18

PBX SYSTEMS
NO. 701, 711, OR 740
PBX ACCESS LINE CKT, DIAL
REPEATING, E & M LEAD SIGNALING
ARRANGED FOR PRE-EMPTION

TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit provides two-way service between a dial or manual PBX and a distant switch center. The access line is dial repeating with E and M lead signaling and arranged for pre-emption.

1.02 The circuit is arranged to be used with a 24 V4 repeater. A switchable 2-db pad is removed for tandem or through connections.

2. GENERAL METHOD OF OPERATION

2.01 The access line is seized by a station or tie trunk from the selector or selector-connector banks or at a switchboard by the attendant. A seizure (off hook) is sent to the switch center. Dial pulses or TOUCH-TONE signals are transmitted to the switch center after receiving dial tone. When the call is answered at the distant end, answer supervision is transmitted back to the access line.

2.02 The switch center seizes the access line (off hook) and transmits pulses to the access line to complete the call. When the call is completed, the access line transmits answer supervision to the switch center.

2.03 The attendant can pre-empt a routine call on the access line. A pre-empt tone is supplied to the called and calling parties for 3 seconds and then disconnect is sent to the switch center. The access line reseizes the distant end upon disconnect by the switch center to initiate the precedence call.

2.04 The switch center can pre-empt any call. A pre-empt signal is transmitted to the access line signal circuit and pre-empt tone is supplied for 3 seconds from the switch center. The access line disconnects the PBX party if it is off hook at the end of 3 seconds. An on hook is transmitted to the switch center at the end of 3 seconds or when the PBX party changes to an on-hook condition.

SECTION II - DETAILED DESCRIPTION

1. INCOMING CALL

A. Seizure

1.01 The access line is seized at the distant end by a ground on lead E. Lead E grounded operates relay E.

1.02 Relay E operated:

(a) Operates relay EA.

(b) Completes part of the dialing loop to the selector bank or to the switchboard.

(c) Opens the operate path of relay PT1.

(d) Opens the operate path of relay E. The relay E break contact, resistors RE1 and RE2, and capacitor CE prevent distortion of lead E pulses.

(e) Opens the operate path of the sequence count relays P1, P2, P3, and P4.

(f) Opens the operate path of relay C.

(g) Prepares a locking path for itself.

1.03 Relay EA operated:

(a) Locks operated under control of relay PT.

(b) Operates relay B1.

(c) Prepares the operate path for relay WK.

1.04 Relay B1 operated:

(a) Closes the dialing loop to the selector bank and switchboard.

(b) Grounds lead S to the selector bank to mark access line busy to outgoing dial-selected calls.

(c) Operates relay OP (V option) to route all incoming routine calls to the attendant and prepares a locking path for it.

(d) Prepares the operate path for relay C.

(e) Starts the timed operation of relay AT.

(f) Operates relay WK.

(g) Lights the busy lamps.

1.05 Relay WK operated:

(a) Operates relay P4 to start sequence count.

(b) Operates relay B2.

1.06 Relay B2 operated:

(a) Locks operated via its own contact and the operated relay B1.

(b) Removes the idle line termination (Resistor IL).

(c) Connects the contact protection network D1 across the pulsing contact of relay E.

(d) Grounds lead S to access line and jack circuit for restoring air ground and data trunks.

(e) Provides holding paths for relays PT and PO when operated.

B. Manual PBX (Routine Call)

1.07 Relay P4 operated:

(a) Releases relay WK.

(b) Operates relay DB (digit begin).

(c) Locks operated via relay B1.

1.08 Relay DB operated:

(a) Operates relay DE (digit end).

(b) Grounds lead IN to the traffic usage registers indicating an incoming call.

1.09 Relay AT operates in about 3 seconds to light the routine line lamp.

C. Manual PBX (Precedence Call)

1.10 On an incoming precedence call, the access line is seized by a repeated 1650 ms off-hook and a 345 ms on-hook signal on lead E. The off-hook portion of the priority alert signal seizes the access line in the normal manner.

1.11 Circuit action proceeds same as for a routine call until relay E releases due to the on-hook portion of the priority alert signal.

1.12 Relay E released:

(a) Operates relay C.

(b) Starts timed operation of relay PT1. Relay PT1 does not operate on pulse breaks of incoming digits.

1.13 Relay PT1 operates in about 250 ms after the release of relay E. Relay PT1 operated operates relay PT.

1.14 Relay PT operated:

(a) Starts the slow release of relay EA.

(b) Starts the slow release of relay B1.

(c) Prepares a path for operating relay PR.

(d) Releases relay PT1.

(e) Provides a locking path for relay E.

1.15 Relay PT1 released starts another timed operation when relay EA releases. Its reoperation is prevented by the reoperation of relay E on the repeated priority alert signal.

1.16 Relay B1 released releases relay B2. With relay B2 released and relays PT and EA operated, relay PR operates.

1.17 Relay PR operated:

(a) Releases relay PT.

(b) Prepares an operating path for relay AR.

(c) Applies ground on lead FY to the access line and jack circuit for restoring air ground and data trunks to indicate a priority busy condition.

1.18 With relay PT released and relay EA operated, relay B1 operates. Relay B1 operated operates relay AR. The precedence busy lamp is extinguished and the precedence line lamp is lighted steady.

1.19 Relay AR operated:

(a) Provides precedence audible ringing to the distant end.

(b) Provides a holding ground for relay PR.

(c) Switches in resistor RT6 to increase the operate time of relay PT1 to approximately 550 ms to prevent its operation on the next on-hook part of the priority alert signal.

1.20 Relay C operating at the beginning of each on-hook signal recycles the timed operation of relay AT.

D. Dial PBX not Arranged for PNID (Routine Call)

1.21 Relay P4 operated:

(a) Locks up under control of relay B1.

(b) Releases relay WK.

(c) Prepares a path to operate relay DB.

