volt side of the meter and the ring lead to the negative side. The meter reads the negative voltage on the ring lead with respect to the tip lead. If the direction of deflection is wrong, the VMR key is operated to reverse meter connections.

Test for Short Circuit Between Tip and Ring

4.23 The test for short circuit between tip and ring examines tip and ring leads of a circuit under test for a short circuit. Operation of the GRD key is required. If a short circuit exists, the voltmeter will deflect. A voltmeter reading with the GRD key released indicates a leakage to ground on the ring lead.

4.24 When operated, the GRD key grounds the tip lead, and the ring lead is connected through the voltmeter to test voltage (either +20 volts or +100 volts, depending on the range selected). The voltmeter indications for a short circuit can be converted into resistance readings (Table C). This procedure will also aid in calculating loop resistance (Fig. 12) to determine proper operation of coin telephone relays and the need for range extenders or dial long line circuits.

Capacitance Test

4.25 To determine capacitance, the GRD key is operated. The TRR key is operated after the meter needle comes to rest. This causes a momentary deflection proportional to the capacitance of the ring lead (Fig. 13). Restoring the TRR key causes a momentary deflection proportional to the capacitance on the tip lead. The greater the deflection, the greater the capacitance and vice versa.

4.26 Operation of the GRD key grounds the tip lead, and the ring lead is connected to +100 volts through the voltmeter. The circuit capacitance charges to this 100-volt potential through the 10,000-ohm voltmeter resistance plus the external circuit resistance. The meter needle stabilizes, operation of the TRR key reverses the tip and ring connections, and the circuit capacitance charges to the opposite potential. The TRR key is then released, and the original voltage polarity is placed on the circuit under test. Resulting meter deflections are proportional to the circuit capacitance. The test will indicate unbalanced or open subscriber lines.

Breakdown Test

4.27 The breakdown test is a test of line insulation breakdown at 200 volts (Fig. 14). The BT (breakdown test) key is operated; then the 1K key is operated. A meter reading will indicate an insulation breakdown on the ring lead. The 1K key should be released before the BT key to avoid tapping the subscriber telephone bell. To test the tip lead, the TRR key is operated and the test is repeated.

4.28 Operation of the BT key connects +200 volts through the 120-volt, 100,000-ohm terminals of the meter to the side of the line under test (tip or ring). The high meter resistance provides capability for the line to charge without tapping any ringer bell. When the 1K key is operated, the meter is changed to a 24-milliamp meter by shunting it with a 1050-ohm resistor. A meter reading indicates an insulation breakdown.

+STA and −STA Test

4.29 This test is used to check gas tubes (located in the telephone station ringer) on 4-party full-selective and 8-party semi-selective subscriber lines (Fig. 15). Operation of the +STA or −STA key applies a voltage (+116 volts or −116 volts) to the ring lead of a subscriber line. Telephone gas tube ringers will ionize when the proper potential and polarity are applied. When one gas tube ionizes, an approximate voltmeter deflection of one-third of full scale will be observed. Gas tubes in telephone sets on the tip lead may be checked in the same manner by operation of the TRR key. A knowledge of line facilities permits an estimate of the number of tubes ionized in each test.

CDF Testing

4.30 A subscriber line or a vacant cable pair may be tested by placing a W2HA test cord (test shoe) at the CDF between the cable pair pin jacks and the test shoe jacks located in the test talk box. If the W2HA test cord is not available, a W2FH test cord with a KS-21386 adapter may be used. Depressing the CDF OUT key on the TLTP bypasses the switching network and permits testing directly on the outside

plant cable pair. With the VM1 key depressed, a voltmeter testing capabilities are possible. Transmission testing can be performed by depressing the TRMT 1 key. Releasing the CDF OUT and depressing the CDF IN key connects access trunk 1 to the subscriber line network appearance and permits testing into the line ferrod associated with the subscriber line being tested.

B. Coin Collect and Return Tests

4.31 Depressing the COIN COLLECT key applies coin collect potential to the tip lead (Fig. 16). The junctor should be in the bypass state for this test. The coin relay should operate and collect any coins in the coin telephone connected to the TLTP for test. The COIN RETURN key applies coin return potential to the coin relay to return coins.

4.32 The coin collect and return potential is ±130 volts. A wiring option is provided to meet correct polarity requirements which vary in different localities. Depressing the COIN COLLECT key connects the correct 130-volt polarity through the circuit to the coin relay. The COIN RETURN key operation connects 130 volts of the opposite polarity through the circuit to the coin relay. Depressing the COIN COLLECT or COIN RETURN key lights the coin lamp momentarily. This indicates that the coin was collected or returned. If the coin is stuck in the coin chute, the lamp will remain lighted as long as the COIN COLLECT or COIN RETURN key remains depressed.

C. Transmission Tests

4.33 The TLTP has the capacity to apply an open, ac short, or a balance termination at 0-dBm or −10 dBm level on both access trunks. Transmission tests can be made on trunks, PBX lines, and subscriber lines.

4.34 The keys commonly used in performance of the transmission test are as follows:

(a) ***CAL (Calibrate) Key:*** Energizes CAL relay while disconnecting access trunks 1 and 2 from the test equipment and allowing the test equipment to be calibrated.

(b) ***REVERSE ACCESS TRUNK Key:*** Energizes the RT relay while exchanging the tip and ring leads of access trunk 1 with corresponding leads of access trunk 2.

(c) ***BALANCE (1 or 2) Key:*** Energizes BAL relay and places a balance termination of 898 ohms and 2.15 microfarads across the access trunks.

(d) ***TRMT (1 or 2) (Transmit) Key:*** Energizes the associated XMS relay and connects selected access trunk to the transmission.

(e) ***TRMT OPEN Key:*** Energizes TO relay while placing an open on the access trunk.

(f) ***TRMT SHORT Key:*** Energizes TS relay while placing an ac short on the access trunk.

(g) ***0 DBM Key:*** Applies 1000 Hz at 0 dBm to the access trunk.

(h) ***−10 DBM Key:*** Applies 1000 Hz at −10 dBm to the access trunk.

4.35 Jacks TM1 and TM2, located on the writing shelf, are used to connect portable test equipment to their associated access trunks via the TLTP. When test cords are inserted into the jacks, the access trunks are disconnected from the transmission measuring set and the milliwatt test signal. Test sets plugged into these jacks are connected through isolation capacitors to the access trunks. These capacitors isolate any dc voltage on the access trunk from the test set.

4.36 When the TRMT 1 key is operated, access trunk 1 will be connected to the circuitry which provides the open circuit, the alternating current, short circuit, and access to the milliwatt distribution circuit through contacts in jack TM1. With TRMT 2 operated, access trunk 2 is connected to the optional transmission measuring set (TMS) (Fig. 17) through contacts of jack TM2. By operating the REVERSE ACCESS TRUNKS key, the transmission equipment will become transposed with the access trunks.

Milliwatt Receiving Test

4.37 A connection is made to the milliwatt test line in the distant office (Fig. 18 and 19). Either access trunk can be used; however, using access trunk 2 does not require operation of the REVERSE AC-

CESS TRUNKS key. If using access trunk 2, signal loss can be measured by operating the TRMT 2 key and observing the optional TMS or portable TMS plugged into jack TM2. Releasing the TRMT 2 key permits incoming tone to be heard in a headset plugged into TEL SET A- and B-jacks or in the telephone handset.

Milliwatt Transmitting Test

4.38 A milliwatt tone is supplied from the office over a connection to the distant office (Fig. 18). The signal is measured at the distant office on its transmission measuring set to determine signal loss.

4.39 The transmitting signal (0 or −10 dBm) is developed from the milliwatt distribution circuit. A resistor network provides attenuation to decrease the 0-dBm level signal to a −10 dBm level signal. With the TRMT 1 key operated, operation of either the 0 DBM or −10 DBM key connects the milliwatt distribution circuit to access trunk 1.

Looparound Test

4.40 Connections from both access trunks are made to the looparound test line in the distant office (Fig. 19). Access trunk 1 becomes the sending facility, and access trunk 2 becomes the receiving facility. The milliwatt tone is sent from the 3ESS switch to the distant office and back to the 3ESS switch. The total signal loss is then measured using the transmission measuring set. The transmitting loss (office to distant office) can be calculated by subtracting the receiving loss (paragraph 4.36) from the total loss. Operation of the REVERSE ACCESS TRUNKS key permits sending on access trunk 2 and receiving on access trunk 1.

4.41 Local line transmission tests can be performed in the same manner as trunk transmission tests with one exception. Line transmission testing is available only on access trunk 1. The LINE TRMSN TEST key is operated to supply battery and ground (talk battery) to tip and ring leads of the line connected to access trunk 1. This key must be released when sending and receiving tone.

Balance Test

4.42 The requirement for a 900-ohm termination, when making terminal office balance tests, can be provided by either access trunk. Operating the BALANCE 1 or BALANCE 2 key places an 898-ohm resistance in series with 2.15-μF capacitance across tip and ring of the associated access trunk (Fig. 20).

