REMOTE TEST SYSTEM
CENTRA-LINE 612A
OPERATION AND TEST PROCEDURE

1. GENERAL

1.01 This Section contains operating instructions for the CENTRA-LINE 612A Remote Testing System.

1.02 The System operates from a central location to test subscribers' lines extending from attended or unattended Community Dial Offices (CDO's). Dedicated or physical facilities are not required between the testing facility and the remote CDO. The 612A utilizes any voice-grade telephone circuit to signal the remote station (a completely self-contained test set) to make test measurements on, or to switch office equipment to and from, subscriber lines. Test results are transmitted back to the master station for display on a meter.

1.03 The 612A System can include a single master station operating with any number of remote stations. The master station (Figure 1) is generally located in a test center or central office. Each remote station (Figure 2) is situated in a remote CDO. A typical system layout showing the relationship between the 612A and the telephone equipment is shown in Figure 3.

1.04 From the master station, the operator must access the 612A Remote Station through any one of several techniques available (Dedicated Trunk, EAS, or Toll Trunk). Once the remote station is accessed, subscriber lines can be selected via a test distributor, verification selector or test trunk. This is done by means of the rotary dial or tone pad on the master station console.

Figure 1 - CL612A Master Station

The operator can then initiate test measurements by pressing appropriate pushbuttons on the console.

1.05 When the operator initiates a test measurement, the master station sends a binary-coded phase-shifted carrier signal to the remote station. At the remote station, the signal is detected, decoded and checked for parity and security. Provided that all conditions are met, appropriate relays corresponding to the required measurement are then actuated. The relays, in turn, connect the proper measuring circuit to the subscriber's line under test. The analog test result is then transmitted back to the master station, via a second phase-shifted carrier, for ultimate display as a steady-state reading on the console's test meter.

1.06 Basic measurements are set up in four configurations: (1) LOOP, (2) RING TO GROUND, (3) TIP TO GROUND, and (4) SLEEVE TO GROUND. Four quantities are measured: (1) DC VOLTS, (2) AC VOLTS, (3) OHMS, and (4) CAPACITANCE in microfarads.

1.07 In addition to test measurements, common service equipment can be switched, upon command, to the subscriber's line. During use of the service equipment, a test measurement is set up automatically to monitor its operation as follows:

Service Equipment Selected	Resultant Meter Reading
Ring 1 Ring 2 Ring 3 Ring 4 Ring 5	AC volts, 0 to 150 VAC
Howler	Loop AC volts, 0 to 75 VAC (1/2 reading on 150 V scale)
Coin Collect	Ring ground volts, 0 to +150 VDC
Coin Return	Ring ground volts, 0 to -150 VDC

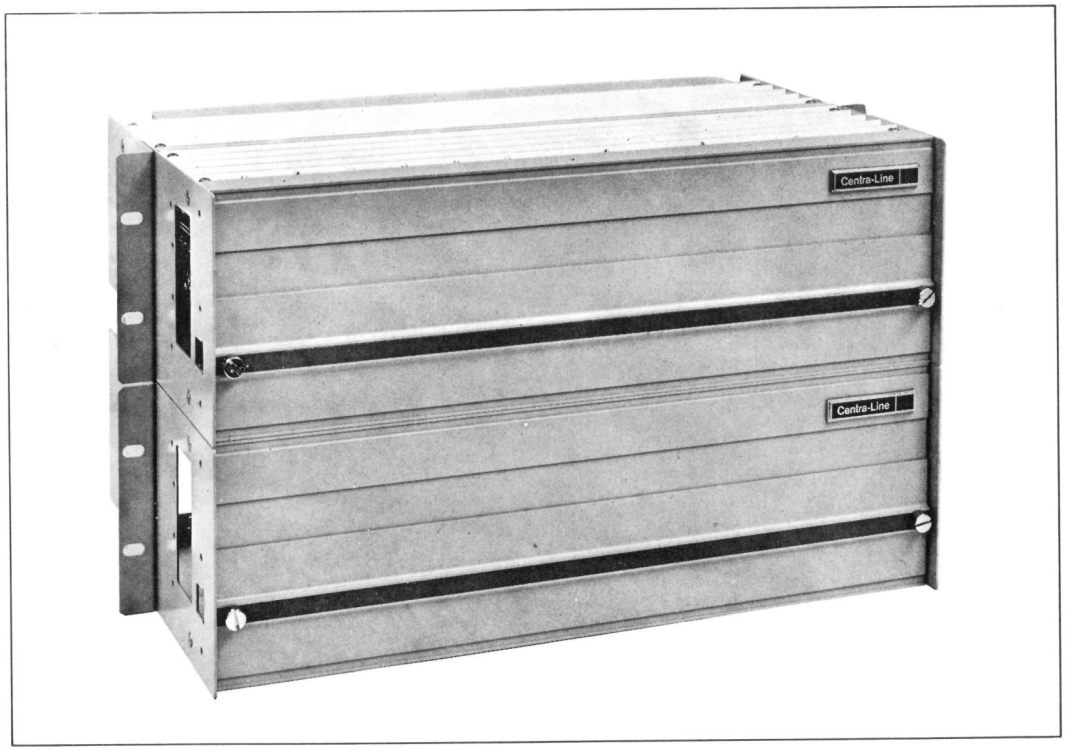


Figure 2 - CL612A Remote Station

1.08 Also available for various tests are these control features: BCO/3WO, Talk, Monitor, Permanent Release, In-Test (Dial Tone) and In-Dial. Seven additional control functions are provided for special user requirements, typically for switching loop extenders out-of-line and for releasing calling-party holds.