1.22 An on-hook signal from the switch center will release relay E. Relay E released:

(a) Steps the incoming selector.

(b) Operates relay C.

(c) Starts the timed operation of relay PT1. Relay PT1 does not operate on pulse breaks of incoming digits.

1.23 Relay C remains operated during the pulsing of each digit. Relay C operated:

(a) Stops the timed operation of relay AT. The timed operation of relay AT which will be completed does not start until the release of relay C after the last digit.

(b) Removes relay D and inductor A from the pulsing path.

(c) Removes capacitor A and resistor AA from the hybrid coil of the terminating set used.

(d) Inserts capacitors C and C1 across the hybrid coils to prevent pulse transient interference.

(e) Operates relay DB.

1.24 Relay DB operated:

(a) Operates relay DE at end of digit. (Relay C released).

(b) Locks operated via relay B1.

(c) Grounds lead IN to traffic usage register.

1.25 The digits are repeated from lead E by relay E to step the selectors or connectors through the released relay AR contact.

1.26 Audible ringback or busy tone is returned to the switch center directly from the switch train.

E. Dial PBX not Arranged for PNID (Precedence Call)

1.27 On an incoming priority call, the access line is seized by a repeated 1650 ms off-hook and a 345 ms on-hook signal on lead E. The off-hook portion of the priority alert signal seizes the access line in the normal manner.

1.28 The on-hook portion of the priority alert signal releases relay E as a normal on-hook pulse signal.

1.29 Relay E released:

(a) Operates relay C.

(b) Starts the timed operation of relay PT1.

(c) Opens the loop to the selector releasing the switch train. The release of relay E steps the selector one level, but the selector loop is opened longer than a dial pulse forcing release.

1.30 Relay PT1 operates in about 250 ms after the release of relay E. Relay PT1 operated operates relay PT.

1.31 Relay PT operated:

(a) Starts the slow release of relay EA.

(b) Starts the release of relay B1.

(c) Prepares a path for operating relay PR.

(d) Releases relay PT1.

(e) Provides a locking path for relay E.

1.32 Relay PT1 released starts another timed operation when the slow release relay EA releases. Relay PT1 operation is prevented by the reoperation of relay E.

1.33 Relay B1 released releases relay B2. With relay B2 released and relays PT and EA operated, relay PR operates.

1.34 Relay PR operated:

(a) Releases relay PT.

(b) Prepares an operating path for relay AR.

(c) Applies ground on lead PY to the access line and jack circuit for restoring air ground and data trunks to indicate a priority busy condition.

1.35 With relay PT released and relay EA operated, relay B1 operates. Relay B1 operated operates relay AR. The precedence busy lamp is extinguished and precedence line lamp is lighted steady.

1.36 Relay AR operated:

(a) Provides precedence audible ringing to the distant end.

(b) Provides a holding ground for relay PR.

(c) Switches in resistor RT6 to increase the operate time of relay PT1 to approximately 550 ms to prevent its reoperation on the next on-hook part of the priority alert signal from the switch center.

(d) Opens the dialing loop to the selector to disconnect the switch train.

1.37 Relay C operating at the beginning of each on-hook signal recycles the timed operation of relay AT.

F. Dial PBX Arranged for PNID (Routine or Precedence Call)

1.38 Relay P4 operated:

(a) Locks under control of relay B1.

(b) Releases relay WK.

(c) Prepares a path to operate relay DB.

1.39 The operation and release of relay WK connects battery on lead M momentarily to signal the switch center that the access line is ready to receive the incoming digits.

1.40 Relay E follows the lead E pulses sent from the switch center. Relay C operates and remains operated during the pulsing of each digit.

1.41 Relay C operated:

(a) Removes relay D and inductor A from the pulsing path.

(b) Removes capacitor A and resistor AA and inserts capacitors C and C1 to improve pulsing.

(c) Operates relay DB.

1.42 Relay P1 operates on the first release of relay E. Relay P4 releases when relay E reoperates. The sequence count of relays P1, P2, P3 and P4 indicates the precedence of the incoming call. The sequence recycles as pulses of the precedence digit are received.

1.43 Relay C releases at the end of the precedence digit. Relay C released:

(a) Operates relay DE (digit end).

(b) Restores pulsing path to normal.

1.44 Relay DE (digit end) operated:

(a) Locks operated via its contact.

(b) Closes the loop to the incoming selector and switchboard. The incoming selector is seized to operate when the E relay pulses on the next digit.

(c) Removes the operating ground for the sequence counter. The sequence counter remains in the same state until disconnect.

1.45 If the sequence counter relay P4 is operated after the precedence digit, the call is routine. Relay E pulses the switch train in the normal manner.

1.46 If the sequence counter relays P1, P2, or P3 are operated, the call is translated as a precedence call. Relay PR (precedence) operates via contacts of relays DE and P-.

1.47 Relay PR operated operates relay AR. Relay PR applies ground to lead PY to indicate to the access line and jack circuit for restoring air ground and data trunks a precedence busy condition.

1.48 Relay AR operated:

(a) Provides a holding path for relay PR.

(b) Provides precedence audible ringing to the distant end.

(c) Transfers the pulsing path to the incoming selectors from the terminating set to a path through relay AR contacts.

1.49 The digits following the precedence digit pulse the switch train in the normal manner.

G. Calls Routed to Attendant (Precedence Call to a Busy Station or Precedence Call Unanswered by Station)

1.50 The first release of relay E at the beginning of each digit operates relay C. Relay C releases when relay E remains operated between digits. The operation of relay C prevents the timed operation of relay AT. If relay C is released and the called station is busy or does not answer, relay AT operates in about 12 seconds.

1.51 Relay AT operated alerts the attendant by flashing the line lamp at 60 ipm.

H. Listed Number Call

1.52 The access line transfers listed number calls to the attendant. The incoming selector or selector connector is seized and operated in the normal manner. The incoming selector is arranged to apply direct ground on lead O to the access line if the call is to be completed to the attendant.

