

CROSSBAR SYSTEMS  
NO. 3  
INCOMING PLUG-ENDED TRUNK  
CIRCUIT  
REVERSE BATTERY SUPERVISION

## CHANGES

B. Changes in Apparatus

B.1	<u>Superseded</u>	<u>Superseded By</u>
	R1 Capacitor 535AS, Fig. 1, K Option	R1 Capacitor 535BS, Fig. 1, J Option
	T1 Capacitor 535AS, Fig. 1, K Option	T1 Capacitor 535BS, Fig. 1, J Option

D. Description of Changes

D.1 The FS1 has been revised to show the addition of J and G options. Wiring formerly not designated has been designated K and H options, respectively, and are rated Mfr Disc. Circuit Note 104 has been changed to reflect the addition of J and G options.

F. Changes in CD Section II

## F.1 Change 5.01 to read:

5.01 The calling station hanging up causes the A relay to release. Contact 6 make of the A opens the lock path of slow-release CT relay which releases. The CT released:

(a) Removes locking ground from the slow-release DS relay.

(b) Opens the R lead to the trunk switch and connector circuit which opens the loop to the called customer, releasing the S relay.

With both the S and CT relays released, ground is removed from the sleeve lead S which releases the channel to the called party thus placing the line on line lockout until the party hangs up. The DS relay is slow to release so that false starts are not made to the IRL, should the A relay bounce due to line discharges during release.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-HNS

WE DEPT 355-JRF-GWC-JCM

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first the trunk releases the connection to the called party and returns to normal. Should the called party disconnect first the trunk sends on-hook supervision to the calling end and awaits their disconnect. An optional time-out feature, if provided, will within 32 seconds release the local (called) customers line should the calling customer fail to hang up.

2.04 This trunk has a link reseizure delay feature which prevents seizure of the incoming register link and an incoming register due to line discharges generated on disconnect.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE - SC1

1.01 Closure of the loop at the distant office causes relay A to operate. The 6 make of relay A closes resistive battery to the incoming register link over the ST lead and in response to this signal 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 for digit pulsing to the register. Relay CO operated:

- (a) Contacts 2 and 3 break out the A relay from the trunk conductors to provide clear T and R leads to the register.
- (b) Transfers the resistance battery from the ST lead to the sleeve of the T jack. The potentials which are switched on and off of the T jack sleeve are for use of the test circuit when a test call is directed to the trunk.
- (c) Through contact 4 make, partially closes a lock path for itself and also cuts the ground on the CO lead onto the BL lead as an indication to the incoming register that the CO relay has operated.
- (d) Opens the operate path to the RL thermal relay.
- (e) Through contact 5 make, partially close a path to ground for the S sleeve lead and an operate path to the PU relay.

1.02 The incoming register signals the originating end to outpulse and when it 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 operated:

- (a) Through the 8 and 10 make-contacts reconnects the A relay to the tip and ring to provide supervision of the calling end.
- (b) Locks CO relay operated through contact 2 make.
- (c) Through 12 make, closes ground to the path which later will connect to the S sleeve lead and hold the connection to the called line.
- (d) The 2 break-contact removes the short circuit shunt from the secondary winding of A relay (option V).
- (e) Transfers the sleeve of the T jack from resistance battery to ground.
- (f) Partially closes the operate path of relay DS.
- (g) Locks to ground through 1 make CT, 6 make A relay, and 4 make CT.

Relay CT is a slow-release relay so as to give the A relay time to reoperate and to enable the trunk to hold over any momentary releases of the A relay during the call. 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. MARKER OPERATIONS - SC1

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 operate path of PU pickup relay.
- (b) Grounds the JC, SW, and TT1 leads to the trunk switch and connector circuit.
- (c) Cuts through to the marker the operate paths of the R2, R3, and TP ringing combination relays.
- (d) Transfers the T, R, and S leads to the marker over the T1, R1, and SL leads. 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 relay DS through its 3 make-contact.

2.02 Relay DS operated locks through its 6 make-contact to 2 make CT. Its 8 break-contact further opens the ST to the link and later during disconnect will perform the delay link seizure function. Contact 12 make partially completes the path from ground to the sleeve lead.

2.03 The marker operates the RC ringing control relay. It checks that RC operates and that its locking path is intact by checking for ground on the RA lead. The path to ground starts at the RA lead and goes through 6 make F, 6 break RT, 5 make RC, and 12 make CT to ground. The marker stores the called party ringing information in the trunk by operating the proper combination of R2, R3, and TP relays. These relays lock to ground through 5 make RC and 12 make CT.

2.04 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. The marker checks for ground, through 12 make CT, 5 make CO, 12 make DS, and 8 break F, to the sleeve lead and then releases. When it releases, the marker dismisses the incoming register which releases.