D. Talk and Monitor Tests

4.43 The talk function is used to supply battery and ground to the telephone circuit. The monitor function is used to monitor a network connection or to listen to signals being received over the access trunk.

4.44 The TALK LINE key provides talking battery to the subscriber line. The junctor should be placed in the bypass state.

4.45 The talk function is used in conjunction with the handset or a headset plugged into TEL SET A- and B-jacks. The TALK LINE key, when operated, energizes the talk line relay which supplies battery and ground to the subscriber line. The MONITOR (1 or 2) key is used to initiate a request to the system to bridge onto a busy circuit via the test access vertical. To establish a monitor connection, the PROGRESS OR ERROR lamp will indicate success or failure. Operation of the MONITOR key also energizes the corresponding monitor relay by placing the high impedance input of the monitor amplifier across the selected access trunk. If the telephone handset or headset is inserted in TEL SET A- and B-jacks, the output of the monitor amplifier will be connected to the handset or headset.

E. Circuit State Control Tests

4.46 The state change control circuitry is used to request the system to place a trunk, junctor, or service circuit into one of its possible states. The state of the circuit depends on the condition of the state control relays in that circuit.

4.47 The STATE CONTROL ACCESS TRUNK key, ASSOCIATED JUNCTOR key, ($A\bar{A}$, $B\bar{B}$, $C\bar{C}$) keys, and PD TRIPLET switch (Table B) are set up to select the desired test configuration of state relays in the circuit under test. When the EXECUTE key is depressed, the execute relay is energized and the 3A CC is notified by a scanner that a request is made by the TLTP. The system determines the validity of this request; and if the request is valid, the test setup is made.

4.48 When the RING key is depressed, ringing is requested to be applied to the line connected to the designated access trunk. If the PD TRIPLET switch is in the SPEC RING position, the ringing combination designated by A$\overline{A}$, B$\overline{B}$, and C$\overline{C}$ keys will be applied. If not in the SPEC RING position, the ringing combination normal to that line will be applied.

4.49 Ringing of the line under test is accomplished by first disconnecting the network path (TJCTR) from the TLTP to the line (Fig. 21). Ringing is applied to the line from a ringing circuit via a second network path (BJCTR) and audible ringing is returned to the TLTP via a half-path connection to the TJCTR. If the ringing is tripped or if the RING key is depressed to stop ringing the line, the connection of the ringing circuit to the line under test is released, and the connection from the TLTP to the line under test is reestablished with the junctor (TJCTR) in the line-to-line state. The state-change control keys must be used to return the junctor to the bypass state if further voltmeter tests of the line are desired.

4.50 The STATUS CONTROL consists of three keys and a lamp. After a circuit has been dialed up and test completed, the circuit may be placed out of service or put back into service. Depressing the OUT OF SERVICE key and appropriate RELEASE key places the circuit under test out of service. Depressing the ACTIVE IDLE key and the appropriate RELEASE key places the circuit under test back into service. If neither the OUT OF SERVICE nor ACTIVE IDLE key is depressed when the circuit is released, the circuit will be returned to the same state that it had when it was seized. Depressing the OUT OF SERVICE key and PD GROUP key removes from service all circuits sharing the same PD board with circuit under test. Depressing the ACTIVE IDLE key and PD GROUP key restores to service all circuits sharing the same PD board with circuit under test. The CIRCUIT LIMIT lamp lights when the out-of-service limit is exceeded. Efficiency of the system to handle busy hour calls is reduced. The CIRCUIT LIMIT lamp feature will not be affected however, when the PD GROUP key is used. If the CIRCUIT LIMIT lamp lights and the circuit must be removed from service, verify that the STATE CONTROL ACCESS TRUNK 1/2 switch is in the appropriate position, then depress the EXECUTE key. The circuit will be removed from service unconditionally.

F. Lamp Test

4.51 The lamp test feature is provided to verify that the lamps on test panel and voltmeter will light. When the LAMP TEST key is depressed and held, the voltmeter keys, status LEDs (light-emitting diodes), and all keys listed in Table A with a lamp designation will light.

▶TAKING EQUIPMENT OUT OF SERVICE

4.52 When remote operation is desired, battery and ground terminals on the TLTP interface circuit are closed by the mini-RTTU. This action switches off power to the panel. The test panel can also be taken out of service by taking the access trunk network appearances out of service. No circuit packs should be removed without first removing associated fuses.◀

5. POWER

−48 VOLT POWER

5.01 The −48 volt power is used on the TLTP for relay operation, lamp power supply, and talk battery. Filtering and fusing of the −48 volt power supplied to the TLTP are located on the test frame. The −48 volt power control is supplied by the 151A power plant. If a fuse opens, the FA relay in the 151A power plant is operated. This operation notifies the system via the master scanner that a fuse is open. The proper alarms are activated.

±130 VOLT POWER

5.02 The ±130 volt power is supplied by 184B-type converters located on the miscellaneous power frame. Power control, fusing, and alarms are provided on the miscellaneous power frame. The ±130 volt power is used on the TLTP for coin collect and return tests.

TEST VOLTAGES

5.03 The KS-19412 rectifier provides the test voltages (+20, +100, +116, −116, and +200) required by the TLTP. The rectifier provides control and fusing for these test voltages. The rectifier output voltage fuses have no alarm connections. The indicator (70-type) fuses must be visually inspected to determine if any are blown. The 115-volt, 60-Hz

power required by the rectifier is supplied from the service entrance distribution panel.

6. MAINTENANCE

6.01 The TLTP is not maintained by software programs. Proper operation of the TLTP is verified by performance of tests on the TLTP. These tests are performed on a periodic basis as prescribed by routine maintenance procedures or when a malfunction of the TLTP is suspected.

TABLE A

TRUNK AND LINE TEST PANEL AND KEYS

VOLTMETER (NOTE 1)					
KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
Ground (GRD)	L	—	GRD	—	Puts ground on tip lead.
Voltmeter reverse	L	—	VMR	—	If VMR nonoperated, meter reads negative voltage. If VMR operated, meter reads positive voltage.
Tip and ring reverse (TRR)	L	—	TRR	—	Tip and ring reverse of voltmeter circuit. The tip lead is checked for leakage resistance to ground.
Foreign electromotive force (FEMF)	L	—	FEMF	—	FEMF tests the ring lead for a negative potential with respect to ground.
Metallic voltmeter (MVM)	L	—	MVM	—	MVM key tests the ring lead for a negative potential with respect to the tip lead.
1K, 20K	L	—	1K, 20K	—	Provides midscale deflection for meter measurements.
—	—	—	100K	—	Indicates internal voltmeter resistance.
Breakdown test (BT)	L	—	BT	—	A test of line insulation for breakdown at 200 volts.
+Station (+STA)	L	—	+STA	—	Positive station gas tube breakdown test.
–Station (–STA)	L	—	–STA	—	Negative station gas tube breakdown test.
Spare (SP)	—	—	—	—	Key is not used.

See notes at end of table.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

ACCESS TRUNK CONTROL (NOTE 2)					
KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
Access trunk	NL	2	ACCESS TRUNK	2	Connects telephone set to network; closes supervision to scanner. Steady — Access trunk is connected to telephone set. 30 ipm — Access trunk is placed on hold. 60 ipm — There is an incoming call on access trunk (accompanied by ringing).
HOLD	NL	1*	HOLD	—	Holds network connection from access trunk or communication line but opens connection to telephone set. Indicates an access trunk or that the communication link is on hold.
RELEASE	NL	1*	—	—	Initiates release of network connection to access trunk.
COMM LINE	NL	—	COMM LINE	—	Connects telephone set to network. Steady — Communication line is connected to network. 30 ipm — Communication line is on hold.
RELEASE COMM LINE	NL	—	—	—	Opens telephone set connection to network.
ACTIVE IDLE	NL	1	ACTIVE IDLE	2†	Restores associated circuit to service when access trunk is released. (If IDLE key is not depressed, the circuit is placed in the state it was in before tests were made.) Indicates request to restore circuit to service.

See notes at end of table.

* Shares access trunk scan point.

† One distribute point is used to extinguish the OUT OF SERVICE and ACTIVE IDLE.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
ACCESS TRUNK CONTROL (NOTE 2) (Contd)					
OUT OF SERVICE	NL	1			Requests that associated circuit be removed from service when access trunk is released.
			OUT OF SERVICE	2†	Indicates request to remove circuit from service.
PD GROUP	NL	1			Requests that all circuits on the same peripheral decoder board, with the circuit connected to the access trunk, be marked out of service or restored to service, depending on whether OUT OF SERVICE or ACTIVE IDLE key is also operated.
			PD GROUP	3*	Indicates request to perform PD group function.
—	—	—	CIRCUIT LIMIT	—	Indicates denial of request to remove circuit from service since excessive number of circuits in group would be out of service.
TEST SELECT (NOTE 2)					
BALANCE	L	—		—	Connects balance termination to access trunk.
			BALANCE		Indicates balance termination is connected to access trunk.
TRMT	L	—		—	Connects associated access trunks to transmission circuitry.
			TRMT		Indicates connection of access trunk to transmission circuitry.
VM	L	—		—	Connects associated access trunks to voltmeter circuitry.
			VM		Indicates connection of access trunks to voltmeter circuitry.
MON	L	2		—	Connects high-impedance monitor amplifier between circuit under test and associated access trunk via test access vertical.
			MON		Indicates monitor circuit connected.