1.53 Direct ground on lead O operates relays DVT and TPC. Relay DVT operated operates relay OP. Relay OP operated:

(a) Locks operated via its own contact.

(b) Opens the loop to the incoming selector.

(c) Prepares the lamp circuit to alert the attendant.

(d) Prepares the timed operation of relay AT for a 3-second interval.

1.54 The incoming selector releases when the loop is opened by relay OP. Lead O ground is removed when the selector releases.

1.55 Relay AT operates three seconds after the last digit is received (release of relay C). The operation of relay AT is delayed to prevent the attendant from answering a listed number call before the switch center has completed pulsing the entire number. The access line absorbs all digits after relay OP has operated.

1.56 The attendant is alerted by a steady line lamp indicating a listed number incoming call.

I. Answer by Station or Tie Trunk

1.57 A station or tie trunk upon answer reverses battery and ground on leads T and R. Relay D operates over the station or trunk loop indicating answer. Relay D operated operates relay F1. Relay F1 operates relay D1.

1.58 Relay D1 operated:

(a) Connects battery to lead M to indicate answer to the switch center.

(b) Opens the operate path of relay AT.

(c) Releases relay AR if operated to disconnect precedence audible ringing.

(d) Starts the 1.1 second timed operation of relay CC (call complete).

(e) Adds a parallel path in the pulsing loop across the relay E contact. The path is used to prevent immediate disconnect on calls pre-empted.

(f) Provides a holding path for relay B1. Relay B1 is held operated by both the originating and terminating ends.

(g) Extinguishes the precedence busy lamp if the call was routine class.

1.59 Relay CC operated:

(a) Locks operated via relay EA. Relay CC remains operated until disconnection of call.

(b) Opens the operate path of relays OP and AR to prevent false lamp indications on disconnect.

J. Answer by Attendant

1.60 The attendant inserts either cord plug into the jack associated with a lighted line lamp. Direct ground is provided on lead SL in the jack circuit when the attendant inserts plug. Ground is applied on the sleeve of the cord circuit via diodes D or PD to indicate a station appearance. Relay S or SP (depending on line lamp lighted) operates from the cord circuit of the switchboard. Relay S or SP operates relay J or JP respectively.

1.61 Relay J operated (routine call):

(a) Releases relay S.

(b) Operates relay J1.

(c) Completes part of the T and R connection to the access line from the cord circuit.

(d) Releases relay OP if operated.

(e) Operates relay JP1 to allow pre-empt by the attendant after a routine call is answered by the attendant.

1.62 Relay J1 operated:

(a) Operates relay D1.

(b) Opens the loop to the incoming selector.

(c) Completes the talking path to the attendant cord circuit.

1.63 Relay D1 operated:

(a) Returns answer supervision to switch center by application of battery on lead M.

(b) Releases relay AT.

(c) Adds a parallel path around relay E pulsing contact to prevent immediate disconnect supervision on pre-empt.

(d) Adds a holding path for relay B1.

(e) Starts the 1.1 second timed operation of relay CC (call complete).

(f) Operates relay B2 which grounds lead ALL to the traffic usage registers.

1.64 Relay JP operated (precedence call):

(a) Releases relay SP.

(b) Operates relay JP1.

(c) Completes part of talking path to cord circuit.

(d) Releases relay OP if operated.

(e) Opens operate path of J1 relay.

(f) Lights the precedence busy lamp.

1.65 Relay JP1 operated:

(a) Operates relay D1.

(b) Completes talking path to cord circuit.

(c) Disconnects the incoming selector.

1.66 Relay D1 operated:

(a) Applies battery to lead M to transmit answer supervision to switch center.

(b) Releases relay AT if operated.

(c) Releases relay AR to trip precedence audible ringing and extinguish the precedence line lamp.

(d) Adds a holding path for relay B1.

(e) Adds a parallel path around the pulsing relay E contact to prevent immediate disconnect supervision on pre-empt.

(f) Starts the 1.1 second timed operation of relay CC (call complete).

(g) Operates relay B2 which grounds lead ALL to the traffic usage registers.

1.67 Relay CC operated opens the operate path for relays OP and AR to prevent false lamp signals on disconnect.

2. DISCONNECT ON INCOMING CALLS

A. Disconnect - Called Party First

2.01 Relay D releases when station or tie trunk goes on hook. Relay D released operates relay F2. Relay F2 operated:

(a) Locks operated under control of relays F1 and OP.

(b) Starts the timed operation of relay AT.

(c) Sets the time delay operation of relay AT to about 1.2 seconds.

2.02 Relay AT operates in about 1.2 seconds. Relay AT operated:

(a) Releases relay F1.

(b) Releases relay CC.

2.03 Relay F1 released:

(a) Releases relay F2.

(b) Releases relay D1.

(c) Releases relay AT.

2.04 Relay D1 released:

(a) Removes battery from lead M to indicate disconnect to the switch center.

(b) Removes the parallel path across the relay E pulsing contact.

(c) Removes the holding ground to relay B1.

2.05 When the switch center disconnects, relay E releases. Relay E released:

(a) Removes the operate path for relay EA.

(b) Starts the 250 ms timed operation of relay PT1.

(c) Opens the loop to the incoming selector to release the switch train.

2.06 Relay PT1 operated operates relay PT.

2.07 Relay PT operated:

(a) Releases relay B1.

(b) Releases relay PT1.

(c) Releases relay EA.

(d) Starts the timed operation of relay AT (no function).

2.08 Relay B1 released:

(a) Releases relay B2.

(b) Releases relays DB and DE and sequence count relays P1-4.

(c) Opens the loop to the incoming selector.

2.09 Relay B2 released.

(a) Inserts idle line termination (resistor IL).

(b) Removes network D1 from across the pulsing relay E contact.

(c) Extinguishes the busy lamps.