2. ARRANGEMENT OF THE MASTER STATION CONSOLE

2.01 Before proceeding with accessing and operating procedures, the test operator should familiarize himself with the layout of the various operating controls and indicators. These are located in two control panels. (See Exhibit 1 and Table 1.) The lower panel contains all the test measurement pushbuttons, the operating control pushbuttons, and the telephone dial and tone signalling units. On the upper panel are situated the test meter, some additional control pushbuttons, the hook (HK) and operator's talk battery (TK) pushbuttons, and the power key and indicator.

2.02 Table 1 identifies each of the controls and indicators in terms of front-panel designation, type and function. The numeric order of the callouts does not necessarily suggest an operating sequence to be followed by the operator.

3. PRELIMINARY OPERATING CONSIDERATIONS

3.01 Power Application: To apply power to the 612A Master Station Console, turn the power on-off key to the right. The PWR lamp then lights to indicate application of power. The key may be removed from the lock in either the "on" or the "off" position.

3.02 Live-Zero Potential: Before performing any accessing or operating procedures, observe that the test meter's pointer lies off-scale to the left. (Figure 4). This is the normal position of the pointer and is called "mechanical zero". Most of the pushbuttons, when operated after the remote station has been accessed, cause the pointer

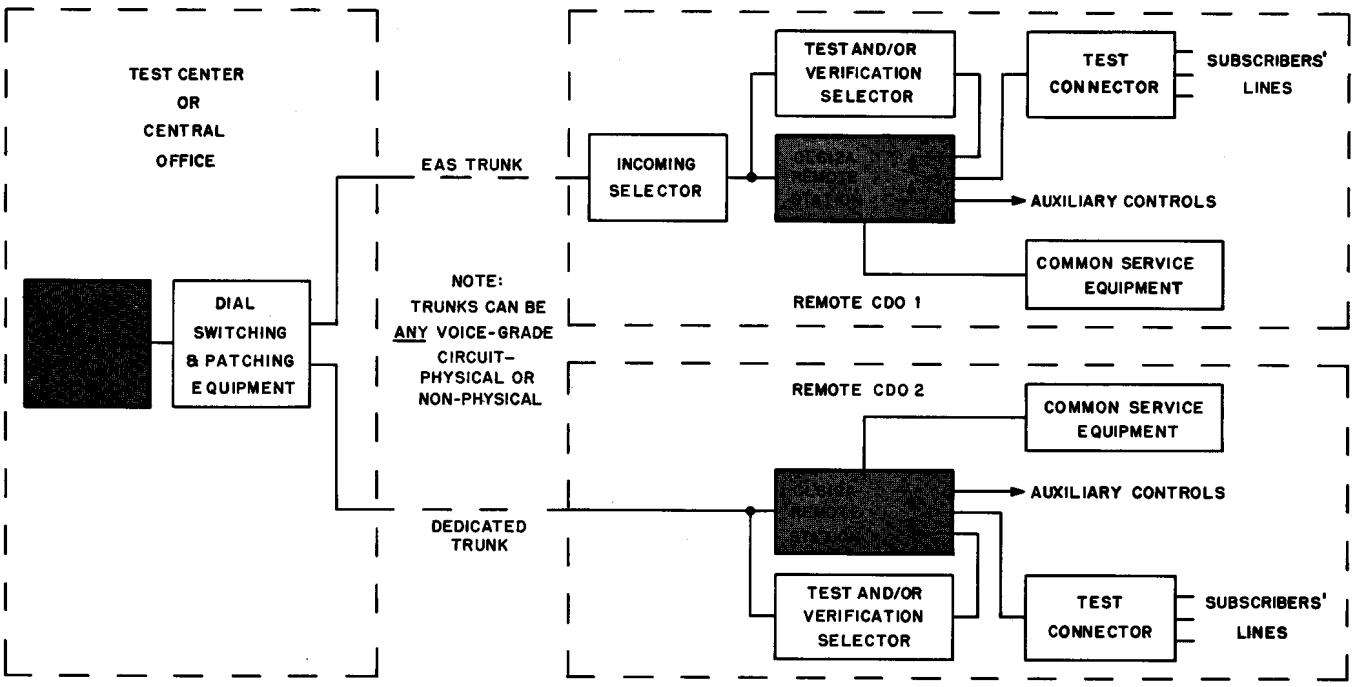


Figure 3 - Block Diagram Showing Relationship Between CL612A and Telco Equipment

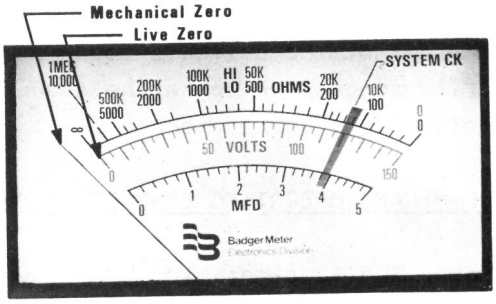


Figure 4 - Console Test Meter with Mechanical- and Live-Zero Marks Identified

to deflect to the 0-volt mark on the scale. This is a normal condition. The potential that brings the pointer to 0 volts is called the "live-zero" potential. Since this potential originates in the remote station, it provides a positive indication that the station has correctly responded to a measurement command from the master station. Absence of live zero in response to a measurement command indicates a malfunction or the existant of a positive-voltage measurement. (In the latter case, operation of the METER REV pushbutton will produce an upscale reading.)

3.03 Each pushbutton should immediately be restored to its normal position upon completion of any test measurement or control function. On the lower control panel, two red RESET pushbuttons are provided for that purpose. (Alternatively, another pushbutton in the same row may be operated when a sequence of tests is being conducted.) Each pushbutton on the upper panel must be pressed a second time in order to terminate a test.

4. ACCESSING METHODS AND PROCEDURES

4.01 Direct Access: The Direct Access method allows quick access to the test distributor and makes use of a dedicated line between the master station and the test distributor. The procedure for accessing a subscriber's line is as follows:

