

**J59204 ELECTRONIC TIE TRUNK (SD-1E500-01 AND SD-1E500-02)  
TROUBLE-LOCATING PROCEDURES AND DIAGNOSTIC TESTS  
PBX SYSTEMS**

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL . . . . .	1	E. Call States and Sequences—Outgoing Call From Dial-Selected Station . . .	13
2. MEASURING LOGIC LEAD TEST POINTS .	2	F. Call States and Sequences—Incoming Call to Attendant With Switchboard Interface Arranged to Accept Calls on Dial-Repeating Basis (Option E) . . .	15
A. Logic State Definition . . . . .	2	G. Call States and Sequences—Incoming Call to Attendant With Switchboard Interface Arranged to Accept Calls on Automatic Basis (Option F) . . . . .	18
B. Test Meter Requirement . . . . .	2	H. Call States and Sequences—Attendant-Originated Call . . . . .	21
C. Performing Logic Measurements . . .	2		
3. DESCRIPTION OF LOGIC LEADS . . . . .	2		
4. LOGIC LEAD PIN NUMBER LOCATIONS . .	4		
5. CALL STATES AND SEQUENCES . . . . .	4		
6. APPLICATION OF CALL STATES AND SEQUENCES TABLES . . . . .	4		
7. REFERENCES . . . . .	5		
		<b>1. GENERAL</b>	
		1.01 This section provides trouble-locating procedures and diagnostic testing information for the J59204 electronic tie trunk (ETT). The principle diagnostic technique described in this section is approached in the following manner.	
		(a) The logic lead descriptions in Part 3 impart an understanding of logic lead functions. (These descriptions include what the logic leads do and their relationship to the various circuit packs [CP] within the tie trunk.)	
		(b) The logic lead test point locations described in Part 4 and listed in Tables A, B, and C convey the location of the logic lead test points within the various type carriers used with the ETT.	
		(c) The call states and sequences tables in Part 5 analyze the high/low state of the logic	
<b>FIGURES</b>			
1. Rear View of CP Connector . . . . .	3		
<b>TABLES</b>			
A. J59204BC-1 Carrier (SD-1E500-01)—Pin Number Locations of Logic Leads . . . . .	7		
B. J59204BC-2 Carrier (SD-1E500-02)—Pin Number Locations of Logic Leads . . . . .	8		
C. J59204BA-1 Carrier (SD-1E500-02)—Pin Number Locations of Logic Leads . . . . .	9		
D. Call States and Sequences—Incoming Call to Dial-Selected Station . . . . .	10		

**NOTICE**

Not for use or disclosure outside the Bell System except under written agreement

## SECTION 534-364-300

leads of the ETT in relation to an event within a call sequence state.

(d) The call states and sequences tables allow the user to obtain the ability to rationalize the cause of a tie trunk failure by recognizing symptoms such as an improper logic lead state or the absence of an event occurring in its proper sequence.

(e) Through the knowledge gained in analyzing the call sequences tables, the user should be able to isolate a trouble to a particular CP by analysis of the logic lead input/output of the CP.

**1.02** Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

**1.03** This issue of the section is based on the schematic diagrams (SD) listed in Part 7. If this section is to be used with equipment or apparatus reflecting later issue(s) of the drawings, reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.

**1.04** This section coverage is limited to the following:

(a) Troubles located immediately within the tie trunk—Once it can be determined that the trouble source is outside the tie trunk (such as within the PBX), no further coverage is provided.

(b) Troubles caused by a single fault or failure—No consideration is given to failures of a catastrophic nature.

(c) Troubles caused by a failed component—Intermittent failures or troubles that require the use of time-event recorders are beyond the scope of this document. A trouble that causes the tie trunk to be in an erratic state (such as pumping) cannot be detected by the logic lead state and, therefore, is not covered in this document.

## 2. MEASURING LOGIC LEAD TEST POINTS

### A. Logic State Definition

**2.01** When the logic lead test point is measured with a meter, the following general rules should apply.

(a) Logic low is defined as any voltage of 0.8 volt or less.

(b) Logic high is defined as any voltage 1.8 volts or greater.

### B. Test Meter Requirement

**2.02** When measuring the logic lead voltage, use only a high-quality VTVM or VOM which has a sensitivity of at least 20,000 ohms per volt. A digital voltmeter, if available, is preferred.

### C. Performing Logic Measurements

**2.03** When measuring the logic voltage on the connector pins at the rear of the CP, pick up ground for the meter on terminal 1 of the dc-to-dc converter. **Do not attempt to use the CP ground (pin A15 of CP).**

**CAUTION: When measuring voltage on pins at the rear of the CP, use well-insulated meter leads and exercise extreme care in making these measurements. Shorting pins when making these measurements will blow the CP.**

**2.04** When checking the CP ground, put the + (red) lead of the meter to a +5 volt power supply terminal and put the - (black) lead to A15 of the CP in question.

**2.05** For the location of pins on a CP connector, see Fig. 1.

## 3. DESCRIPTION OF LOGIC LEADS

**3.01** The logic leads within the ETT serve definite functions during ETT operation. An understanding of the logic lead functions is of primary importance in understanding how the tie trunk operates and thus being able to wisely troubleshoot a failed tie trunk. A description of the logic leads follows.

**Note:** When a logic function is described for an unlettered CP, it is understood that the function applies to later coded CPs as well. When "B" or later coded CPs are specified, do not assume that the logic function is available on unlettered CPs.