2.10 Relay EA released starts the 250 ms timed operation of relay PT1. Relay PT1 operated releases relay PT.

2.11 Relay PT released releases relay PT1 and opens the operate path for relay AT.

B. Disconnect - Calling Party First

2.12 Relay E releases when the switch center disconnects. Relay E released:

(a) Removes the operating path of relay EA. Relay EA is held operated by relay PT released.

(b) Starts the timed operation of relay PT1 to determine if lead E on hook is a pre-empt signal.

(c) Removes one of the parallel paths holding the incoming selectors.

2.13 Relay PT1 operates in about 250 ms. Relay PT1 operated operates relay PT.

2.14 Relay PT operated:

(a) Releases relay PT1.

(b) Releases relay EA.

(c) Removes a holding path for relay B1.

(d) Starts the timed operation of relay AT (no function).

2.15 Relay EA released starts the 250 ms timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

2.16 Relay PT released releases relay PT1 and opens the operate path for relay AT.

2.17 Relay D releases when the called station goes on hook. Relay D released operates relay F2.

2.18 Relay F2 operated:

(a) Locks operated under control of relays F1 and OP.

(b) Starts the timed operation of relay AT.

(c) Sets the time delay operation of relay AT to about 1.2 second.

2.19 Relay AT operates in about 1.2 seconds. Relay AT operated releases relay F1.

2.20 If relay CC has released before the called party disconnects, the holding path for relay F1 is opened and relay F1 releases as soon as the D relay releases rather than after the 1.2 second timed operation of relay AT.

2.21 Relay F1 released:

(a) Releases relay F2.

(b) Releases relay D1.

(c) Releases relay AT.

2.22 Relay D1 released:

(a) Opens the loop to the incoming selector.

(b) Releases relay B1.

(c) Removes lead S ground (busy indication to selector banks for outgoing calls).

2.23 Relay B1 released releases relay B2. Relay B2 released:

(a) Extinguishes the busy lamps.

C. Disconnect by Attendant

2.24 The attendant disconnects from access line by removing cord from the jack used. Relay J or JP is first to release when cord is removed.

2.25 Relay J or JP released:

(a) Releases J1 or JP1 respectively.

(b) Opens the transmission path to the cord circuit.

(c) Releases relay D1.

2.26 The switch center releases the access circuit by an on-hook lead E which releases relay E. Relay E released:

(a) Removes the operating path for relay EA.

(b) Operates relay PT1 in about 250 ms.

2.27 Relay PT1 operated operates relay PT.

2.28 Relay PT operated:

(a) Releases relay B1.

(b) Releases relay PT1.

(c) Releases relay EA.

(d) Starts the timed operation of relay AT (no function).

2.29 Relay B1 released:

(a) Releases relay B2.

(b) Releases relays DE, DB, and the sequence count relays P1-4.

2.30 Relay B2 released:

(a) Extinguishes the busy lamps.

(b) Inserts idle line termination.

2.31 Relay EA released starts the 250 ms timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

2.32 Relay PT released releases relay PT1 and opens the operate path for relay AT.

D. Disconnect by Switch Center

2.33 Lead E on hook releases relay E on disconnect from the switch center. Relay E released:

(a) Removes the operate path of relay EA.

(b) Operates relay PT1 in about 250 ms.

(c) Operates relay C (no function).

2.34 Relay PT1 operated operates relay PT.

2.35 Relay PT operated:

(a) Releases relay PT1.

(b) Releases relay EA.

(c) Starts the timed operation of relay AT (no function).

2.36 Relay EA released starts the 250 ms timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

2.37 Relay PT released releases relay PT1 and opens the operate path for relay AT.

2.38 The talking path to the cord circuit is opened when relay CC releases. The cord circuit supervisory lamp lights when the talking path is opened to indicate disconnect.

2.39 When the attendant removes the cord from the jack used, relay J or J1 releases. The release of relay J or JP releases relays J1 or JP1 respectively. Relay D1 releases when the jack relays release.

2.40 Relay D1 released:

(a) Grounds lead M to indicate disconnect to the switch center.

(b) Releases relay B1.

2.41 Relay B1 released:

(a) Releases relay B2.

(b) Releases relays DB, DE and sequence count relays P1-4..

2.42 Relay B2 released:

(a) Extinguishes busy lamps.

3. TRANSFER TO ATTENDANT

3.01 Calls completed by the attendant can be transferred by the attendant entering the connection in the normal manner.

3.02 Calls completed direct to the station by a network-in-dial method can be transferred to the attendant by the station depressing the switchhook and then releasing the switchhook within 1.2 seconds.

3.03 Relay D releases when the station switchhook is depressed. Relay D released operates relay F2.

3.04 Relay F2 operated:

(a) Locks operated under control of relays OP and F1.

(b) Sets the timed operation of relay AT for 1.2 seconds.

3.05 Relay OP operates if the station goes off hook within 1.2 seconds. Relay OP operated:

(a) Alerts the attendant by flashing the line lamp at 120 ipm. The line lamp that flashes depends on the precedence of the call.

(b) Supplies audible ringing to the station requesting a transfer and the distant end. The audible ringing supplied depends on the precedence of the call, (i.e. normal for a routine call or precedence audible ringing for a precedence call).

(c) Releases relay F2 to prevent disconnect.

3.06 The attendant answers the call by the same procedure as an incoming call. Relay F1 operated holds the loop to the incoming selector closed.

3.07 The transmission path of the cord circuit and the incoming selector loop are coupled by capacitors RF and TF. Inductor C is used to terminate the cord circuit. The dc path through inductor C provides answer supervision for the cord circuit used.

3.08 When the station depresses the switchhook for disconnect, relay D releases.

3.09 Relay F2 operates when relay D releases.

3.10 Relay F2 starts the timed operation of relay AT. Relay AT operates in about 1.2 seconds to release relays F1 and CC.

3.11 Relay F1 released:

(a) Transfers control of relay D1 to the jack relays.