See notes at end of table.

* One distribute point is used to extinguish the RING, PD GROUP, and EXECUTE.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
LINE TEST (NOTE 2)					
COIN COLLECT	NL	—	—	—	Applies coin collect potential via tip lead of access trunk.
COIN RETURN	NL	—	—	—	Applies coin return potential via tip lead of access trunk.
—	—	—	COIN	—	Indicates presence of ground on tip lead while COIN COLLECT or COIN RETURN key is operated.
ROH	NL	—	—	—	Applies receiver off-hook tone via selected access trunk.
CDF OUT	L	—	CDF OUT	—	Connects access trunk 1 appearance to customer cable pair, bypassing network. Indicates CDF OUT connections.
CDF IN	L	—	CDF IN	—	Connects access trunk 1 appearance to network appearance of customer line. Indicates CDF IN connections.
TALK LINE	L	—	TALK LINE	—	Connects battery to access trunk for talking to called line. Indicates that TALK LINE key is operated.
TRANSMISSION TEST (NOTE 2)					
0 DBM	L	—	0 DBM	—	Applies 0-dBm signal via access trunk. Indicates that 0 DBM key is operated.
–10 DBM	L	—	–10 DBM	—	Applies –10 dBm signal via access trunk. Indicates that –10 DBM key is operated.
TRMT OPEN	L	—	TRMT OPEN	—	Applies open circuit to transmission pair. Indicates that TRMT OPEN key is operated.

See notes at end of table.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

TRANSMISSION TEST (NOTE 2) (Contd)					
KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
TRMT SHORT	L	—		—	Applies ac short circuit to transmission pair.
			TRMT SHORT		Indicates that TRMT SHORT key is operated.
LINE TRMSN TEST	L	—		—	Applies battery and ground to the access trunk 1 transmission test pair for line transmission testing.
			LINE TRMSN TEST		Indicates that the LINE TRMSN TEST key is operated.
REVERSE ACCESS TRUNKS	L	—		—	Connect milliwatt signal (or TM1 jack) to access trunk 2 and transmission measuring set (or TM2 jack) to access trunk 1, the reverse of normal.
			REVERSE ACCESS TRUNKS		Indicates that REVERSE ACCESS TRUNKS key is operated.
CAL	L	—		—	Connects transmission measuring set (or TM2 jack) to milliwatt distribution circuit.
			CAL		Indicates that CAL key is operated.
STATE CONTROL (NOTE 2)					
ACCESS TRUNK 1/2	T	1	—	—	Designates identity of access trunk on which state change, peripheral decoder group status change, circuit supervisory scan point monitoring, or ringing is to be applied.
ASSOCIATED JUNCTOR	T	1	—	—	Yes — Designates that state change is to be applied to junctor circuit associated with the access trunk designated by the position of ACCESS TRUNK 1/2 switch.

See notes at end of table.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

STATE CONTROL (NOTE 2) (Contd)

KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
A,B,C	T	3	—	—	When EXECUTE key is operated, designates states in which a triplet of state relays are to be placed. When RING key is operated and PD TRIPLET switch is in SPECIFIED RING position, designates ringing combination to be applied to line.
EXECUTE	NL	1			Indicates that a state change is to be applied to a circuit on the access trunk designated by the ACCESS TRUNK 1/2 switch.
			EXECUTE	3*	Indicates that request has been entered to apply state change to a circuit.
RING	NL	1			Indicates: (a) Ringing is to be applied to the line connected to the access trunk designated by the ACCESS TRUNK 1/2 switch. (b) State change is to be applied to circuit triplets 4 through 7 which control state relays beyond relay M. (c) State change is to be applied to a circuit or junctor that is connected to the third part of a 3-part conference circuit.
			RING	3*	Indicates that request has been entered to apply ringing to a line.

See notes at end of table.

* One distribute point is used to extinguish the RING, PD GROUP, and EXECUTE.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

STATE CONTROL (NOTE 2) (Contd)					
KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
PD TRIPLET	RSW	2	—	—	When the EXECUTE key is depressed, the triplet of state relays (ABC, DEF, GHJ, or KLM) selected is operated or released according to the position of A, B, and C toggle switches. In the ABC position and when testing line circuits, depressing the EXECUTE key will change the state of coin line circuits. In the DEF position and when depressing the EXECUTE key, the state of noise immunity line circuits can be changed. When RING is operated, SPECIFIED RING designates that ringing combination is set on ABC switches. Not SPECIFIED RING designates that ringing code for line under test is applied to the line.
STATUS (NOTE 2)					
—	—	—	EQUIPMENT STATUS	4	Lighted Steady — Selected circuit was in idle state. 60 ipm — Selected circuit was traffic busy. 120 ipm — Selected circuit was out of service.
—	—	—	PROGRESS OR ERROR	2	Lighted Steady — Request was successfully completed. 120 ipm — There is an error in either system action or input information. Momentarily Off — New request has been recognized. 60 ipm — There is an unsuccessful system connection; valid request cannot be performed.

See notes at end of table.

TABLE A (Contd)

TRUNK AND LINE TEST PANEL AND KEYS

STATUS (NOTE 2) (Contd)					
KEY		LAMP			FUNCTION OR INDICATION
DESIGNATION	TYPE	SCAN POINTS	DESIGNATION	DIST	
—	—	—	CALLED SUPERVISION	1	Lighted — Off-hook is received from called office via outgoing trunk.
MISCELLANEOUS					
ON	NL	1	ON	2	Requests loading or aborting of program. Steady — Program has been loaded. 60 ipm — Loading request is accepted by MSFC; program is being loaded. 120 imp — Loading request is denied by MSFC.
LAMP TEST	NL	—	—	—	When the LAMP TEST key is operated, the voltmeter keys, status LEDs, and all keys on the trunk and line test panel with a lamp designation will light.

Note 1: Refer to Fig. 6.

Note 2: Refer to Fig. 3.

TABLE B

ASSIGNED DIALING CODES (NOTE)

TYPE OF CIRCUIT	KEYING FORMAT											
	1	2	3	4	5	6	7	8	9	1	2	
Trunk circuit	1	TGN			MEMN			#				
Trunk circuit with outpulsing	1	TGN			MEMN			*	(Wait for dial tone)			Digits to be outpulsed #
Service circuit	1	TGN			MEMN			#				
Service circuit with more than one port	1	TGN			MEMN			PN	#			
Tone and announcement circuit	1	TGN			MEMN			#				
Subscriber line	2	Directory number						#				
Junctor	3	CGN		JSN				#				
Trunk to No. 5 crossbar ACD	6	TGN			MEMN			*	(Wait for dial tone)		SF	#

Note:
TGN = Trunk group number
MEMN = Member number
CGN = Concentrator group number
JSN = Junctor switch number
PN = Port number (0, 1, 2)
SF = 0 without SF unit; 1 with SF unit
* = Eleventh button on touch-tone pad
\# = Twelfth button on touch-tone pad.

TABLE C

METER RESISTANCE

100,000-OHM METER RESISTANCE
120-VOLT SCALE
20K KEY NONOPERATED
1K KEY NONOPERATED

METER READING	RESISTANCE OHMS TEST BATTERY VOLTAGE		
VOLTS	99	100	101
100		0	1,000
98	1,020	2,040	3,061
96	3,125	4,166	5,208
94	5,319	6,382	7,446
92	7,608	8,695	9,782
90	10,000	11,110	12,220
88	12,500	13,640	14,770
86	15,120	16,280	17,440
84	17,860	19,050	20,240
82	20,730	21,950	23,170
80	23,750	25,000	26,250
78	26,920	28,200	29,490
76	30,260	31,580	32,890
74	33,780	35,130	36,490
72	37,500	38,890	40,280
70	41,430	42,860	44,280
68	45,590	47,060	48,530
66	50,000	51,510	53,030
64	54,690	56,250	57,810
62	59,680	61,290	62,900
60	65,000	66,670	68,330
58	70,690	72,410	74,140
56	76,780	78,570	80,360
54	83,330	85,180	87,040
52	90,380	92,310	94,320