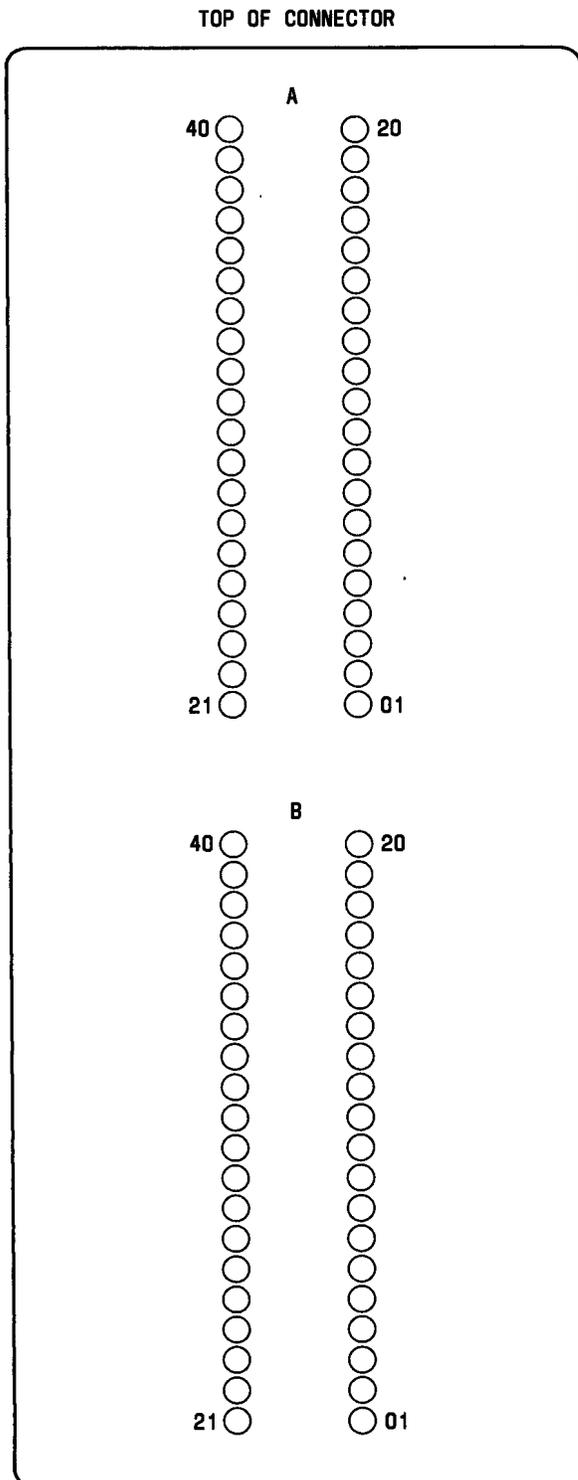


Fig. 1—Rear View of CP Connector

- L-AA0—Controlled by the HJ14 CP. When this lead is low, it indicates that an attendant is attached and causes the circuit-busy control in the HJ2B CP to be set if the call was attendant-originated and held if the call was incoming.
- L-A0—Controlled by the HJ14 CP. When the L-A0 lead is low, it indicates that the attendant-origination detector has been set, which inhibits local dial-selected and distant-origination memories from being set.
- L-A00—Controlled by the HJ4 CP. When the cord-in control is set, that lead goes low and causes the local loop status to function. This, in turn, causes the L-LO0 and L-PA0 leads to go low. This action generates an off-hook condition to the distant end as the result of the cord being plugged in. If this lead goes high, the local loop status control is placed under control of the battery feed supervision to detect dial pulses or attendant disconnect.
- L-B0—Under control of the HJ2 CP (local loop supervision). When low, it indicates the tie trunk circuit is busy. Its logic status, at the time a call is originated, determines whether the call will be handled as incoming or outgoing. If the distant end is detected off-hook first (incoming call), the L-D0 and L-D00 leads will go low before the L-B0 lead does. This conditions the tie trunk to function in the incoming direction only. If the L-FBL0 and L-P0 leads or (if attendant-originated) the L-AA0, L-A00, and L-A0 leads go low first, the L-B0 lead will go low and set the proper origination memory. This action places the cut-and-terminate function and the pulse corrector under control of the on-hook/off-hook signals received from the originated end.
- L-CA0—Controlled by the HJ9B CP. This lead going low indicates an incoming call to the switchboard attendant.
- L-D0—Controlled by the HJ3 CP. A low on this lead indicates that the call was originated at the distant end. This action inhibits the local dial-selected and attendant-origination memories from being set.

- L-DO0—Under control of the HJ3 CP (distant-end supervision). When low, it indicates that the distant end is off-hook. This lead follows distant-end supervision to repeat the supervision to the PBX over the T and R leads. It then sets or holds the circuit-busy control in the HJ2 CP.
- L-FBL0—Controlled by the HJ9 CP on dial-selected outgoing calls or HJ4 CP on attendant-originated calls. This lead goes low to provide battery feed toward the PBX. On attendant calls, this lead goes low when the attendant is dialing or when the attendant has disconnected.
- L-PA0—On SD-1E500-01 vintage equipment, this lead is controlled by the HJ9 CP; on SD-1E500-02 vintage equipment, this lead is controlled by the HJ2B CP. When this lead is low it indicates that the PBX is attached and sets or holds the circuit-busy control.
- L-LO0—Controlled by the HJ2 CP. When low, this lead indicates that the PBX is off-hook. This lead signals to the distant PBX. It follows local supervisory signals which are to be repeated to the distant end. In conjunction with the L-PA0 lead, the L-LO0 lead sets the circuit-busy control.
- L-P0—Controlled by the HJ9 CP. This lead going low indicates a dial-selected call (PBX-originated call). This action inhibits the attendant- and distant-origination memories from being set.
- L-PO0—Controlled by the HJ9 CP. A low on this lead indicates that the 2-Db pad should be taken out of the circuit.
- L-R0—Controlled by the HJ3 CP. A low on this lead indicates that the DX or E&M lead signaling unit has detected an off-hook from the distant end. This lead follows distant-end supervision which is to be repeated to the PBX with no pulse correction taking place.
- L-TDJ0—Controlled by the HJ4 CP. On attendant-handled calls, this lead going low causes the 2-Db pad to be removed from the circuit.

#### 4. LOGIC LEAD PIN NUMBER LOCATIONS

4.01 The logic lead pin number locations are shown in Tables A, B, and C. Table A shows the logic lead locations when the system is equipped with the J59204BC-1 carrier. Table B shows the logic lead locations when the system is equipped with a J59204BC-2 carrier. Table C shows the logic lead locations when the system uses the J59204BA-1 carrier.

