

CROSSBAR SYSTEMS
NO. 3
INCOMING PLUG-ENDED TRUNK
CIRCUIT
NO TEST
SIMPLEX CONTROLLED RINGING
REVERSE BATTERY OR
E AND M LEAD SUPERVISION

CHANGES

D. Description of Changes

- D.01 Option R is designated and option Q is added. Both are rated Standard.
- D.02 Circuit Notes 102 and 104 are changed and Circuit Notes 105 and 106 are added.

F. Changes in CD Sections

- F.01 In SECTION I, under 1. PURPOSE OF CIRCUIT, change 1.01 to read as follows:
1.01 This incoming trunk circuit is used by attendants at toll and DSA switchboards or TSPS, to connect to a called line, whether

it is idle or busy. When the line is idle ringing may be started by the switchboard attendant (the TSPS attendant can not start ringing). When the line is busy, a talking path may be established through this trunk to the busy line. This circuit is arranged for reverse-battery or E and M lead supervision.

F.02 In SECTION II, change the title of 3.04 through 3.06 to read as follows:

START RINGING - OPTION R

F.03 In SECTION III under 4. CONNECTING CIRCUITS, add the following:

- (f) Busy Line Verification Limiting Amplifier Circuit - SD-97761-01.

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DEPT 5242-DAJ

WE DEPT 45820-RUH-WEA-SVB

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<u>SECTION II - DETAILED DESCRIPTION</u>	2	<u>2. GENERAL DESCRIPTION OF OPERATION</u>
<u>1. SEIZURE AND PULSING</u>	2	2.01 This trunk is used primarily for verification of busy lines. It provides for connecting to the called line. If busy, the operator can listen for verification and if necessary talk to the parties on the busy connection. If the called-busy line is in a PBX hunting group, the PBX hunting feature will not be effective to advance from the busy line to an idle line in the same group. If the called line should be idle, this trunk will connect to it through the trunk switch and connector circuit. However ringing will not be connected to the line until the operator starts it. When the selected marker connects to the trunk, it is signaled by the trunk that this is a no-test trunk.
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<u>2. CALLED LINE BUSY - NO-TEST CHANNEL AVAILABLE</u>	3	2.02 This trunk can be arranged to work with either reverse-battery supervision, App Fig. 2, or E and M lead supervision, App Fig. 3, from the distant end. On reverse-battery supervision the trunk is arranged so that its initial condition with respect to the polarity of the A relay toward the distant office may easily be changed to that which is required by the distant office. It is also arranged so that the initial polarity and the polarity when awaiting customer answer may be made the same or opposite depending on whether the initial condition required is on- or off-hook. Option X is provided on loops less than 3115 ohms to avoid unnecessary operation of the A relay (false start) when
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the trunk restores to normal. Another condition where the A relay might operate falsely is on disconnect where the circuit is connected over cable of more than 35 miles and delay dial signal operation is used. To avoid this type of false start, link reseizure delay, is used which holds the ST lead open during the release time of the slow-release relay after disconnect.

2.03 Ringing current is supplied directly to the trunk circuit from the power, ringing, and tone distributing circuit. By the proper selection of relays R2, R3, and TPR the trunk can be supplied with any type or code of ringing used in the office on either tip or ring. Line-busy and overflow are provided to the calling end from the trunk switch circuit.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE AND PULSING

REVERSE-BATTERY SUPERVISION - APP FIG. 2

1.01 When the loop is closed to the trunk, relay A operates and closes battery to the incoming register link start lead ST. If a register is available, the link switch operates to connect the trunk and register together at which time the register takes control of the link start lead and operates relay CO.

1.02 Relay CO opens relay A from the tip and ring of the trunk to give a clean pulsing path to the register, opens the ST lead, prepares a locking circuit for slow-release relay CT under control of relay A, and extends the CT relay windings to the sleeve of the test jack. Relay CO grounds the BL lead to the register as a check of its operation.

1.03 When pulsing is completed, the register grounds the CT lead operating relay CT. Relay CT operated, closes relay A and the transmission circuit to the tip and ring of the trunk, closes a locking path for the CO relay, and when relay A operates holds under control of the A relay. The locking ground is a check to the register that relay A and CT are operated. Relay CT operated, partially supplies ground to the S lead to hold the connection to the called line if idle after it is established by the marker. The CT relay operated connects the R relay in series with the A relay for the remainder of the call but the R relay will not operate while a dry bridge is at the distant office because the R relay windings are connected series opposing. Should the operator operate the cord circuit ringing key to start ringing, a simplex positive potential is connected, unbalancing the current through the R relay windings, thereby operating relay R, while holding the A relay.