(b) Removes capacitors TF and RF and inductor C from the transmission path to the cord circuits. The cord circuit is thus connected directly to the access line.

(c) Releases the incoming selector switch train by opening the loop.

(d) Releases relay F2.

(e) Releases relay AT.

4. OUTGOING CALLS (DIAL SELECTED)

A. Dial Selected Call Seizure

4.01 Only the lowest class of precedence calls can be dial selected. The access line is seized by a ground on lead S from the selector or selector-connector bank multiple. Lead S ground operates relay TR. Relay TR operated:

(a) Transfers the leads T and R to the windings of relays A and L.

(b) Prepares a path for operating relay RV upon answer.

(c) Removes inductor A and relay D from the talking path.

4.02 Relays A and L operate over the loop from a station or tie trunk. Relay A operated places battery on lead M to seize the distant end. The switch center when ready to receive dial pulses returns dial tone.

4.03 Relay L operated operates relay B. Relay B operated:

(a) Provides a ground on lead S to hold the switch train until relay B1 operates.

(b) Operates relay B1.

(c) Operates relay B2.

(d) Prepares a path to operate relay CC on completion of call.

(e) Opens the operate paths of relays AR, AT and OP.

(f) Prepares the operate path of relay C.

4.04 Relay B1 operated:

(a) Grounds lead S for the duration of the call.

(b) Lights the routine busy lamp.

4.05 Relay B2 operated:

(a) Removes the idle line termination (resistor IL).

(b) Grounds leads S and ALL to indicate busy conditions to connecting circuits.

(c) Provides holding paths for relays PT and B2.

4.06 Relays A and L follow and repeat the dial pulse digits from the station or tie trunk. The release of relay A changes lead M to ground from battery. The breaks of the dial pulses are transmitted to the switch center as lead M grounds.

4.07 The first release of relay L in each digit operates relay C. Relay C operated remains operated over the dial pulses of each digit. Relay C operated:

(a) Removes capacitor A and resistor AA from the transmission termination.

(b) Adds capacitors C and C1 across the hybrid coils of the transmission termination.

4.08 Dial pulse transients are reduced by the operation of relay C. Diodes T and R are used to reduce the transient effect of the first break and make of each digit before relay C operates. Varistors B and B1 are used to prevent "ring-tap" of stations during dialing.

4.09 Stations equipped with TOUCH-TONE do not release relays A and L during dialing.

B. Answer of Dial Selected Calls

4.10 Ground is applied to lead E of the access line upon answer by the distant end. Relay E is operated. Relay E operated operates relay EA.

4.11 Relay EA operated:

(a) Starts the 1.1 second timed operation of relay CC (call complete).

(b) Locks operated under control of relay PT.

(c) Provides a holding path for relay B1.

4.12 Relay CC operated operates relay RV.

4.13 Relay RV operated reverses the battery and ground from the windings of relays A and L towards the station or tie trunk to return answer supervision. Resistors RV1 and RV2 are inserted by relay RV when reversing the tip and ring to prevent a momentary open of the talking path and to discharge line capacitance of the incoming circuit. This is to prevent momentary release of relays in the access line.

C. Dial Selected Disconnect (Calling Party Releases First)

4.14 When the calling party disconnects first, relays A and L release over the station or trunk loop. Relay A released grounds lead M to signal disconnect to the switch center. Relay L released operates relay C (no function) and releases relay B.

4.15 Relay B released:

(a) Releases relay C.

(b) Releases relay TR.

(c) Removes a holding ground for relay B1.

4.16 When the distant end disconnects, ground is removed from lead E. This releases relay E. Relay E released:

(a) Operates relay C (no function).

(b) Removes the operate path of relay EA.

(c) Starts the timed operation of relay PT1.

4.17 Relay PT1 operated operates relay PT.

4.18 Relay PT operated:

(a) Releases relay B1.

(b) Releases relay PT1.

(c) Releases relay EA.

(d) Starts the timed operation of relay AT.

4.19 Relay B1 released:

(a) Releases relay B2.

(b) Removes the busy indication (ground on lead S) to the selector banks.

4.20 Relay B2 released:

(a) Extinguishes the busy lamps.

(b) Inserts the idle line termination (resistor IL).

(c) Removes the ground to the traffic usage registers and the access line and jack circuit for restoring air ground and data trunks.

4.21 Relay EA released starts the 250 ms. timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

4.22 Relay PT released releases relay PT1 and opens the operate path for relay AT.

D. Dial Selected Disconnect (Called Party Releases First)

4.23 When the distant end disconnects, relay E releases. Relay E released:

(a) Removes the operate path of relay EA.

(b) Operates relay PT1 in about 250 ms.

4.24 Relay PT1 operated operates relay PT.

4.25 Relay PT operated:

(a) Releases relay PT1.

(b) Releases relay EA.

(c) Removes a holding path for relay B1.

(d) Starts the timed operation of relay AT (no function).

4.26 Relay EA released starts the 250 ms. timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

4.27 Relay PT released releases relay PT1 and opens the operate path for relay AT.

4.28 Relays A and L release when the station or tie trunk goes on hook. Relay A released grounds lead M to indicate disconnect to the switch center.

4.29 Relay L released releases relay B. Relay B released:

(a) Releases relay B1.

4.30 Relay B1 released releases relay B2. Relay B2 released:

(a) Removes ground from the traffic and busy indication leads.

(b) Extinguishes the busy lamps.

(c) Inserts the idle line termination (resistor IL).

5. OUTGOING CALLS COMPLETED BY ATTENDANT

Routine Seizure

5.01 The attendant can place an outgoing call through the access line by inserting a cord into the jack of the precedence desired.

A. Routine

5.02 Routine connections require the attendant to insert either cord (answer or calling, station or trunk) into a routine (nonprecedence) jack with a dark busy lamp. Ground is connected to the sleeve of the plug indicating a station appearance to the cord circuit.