#### 5. CALL STATES AND SEQUENCES

5.01 The call states and sequences which occur during a call are covered in Tables D through H. Both incoming and outgoing calls from a dial-selected station has four unique states: seizure of the trunk, dialing, answering, and disconnect. On both incoming and outgoing calls when an attendant is involved, these same states occur and, after dialing has occurred, an alerting state is involved on calls to the attendant. Certain events should occur during all these states. The absence of an event occurring in its proper sequence is the method by which a trouble can be found within the ETT.

#### 6. APPLICATION OF CALL STATES AND SEQUENCES TABLES

**Note:** When attempting to troubleshoot the J59204 ETT, it is a good practice to first check all power supply output voltages to ensure that they are all within their specified limits. The power supply voltages are critical to the proper operation of the tie trunk. The power supply output voltages of the tie trunk are -48 volts,  $\pm 12$  volts, +5 volts, and  $\pm 24$  volts.

6.01 When troubleshooting the J59204 ETT, attempt to set up either an outgoing or incoming call with a distant station. (The type call, incoming or outgoing, depends on what symptoms were reported.) During a call process, certain events should happen that result in a visual or measurable occurrence. Look for the absence of one of these events (such as a lamp that should be lighted, but is not). Once an absence of an event is found, go back through the call states and sequences table and measure the high or low state of the logic leads listed in the table until one is found that is in an improper state. Once the faulty state is found, determine which CP or

other component feeds this logic point. Replace the CP or other component involved and see if this repairs the tie trunk.

**6.02** If the above action does not make the tie trunk operational, consider (if the situation warrants it) what the logic point feeds. In some cases, a CP(s) fed from the logic point may be faulty and may create an excessive load on the logic point, pulling down the logic point voltage. A logic point being pulled down by a faulty component is not as common as the logic point drive being faulty. However, this can occur and should be kept in mind.



***When troubleshooting a tie trunk by CP replacement, if changing a CP within the tie trunk does not repair the tie trunk, the original CP should be placed back into service. Exercise much care to avoid mixing bad or suspected CPs with the factory-tested replacement boards.***

**6.03** If the above actions do not correct the fault, consider that the trouble may possibly be external to the tie trunk (such as within the PBX or at the distant end). Check the outputs or inputs to the PBX; if they seem correct, recheck the switch settings and alignment of the repeaters. If they are properly set and aligned, then consider a possible wiring problem.



***If it is necessary to disconnect the wiring, keep in mind that the connections are all of the wire-wrap type and removing and replacing these connections can result in a bad connection thus introducing more problems into the tie trunk. Connections should be broken only when it is essential to repairing the tie trunk.***

**6.04** If none of the actions indicated above repair the tie trunk, the problem is beyond the scope of this document. In which case, additional tests, using test equipment not generally available to maintenance personnel, are required.

## 7. REFERENCES

**7.01** This issue of the section is based on the following drawings:

SD-1E500-01, Issue 2

SD-1E500-02, Issue 1

SD-1E501-01, Issue 1

**7.02** The following sections provide information on the ETT and connection circuits.

SECTION	TITLE
534-364-100	HJ12 Repeater (SD-1E501-01)—Description and Tests
534-364-180	HJ12 Repeater (SD-1E501-01)—Method for Generating Prescription Settings for Equalization and Gain When Used With Another HJ12 Repeater or Metallic Facility Terminal Repeater—Nonloaded and Loaded Cable Facilities
534-364-181	HJ12 Repeater (SD-1E501-01)—Method for Generating Prescription Settings for Equalization and Gain When Used With Repeaters and Other Cable Terminating Equipment Which Use V4 Equalization Techniques—Nonloaded Cable Facility
534-364-212	J59204 Electronic Tie Trunk (ETT) SD-1E500-01, SD-1E500-02—Identification, Installation, and Connections—PBX Systems
981-010-100	Private Branch Exchange Tie Trunk Circuits—General Descriptive Information

**7.03** The following SDs provides additional information on the ETT and connection circuits.

SD NUMBER	TITLE
1E034-01 or 1E053-00	Tie Trunk Access for TOUCH-TONE Conversion

**SECTION 534-364-300**

1E363-01	No. 770A Tie Trunk Interface Circuit	66359-01	First Selector Circuit (Typical)
1E406-01	No. 812A Tie Trunk Interface Trunk Circuit	66360-01	Incoming First Selector Circuit (Typical)
1E407-01	No. 812A CCSA Interface Trunk Circuit	66596-01	Incoming Connector Circuit (Typical)
38200-01	Traffic Measurement System No. 1A (Typical)	66653-01	Night Alarm Circuit
65721-01	Selector Connector Circuit (Typical)	66722-01	Auxiliary Signal, Fuse Alarm, Battery Cut-Off, and Miscellaneous Circuit (Typical)
65741-01	756A Line, Link, and Marker Circuit	66724-01	AC Lamp Relay Circuit
65774-01	Traffic Register Circuit	66765-01	757 Auxiliary Tie Trunk Circuit
65778-01	Switchboard Jack Circuit	96549-01	Traffic Usage Recorder Circuit
65783-01	Idle Trunk Indicating Circuit	99421-01	Signaling and Transmission Systems

TABLE A

## J59204BC-1 CARRIER (SD-1E500-01) – PIN NUMBER LOCATIONS OF LOGIC LEADS

LEAD	CIRCUIT PACK*				
	LOCAL LOOP SUPERVISION HJ2	DISTANT-END SUPERVISION HJ3	2-WIRE TRANSMISSION HJ5	4-WIRE TRANSMISSION HJ7	COMMON SYSTEMS PBX INFORMATION HJ9
L-B0	A14†	A13			A35
L-D0	A17	A4†			A38
L-DO0	A38	A3†			
L-FBL0	A37	A5			A17†
L-LO0	A3†	A14			A39
L-PA0	A19				A19†
L-P0	A40	A19			A16†
L-PO0	A32			A3	A18†
L-R0		A22‡			

\* On this carrier, any vintage or equivalent code CP may be used.

† Designates origination of logic lead.

‡ Does not serve as a logic point except on the HJ3 CP. It can be used as a test point.