E AND M SUPERVISION - APP FIG. 3

1.04 When this circuit is seized from the distant switchboard, off-hook is received over lead E in the form of a ground to operate relay E. The E relay operated:

(a) Connects resistance ground to the R lead. This will simulate a loop to the incoming register when the trunk is arranged for dial pulsing (option V).

(b) Partially closes a resistive bridge across the T and R leads. This will simulate a loop to the incoming register when the trunk is arranged for multi-frequency pulsing (option W).

(c) Connects resistance battery to the ST lead to the incoming register link as a bid for an incoming register.

(d) Operates the T relay which transfers the M lead from ground to resistance battery. This off-hook signal is the first reversal of the wink, start-dial, signal. In response to the bid for a register, the link functions to connect an idle incoming register to the trunk. Ground on lead CO is the signal that a register is attached and operation of the CO relay conditions the trunk and grounds the BL lead as an indication to the incoming register that the CO relay has operated.

1.05 When the incoming register is ready to receive digits from the originating end it grounds the tip lead operating the RV relay in the trunk. The RV locks under control of the CO relay and releases the T relay. It removes the T idle circuit termination bridged across the T and R. On trunks arranged for MF pulsing (option W) RV applies a 4700-ohm bridge across the tip and ring to the register. When the T relay releases it transfers the signaling circuit M lead from resistance battery to ground. This is an on-hook signal to the originating end and it is the second and last reversal of the wink signal. The originating end outpulses the called number. When this trunk receives dial pulses, the E relay follows the pulses and transmits them to the incoming register.

1.06 When the register has received all of the digits, it makes a marker start and grounds the CT lead to the trunk which operates the CT cut-through relay. The CT relay operated; locks relay CO operated, cuts through the tip and ring leads, partially closes ground to the S sleeve lead, removes the N or R resistor which is bridged on the ring lead, closes its own lock path under control of the E relay operated.

1.07 Relay CT is a slow-release relay to hold over momentary releases of the E relay due to noise on the channel. The register monitors the CT lead for the return of the CT relay locking ground as an indication that the call has not been abandoned. Absence of the ground causes the incoming register to time-out and release.

2. CALLED LINE BUSY - NO-TEST CHANNEL AVAILABLE

MARKER OPERATION

2.01 The marker seizes the trunk through crosspoints on the incoming register link circuit. Resistance battery from the marker over lead F operates the F relay. Relay F operated.

- (a) Opens the operate path of the PU relay.
- (b) Grounds the TT1, SW, and JC leads to the trunk switch and connector circuit.
- (c) Cuts through to the marker the operate path of the BY relay.
- (d) Transfers the T, R, and S leads to the marker over the T1, R1, and SL leads, respectively. The marker performs a trouble ground test on the sleeve and controls the channel over the SL lead. After the channel has been set up, the marker checks tip and ring continuity using the T1 and R1 leads.
- (e) Operates relays DS and F1.

2.02 With the F1 relay operated, ground is extended to the marker through the NT lead indicating that this is a no-test call. When the marker functions and the called line is busy the BY relay is operated and holds open the battery and ground supply from the called line and relay S does not operate to send answer supervision, BY relay operated operates the T relay to give off-hook supervision on a no-test connection to the operator. The operator functions to confirm the off-hook then disconnects. The operator disconnect releases relay A (App Fig. 2) or relay E (App Fig. 3). Relay A or E released releases relay CT.

2.03 Relay CT released, releases relays BY, CO, DS, RC, and also releases the channel to the called line. Relay BY released releases the T relay which sends on-hook supervision to the distant end. Relay CO released releases RV relay if it was operated and relay RC released releases relays TPR, RS, and R3 if they were operated. Relay DS releases returning the trunk to its normal idle state.

3. CALLED LINE IDLE

3.01 If the called line is idle, the F relay is operated as before through the incoming register link by the marker. Relay F operated, operates relays DS and F1. Relay F1 operated, closes through to the marker the operate path of the R2, R3, TPR, and RC relays. The marker functions and sets up the proper ringing code by operating a combination of relays R2, R3, and/or TPR. The marker completes the ringing connection by operating relay RC which closes a lock path for relays R2, R3, and TPR if they are operated. Relay RC operated, grounds lead RA to the marker via the trunk switch and connector as a check that its lock path is grounded.

3.02 The marker sets up the channel from the called line to the trunk, performs its tests on the T, R, and S and prepares to release by releasing the trunk F relay. The released F relay transfers the T, R, and S from the line into and under control of the trunk and also releases the F1 relay.