METER READING	RESISTANCE OHMS TEST BATTERY VOLTAGE		
VOLTS	99	100	101
50	98,000	100,000	102,000
48	106,200	108,300	110,400
46	115,200	117,400	119,600
44	125,000	127,300	129,500
42	135,700	138,100	140,500
40	147,500	150,000	152,500
38	160,500	163,200	165,800
36	175,000	177,800	180,600
34	191,200	194,100	197,100
32	209,400	212,500	215,600
30	230,000	233,300	236,700
28	253,600	257,100	260,700
26	280,800	284,600	288,500
24	312,500	316,700	320,800
22	350,000	354,500	359,100
20	395,000	400,000	405,000
18	450,000	455,600	461,100
16	518,700	525,000	531,300
14	607,100	614,300	621,400
12	725,000	733,300	741,700
10	890,000	900,000	910,000
8	1,127,000	1,150,000	1,162,000
6	1,550,000	1,367,000	1,583,000
4	2,375,000	2,400,000	2,425,000
2	4,850,000	4,900,000	4,950,000

TABLE C (Contd)

METER RESISTANCE

20,000-OHM METER RESISTANCE
24-VOLT SCALE
20K KEY OPERATED
1K KEY NONOPERATED

METER READING	RESISTANCE OHMS TEST BATTERY VOLTAGE		
VOLTS	19.4	20	20.6
20.0		0	600
19.6		408	1,020
19.2	208	833	1,458
18.8	638	1,276	1,914
18.4	1,086	1,739	2,392
18.0	1,556	2,222	2,888
17.6	2,046	2,727	3,410
17.2	2,558	3,255	3,954
16.8	3,096	3,809	4,524
16.4	3,658	4,390	5,122
16.0	4,250	5,000	5,750
15.6	4,872	5,641	6,410
15.2	5,526	6,315	7,106
14.8	6,236	7,838	7,027
14.4	6,944	8,612	7,777
14.0	7,714	9,428	8,571
13.6	8,530	10,290	9,411
13.2	9,394	11,210	10,300
12.8	10,310	12,260	11,250
12.4	11,290	13,230	12,260
12.0	12,330	14,330	13,330
11.6	13,450	15,520	14,480
11.2	14,640	16,790	15,710
10.8	15,930	18,150	17,040
10.4	17,310	19,620	18,460

METER READING	RESISTANCE OHMS TEST BATTERY VOLTAGE		
VOLTS	19.4	20	20.6
10.0	18,800	20,000	21,200
9.6	20,420	21,670	22,920
9.2	22,170	23,480	24,780
8.8	24,090	25,450	26,820
8.4	26,190	27,620	29,050
8.0	28,500	30,000	31,500
7.6	31,050	32,630	34,210
7.2	33,890	35,360	37,220
6.8	37,060	38,820	40,590
6.4	40,620	42,500	44,380
6.0	44,670	46,670	48,670
5.6	49,290	51,430	53,570
5.2	54,620	56,920	59,230
4.8	60,830	63,330	65,830
4.4	68,180	70,910	73,640
4.0	77,000	80,000	83,000
3.6	87,780	91,110	94,450
3.2	101,200	105,000	108,800
2.8	118,600	122,900	127,100
2.4	141,700	146,700	151,700
2.0	174,000	180,000	186,000
1.6	222,500	230,000	237,500
1.2	303,300	313,300	323,300
0.8	465,000	480,000	495,000
0.4	950,000	980,000	1,010,000

TABLE C (Contd)

METER RESISTANCE

1,000-OHM METER RESISTANCE
1K KEY OPERATED
20K KEY NONOPERATED

METER READING	RESISTANCE		
	OHMS		
	TEST BATTERY VOLTAGE		
VOLTS	19.4	20	20.6
20.0		0	30
19.6		20	51
19.2	10	42	73
18.8	32	63	96
18.4	54	87	120
18.0	78	111	144
17.6	102	136	171
17.2	128	163	198
16.8	155	190	226
16.4	183	220	256
16.0	213	250	288
15.6	244	282	321
15.2	276	316	355
14.8	312	351	392
14.4	347	389	431
14.0	386	428	471
13.6	427	471	515
13.2	470	515	561
12.8	516	563	613
12.4	565	613	661
12.0	617	667	717
11.6	672	724	776
11.2	732	786	839
10.8	796	852	907
10.4	865	925	981

METER READING	RESISTANCE		
	OHMS		
	TEST BATTERY VOLTAGE		
VOLTS	19.4	20	20.6
10.0	940	1,000	1,060
9.6	1,021	1,083	1,146
9.2	1,109	1,174	1,239
8.8	1,205	1,273	1,341
8.4	1,310	1,381	1,452
8.0	1,425	1,500	1,575
7.6	1,553	1,632	1,711
7.2	1,694	1,778	1,861
6.8	1,853	1,941	2,029
6.4	2,031	2,125	2,219
6.0	2,233	2,333	2,433
5.6	2,464	2,571	2,679
5.2	2,731	2,846	2,962
4.8	3,042	3,167	3,292
4.4	3,409	3,545	3,682
4.0	3,850	4,000	4,150
3.6	4,389	4,556	4,722
3.2	5,062	5,250	5,438
2.8	5,929	6,143	6,357
2.4	7,083	7,333	7,583
2.0	8,700	9,000	9,300
1.6	11,130	11,500	11,880
1.2	15,170	15,670	16,170
0.8	23,250	24,000	24,750
0.4	47,500	49,000	50,500