5.03 Relay S operates over the cord circuit loop with the 551, 552, 555, 556, and 605A-type switchboards. Battery on the ring of the cord circuit operates relay S when used with 607 and 608A switchboards.

5.04 Relay S operated operates relay J. The operation of relay J in the access line is delayed by thermistor J to allow time for automatic ringing to be tripped on 607A and 608A switchboards by relay S. Ringing is tripped by relay S on the dc component of ringing to allow immediate seizure of the access line.

5.05 Relay J operated:

(a) Releases relay S.

(b) Operates relay J1.

(c) Prevents operation of relay JP1.

(d) Completes part of the talking path.

5.06 Relay J1 operated:

(a) Completes talking path to the access line.

(b) Opens the loop to the incoming selector.

(c) Operates relay D1.

(d) Changes the sleeve of the precedence jack to a trunk condition.

5.07 Relay D1 operated:

(a) Connects battery to lead M to seize the distant end.

(b) Operates relay B1.

(c) Operates relay B2.

5.08 Relay B1 operated:

(a) Lights the busy lamps.

(b) Provides a locking path for relay B2.

(c) Grounds lead S to indicate trunk is busy to outgoing dial selected calls.

5.09 Relay B2 operated:

(a) Removes the idle line termination.

(b) Grounds leads ALL and S to traffic register and connecting circuits to indicate busy.

B. Dialing Routine Calls

5.10 Insertion of a trunk or calling cord into the routine jack allows TOUCH-TONE calls to be completed using one cord.

5.11 If the switchboard is not arranged for TOUCH-TONE dialing or a station cord is inserted into the routine jack, the precedence jack is used as a dial jack.

5.12 A trunk cord of an idle pair is inserted into the precedence jack. Relay JP operates through the operated relay J contact. Relay TR operates to transfer the access line to the dial jack.

5.13 Relays A and L operate over the cord circuit loop. Relay A operated places battery on lead M to hold the switch center connection when relay D1 releases.

5.14 Relay L operated operates relay B. Relay B operated releases relay D1 and provides a holding path for relay B1. Relay D1 released transfers control of lead M to relay A.

5.15 Dialing is completed through the cord inserted in the precedence jack. TOUCH-TONE digits are transmitted without the release of relays A and L. Relays A and L follow the dial pulses of the attendants rotary dial.

5.16 Relay A releasing changes lead M to ground for each break of a digit to transmit the digits to the switch center. The first release of relay L during a digit operates relay C. Relay C operated adds capacitors C and C1 across the terminating set coils and removes capacitor A from across the terminating set to prevent dial pulse transient interference with signal circuits.

5.17 Relay D1 reoperates if the attendant removes the dialing cord before the distant end answers through relay B.

C. Distant End Answers

5.18 Relay E operates from ground on lead E when the distant end answers. Relay E operates relay EA. Relay EA operated:

(a) Provides a holding ground for relay B1.

(b) Starts the 1.1 second timed operation of relay CC (call complete).

(c) Operates relay JP1 with relay JP released.

5.19 Relay JP1 operated changes the precedence jack appearance to station class (ground on sleeve lead).

D. Precedence Call

5.20 Precedence connections require the attendant to insert either cord (answer or calling, station or trunk) into a precedence jack with a dark busy lamp. Ground on the sleeve of the plug indicates a station appearance to the cord circuit.

5.21 Relay SP operates over the cord circuit loop with the 551, 552, 555, 556 and 605A-type switchboards. Battery on the ring of the cord circuit operates relay SP when used with 607 and 608A switchboards.

5.22 Relay SP operated operates relay JP. Relay JP operates through thermistor JP when used with 607A and 608A switchboards to allow sufficient time delay for tripping the automatic ringing furnished by these switchboards.

5.23 Relay JP operated:

(a) Releases relay SP.

(b) Operates relay JP1.

(c) Prevents operation of relay J1.

(d) Completes part of the precedence talking path.

5.24 Relay JP1 operated:

(a) Completes talking path to the access line from the precedence jack.

(b) Opens the loop to the incoming selector.

(c) Operates relay PE.

(d) Changes the sleeve condition of routine jack from station to trunk class.

5.25 Relay PE operates relay PT1. Relay PT1 operates to insure the access line goes on hook before reseizure of the switch center during pre-empt. Relay PT1 operated operates relay PR.

5.26 Relay PR operated closes the operate path of relay D1 and releases relay PE. Relay D1 operated:

(a) Connects battery to lead M to seize the distant end.

(b) Operates relays B1 and B2.

5.27 Relay B1 operated:

(a) Lights the busy lamps.

(b) Provides a locking path for relay B2.

(c) Grounds lead S to indicate access line is busy to outgoing dial selected calls.

5.29 Relay B2 operated:

(a) Removes the idle line termination.

(b) Grounds leads ALL and S to traffic register and connecting cirucits to indicate busy.

E. Dialing Precedence Calls

5.30 Insertion of a trunk or calling cord into precedence jack allows TOUCH-TONE calls to be completed using one cord.

5.31 If the switchboard is not arranged for TOUCH-TONE dialing or if a station cord is inserted into the precedence jack, the routine jack is used as a dial jack.

5.32 A trunk or calling cord of an idle pair is inserted into the routine jack. Relay J operates through the operated relay JP contact. Relay TR operates to transfer the access line to the dial jack.

5.33 Relays A and L operate over the cord circuit loop. Relays A and L operate and perform the same functions as described for a routine call. Relays E and EA operate when the distant end answers.

6. PRE-EMPTION

A. Pre-emption by Switch Center

6.01 A pre-empt signal is a nominal 345 millisecond on-hook signal from the switch center. The on-hook signal is timed to verify that it exceeds the minimum 250 ms pre-empt time but does not exceed 500 ms. The access line may be pre-empted at any time by the switch center. Relay E releases during the on-hook signal from the switch center. Relay E released:

(a) Removes the operating ground of relay EA.