1. Select the proper trunk to the desired CDO.

2. Go off-hook by pressing the HK pushbutton, which then lights. This step loops the test distributor.

3. Dial the subscriber's line number, typically four digits.

4. Proceed with the testing procedures (Para. 5).

5. Terminate testing on that line by again pressing the HK pushbutton to go on-hook. The pushbutton's light then goes out.

4.02 EAS Access: EAS Access requires the use of an EAS trunk. Since this method is sometimes subject to accidental access by a subscriber, a call trap should be strapped in at the remote station. An identification tone is then used to indicate verification of access. The procedures for EAS accessing may differ slightly from remote station to remote station, depending on the individual station's wiring configuration. A general procedure is as follows:

1. To go off-hook, press the HK pushbutton, which then lights.

2. Dial the exchange digits to gain access to the remote office.

3. Dial the level of the remote station; e.g., 0 or 00.

4. If the call trap is used, listen for the verification tone. Then defeat the call trap by using a predetermined control (usually CONT 1). This removes the verification tone and allows dialing into the test distributor.

5. Dial the subscriber's line number, typically four digits.

6. Proceed with the testing procedures (Para. 5).

7. Press the HK pushbutton to go on-hook and terminate line-testing. The push-button's light is then extinguished.

4.03 Toll Access: Toll Accessing involves DDD and other accessing schemes that limit loop dialing (by means of register-senders, for instance). With this kind of arrangement, it is first necessary to ready the remote office with an ordinary telephone call. The 612A System allows this call to be held at an assigned connector number. At the master station, a dial thru FSK tone transmitter is placed under rotary-dial control and transmits dial pulse information to the remote station. The latter converts these pulses to loop pulses for stepping the test train. (Figure 5). The procedure for this method of access is as follows:

1. Go off-hook by pressing the HK push-button, which then lights.

2. Dial the assigned connector number in the remote office, just as though you were making a normal call. (The total number of digits required may be 7, 10, or 11.)

3. Listen for an ID tone, which verifies that you have dialed the proper number. (If the call trap is used, defeat it by using a predetermined control - generally CONT 1. This removes the verification tone and allows dialing into the test distributor.)

4. Press the DIAL THRU pushbutton, wait two seconds and dial the subscriber's number (typically four digits) then press the RESET pushbutton that releases DIAL THRU.