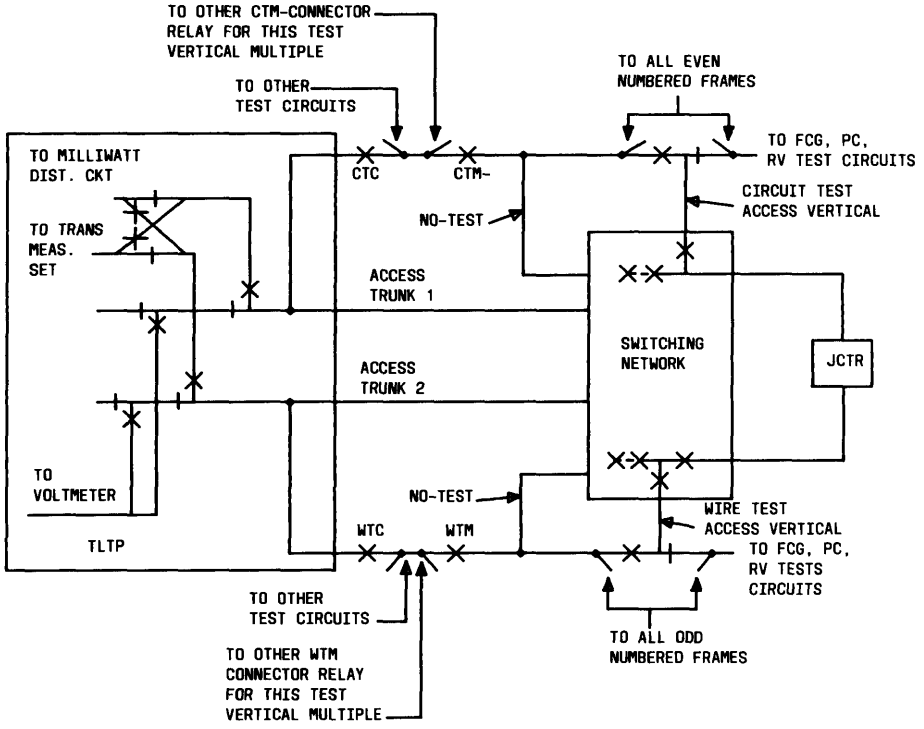


Fig. 1—Connection of TLTP to Test Circuit Multiple

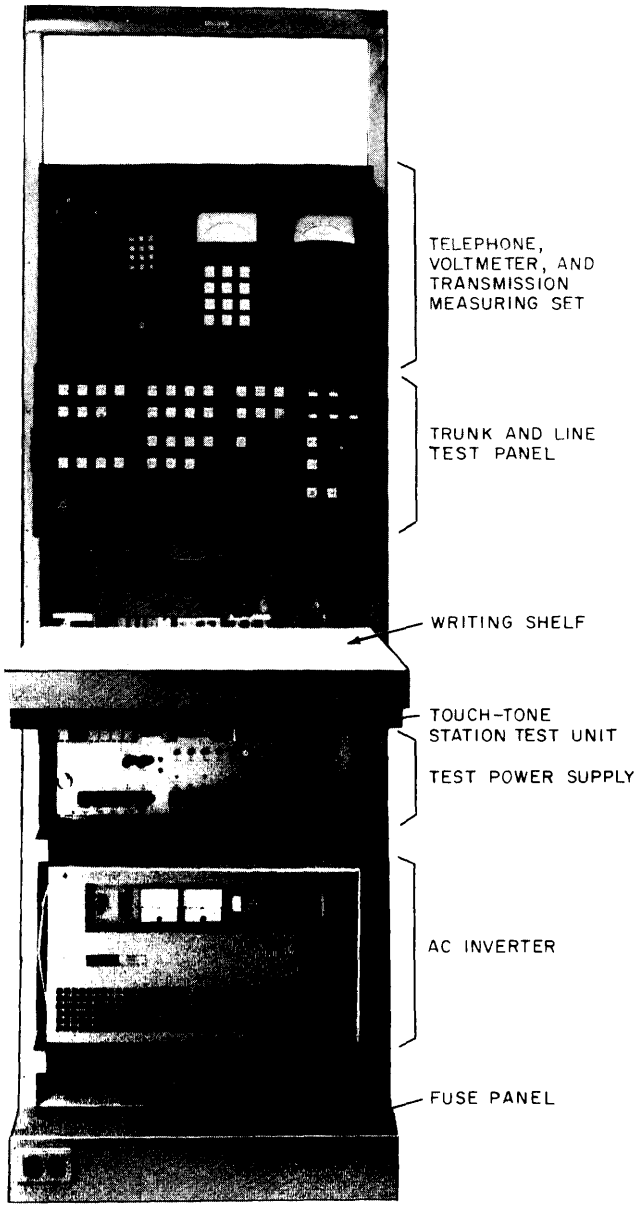


Fig. 2—Test Frame

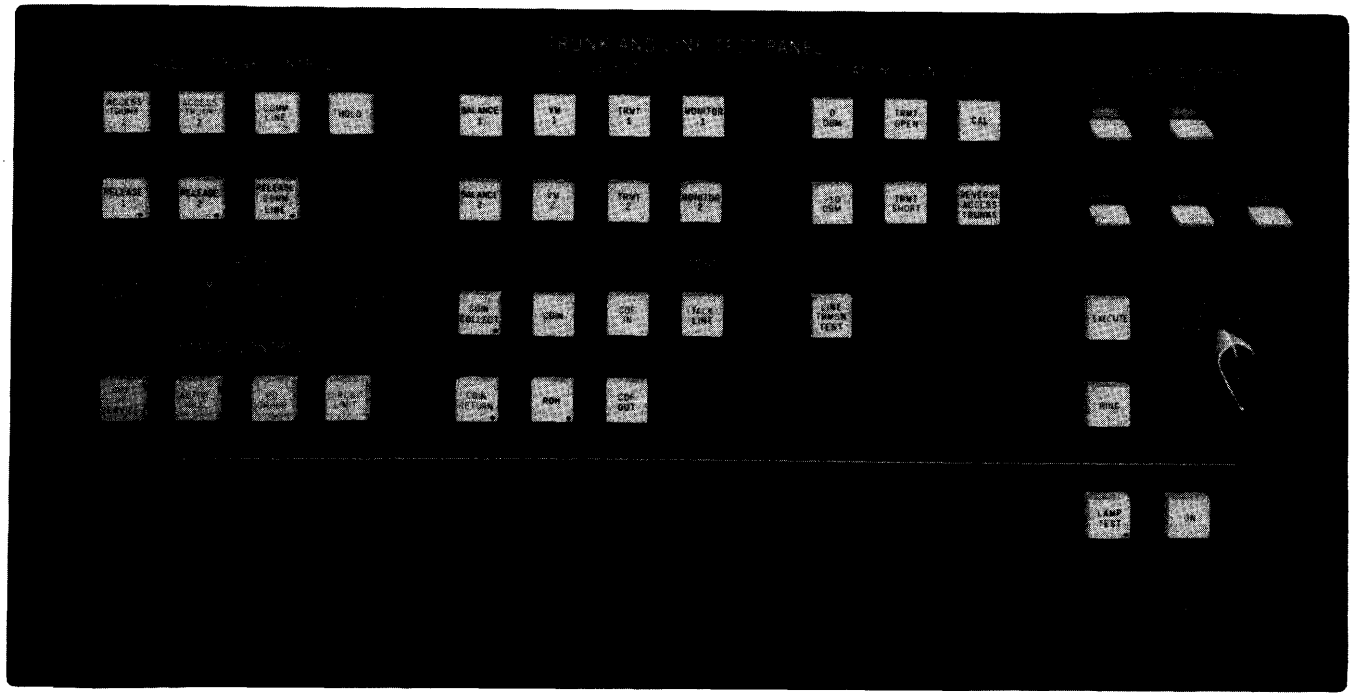


Fig. 3—*Trunk and Line Test Panel (Lower Panel)*

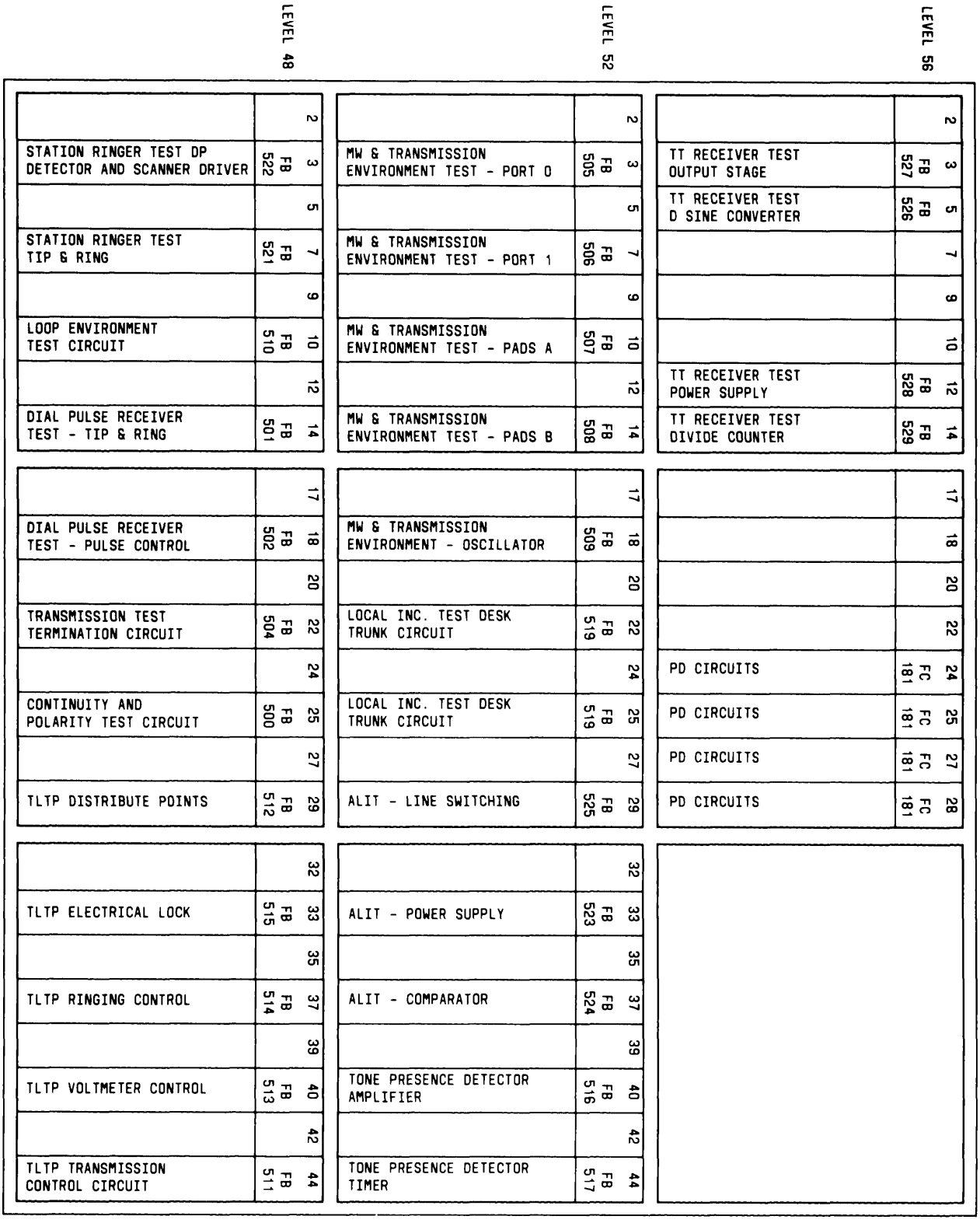


Fig. 4—Peripheral Test Unit

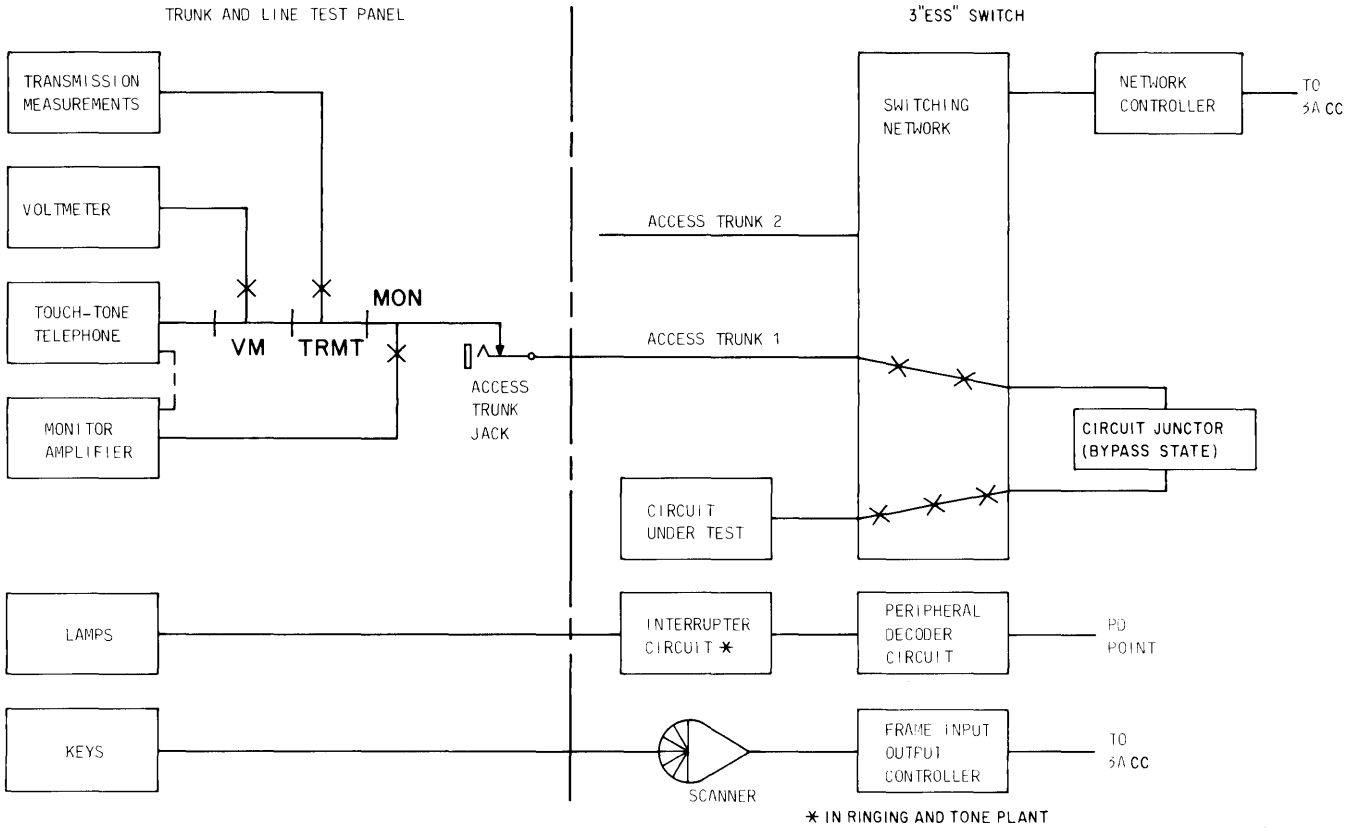


Fig. 5—Trunk and Line Test Panel Interface

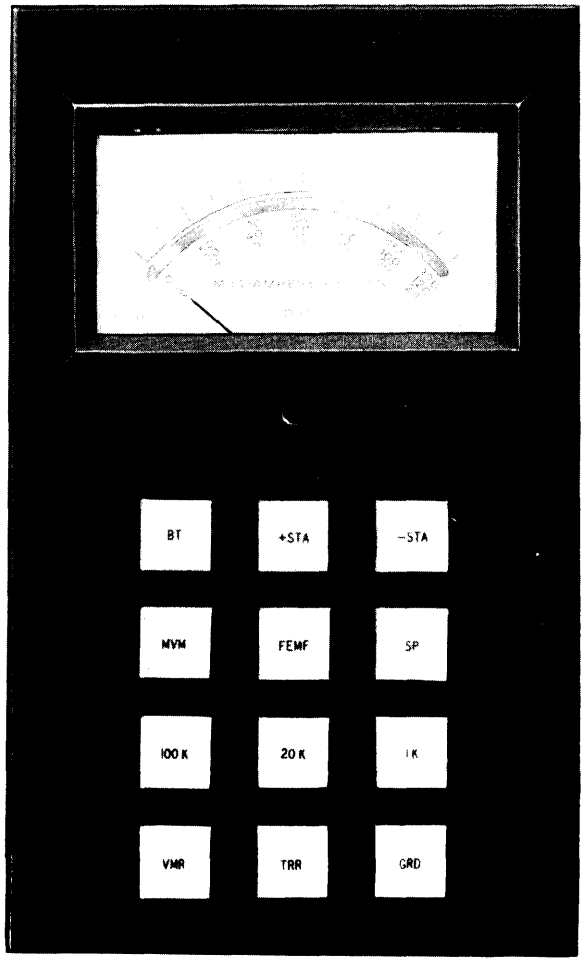


Fig. 6—Voltmeter

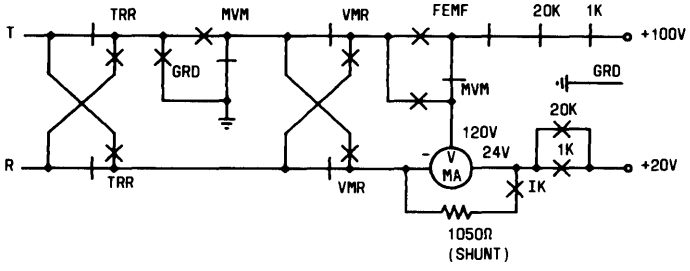
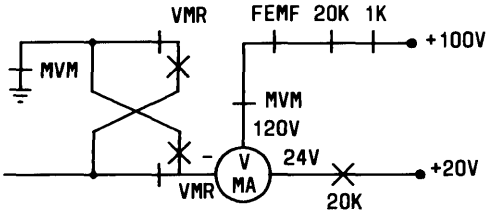
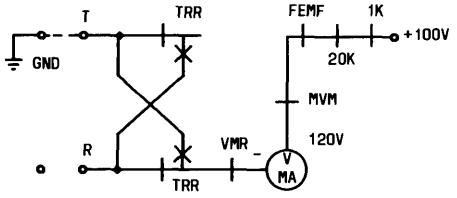


Fig. 7—Voltmeter Circuit