(b) Starts the timed operation of relay PT1.

6.02 Relay PT1 operates in about 250 milliseconds (minimum on-hook pre-empt) after relay E releases. Relay PT1 operated operates relay PT.

6.03 Relay PT operated:

(a) Remains operated until the trunk is idle.

(b) Starts the timed operation of relay AT.

(c) Opens a part of the parallel combination of relays AT, PE and PT in the tip and ring conductors.

(d) Prepares an operate path for relay PR when relay B2 releases.

(e) Releases relay EA.

6.04 After the on-hook wink signal from the switch center, relay E reoperates. Relay E operated operates relay EA. Relays EA and PT operated prevent the reoperation of relay PT1. This verifies that the E lead on-hook signal is not a disconnect signal.

6.05 Relay AT operates in about 3 seconds to complete the opening of the tip and ring conductors. Relay AT remains operated under control of relay PT.

6.06 If the call to be pre-empted is a network-in-dialed call, the opening of the tip and ring conductors releases the incoming selector switch train and releases relay D in the access line. Relay D releases relay F1 which releases relay D1. Relay D1 released sends disconnect to the switch center.

6.07 If the call to be pre-empted is a network-out-dialed call (station or tie trunk originated), the opening of the tip and ring conductors releases relays A and L in the access line if the originating party is off hook. Relay A released sends disconnect to the switch center. Relay L releases slow-release relay B.

6.08 If the originating station or tie trunk is off hook, operated relays AT and B operate relay RL1. Relay RL1 operated:

(a) Remains operated until originating party goes on hook.

(b) Grounds lead S to the selector bank multiple. Relay RL1 operated marks the trunk busy to outgoing calls but allows incoming and attendant placed calls to be completed.

(c) Disconnects the transmission path of the access line and the selector bank multiple.

(d) Operates relay RL2.

6.09 Relay RL2 operated opens the operate path of relay TR to prevent the relay RL1 ground from seizing the access line. When the station or tie trunk goes on hook, relay RL1 releases.

6.10 Relay RL1 released:

(a) Releases slow release relay RL2.

(b) Reconnects the path from the selector banks to the access line.

6.11 The slow release of relay RL2 holds lead S open after relay RL1 releases to wink the outgoing switch train released. Ground is held on lead S until the station or trunk goes on hook to prevent faulty release of the outgoing switch train.

6.12 If the call to be pre-empted is an attendant completed or originated connection, relays AT and PT operated release relay J1 or JP1. Relays J1 or JP1 released:

(a) Release relay D1 to send disconnect to the switch center.

(b) Open the tip and ring conductors to the cord circuit to indicate disconnect to the attendant.

6.13 Relay PT operated and relays D1 and B released release relay B1. Relay B1 released releases relay B2. The release of relay B2 allows an incoming precedence call to be completed.

6.14 Relay B2 released releases relay PT if the call pre-empted did not require attendant assistance. Relay PT remains operated until the attendant removes the cord from the jack circuit through relay J and JP contacts if the call is pre-empted for nonreuse.

6.15 Relay PR operates if the access line is pre-empted for reuse (incoming call of higher precedence). Relay PR operated:

(a) Locks operated under control of relay EA.

(b) Removes the operate path of relay J1.

(c) Releases relay PT if relay E is operated (off portion of repeated priority signal on lead E) and relay J operated. This allows incoming precedence calls to be completed before the attendant removes the cord from the routine jack.

6.16 Relay JP operated (attendant cord in precedence jack) prevents the completion of an incoming precedence call. Relay PT is held operated by relay JP.

6.17 When relay PT releases and relay EA is operated, relay B1 operates. Relay B1 operated:

(a) Operates relay AR to send precedence audible ringing to the switch center

(b) Operates relay WK to send wink on lead M to indicate to the switch center that the access line is ready to receive dial pulses (access line arranged for PNID).

6.18 The completion of the call is as described in the section covering incoming precedence calls.

B. Pre-emption by Attendant

6.19 The attendant can pre-empt a routine call by inserting a cord into the precedence jack when the precedence busy lamp is dark. Relay SP operates when the attendant inserts a cord into the precedence jack. Relay SP operates relay JP. Relay JP operated operates relay JP1 and releases relay SP.

6.20 Relay JP and JP1 operated operate relay PE. Relay PE operated:

(a) Supplies pre-empt tone to the calling and called parties to indicate pre-emption of the call.

(b) Starts the timed operation of relay AT.

(c) Provides a holding path for relay JP1 when relay AT operates.

(d) Opens the operate path of relay TR.

6.21 Relay AT operated:

(a) Opens the tip and ring conductors to release relays A and L (dial selected network-out-dialed call).

(b) Opens the tip and ring conductors to release relay D and the incoming selector (network-in-dialed call to station or tie trunk). Relay D released releases relay F1. Relay F1 released releases relay D1 which sends disconnect to the switch center.

(c) Relay J1 releases if a cord is in the routine jack. Relay J1 releases relay D1. Relay D1 released sends disconnect to the switch center.

6.22 Pre-empt tone is supplied to the distant end for 3 seconds. Relay E releases on the disconnect signal from the switch center. Relay E released:

(a) Removes the operate path of relay EA.

(b) Starts the timed operation of relay PT1.

6.23 Relay PT1 operates in about 250 ms. Relay PT1 operated operates relay PT.

6.24 Relay PT operated:

(a) Releases relay B1.

(b) Releases relay PT1.

(c) Releases relay EA.

6.25 Relay EA released starts the 250 ms. timed operation of relay PT1. Relay PT1 operated releases relays PT and CC.

6.26 Relay PT released releases relay PT1.

6.27 Relay B1 released releases relay B2.

6.28 Relay B2 released operates relay PR.

6.29 Relay PR operated:

(a) Marks the access line as precedence busy.

(b) Releases relay PE if the routine jack is idle.