5. Proceed with the testing procedures (Para. 5).

6. If another subscriber's line in the same office is to be tested, perform these steps:

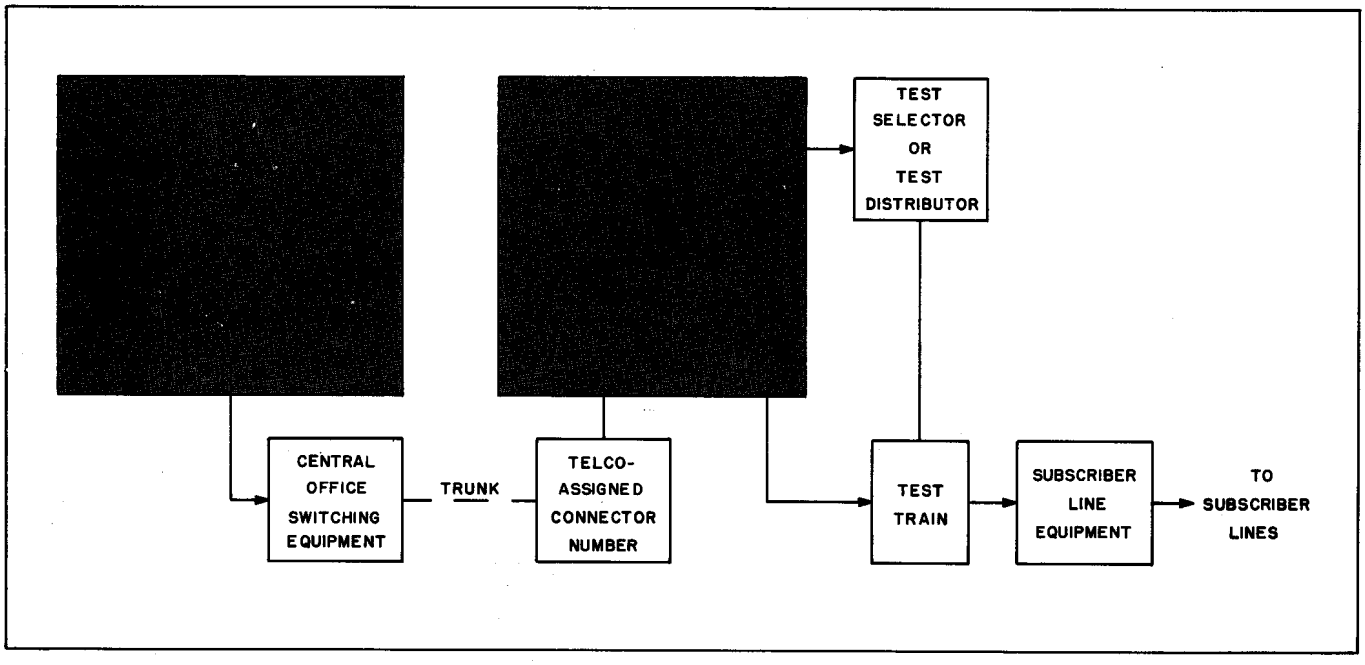


Figure 5 - Simplified Block Diagram Showing How Toll Accessing is Accomplished

(a) Press the DIAL THRU pushbutton again.

(b) Again press the HK pushbutton, to go on-hook.

(c) After pausing at least one second, press the HK pushbutton once more (light comes on again to signify the off-hook condition).

(d) Dial the next subscriber's number.

(e) Press the RESET pushbutton to release DIAL THRU.

7. Upon completion of testing at the office, go on-hook by pressing the HK pushbutton once again. Since this step disconnects all lines, another seven-digit number must be dialed to re-access a remote station.

5. OPERATING PROCEDURES

5.01 After the remote CDO has been accessed and a subscriber's number has been dialed, normal verfication routines may be conducted to determine the status of the called line. The following paragraphs give procedures for carrying out these routines - test measurements, control functions, etc. - from the master station.

5.02 It is recommended that the procedures outlined in paragraphs 5.03 through 5.06 be performed in the sequence given. This sequence calls for (1) a system check (optional), (2) a busy test, and (3) a permanent-line-condition check and, if necessary, release of the permanent condition. Not only do these procedures prevent accidental intrusion on a busy line, but they also avert errors in subsequent test measurements.

5.03 System Check: How frequently this optional check should be made is left to the operator's discretion. Its purpose is to allow a quick test to be made of the master-to-remote-station measurement system. Specifically, it checks the communication link between the master and remote stations and indicates measurement accuracy for DC volts, resistance and capacitance.

5.04 Associated with the system check are five green pushbuttons: SYSTEM CHK, RING DC VOLTS, LOOP LO OHMS, LOOP HI OHMS, and TIP CAPACITANCE. The check is made as follows:

1. Access the remote station. It is unnecessary to dial subscriber's line.

2. Press the RING DC VOLTS pushbutton, checking for a live-zero indication on the meter.

3. Press the SYSTEM CHK pushbutton, leaving it pressed during steps "a" through "c" below. The meter should indicate 120 VDC, in the green SYSTEM CK area on the meter scale. (Figure 6).

   (a) Press the LOOP LO OHMS pushbutton. The meter should read 125 ohms (green).
   (b) Press the LOOP HI OHMS pushbutton. The meter should read 12.5 kilohms (green).
   (c) Press the TIP CAPACITANCE pushbutton. The meter should read 3.87 microfarads (green).

4. Press both RESET pushbuttons to clear the keyboard.

NOTE: If any reading does not fall within the green zone on the meter, refer to BSP 662-495-901SW for diagnosis.