START RINGING

A. Reverse-Battery Supervision - App Fig. 2

3.04 A 100-volt minimum simplex dc signal from the calling operator operates relay R. Relay R operated, operates relay RS which operates and locks to a make-contact of RC relay under control of the RT relay. Relay R then releases.

3.05 Relay RS operated completes a path from the PU relay to either ground or to the PU lead. The combination of transfer contacts on the R2 and R3 relays and options S and T provide that the PU relay will be

operated immediately for CODE 1 ringing. For other than CODE 1 ringing the PU relay will be operated by the PU pulse on the PU lead. Relay PU and RS operated connects ringing to the called line.

B. E and M Lead Supervision - App Fig. 3

3.06 The originating operator operates the ringing key of the cord circuit. When the ringing key is released a single pulse is received over the E lead which releases relay E momentarily. Relay RS operates through E released and RC operated, locking under control of the RT relay. When E re-operates, ringing is connected to the line and controlled as explained in 3.05.

CALLED CUSTOMER ANSWERS

3.07 Ringing potential is applied to the ring lead of the customers line, and ringing ground is applied to the side of the line opposite from ringing potential. Some of the ringing potential is feedback as audible tone to the calling customer through the T1 and R1 capacitors. When the called customer answers the RT relay operates on the increased current flow. Relay RT operated, functions:

(a) To release the RS relay, which disconnects ringing and closes the talking circuit operating relay S. Relay S operated, operates the T relay. Relay T operated; with App Fig. 2 provided returns reverse-battery supervision, extinguishing the cord supervisory lamp at the switchboard. With App Fig. 3 provided and relay T operated, the potential on the M signaling lead is changed from ground to resistance battery as the off-hook signal to the originating end.

(b) Opens the locking path of the PU relay releasing it, the PU relay released, releases relay RT.

(c) Opens the lock path of the RC ringing control relay causing it to release. The RC relay released, releases the ringing combination relays R2, R3, and TPR if they are operated.

The trunk is now in the state in which conversation can take place between the calling and called customers. It will remain in this state with A (App Fig. 2) or E (App Fig. 3), CT, CO, DS, S, and T relays operated, until disconnect.

OPERATOR DISCONNECTS

3.08 When the operator disconnects, relay A (App Fig. 2) or E (App Fig. 3) releases, releasing relay CT. Relay CT released functions:

- (a) To release the CO relay which reconnects the A (App Fig. 2) relay to the tip and ring and releases the RV relay if it is operated.
- (b) Open the tip and ring paths through the trunk.
- (c) Release the channel to the called line. The release of the channel releases the S relay and then the T relay releases which changes the potential on the M signaling lead from resistance battery to ground as an on-hook signal.
- (d) Release the DS relay and opens the sleeve lead controlling the connection to the called line. The trunk is now returned to normal.

4. LINE-BUSY TONE OR OVERFLOW TONE

4.01 If the called line is busy or if there are no paths through the switches, the marker releases the RC relay. The released RC relay removes locking ground from the R2, R3, and TPR ringing combination relays

and the RS ring start relay which release. The released RS relay transfers the called end tip and ring leads from the ringing potential leads and cuts them through to the calling end. The marker connects the trunks vertical appearance on the trunk switch to level 9 of that switch. If it selects appearance A on level 9, 60-IPM line-busy tone will be sent to the calling end and selecting appearance B will send 120-IPM overflow tone. When the marker releases the F relay line-busy or overflow will be returned to the calling end. Relay S does not operate to send answer supervision.

4.02 The trunk remains in this state until the calling customer hangs up. Relay A or E releases, which releases relay CT as described in 2.03.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The customer working limits for this trunk will be found in the No. 3 cross-bar keysheet.

1.02 Trunk Selection (App Fig. 2).

	<u>Resistance</u>		<u>Cable</u>
Relay A	45V Min 48V Max		
Max Ext Ckt Loop			
Dial or MF Pulsing	6400	6800	60 miles
Min Ins Res	30,000		

1.03 Trunk Supervision (App Fig. 2).

	<u>Resistance</u>		<u>Cable</u>
Relay A	45V Min 48V Max		
Max Ext Ckt Loop			
Dial or MF Pulsing	6000	6400	60 Miles
Min Ins Res	30,000		
Relay R	+100V Min	+112V Min	+125V Min
Max Conductor Res	4500	5800	7000
Min Ins Res	30,000	30,000	30,000
Max Earth Potential	+20V	+20V	+20V