TABLE B

## J59204BC-2 CARRIER (SD-1E500-02) – PIN NUMBER LOCATIONS OF LOGIC LEADS

LEAD	CIRCUIT PACK*				
	LOCAL LOOP SUPERVISION HJ2B	DISTANT-END SUPERVISION HJ3B	2-WIRE TRANSMISSION HJ5B	4-WIRE TRANSMISSION HJ7B	COMMON SYSTEMS PBX INFORMATION HJ9B
L-B0	A14†	A13			A35
L-D0	A17	A4†			A38
L-DO0	A38	A3†			
L-FBL0	A37				A17†
L-LO0	A3†	A14			
L-PA0	A3†, A19‡				
L-P0	A40	A19			A16†
L-PO0	A32			A3	A18†
L-R0		A22§			

\* On this carrier, only "B" or later coded CPs should be used.

† Designates origination of logic lead.

‡ This lead both originates and terminates on the same CP as indicated.

§ Does not serve as a logic point except on the HJ3 CP. It can be used as a test point.

TABLE C

## J59204BA-1 CARRIER (SD-1E500-02) – PIN NUMBER LOCATIONS OF LOGIC LEADS

LEAD	CIRCUIT PACK*					
	LOCAL LOOP SUPERVISION HJ2B	DISTANT-END SUPERVISION HJ3B	SWITCHBOARD INTERFACE HJ4	2-WIRE TRANSMISSION HJ5B	4-WIRE TRANSMISSION HJ7B	COMMON SYSTEMS PBX INFORMATION HJ9B
L-AA0†	A39		A37‡			
L-A0	A33		A38‡			A36
L-AO0†	A5		A36‡			
L-B0	A14‡	A13	A35			A35
L-CA0†	A30		A5			A14‡
L-D0	A17	A4‡	A3			A38
L-DO0	A38	A3‡				
L-FBL0	A37		A39‡, §			A17‡, §
L-LO0	A3‡	A14	A14			
L-PA0	A3‡, A19¶					
L-P0	A40	A19	A4			A16‡
L-PO0	A32				A3	A18‡
L-R0		A22**				
L-TDJ0†			A6‡			A40

\* On this carrier only "B" or later coded CPs (except for the HJ4 CP) should be used.

† These logic leads are nonfunctional on systems that do not require an HJ4 CP.

‡ Designates origination of logic lead.

§ On switchboard application, the L-FBL0 lead originates on HJ4 CP; on dial-selected calls, this lead originates on HJ9 CP.

¶ This lead both originates and terminates on the same CP as indicated.

\*\* Does not serve as a logic point except on the HJ3 CP. It can be used as a test point.

TABLE D

## CALL STATES AND SEQUENCES—INCOMING CALL TO DIAL-SELECTED STATION

CALL STATE		RESPONSE
1	Distant end goes off-hook.	<ul style="list-style-type: none"> <li>• Local signaling units detect off-hook (HJ3B CP).</li> <li>• L-R0 lead at A22 (HJ3B CP) goes low.</li> <li>• L-DO0 lead at A3 (HJ3B CP) and L-D0 lead at A4 (HJ3B CP) go low.</li> <li>• Position-busy control set (HJ4 CP).</li> <li>• L-B0 lead at A14 (HJ2B CP) goes low.</li> <li>• CKT BSY LED (HJ2B CP) lights steadily (transmission facilities cut and terminated for 100 ms).</li> <li>• Local PBX responds with dial tone.</li> </ul>
2	(a) Distant end abandons call (goes on-hook) prior to dialing.	<ul style="list-style-type: none"> <li>• L-R0 lead at A22 (HJ3A CP) goes high.</li> <li>• L-DO0 lead at A3 (HJ3B CP) goes high.</li> <li>• Release timing started.</li> <li>• After approximately three-fourths of a second, CKT BSY LED goes off.</li> <li>• L-B0 lead goes high and then L-D0 lead goes high.</li> </ul>
	(b) Distant end begins dialing a digit.	<ul style="list-style-type: none"> <li>• PBX functions to receive dial pulses.</li> <li>• L-R0 leads goes high.</li> <li>• On first break, transmission facilities cut and terminated.</li> <li>• L-DO0 lead at A3 (HJ3 CP) goes high.</li> <li>• Loop to PBX open.</li> <li>• L-DO0 and L-R0 leads switch back and forth between low and high during dialing sequence.</li> <li>• Dialed number repeated into PBX.</li> </ul>
3	Distant end completes dialing a digit. <i>Note:</i> Steps 2(b) and 3 are repeated with each digit dialed. The response is the same as in the first digit with each digit dialed.	<ul style="list-style-type: none"> <li>• On last make, L-DO0 and L-R0 leads stay low; loop is closed.</li> <li>• After 100 ms, cut and terminate removed from transmission facilities.</li> <li>• Call progress tones heard.</li> </ul>
4	Called party answers.	<ul style="list-style-type: none"> <li>• Answer supervision detected (HJ2B CP).</li> <li>• L-LO0 lead at A3 (HJ2B CP) goes low.</li> <li>• Answer supervision transmitted to distant tie trunk (HJ3B CP).</li> </ul>

TABLE D (Cont)