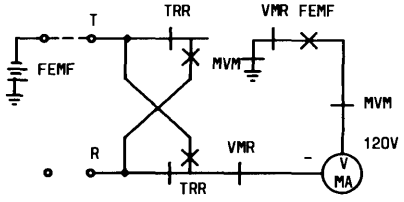
NOTE
1. VMR key operated; 20K key operated to test 20V test voltage; 20K key released to test 100V test voltage.

Fig. 8—Voltmeter Test Voltage Supply Test (NOTE 1)



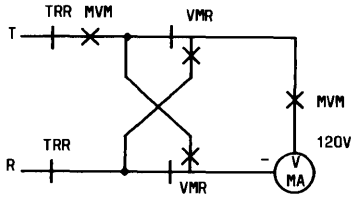
NOTE:
1. TRR key operated to test TIP; released to test ring.

Fig. 9—Resistance to Ground Test (NOTE 1)



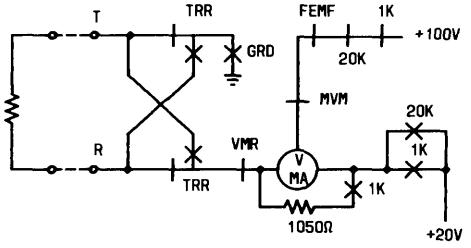
NOTE:
1. FEMF key depressed. TRR key operated to test TIP; released to test ring.

Fig. 10—Foreign Battery Test (NOTE 1)



NOTE:
1. MVM key depressed.

Fig. 11—Voltage Between Tip and Ring Lead Test (NOTE 1)



NOTE:
1. GRD key operated.