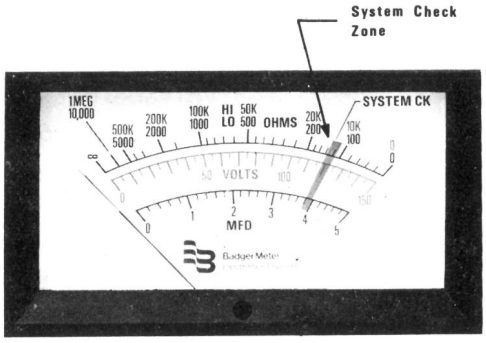


Figure 6 - Console Test Meter with SYSTEM CK Zone Identified

5.05 Busy Test: The purpose of this check is to determine that the line to be tested is not in use. This is done by measuring the potential on the third wire associated with the subscriber's line equipment. It is important to follow this procedure:

1. Press the BCO/3WO pushbutton. This prevents the remote station from grounding the sleeve if the line is not busy.

2. Press the SLEEVE DC VOLTS pushbutton.

3. Check the reading on the test meter: 48 VDC indicates that the line is idle (line coil not energized), and that the operator may proceed with normal testing; 0 VDC indicates that the subscriber's line equipment is seized. This may be due to normal use or to a line fault.

4. Press the MON pushbutton and listen for conversation or other sounds. (Since the pushbuttons are mechanically interlocked, BCO/3WO will release when MON is pressed.)
   NOTE: Whenever the MON pushbutton is pressed, an audible beeper tone is applied to the line every 8 seconds after the first 14 seconds.

   (a) If the line is in use, it should be abandoned.
   (b) If no indication of line usage is observed, clear the keyboards by pressing both RESET pushbuttons. Then proceed to the following test.

5.06 Permanent Line Condition Check: A permanent line condition is generally caused by a subscriber's receiver being off-hook or by a fault that places a permanent loop on his line. To determine if such a condition exists and, if possible, to force it down, follow these steps:

1. Press the RING DC VOLTS pushbutton and then the TIP DC VOLTS pushbutton, observing the meter reading for each.

   (a) If the meter pointer remains at mechanical zero (to the left of 0 VDC) or deflects up-scale and slowly returns to mechanical zero, press the METER REV pushbutton. The potential then indicated on the meter is positive with respect to ground. Consequently, no further testing can be conducted; a trouble exists and should be referred to the repairman.
   (b) Should the tip or ring potential be positive or greater than -56 VDC with respect to ground, this also indicates a fault that should be brought to the repairman's attention.

   NOTE: With an off-hook condition, the potential on the ring side of the line will be slightly higher than that on the tip.

2. Press the LOOP DC VOLTS pushbutton, observing the meter reading. A reading between 9 and 50 VDC indicates a probable permanent condition. If the meter pointer swings to the left of 0 VDC, press the METER REV pushbutton

to get an upscale deflection.

3. Press the TALK pushbutton and inquire if anyone is using the line.

4. If there is no response, press the PERM REL pushbutton. This action disconnects the subscriber's line from the office equipment, provided that the loop voltage measured at step 2 above is at least 16 volts (indicating a minimum loop resistance of 150 ohms). If the permanent condition is released, the meter pointer will first deflect up-scale to approximately 50 VDC, then drop to 0 VDC.

   NOTE: If the permanent condition fails to release within 15 seconds, the loop resistance is probably less than 150 ohms as indicated by the loop voltage. If, however, the remote station's permanent release circuit is strapped for two-second timing, reset and re-operate the PERM REL pushbutton several times. If the permanent condition still persists, the loop resistance is too small to be released remotely. Under no circumstances, though, operate the LINE REV pushbutton while the PERM REL pushbutton is pressed.

5. With the subscriber's line now disconnected from the office equipment, the test operator may proceed with testing.

5.07 Test Measurements: Test Measurements may be made for voltage (DC and AC), resistance and capacitance. To prevent errors in measurement and consequent misinterpretation, the test operator must be aware of the status of the line he is testing. He must therefore conduct the measurements in the following manner:

1. DC voltage: This is always the first check; any voltage on a line renders meaningless any resistance or capacitance measurement. Check for voltage between ring and ground, between tip and ground, and across the loop.

2. AC voltage: If a foreign a-c potential is suspected of being in contact with the line, check for ring-to-ground and tip-to-ground a-c potentials.

3. Resistance and capacitance: Only when no voltages of any kind are measured on the line should resistance and capacitance checks be made, to permit analysis of the line fault that may exist. Resistance measurements should be made on the high scale first (HI pushbutton pressed). If the reading obtained is less than 5 kilohms, then read the resistance on the low scale (LO pushbutton pressed).

While test measurements are being made, a sleeve-control circuit in the 612A Remote Station controls access of the office to the subscriber's line by grounding the sleeve lead. This action prevents incoming calls from interfering with the measurements and disconnects any office potentials that may be present on the subscriber's line. Table 2 lists each test measurement pushbutton and the corresponding measuring range indicated by the test meter. The table also provides useful operating notes. To make a measurement, simply press the appropriate pushbutton and read the result on the meter. If no meter response is obtained, the system check (para. 5.03) can be used to verify access to the remote station.

5.08 Operating Control Functions: A brief description of the various control functions that the test operator has available to him are given in the following subparagraphs:

1. MONITOR - Pressing the MON pushbutton actuates the test operator's handset receiver and connects an a-c path to the subscriber's line via the 612A Remote Station. It also applies an audible tone to the line.