## CALL STATES AND SEQUENCES—INCOMING CALL TO DIAL-SELECTED STATION

CALL STATE		RESPONSE
5	Called party disconnects (goes on-hook).	<ul style="list-style-type: none"> <li>• Disconnect supervision detected (HJ2B CP).</li> <li>• After 100 ms, L-LO0 lead goes high.</li> <li>• Disconnect supervision transmitted to distant tie trunk (HJ3B CP).</li> </ul> <p><i>Note:</i> Tie trunk is always calling party controlled. At this point nothing else happens until calling party disconnects (goes on-hook).</p> <ul style="list-style-type: none"> <li>• When calling party goes on-hook, L-R0 lead goes high; 60-ms delay occurs; L-DO0 lead goes high; loop to PBX is opened; transmission facilities cut and terminated; 750-ms delay occurs; and release timing completed.</li> <li>• Cut and terminate removed from transmission facilities (HJ2B CP), CKT BSY LED goes off, and L-B0 lead at A14 (HJ2B CP) goes high.</li> <li>• Distant-end origination memory reset (HJ3B CP) and L-D0 lead at A4 (HJ3B CP) goes high.</li> <li>• Attendant and PBX origination detectors enabled (HJ4 and HJ9B CPs), position-busy control reset (HJ4 CP), and ground removed from S lead.</li> </ul>
6	Calling party disconnects (on-hook from distant end).	<ul style="list-style-type: none"> <li>• Signaling units detect on-hook (HJ3B CP).</li> <li>• L-R0 lead goes high.</li> <li>• After 12 ms, split pulse filter functions (HJ3B CP).</li> <li>• After 49 ms, pulse corrector functions (HJ3B CP) and L-DO0 lead at A3 (HJ3B CP) goes high.</li> <li>• Loop to PBX opens (HJ2B CP), PBX releases, and transmission facilities cut and terminated.</li> <li>• L-LO0 lead goes high when PBX releases.</li> <li>• After 750 ms, release timing completed; cut and terminate removed from transmission facilities (HJ2B CP).</li> <li>• CKT BSY LED goes off.</li> <li>• L-B0 lead at A14 (HJ2B CP) goes high and ground removed from S lead.</li> <li>• Distant-end origination memory reset (HJ3B CP).</li> <li>• L-D0 lead at A4 (HJ3B CP) goes high.</li> </ul>

TABLE D (Cont)

CALL STATES AND SEQUENCES—INCOMING CALL TO DIAL-SELECTED STATION

CALL STATE		RESPONSE
6 (Contd)		<ul style="list-style-type: none"><li>• Attendant and PBX origination detectors enabled (HJ4 and HJ9B CPs), position-busy control reset (HJ4 CP), and ground removed from S lead to switchboard.</li></ul>

TABLE E

## CALL STATES AND SEQUENCES—OUTGOING CALL FROM DIAL-SELECTED STATION

	CALL STATE	RESPONSE
1	Local end goes off-hook.	<ul style="list-style-type: none"> <li>● PBX grounds S or S2 lead.</li> <li>● Outgoing origination detected (HJ9B CP) causing L-FBL0 lead at A17 (HJ9B CP) and L-P0 lead at A16 (HJ9B CP) to go low.</li> <li>● Local loop battery feed functions (HJ2B CP) tie trunk providing battery feed toward PBX.</li> <li>● Distant-end origination detectors inhibited (HJ3B CP), position-busy control set (HJ4 CP), and S lead grounded.</li> <li>● Tie trunk transferred from incoming to outgoing port of PBX (HJ9B CP).</li> <li>● Battery feed supervision detects loop (HJ2B CP) and causes L-LO0 and L-PA0 lead at A3 (HJ2B CP) to go low.</li> <li>● Circuit-busy control set (HJ2B CP) causing L-B0 lead at A14 (HJ2B CP) to go low and CKT BSY LED to light steadily, and grounds S or S2 lead to hold PBX.</li> <li>● Transmission facilities cut and terminated (HJ2B CP).</li> <li>● Outgoing origination memory set (HJ2B CP).</li> <li>● Battery feed supervision (as well as causing events listed four steps above) causes L-LO0 lead at A3 (HJ2B CP) to go low and, after 12-ms delay, causes split pulse filter to function (HJ3B CP), pulse corrector to be set, and off-hook transmitted to distant tie trunk.</li> <li>● After 100-ms delay, cut and terminate removed from transmission facilities (HJ2B CP) and distant PBX conditioned to receive dial pulses.</li> </ul>
2	Local end begins dialing a digit.	<ul style="list-style-type: none"> <li>● L-LO0 lead goes high.</li> <li>● On first break, transmission facilities cut and terminated.</li> <li>● L-LO0 lead switches back and forth between high and low during dial sequence.</li> </ul>
3	<p>Local end completes dialing a digit.</p> <p><i>Note:</i> Steps 2 and 3 are repeated with each digit dialed. The response is the same as the first digit with each digit dialed.</p>	<ul style="list-style-type: none"> <li>● On last make, L-LO0 lead is left low.</li> <li>● After 100-ms delay, cut and terminate removed from transmission facilities.</li> <li>● Call progress tones returned to calling party.</li> </ul>

TABLE E (Contd)

## CALL STATES AND SEQUENCES—OUTGOING CALL FROM DIAL-SELECTED STATION

CALL STATE		RESPONSE
4	Distant end answers.	<ul style="list-style-type: none"> <li>● Signaling unit detects answer (HJ3B CP).</li> <li>● L-R0 lead goes low.</li> <li>● L-DO0 lead goes low.</li> <li>● Tip and ring pair are reversed.</li> </ul>
5	Called party disconnects first (goes on-hook).	<ul style="list-style-type: none"> <li>● Signaling unit detects on-hook (HJ3B CP).</li> <li>● L-R0 lead goes high.</li> <li>● L-DO0 lead goes high.</li> <li>● Tip and ring to PBX restored to normal.</li> </ul> <p><i>Note:</i> Tie trunk is always calling party controlled. At this point nothing else happens until calling party disconnects (goes on-hook).</p>
6	Calling party disconnects first or last.	<ul style="list-style-type: none"> <li>● When calling party goes on-hook, battery feed supervision detects on-hook and L-PA0 and L-LO0 leads at A3 (HJ2B CP) go high.</li> <li>● Transmission facilities cut and terminated.</li> <li>● After 12-ms delay, split pulse filter functions.</li> <li>● After 49-ms delay, pulse correction circuit functions.</li> <li>● Disconnect supervision is transmitted to distant end.</li> <li>● After 750-ms delay, release timing completed (HJ2B CP), ground removed from S lead (PBX releases), CKT BSY LED goes off, cut and terminate removed from transmission facilities, and L-B0 lead at A14 (HJ2B CP) goes high.</li> <li>● Outgoing origination memory reset (HJ9B CP) causing L-FBL0 lead at A17 (HJ9B CP) to go high and local loop battery feed to be removed.</li> <li>● Tie trunk transferred to incoming port of PBX, ground removed from COG lead, and L-P0 lead at A16 (HJ9B CP) goes high.</li> <li>● Position-busy control reset (HJ4 CP) and ground removed from S lead.</li> <li>● Distant-end origination detectors enabled.</li> </ul>