Fig. 12—Loop Resistance Between Tip and Ring Lead Test (NOTE 1)

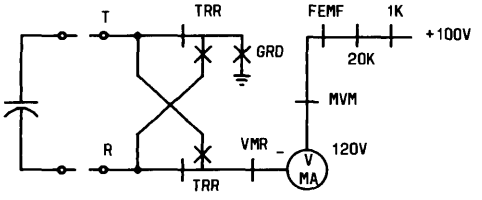


Fig. 13—Capacitance Test

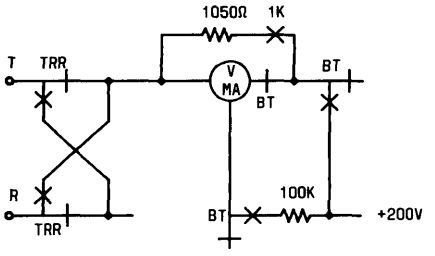


Fig. 14—Breakdown Test

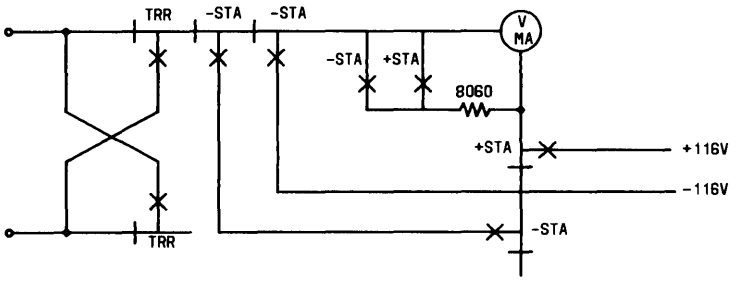


Fig. 15—+STA and −STA Test

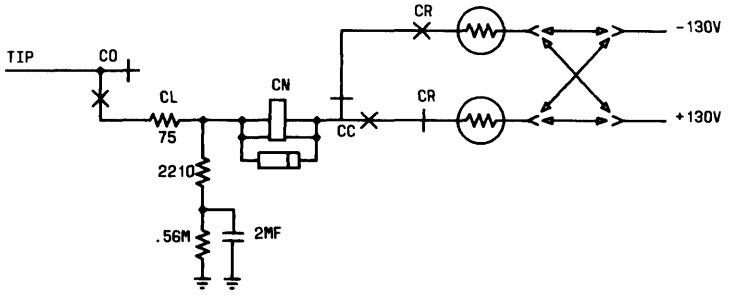


Fig. 16—Coin Collect and Return Test

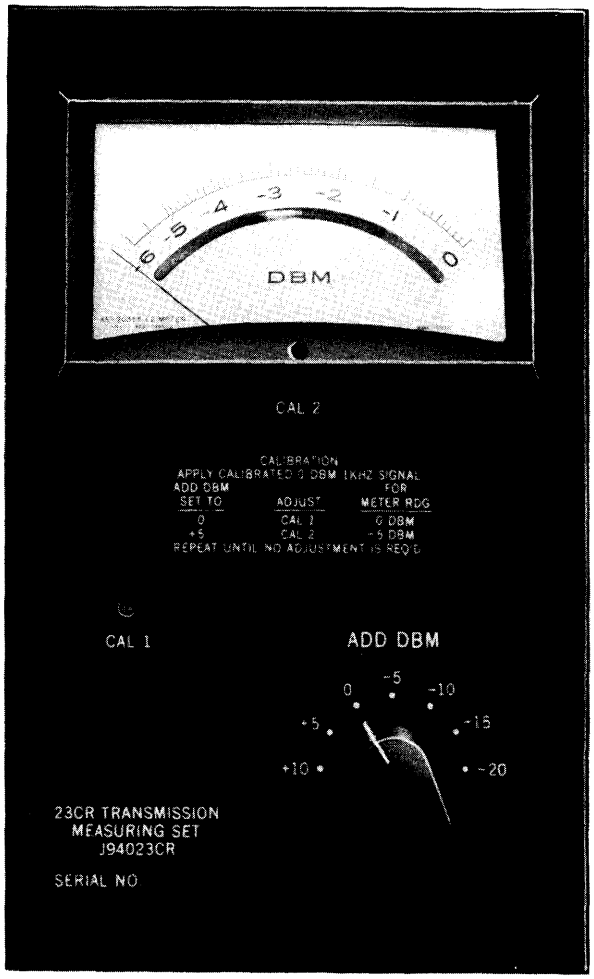


Fig. 17—Transmission Measuring Set (Optional)