LINE-BUSY OR OVERFLOW

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

2.06 The trunk remains in this state until the calling customer hangs up. Relay A releases releasing relay CT. The CT removes ground from the sleeve releasing the trunk switch. Relays CO and DS release returning the trunk to its normal idle state.

3. RINGING - SC1

3.01 The marker released the trunk F relay when it prepared to release. The 12 break of the F completes a path from the P pickup relay coil to either ground or to the PU lead from the PRTD circuit. The combination of transfer contacts, 9 on R2 relay and 4 on R3 relay, and options M and N provide that, if code 1 ringing is to be applied to the tip or ring, the operate path of the PU relay will be grounded and it will operate immediately. If on the other hand any other code of ringing is to be applied, the operate path will be brought out to the PU lead. The 250-millisecond pulse of ground, which appears on the PU lead near the end of the 6-second ringing cycle, operates the PU at a time which assures that ringing codes 2, 3, or 4 are applied at the beginning of their sequences. In any event the PU relay operates and locks through its 8 make-contact to ground appearing at 5 make of the RC. One of the ringing potentials coming from the PRTD over leads C1, C2, C3, and C4 is applied through the RT ringing trip relay and 10 make PU to either the tip or ring of the called customers line. The following chart specifies the ringing codes sent to the called customer for the various combinations of operated R2, R3, and TP relays.

RINGING COMBINATIONS				
Called Party	Relays Oper	Ringing		Applied To
		Superimp	Coded	
1		Code 1-	Code 1-	Ring
2	TP	Code 1-	Code 1-	Tip
3	R2	Code 1+	Code 2-	Ring
4	R2,TP	Code 1+	Code 2-	Tip
5	R3	Code 2-	Code 3-	Ring
6	R3,TP	Code 2-	Code 3-	Tip
7	R2,R3	Code 2+	Code 4-	Ring
8	R2,R3,TP	Code 2+	Code 4-	Tip

4. ANSWER - SC2

4.01 Ringing potential is applied to the ring lead of the customers line through 3 make RC or to the tip lead through 2 make RC. Ringing ground through either 10 break or 11 make TP 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 impedance of the line

is reduced so that the resultant increased current flow operates the RT ringing trip relay. Contact 6 break of the operated RT opens the lock path of the RC ringing control relay causing it to release. The RC released:

- (a) Releases the ringing combination relays R2, R3, and TP.
- (b) Opens both the operating and locking paths of the PU relay releasing it.
- (c) Completes another path, through its 5 break-contact, from ground to the S sleeve lead.
- (d) The 2 and 3 transfer contacts remove ringing from the called line and cut on the S supervisory relay which supplies talking battery and ground to the called party; operating the S relay and releasing RT.

4.02 When the S relay operates:

- (a) Its 6 make-contact closes a path parallel to 12 make CT in the sleeve circuit. The path becomes functional during (calling party first) disconnect.
- (b) Its 4 and 8 transfer contacts reverse the potential on the trunk conductors to the originating office as the answer supervision signal.
- (c) The 7 break-contact opens the lock path of the CO relay releasing it.

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 its A, CT, DS, and S relays operated, until disconnect.

## 5. DISCONNECT - SC2

### CALLING STATION FIRST

5.01 The calling station hanging up causes the A relay to release. Contact 6 make of the A opens the lock path of slow-release CT relay which releases. The 12 make-contact of the released CT opens one of the ground paths to the sleeve lead. However, 6 make S maintains the ground thus placing control of the sleeve lead upon the DS relay. The DS relay is a slow-release relay and it begins releasing when 2 make of the CT opens its lock path. Ground is held on the sleeve, thus holding the channel to

the called line, until the DS relay releases. The slow-release CT and DS relays provide a margin of time, from calling party release until channel release, of approximately 0.3 to 0.9 seconds before the called party is put on line lockout; by that time the party may have already hung up.

### CALLED STATION FIRST

#### A. Without Timing

5.02 When the called party hangs up first the S relay releases. The transfer contacts 4 and 8 of the S reverse the polarity of the trunk conductors to the originating end as an on-hook supervisory signal. The trunk then awaits for the calling customer to release or to be timed off the connection by the originating equipment. When the connection at the far end drops, the loop is opened and the A relay releases. The opened 6 make-contact of A releases slow-release CT relay. The CT relay released does two things. It removes ground from the S sleeve lead which drops the channel hold magnets removing the connection from the trunk to the called customers line; and it releases the slow-release DS delay seizure relay. The trunk is now normal.