TABLE F

**CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON DIAL-REPEATING BASIS (OPTION E)**

CALL STATE		RESPONSE
1	Distant end goes off-hook.	<ul style="list-style-type: none"> <li>• Local signaling units detect off-hook (HJ3B CP).</li> <li>• L-R0 lead at A22 (HJ3B CP) goes low.</li> <li>• L-DO0 lead at A3 (HJ3B CP) and L-D0 lead at A4 (HJ3B CP) go low.</li> <li>• Position-busy control set (HJ4 CP).</li> <li>• L-B0 lead at A14 (HJ2B CP) goes low.</li> <li>• CKT BSY LED (HJ2B CP) lights steadily (transmission facilities cut and terminated for 100 ms).</li> <li>• Local PBX responds with dial tone.</li> </ul>
2	(a) Distant end abandons call (goes on-hook) prior to dialing.	<ul style="list-style-type: none"> <li>• L-R0 lead at A22 (HJ3B CP) goes high.</li> <li>• L-DO0 lead at A3 (HJ3B CP) goes high.</li> <li>• Release timing started.</li> <li>• After approximately three-fourths of a second, CKT BSY LED goes off.</li> <li>• L-B0 lead goes high and then L-D0 lead goes high.</li> </ul>
	(b) Distant end begins dialing a digit.	<ul style="list-style-type: none"> <li>• PBX functions to receive dial pulses.</li> <li>• L-R0 lead goes high.</li> <li>• On first break, transmission facilities cut and terminated.</li> <li>• L-DO0 lead at A3 (HJ3B CP) goes high.</li> <li>• Loop to PBX open.</li> <li>• L-DO0 and L-R0 leads switch back and forth between low and high during dialing sequence.</li> <li>• Dialed number repeated into PBX.</li> </ul>
3	<p>Distant end completes dialing a digit.</p> <p><i>Note:</i> Steps 2(b) and 3 are repeated with each digit dialed. The response is the same as in the first digit with each digit dialed.</p>	<ul style="list-style-type: none"> <li>• On last make, L-DO0 and L-R0 leads stay low; loop is closed.</li> <li>• After 100 ms, cut and terminate removed from transmission facilities.</li> <li>• Call progress tones heard.</li> <li>• PBX grounds 0 lead which sets dial "0" detector (HJ9B CP) and causes L-CA0 lead at A14 (HJ9B CP) to go low.</li> </ul>

TABLE F (Contd)

**CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON DIAL-REPEATING BASIS (OPTION E)**

CALL STATE		RESPONSE
3 (Contd)		<ul style="list-style-type: none"> <li>● Alert-attendant control set, loop to PBX opened, dial "0" detector reset (HJ9B CP), L-CA0 lead goes high, and position-busy control reset.</li> <li>● NA or BS lead (option A) and WFA and MS leads grounded; battery connected to NA or BS lead (option B).</li> <li>● Audible ringing tone sent toward source.</li> </ul>
4	Attendant answers.	<ul style="list-style-type: none"> <li>● Sleeve sensing circuit detects cord seated and sets cord-in control (option M) or loop monitor detects cord seated and sets cord-in control (option K).</li> <li>● Cord-in control set causes L-A00 and L-AA0 leads to go low.</li> <li>● L-A00 lead going low causes local loop status to be set which causes L-LO0 to go low and this transmits answer supervision to distant end.</li> <li>● L-AA0 lead going low starts 500-ms delay to trip switchboard automatic ringing and then attendant connect control memory set.</li> <li>● After attendant connect control memory is set, battery is removed from NA or BS and L leads; ground is removed from NA or BS, WFA, and MS leads; and audible ringing is removed.</li> <li>● Tie trunk is connected to switchboard.</li> </ul>
5	Attendant extends call to desired station.	<ul style="list-style-type: none"> <li>● No tie trunk logic lead states change with this action.</li> </ul> <p><i>Note:</i> Here is a special case. If TGJO jacks are used, TDJO lead goes low indicating pad is to be removed.</p>
6	Calling party disconnects (on-hook from distant end).	<ul style="list-style-type: none"> <li>● Signaling units detect on-hook (HJ3B CP).</li> <li>● L-R0 lead goes high.</li> <li>● After 12 ms, split pulse filter functions (HJ3B CP).</li> <li>● After 49 ms, pulse corrector functions (HJ3B CP) and L-DO0 lead at A3 (HJ3B CP) goes high.</li> <li>● Loop to switchboard opens (HJ2B CP), PBX releases, and transmission facilities cut and terminated.</li> <li>● L-LO0 lead goes high when PBX releases.</li> </ul> <p><i>Note:</i> No farther action occurs until attendant removes cord.</p>

TABLE F (Contd)

**CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON DIAL-REPEATING BASIS (OPTION E)**

	CALL STATE	RESPONSE
7	Attendant disconnects (cord removed).	<ul style="list-style-type: none"> <li>• After 750 ms, cut and terminate function removed from transmission facilities, ground removed from S lead, and CKT BSY LED goes off.</li> <li>• L-B0 lead at A14 (HJ2B CP) goes high.</li> <li>• Attendant connect control memory reset (HJ4 CP).</li> <li>• Distant-end origination memory reset (HJ3P CP) causing L-D0 lead at A4 (HJ3B CP) to go high.</li> <li>• Attendant and PBX origination detectors enabled (HJ4 CP).</li> <li>• Sleeve sensing circuit reset (HJ4 CP).</li> <li>• Dial off-normal detector set (HJ4 CP) causing L-FBL0 lead at A39 (HJ4 CP) to go low which sets local loop battery feed control (HJ2B CP) causing L-LA00 lead to go high.</li> <li>• 100-ms delay occurs and L-LO0 lead goes high to pass disconnect supervision to originating end.</li> <li>• After 100-ms delay has occurred, cord-in control reset (HJ4 CP) causing L-AA0 at A37 (HJ4 CP) to go high.</li> <li>• Dial off-normal detector reset causing L-FBL0 lead at A39 (HJ4 CP) to go high which resets local loop battery feed control (HJ2B CP).</li> </ul> <p><i>Note:</i> Tie trunk is always calling party controlled. At this point nothing else happens until calling party disconnects (goes on-hook).</p> <ul style="list-style-type: none"> <li>• When calling party goes on-hook, L-R0 lead goes high; 60-ms delay occurs; L-DO0 lead goes high; loop to PBX is opened; transmission facilities cut and terminated; 750-ms delay occurs; and release timing completed.</li> <li>• Cut and terminate removed from transmission facilities (HJ2B CP), CKT BSY LED goes off, and L-B0 lead at A14 (HJ2B CP) goes high.</li> <li>• Distant-end origination memory reset (HJ3B CP) and L-D0 lead at A4 (HJ3B CP) goes high.</li> <li>• Attendant and PBX origination detectors enabled (HJ4 and HJ9B CPs), position-busy control reset (HJ4 CP), and ground removed from S lead.</li> </ul>