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designations</u>	<u>Meaning</u>
A (App Fig. 2)	Traditional (Calling End Supervisory)
BY	Busy (Line)
CO	Cutoff
CT	Cut Through
DS	Delay Seizure
E (App Fig. 3)	Traditional (Calling End Supervisory)
F	Frame
F1	Frame Auxiliary
PU	Pickup
R	Ringing
R2	Ringing Combination
R3	Ringing Combination
RC	Ringing Control
RS	Ringing Start
RT	Ringing Trip
RV	Reverse
S	Traditional (Called End Supervisory)
T	Traditional
TPR	Tip Party Ring

3. FUNCTIONS

3.01 To connect battery to the ST lead to the incoming register link as a bid for an incoming register.

3.02 Apparatus Fig. 3 - To bridge the idle circuit termination on the T and R to the transmission and signaling facilities.

3.03 Option V - To provide resistance to ground on the ring lead to the incoming register. This resistive ground simulates the dial-pulsing loop and under control of the E relay transmits the dial pulses to the registers.

3.04 Option W - To provide a T and R path from this trunk to the incoming register and to simulate a loop to the register by connecting a 4700-ohm bridge across the T and R.

3.05 To ground the BL lead to the incoming register as an indication that CO relay has operated.

- 3.06 To remove resistance battery from the ST lead.
 - 3.07 Apparatus Fig. 2 - To connect relay A to the tip and ring of the trunk for operator control of the trunk.
 - 3.08 Apparatus Fig. 2 - To connect the R relay to the tip and ring for operator control of the start of ringing.
 - 3.09 To ground the sleeve of the T1 jack (App Fig. 2) or the T2 jack (App Fig. 3) for test circuit use, when pulsing is completed.
 - 3.10 To operate the trunk F relay when the marker applies resistance battery to F lead of the incoming register link.
 - 3.11 To ground lead NT to the marker through the trunk switch and connector circuit to indicate that this is a no-test call.
 - 3.12 To ground leads JC, SW, and T11 to the trunk switch and connector circuit.
 - 3.13 To cut through to the marker the operate paths of the R2, R3, RC, and TPR relays.
 - 3.14 To transfer the T, R, and S leads to the T1, R1, and SL leads to the marker for tests and control of the channel.
 - 3.15 Apparatus Fig. 3 - To send the wink start dialing signal and the on-hook/off-hook supervisory signals to the originating office over the M lead of the transmission and signaling facilities.
 - 3.16 When the marker releases the F relay, to connect ringing current of the proper code and polarity on the side of the line to which the called customers ringer is attached.
 - 3.17 To operate the PU pickup relay immediately on calls requiring code 1 ringing.
 - 3.18 To delay the start of ringing to the beginning of the ringing cycle for other than code 1 ringing.
 - 3.19 To transmit audible ringing back to the calling customer.
 - 3.20 When the called customer answers, to trip ringing, release the ringing combination relays, establish the connection between the called and calling customers, supply transmitter battery and ground to the called customer, and send to the originating end an answer supervisory signal.
 - 3.21 To provide reverse-battery supervision (App Fig. 2) or E and M lead supervision (App. Fig. 3).
 - 3.22 To provide line-busy tone if the marker finds the called line-busy or overflow tone if the marker encounters an overflow condition.
 - 3.23 To provide talking circuit to busy line without applying a dc bridge.
 - 3.24 To extinguish cord supervisory lamp.
 - 3.25 Called line becomes idle. To release no-test connection and relight cord supervisory lamp.
 - 3.26 To send a disconnect signal to the originating end when the called end disconnects.
 - 3.27 To restore the trunk to normal when the calling end disconnects.
4. CONNECTING CIRCUITS
- 4.01 When this circuit is listed on a keysheet, the connecting information thereon shall be followed.
 - (a) Incoming Register Link Circuit - SD-26394-01.
 - (b) Trunk Switch and Connector Circuit - SD-26383-01.
 - (c) Power, Ringing, and Tone Distributing Circuit - SD-26414-01.
 - (d) CX Set and Repeat Coil Circuit - SD-95004-01 (Typical).
 - (e) N1 Carrier Applique Schematic - SD-95121-01 (Typical).

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all of the functions listed in this Circuit Description and of meeting the requirements listed in the Circuits Requirements Tables.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 To take this trunk out of service, have the associated outgoing trunk circuit in the distant office made busy.

6.02 The T1 and T2 test jacks provide access to this circuit for test purposes. Insertion of plugs in the jacks disconnects the trunk circuit from the transmission and signaling facilities.

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