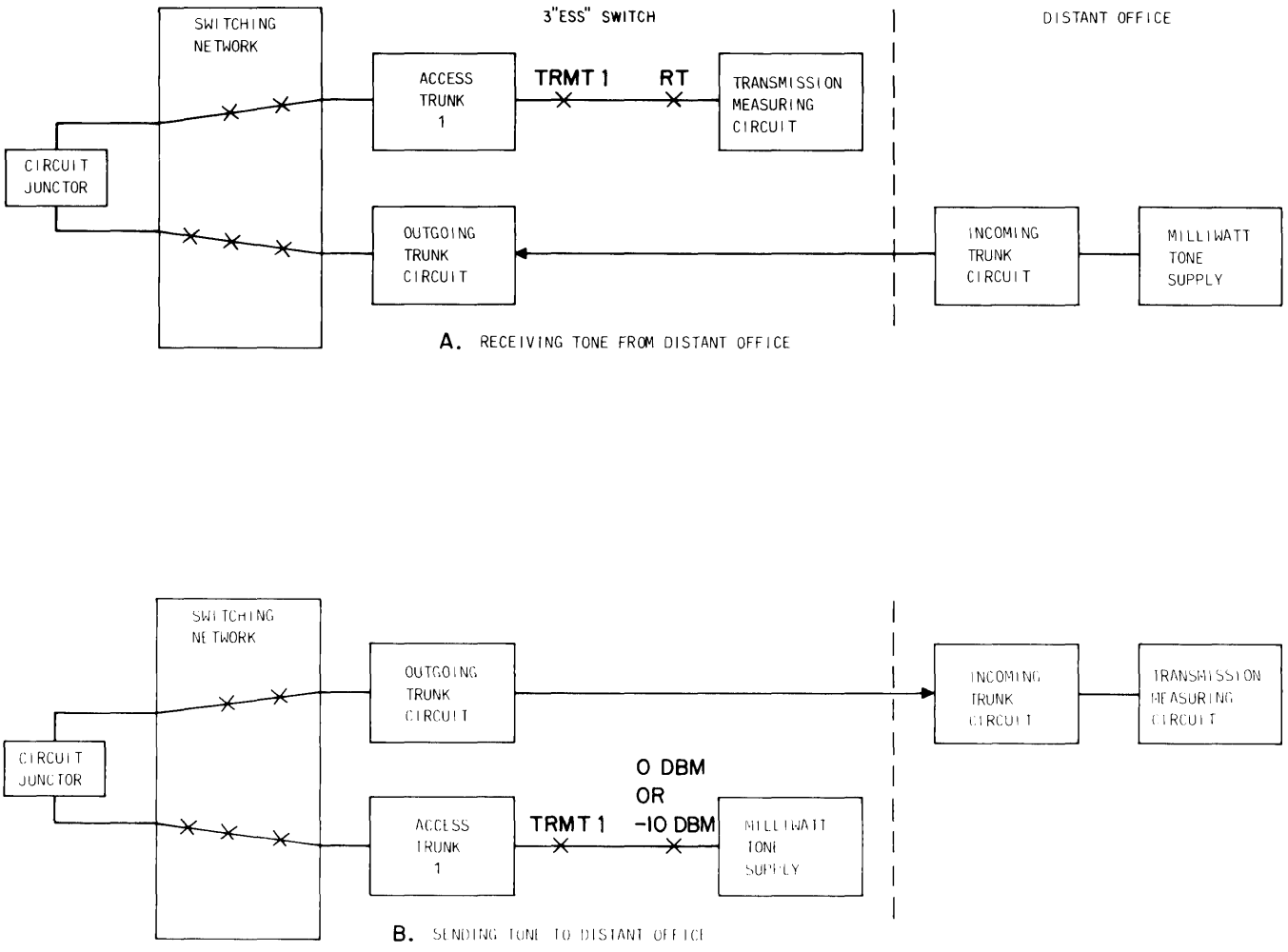


Fig. 18—Transmission Test Paths Using Transmission Facilities at Distant Office

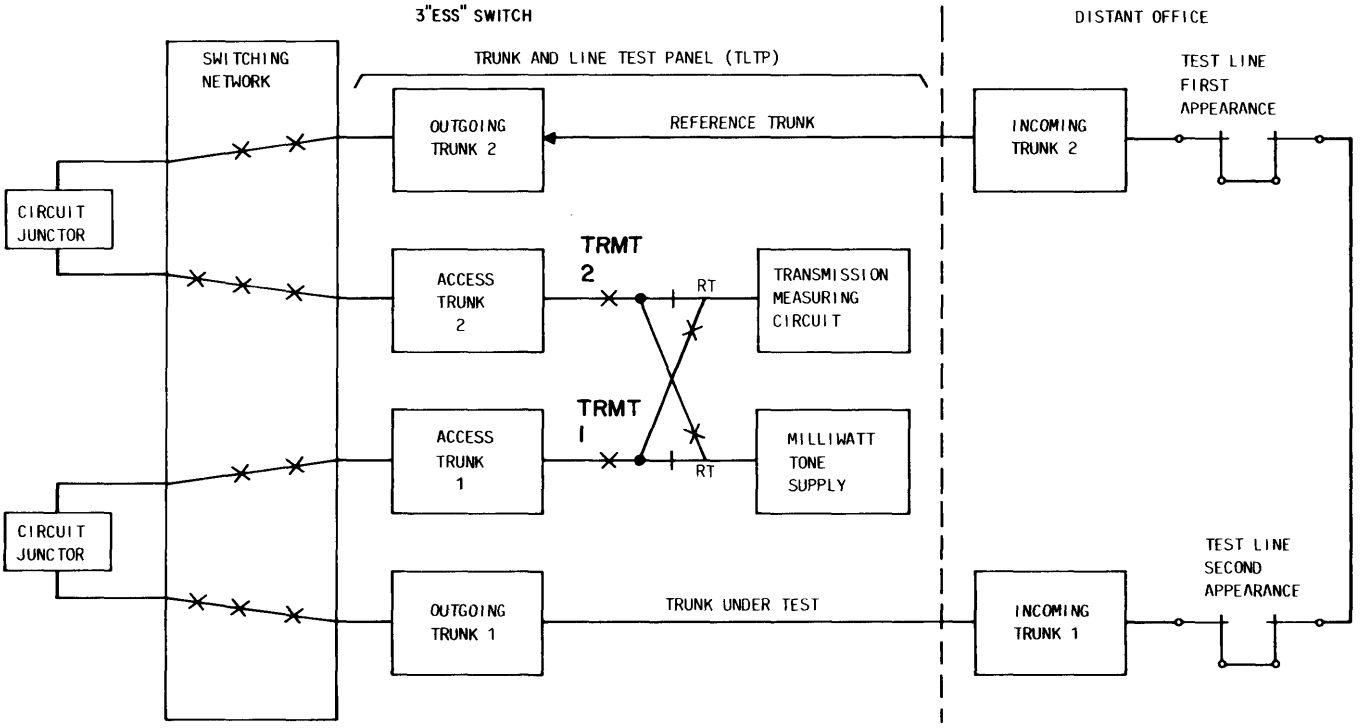


Fig. 19—*Transmission Test Path Using Looparound Circuit at Distant Office*

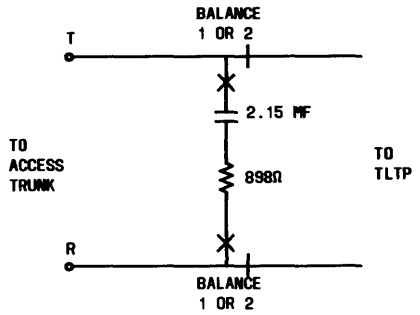


Fig. 20—Balance Test

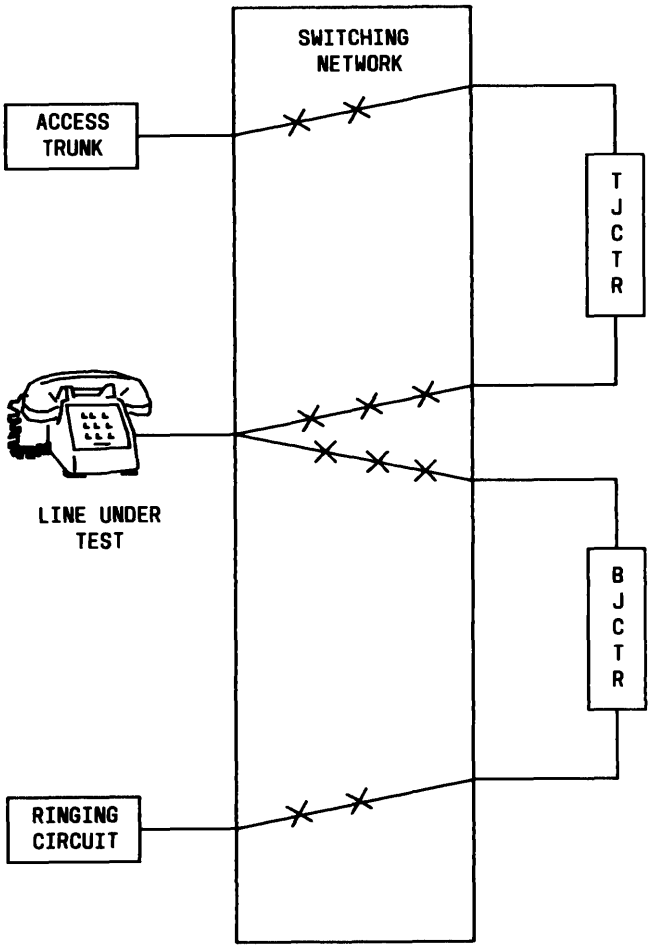
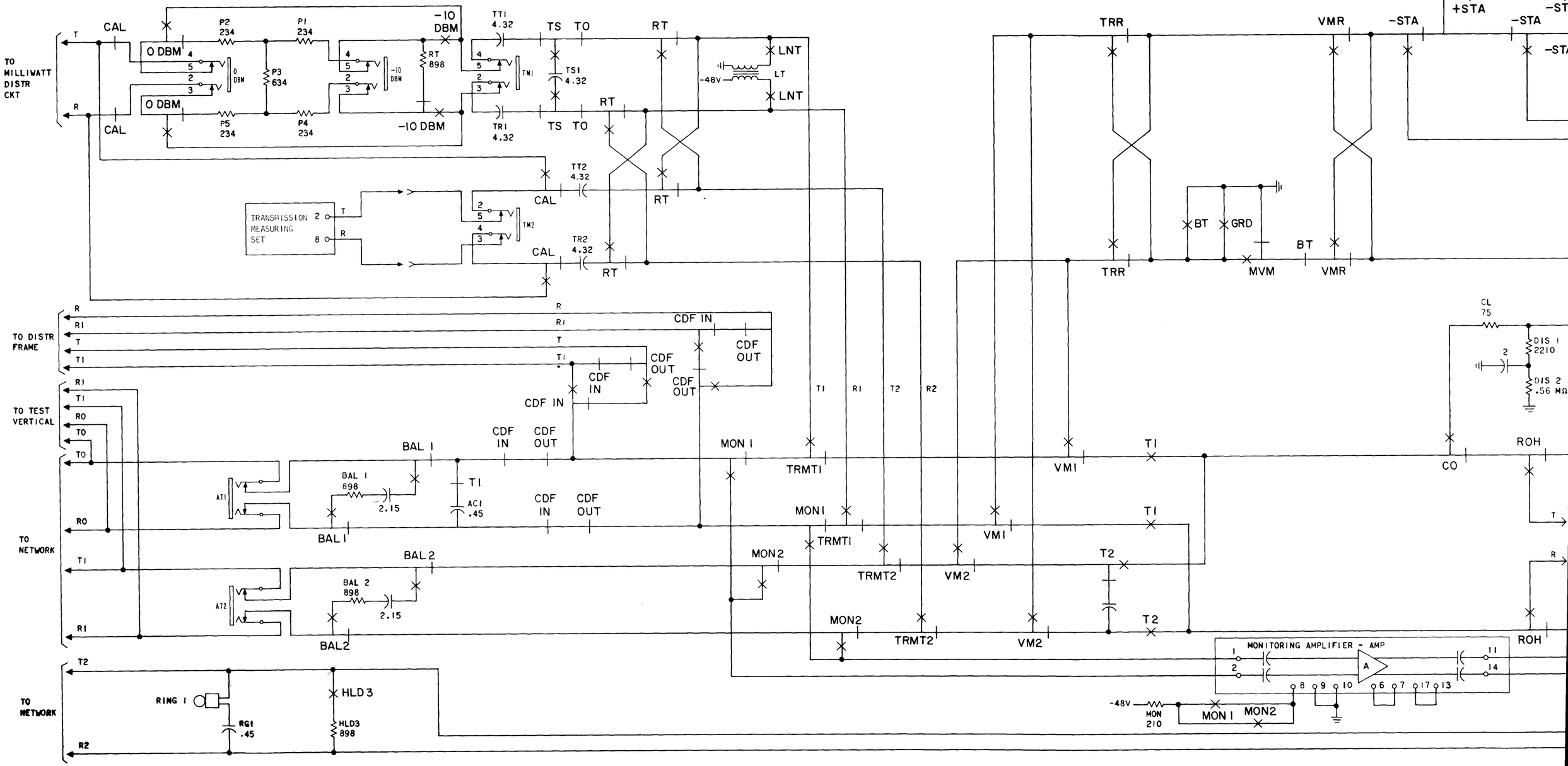


Fig. 21—Network Configuration (During Ringing)


TO MILLIWATT DISTR CKT
T
R
CAL
CAL
P2 234
P1 234
P3 634
P5 234
P4 234
0 DBM
-10 DBM
RT 898
TT1 4.32
TR1 4.32
TS1 4.32
TS TO
RT
LNT
LT
-48V
TT2 4.32
TR2 4.32
TRANSMISSION MEASURING SET
TM1
TM2
TRR
VMR
-STA
+STA
BT
GRD
MVM
TO DISTR FRAME
R1
T1
CDF IN
CDF OUT
TO TEST VERTICAL
RO
TO
TO NETWORK
BAL 1
BAL 2
898
2.15
AT1
AT2
AC1 .45
MON 1
MON 2
TRMT1
TRMT2
VM1
VM2
T2
R2
RING 1
RG1 .45
HLD3
HLD3 898
CL 75
DIS 1 2210
DIS 2 .56 MΩ
CO
ROH
MONITORING AMPLIFIER - AMP
A
MON 210