TABLE G

**CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON AUTOMATIC BASIS (OPTION F)**

CALL STATE		RESPONSE
1	Distant end goes off-hook.	<ul style="list-style-type: none"> <li>● Signaling units detect off-hook.</li> <li>● Distant-end origination detected (HJ3B CP) causing L-D0 lead at A4 (HJ3B CP) to go low.</li> </ul>
2	Distant end seizes tie trunk (either tie trunk code is dialed or distant-end attendant plugs into tie trunk circuit).	<ul style="list-style-type: none"> <li>● Alert-attendant control set, loop to PBX opened, dial "0" detector reset (HJ9B CP), and L-CA0 lead goes high.</li> <li>● NA or BS lead (option A) and WFA and MS leads grounded; battery connected to NA or BS lead (option B).</li> <li>● Audible ringing tone sent toward source.</li> </ul>
3	Attendant answers.	<ul style="list-style-type: none"> <li>● Sleeve sensing circuit detects cord seated and sets cord-in control (option M) or loop monitor detects cord seated and sets cord-in control (option K).</li> <li>● Cord-in control set causes L-A00 and L-AA0 leads to go low.</li> <li>● L-A00 lead going low causes local loop status to be set which causes L-LO0 to go low and this transmits answer supervision to distant end.</li> <li>● L-AA0 lead going low starts 500-ms delay to trip switchboard automatic ringing and then attendant connect control memory set.</li> <li>● After attendant connect control memory is set, battery is removed from NA or BS and L leads; ground is removed from NA or BS, WFA, and MS leads; and audible ringing is removed.</li> <li>● Tie trunk is connected to switchboard.</li> </ul>
4	Attendant extends call to desired station.	<ul style="list-style-type: none"> <li>● No tie trunk logic lead states change with this action.</li> </ul> <p><i>Note:</i> Here is a special case. If TGJO jacks are used, TDJO lead goes low indicating that pad is to be removed.</p>
5	Calling party disconnects (on-hook from distant end).	<ul style="list-style-type: none"> <li>● Signaling units detect on-hook (HJ3B CP).</li> <li>● L-R0 lead goes high.</li> <li>● After 12 ms, split pulse filter functions (HJ3B CP).</li> <li>● After 49 ms, pulse corrector functions (HJ3B CP) and L-DO0 lead at A3 (HJ3B CP) goes high.</li> </ul>

TABLE G (Contd)

**CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON AUTOMATIC BASIS (OPTION F)**

CALL STATE		RESPONSE
5 (Contd)		<ul style="list-style-type: none"> <li>● Loop to switchboard opens (HJ2B CP), PBX releases, and transmission facilities cut and terminated.</li> <li>● L-LOO lead goes high when PBX releases.</li> </ul> <p><i>Note:</i> No farther action occurs until attendant removes cord.</p>
6	Attendant disconnects (cord removed).	<ul style="list-style-type: none"> <li>● After 750 ms, cut and terminate function removed from transmission facilities, ground removed from S lead, and CKT BSY LED goes off.</li> <li>● L-B0 lead at A14 (HJ2B CP) goes high.</li> <li>● Attendant connect control memory reset (HJ4 CP).</li> <li>● Distant-end origination memory reset (HJ3B CP) causing L-D0 lead at A4 (HJ3B CP) to go high.</li> <li>● Attendant and PBX origination detectors enabled (HJ4 CP).</li> <li>● Sleeve sensing circuit reset (HJ4 CP).</li> <li>● Dial off-normal detector set (HJ4 CP) causing L-FBL0 lead at A39 (HJ4 CP) to go low which sets local loop battery feed control (HJ2B CP) causing L-LAO0 lead to go high.</li> <li>● 100-ms delay occurs and lead L-LO0 goes high to pass disconnect supervision to originating end.</li> <li>● After 100 ms, cord in control reset (HJ4 CP) causing L-AA0 at A37 (HJ4 CP) to go high.</li> <li>● Dial off-normal detector reset causing L-FBL0 lead at A39 (HJ4 CP) to go high which resets local loop battery feed control (HJ2B CP).</li> </ul> <p><i>Note:</i> Tie trunk is always calling party controlled. At this point nothing else happens until calling party disconnects (goes on-hook).</p> <ul style="list-style-type: none"> <li>● When calling party goes on-hook, L-R0 lead goes high; 60-ms delay occurs; L-DO0 lead goes high; loop to PBX is opened; transmission facilities cut and terminated; 750-ms delay occurs; and release timing completed.</li> <li>● Cut and terminate removed from transmission facilities (HJ2B CP), CKT BSY LED goes off, and L-B0 lead at A14 (HJ2B CP) goes high.</li> </ul>

TABLE G (Contd)

CALL STATES AND SEQUENCES—INCOMING CALL TO ATTENDANT WITH SWITCHBOARD  
INTERFACE ARRANGED TO ACCEPT CALLS ON AUTOMATIC BASIS (OPTION F)

	CALL STATE	RESPONSE
6 (Contd)		<ul style="list-style-type: none"><li>• Distant-end origination memory reset (HJ3B CP) and L-D0 lead at A4 (HJ3B CP) goes high.</li><li>• Attendant and PBX origination detectors enabled (HJ4 and HJ9B CPs), position-busy control reset (HJ4 CP), and ground removed from S lead.</li></ul>