2. TALK - Pressing the TALK pushbutton actuates the test operator's handset transmitter and receiver and applies an audible tone to the subscriber's line. The remote station completes the function by connecting talk battery to the subscriber's line and by providing an a-c path to the master station.

3. PERMANENT RELEASE - The PERM REL pushbutton is used to disconnect a subscriber's line relay when his line is found in a permanent condition. Disconnection is maintained by the remote station's seizing the sleeve of the line and grounding it. (Refer to para. 5.06.)

4. BATTERY CUTOFF/THIRD WIRE OPEN - Removing control of sleeve ground from the remote station to return it to the subscriber's line equipment requires use of the BCO/3WO pushbutton. Testing procedures involving use of this pushbutton are busy testing (para. 5.05), dail-tone testing (para. 5.08(12)), and in-dial testing (para. 5.08(14)). In addition, BCO/3WO is used in conjunction with the DIAL THRU pushbutton alone or with the DIAL TONE and LINE REV pushbuttons for pay station and PBX ground-start applications, respectively.

5. COIN COLLECT AND RETURN - Pressing the CC and CR pushbuttons applies coin collect and coin return potentials, respectively, to the line under test. In both cases, the meter indicates the battery voltage between the ring side of the line and ground, CC being positive and CR negative.

6. RINGING - Ringing pushbuttons RING 1 through RING 5 allow ringing generators to be applied to the tip and ring of a line in five different configurations. With divided ringing, parties on the ring side will have their ringers actuated automatically, and upon operation of the LINE REV pushbutton (para. 5.08(13)) parties on the tip side will have theirs energized. Where equipped, bridged ringing is applied automatically. During application of ringing, the test meter indicates the ringer's a-c potential on its 0- to 150-volt scale.

7. HOWLER - Connecting the office howler supply to a subscriber's line in order to draw attention to an off-hook condition of his telephone receiver is done by pressing the HWL pushbutton. Some older howlers may require a remote-start input, which can be actuated by operating one of the pushbuttons CONT 3 through CONT 7 (para. 5.08(15)). In either case, the howler output voltage can be read on the test meter's VOLTS scale, but the scale values are divided by two. For example, an indication of 100 volts means an actual value of 50 volts.

8. DIAL THRU - Pressing the DIAL THRU pushbutton switches in a master-to-remote frequency shift channel to provide a tone link for pulse-dialing at a remote station. Make-break pulses generated by the console's rotary dial key the fre - quency shift transmitter. A corresponding receiver at the remote station converts the frequency shifts to loop pulses, which pulse the test distributor to simulate subscriber dialing. (Refer to para. 4.03 for Toll Accessing.)

9. TONE SIGNALING - Tone signaling, initiated by pressing the TONE SIG pushbutton, actuates an optional return supervision channel for transmission of information from the remote station to the master station. The pushbutton also enables the optional MF signaling pad.

Driven by the return channel receiver at the master station are two relays. One of them indicates the presence of carrier (CP), the other the shifted state of the carrier, or frequency respsonse (FR). Contacts of the relays are available at a terminal block on the rear of the master station. Additionally, lamps can be mounted on the upper control panel to provide visual supervision.

10. METER REVERSE - Operation of the METER REV pushbutton inverts the remote station's d-c voltage measuring circuit, allowing measurement and display of positive potentials. (See Table 2.)

11. SYSTEM CHECK - Previously described in para. 4.03, operation of the SYSTEM CHK pushbutton in conjunction with four others allows a pre-operational check of the 612A System's integrity.

12. DIAL TONE - Pressing the DIAL TONE pushbutton permits the test operator to check a subscriber's line equipment - dail tone, line finders, etc. - and establishes an a-c monitoring path from the remote station to the master station, allowing him to hear the dial tone. This control must be used with the BCO/3WO control to ensure that the subscriber's line can be looped. Through repeated operation of the pushbutton, the operator can step through entire line-finder groups.

13. LINE REVERSE - The LINE REV pushbutton, when operated, reverses the tip and ring connections of the remote station's test leads to a subscriber's line. Typically, this control is used in application involving ringing and permanent release.

14. IN-DIAL - The in-dial control allows dialing via the subscriber's line equipment, provided that the subscriber's line first has been checked for absence of faults. Several pushbuttons are used, and must be pressed in this order for the reasons given:

(a) BCO/3WO - releases the subscriber's sleeve to allow his line to be looped.

(b) DIAL TONE - loops the line and permits dial tone to be heard.

(c) IN-DIAL - actuates the master station's dial-thru transmitter and the remote station's dial-thru receiver. Using the rotary dial to dial the test number then drives loop-dialing contacts at the remote station.

NOTE: If the subscriber's line is equipped with touch tone, use the tone pad instead of the dial and omit step d.

(d) IN-DIAL - reset to allow monitoring.

(e) TK - lights and permits operator - subscriber conversations.

(f) DIAL TONE - reset to terminate in-dialing.