#### B. With Timing (Option R)

5.03 The trunk action is the same as in 5.02 except, that while the trunk is waiting for the disconnect signal from the originating end, it starts a timed disconnect function of its own. The S relay released completes a path from ground on 2 make of the CT relay through 7 break S, 4 break CO, and 4 break RC to the heater of the RL thermal time delay relay. Sometime within an interval of 13 to 32 seconds the RL relay closes its contacts and operates the RC relay. Relay RC operated:

- (a) Removes ground from the RL heating element allowing it to cool.
- (b) Removes ground from the S sleeve lead dropping the connection to the called customer thus freeing that line.
- (c) Locks to ground on 12 make CT.

The trunk remains in this state waiting for the disconnect signal from the originating end. When the A relay releases, the results are the same as in 5.02 except that the CT relay releases the RC relay instead of the already released channel.

C. Link Reseizure Delay

5.04 The delay seizure DS relay is operated by the CT relay. It remains operated for the duration of the call and is the last relay to release. Its slow-release characteristic plus its 8 break-contact in the ST start lead to the incoming register link provide the link reseizure delay. By keeping the start lead open, any reoperations of the A relay (due to cable discharges) are prevented from causing repeated link seizures, for the period of the DS relay release time.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

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

1.02 Trunk Selection

Max Ext Ckt	<u>Loop Resistance</u>		<u>Cable Length</u>
	Minimum	Voltage	
	45	48	
Dial or MF Pulsing	6400	6800	60 mi
Minimum Insulation Resistance - 30,000			

1.03 Trunk Supervision

Max Ext Ckt	<u>Loop Resistance</u>		<u>Cable Length</u>
	Minimum	Voltage	
	45	48	
Dial or MF Pulsing	6400	6800	60 mi
Minimum Insulation Resistance - 30,000			

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
A	Traditional
CO	Cut Off
CT	Cut Through
DS	Delay Seizure
F	Traditional

Designation

Meaning

PU	Pickup
R2	Ringing (Combination)
R3	Ringing (Combination)
RC	Ringing Control
RL	Release
RT	Ringing Trip
S	Supervisory
TP	Tip Party

3. FUNCTIONS

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

3.02 To provide clear T and R leads to the incoming register.

3.03 To remove resistance battery from the ST lead.

(a) To apply resistance battery to the sleeve of the T jack for test circuit use, when the incoming register is attached.

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

3.05 Upon the completion of pulsing, to reconnect relay A and the supervisory battery and ground to the T and R leads of the trunk.

3.06 Option V - To remove a short circuit shunt from across the secondary winding of relay A.

3.07 To provide a locking ground for relay CT under control of relay A and extend this ground to the register as a check that the call has not been abandoned.

3.08 To ground the sleeve of the T jack for test circuit use, when pulsing is completed.

3.09 To operate the trunk F relay when the marker applies resistance battery to F lead of the incoming register link.

3.10 To ground leads JC, SW, and TTL to the trunk switch and connector circuit.

- 3.11 To cut-through to the marker the operate paths of the R2, R3, RC, and TP relays.
- 3.12 To return the RC relay locking ground to the marker over lead RA.
- 3.13 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.
- 3.14 Prepares a circuit to ground for the S sleeve lead.
- 3.15 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.
- 3.16 To operate the PU pickup relay immediately on calls requiring code 1 ringing.
- 3.17 To delay the start of ringing to the beginning of the ringing cycle for other than code 1 ringing.
- 3.18 To transmit audible ringing to the calling customer.
- 3.19 When the called customer answers, to trip ringing, release the ringing combination relays, establish the connection between the called and calling customer, supply transmitter battery and ground to the called customer and reverse the potential on the trunk conductors to the originating end as an answer supervision signal.
- 3.20 When the calling customer disconnects first, to release the called customers line.
- 3.21 When the called customer disconnects first, to send an on-hook supervisory signal to the originating end and await disconnect from that end.
- 3.22 Option R - When the called customer disconnects first, to send an on-hook supervisory signal to the originating end and to time for an interval of 13 to 32 seconds; at the end of which, to release the called customers line.
- 3.23 To provide link reseizure delay when restoring to normal.
- 3.24 To provide access for testing the trunk circuit and cut-off of the trunk pair.
4. CONNECTING CIRCUITS
- 4.01 When this circuit is listed on a key-sheet, the connecting information hereon should be followed.
- (a) Trunk Switch and Connector Circuit - SD-26383-01.
- (b) Incoming Register Link Circuit - SD-26394-01.
- (c) Power, Ringing, and Tone Distribution Circuit - SD-26414-01.
- (d) Standard Outgoing Trunks Associated with Senders or a Switchboard - SD-26085-01 (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 Circuit 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 T test jack provides access to this circuit for test purposes. Insertion of a plug in the jack disconnects the trunk circuit from the cable pair.

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