TABLE H

## CALL STATES AND SEQUENCES—ATTENDANT-ORIGINATED CALL

CALL STATE		RESPONSE
1	Attendant inserts cord into switchboard jack.	<ul style="list-style-type: none"> <li>• With option K equipped, loop monitor functions which sets sleeve sensing circuit (HJ4 CP); with option M equipped, sleeve sensing circuit is set (HJ4 CP). With either option, BI lead is grounded.</li> <li>• Cord-in control set (HJ4 CP) causing V lead to be grounded.</li> <li>• Attendant-origination detector set causing L-A0 lead at A38 (HJ4 CP) to go low.</li> <li>• Outgoing port selection control set by grounding COG lead.</li> <li>• PBX and distant-end origination detectors inhibited.</li> <li>• L-A00 lead at A36 (HJ4 CP) goes low causing local loop status to be set (HJ2B CP).</li> <li>• L-LO0 lead at A3 (HJ2B CP) goes low which, after 12-ms delay, causes split pulse filter (HJ3B CP) to be set and pulse corrector to be conditioned.</li> <li>• Local loop status being set (above) causes, after 100-ms delay, cut and terminate to be removed from transmission facilities.</li> <li>• Cord-in control being set (above) causes L-AA0 lead at A37 (HJ4 CP) to go low.</li> <li>• Circuit-busy control is set causing L-B0 lead at A14 (HJ2B CP) to go low and CKT BSY LED to light steadily; transmission facilities are cut and terminated.</li> <li>• After responses above occur, a 500-ms delay results and then attendant connect control memory is set (HJ4 CP) and switchboard is connected to tie trunk (attendant receives dial tone).</li> </ul>
2	Attendant dials first digit of listed directory number (LDN).	<ul style="list-style-type: none"> <li>• With TOUCH-TONE® dialing unit, NI lead grounded; with rotary dial, battery (option M) or ground (option K) connected to S lead. In any case, dial off-normal detector and control set (HJ4 CP) causing L-FBL0 lead to go low.</li> <li>• Local loop battery feed control reset.</li> <li>• Local loop status control transferred from L-A00 lead to switchboard loop.</li> <li>• On first break, L-LO0 lead goes high.</li> <li>• Transmission facilities cut and terminated.</li> <li>• L-LO0 lead switches back and forth between high and low during dialing.</li> </ul>

TABLE H (Contd)

## CALL STATES AND SEQUENCES—ATTENDANT-ORIGINATED CALL

CALL STATE		RESPONSE
3	<p>Attendant completes dialing first digit.</p> <p><i>Note:</i> Steps 2 and 3 are repeated with each digit dialed. The response is the same as in the first digit with each digit dialed.</p>	<ul style="list-style-type: none"> <li>● On last make, L-LO0 lead is latched low; cut and terminate removed from transmission facilities.</li> <li>● With TOUCH-TONE dialing unit, ground removed from NI lead. With rotary dial, switchboard removes ground (option M) or battery (option K) from S lead. Sleeve sensing circuit is set.</li> <li>● Dial off-normal detector reset, causing L-FBL0 lead at A39 (HJ4 CP) to go high.</li> <li>● Local loop battery feed control reset.</li> <li>● Local loop status control transferred from switchboard loop to L-AO0 lead.</li> </ul>
4	Called party answers.	<ul style="list-style-type: none"> <li>● Signaling units detect answer supervision causing L-DO0 lead at A3 (HJ3B CP) to go low.</li> <li>● Loop to switchboard closed.</li> </ul>
5	Called party disconnects.	<ul style="list-style-type: none"> <li>● Signaling units detect disconnect supervision causing L-DO0 lead to go high.</li> <li>● Loop to switchboard opened.</li> </ul> <p><i>Note:</i> Tie trunk is always calling party controlled. At this point nothing else happens until calling party disconnects.</p> <ul style="list-style-type: none"> <li>● When calling party (attendant) goes on-hook, ground removed from S lead and CKT BSY LED goes off.</li> <li>● L-B0 lead at A14 (HJ2B CP) goes high; cut and terminate removed from transmission facilities.</li> <li>● Attendant-origination memory reset which causes L-A0 lead at A38 (HJ4 CP) to go high.</li> <li>● PBX and distant-end origination detectors enabled.</li> <li>● Attendant memory reset; switchboard disconnected from tie trunk.</li> </ul>
6	Attendant disconnects (cord removed from switchboard).	<ul style="list-style-type: none"> <li>● Sleeve sensing circuit reset causing L-AO0 lead at A36 (HJ4 CP) to go high.</li> <li>● Dial off-normal detector set causing L-FBL0 lead at A39 (HJ4 CP) to go low.</li> <li>● Local loop battery feed control set.</li> <li>● Ground removed from BI lead.</li> <li>● After 100-ms, local loop status repeater reset (HJ4 CP) causing L-OO lead to go high.</li> </ul>

TABLE H (Contd)

## CALL STATES AND SEQUENCES—ATTENDANT-ORIGINATED CALL

CALL STATE	RESPONSE
6 (Contd)	<ul style="list-style-type: none"> <li>• After 12 ms, split pulse filter reset.</li> <li>• After 49 ms, disconnect supervision transmitted to distant tie trunk.</li> <li>• 100 ms after L-LO0 lead goes high, cord-in control is reset causing L-AA0 lead to go high and ground to be removed from V lead.</li> <li>• Dial off-normal detector reset causing L-FBLO lead to go high.</li> <li>• Local loop battery feed control reset.</li> <li>• After 750-ms delay, release timing completed causing ground to be removed from S lead, CKT BSY LED to go off, L-B0 lead at A14 (HJ2B CP) to go high, and cut and terminate removed from transmission facilities.</li> <li>• Attendant-origination memory reset causing L-A0 lead at A38 (HJ4 CP) to go high.</li> <li>• PBX and distant-end origination detectors enabled.</li> <li>• Attendant connect control memory reset.</li> <li>• Switchboard disconnected from tie trunk.</li> </ul>