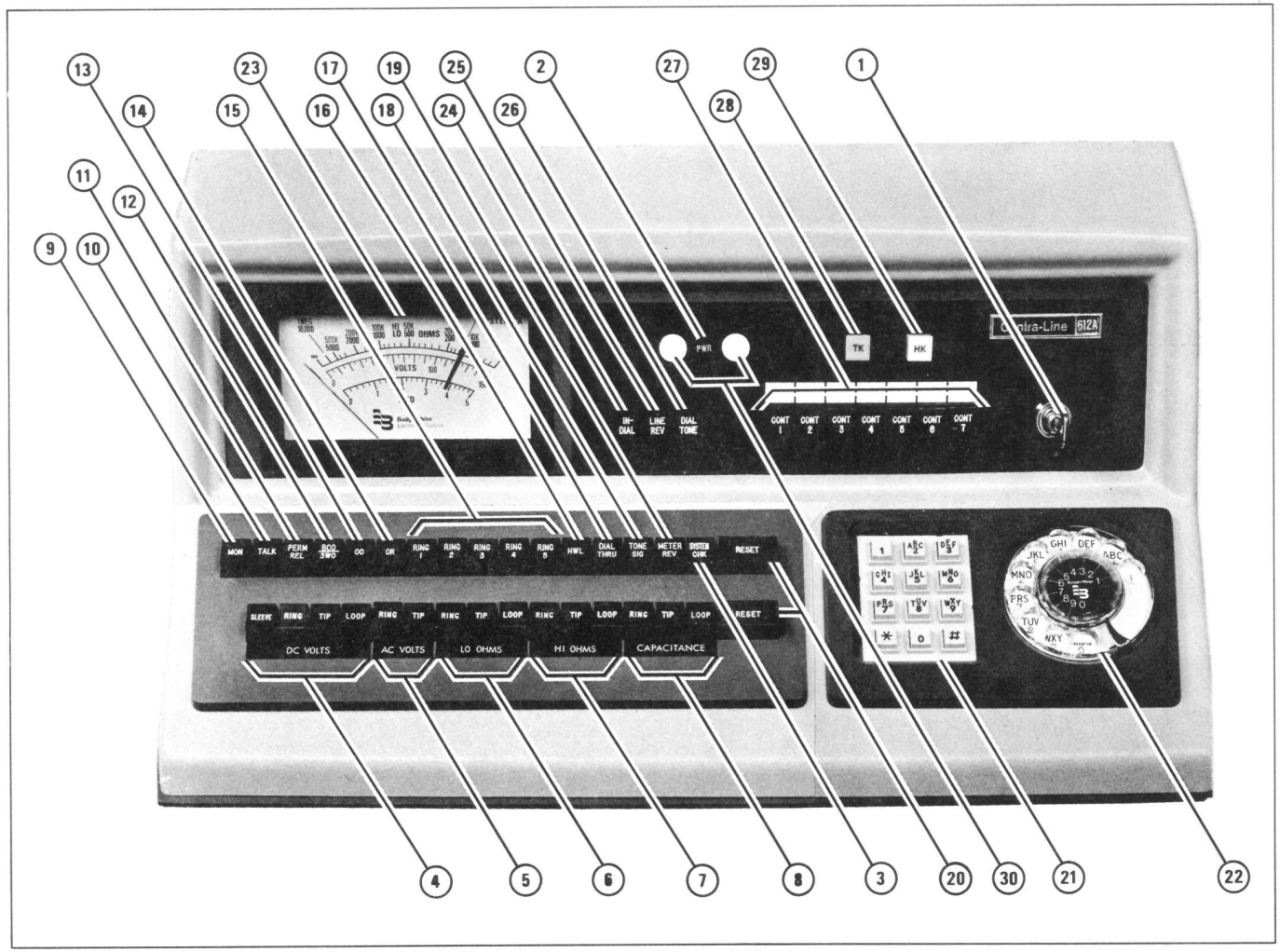
(g) RESET - releases BCO/3WO pushbutton.

15. AUXILIARY CONTROLS 1-7 - Pushbuttons CONT 1 through CONT 7 allow special applications to be implemented at the remote station. Generally, CONT 1 is used to override a call trap for EAS or dial-thru access. (See para. 4.02.) The other CONT pushbuttons may be variously assigned to switch out loop extenders, to release calling-party holds, and so forth.

16. HK AND TK - Pushbutton HK is called the "hook switch". Its

basic function is to loop the operate pair connected to the master station. The off-hook condition is denoted when the push-button is lighted. Pushbutton TK, which provides talk battery to the test operator's telephone, is used in conjunction with push-button HK to allow normal telephone usage.

EXHIBIT 1



Master Station Operator Console with Identifying Callouts

TABLE 1

FUNCTION OF OPERATING CONTROLS AND INDICATORS

Call-out	Panel Designation	Type	Function
1	None	Turnkey	Applies power to master station.
2	PWR	Incan. lamp	Lights when power is applied.
3	SYSTEM CHK	Pushbutton, locking	Allows check of system operation up to the point of application to test selector. Works in conjunction with RING DC VOLTS, LOOP LO OHMS, LOOP HI OHMS and TIP CAPACITANCE pushbuttons.
4	DC VOLTS — SLEEVE, RING, TIP, LOOP	"	SLEEVE is used in conjunction with BCO/3WO pushbutton to allow determination of sleeve potential (busy test) on subscriber lines. RING, TIP and LOOP allow measurement of ring-to-ground, tip-to-ground and loop battery potentials on subscriber lines.
5	AC VOLTS — RING, TIP	"	Permit measurement of AC potential between ring and tip sides of subscriber lines and ground.
6	LO OHMS — RING, TIP, LOOP	"	Permit low-scale measurement of ring-to-ground, tip-to-ground and loop resistances of subscriber lines.
7	HI OHMS — RING, TIP, LOOP	"	Allow high-scale measurement of ring-to-ground, tip-to-ground and loop resistances of subscriber lines.
8	CAPACITANCE — RING, TIP, LOOP	"	Allow capacitance measurement between ring and tip sides of subscriber lines and ground, and across subscriber loops.
9	MON	"	Allows monitoring of subscriber lines without application of talk battery.
10	TALK	"	Allows application of talk battery to subscriber lines for 2-way communications between test operator and linemen, maintenance personnel or subscriber.
11	PERM REL	Pushbutton, momentary	Activates permanent-release circuitry to force access to busy subscriber lines.
12	BCO/3WO	Pushbutton, locking	Permits release of battery cutoff relay in subscribers' line equipment.
13 & 14	CC & CR	Pushbutton, momentary	Permit application of standard telco office potentials to pay stations for purpose of checking coin box mechanisms.
15	RING 1 - RING 5	Pushbuttons, momentary	Allow application of telco ringing generators to ring side of subscriber lines.
16	HWL	Pushbutton, locking	Allows application of telco howler generator to subscriber lines.
17	DIAL THRU	"	Works in conjunction with dial and pushbutton HK to allow access to subscriber lines via a connector number.
18	TONE SIG	"	Used for MF tone signaling to actuate return supervision channel and to connect MF pad to test trunk register. (Optional)
19	METER REV	"	Reverses polarity of DC volts measurements in CL612A Remote Station.
20	RESET	Pushbuttons, momentary	Provide mechanical release and restoration of associated pushbuttons.
21	None	Tone signaling pad	Used for 2-frequency tone signaling in lieu of conventional dial.
22	None	Rotary dial	Used for dialing access, connector and subscriber numbers.
23	None	Test meter	Indicates DC and AC voltages up to 150 V, resistance up to 1 MΩ (high scale) or 10 kΩ (low scale), and capacitance up to 5 μF.
24	IN-DIAL	Pushbutton, locking, press-press	Used in conjunction with DIAL TONE and BCO/3WO pushbuttons to allow outgoing call to be made from subscriber's number under test.
25	LINE REV	"	Permits reversal of tip and ring leads of line connected into CL612A Remote Station.
26	DIAL TONE	"	Permits looping of subscriber line equipment to test for dial tone.
27	CONT 1 - CONT 7	"	Provide means of operating special, unassigned functions and controls in conjunction with associated equipment.
28	TK	Pushbutton, nonlocking, press-press	Provides means of applying local talk battery to CL612A Master Station only.
29	HK	"	Provides means of obtaining dial tone for local phone calls from CL612A Master Station.
30	--	--	Locations for optional return supervision lamps.

TABLE 2

TEST MEASUREMENT FUNCTIONS

Pushbutton	Measurement Range	Operating Notes
DC VOLTS — SLEEVE	0 to -150 VDC	Press METER REV pushbutton to read positive potentials.
DC VOLTS — RING	0 to -150 VDC	
DC VOLTS — TIP	0 to -150 VDC	
DC VOLTS — LOOP	0 to -150 VDC	
AC VOLTS — RING	0 to 150 VAC	Reading indicates foreign AC potential present.
AC VOLTS — TIP	0 to 150 VAC	
HI OHMS — RING	0 to 1 MΩ — Read on HI OHMS scale	Use LO OHMS scale for readings less than 5 kΩ. Regard as infinite those readings greater than 1 MΩ. Pegged meter pointer indicates foreign potential present.
HI OHMS — TIP	0 to 1 MΩ	
HI OHMS — LOOP	0 to 1 MΩ	
LO OHMS — RING	0 to 5 kΩ — Read on LO OHMS scale	Use HI OHMS scale for readings greater than 5 kΩ. Pegged meter pointer indicates foreign potential present.
LO OHMS — TIP	0 to 5 kΩ	
LO OHMS — LOOP	0 to 5 kΩ	
CAPACITANCE — RING	0 to 5 μF — Read on MFD scale	1. Pegged meter pointer indicates foreign potential or capacitance greater than 5 μF. 2. Consecutive erratic readings indicate AC potential on test circuit. 3. The following leakage resistance values will cause significant errors in capacitance measurements: a. More than 10 kΩ, series. b. Less than 50 kΩ, parallel.
CAPACITANCE — TIP	0 to 5 μF	
CAPACITANCE — LOOP	0 to 5 μF	