(c) Opens the operate path of relay J1.

(d) Prepares a path to operate relay D1 via a contact of relay JP1.

6.30 Relay J must be released (attendant cord removed from routine jack) before the switch center is seized for another call. Relay J operated holds relay PE operated which prevents the operation of relay TR.

6.31 Relay D1 operates when the access line is idle. Relay D1 seizes the switch center. The switch center returns dial tone when ready to receive the digits. The call is completed by the same procedure as the precedence outgoing call described in another section.

7. PAD CONTROL

7.01 A 2 db transmission pad is normally in the access line transmission circuit. The pad is comprised of the 185-ohm resistor AA in series with the capacitor in the transmission termination and the 3480-ohm resistor A and capacitor A bridged across the tip and ring. Relay PO (pad out) removes the pad by removing resistor A and capacitor A from across the tip and ring and shunting resistor AA.

A. Incoming Tandem Dial Connection

7.02 An incoming call that is terminated through another trunk requires pad removal. The off-normal post springs of the incoming selector used with the access line are adjusted to place a resistance ground on lead O for levels requiring pad removal. Relays DVT and TPC are connected in series but resistance ground operates only relay TPC.

7.03 Relay TPC operated operates relay PO. Relay PO operated:

(a) Shunts resistor AA.

(b) Removes resistor A and capacitor A from across the tip and ring.

(c) Locks operated via relay B2.

7.04 Relay TPC and DVT both operate if lead O is connected directly to ground. Relay DVT operated operates relay OP to transfer the call to the attendant. Relay OP operated prevents the operation of relay PO in this case.

B. An Outgoing Tandem Dial Connection

7.05 An outgoing call that is originated by another trunk removes the 2 db transmission pad by the operation of relay TSP. Relay TSP operates whenever an outgoing dial-selected call originates from selector-bank levels that require pad removal. Relay TSP operated operates relay PO. Relay PO operated removes the transmission pad.

C. Attendant Completed

7.06 For an attendant completed call that is tandem connected (trunk-to-trunk), the attendant depresses the nonlocking push button associated with the access line for pad removal.

7.07 The push button (nonlocking) depressed operates relay PO.

7.08 Relay PO operated:

(a) Shunts resistor AA

(b) Removes resistor A and capacitor A from across the tip and ring.

(c) Locks operated via relay B2.

8. EXCHANGE OF BUSY CONDITIONS

8.01 The access line and jack circuit for restoring air ground and data trunks requires an exchange of busy conditions with the PBX access line.

8.02 Ground is applied to lead S whenever the access line is busy and remains until the access line is idle. This is used to indicate routine busy to the connecting circuit.

8.03 Ground is applied to lead PY to indicate a priority busy condition. The access line and jack circuit can preempt a routine call to use the transmission facilities normally used with the PBX access line.

8.04 Whenever a PBX access line's transmission facilities are used with the access line and jack circuit for restoring air ground and data trunks, a ground is applied on lead P to the PBX access line to mark the line precedence busy. Ground on lead P operates relay B1. Relay B1 operated:

(a) Grounds lead S to the selector bank to mark access line busy for dial-selected outgoing calls.

(b) Operates relay C to remove the operate path for relay AT.

(c) Lights the routine and precedence busy lamps.

8.05 When ground is removed from lead P, relay B1 releases. Relay B1 released:

(a) Releases relay C.

(b) Extinguishes the busy lamps.

(c) Removes lead S ground from the selector banks.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Station pulsing and supervision maximum conductor loop resistance, 1,500 ohms. Minimum insulation resistance, 15,000 ohms.

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the relays of the access line circuit are listed below:

Designation	Meaning
A	Pulse Transmit
AR	Audible Ringing
AT	Attendant Transfer
B	Busy
B1	Busy Auxiliary
B2	Busy Auxiliary
C	Pulse Control
CC	Call Complete
D	Historical
DB	Digit Begin
DE	Digit End
DVT	Divert to Attendant
D1	D Slave
E	Receive
EA	Receive Auxiliary
F1	Flash 1
F2	Flash 2
J	Jack
J1	Jack Auxiliary
JP	Jack Precedence
JP1	Jack Precedence Auxiliary
L	Pulse
OP	Operator
P1	Pulse Count 1
P2	Pulse Count 2
P3	Pulse Count 3
P4	Pulse Count 4
PE	Pre-empt
PO	Pad Out
PR	Precedence
PT	Precedence Timing Auxiliary
PT1	Precedence Timing
RL1	Release
RL2	Release Auxiliary
RV	Reverse
S	Ring Trip
SP	Ring Trip Precedence
TPC	Transmission Pad Control
TR	Transfer
TSP	Transmission Pad
WK	Wink

3. FUNCTIONS

A. Outgoing Calls Dial Selected from Stations or Tie Trunks or Completed by Attendant

3.01 To light routine busy light if call is dial selected.

3.02 To signal the switch center on seizure.

3.03 To give a disconnect signal to the switch center when the PBX station disconnects.

3.04 To hold the PBX access line busy when the PBX station disconnects until the switch center end of the access line is released.

3.05 To reverse battery upon answer by the distant end to give answer supervision to connecting circuits.

3.06 To disconnect the incoming selector.

3.07 To repeat dial pulses to the signaling circuit.

3.08 To furnish transmitter battery to the calling station.

3.09 To furnish a talking path.

3.10 To remove the idle line termination when the circuit is seized.

3.11 To provide E & M lead signaling.

3.12 To connect to a 24 V-4 terminal repeater.

3.13 To provide pad control at tandem locations.

3.14 To short the repeating coil hybrid during dialing.

3.15 To allow pre-emption at any time by the distant end.

3.16 To allow the attendant to pre-empt a routine call.

3.17 To light the precedence busy lamp when a cord plug is in the precedence jack.

3.18 To make the trunk busy on the selector banks.

3.19 To provide pre-empt tone to the calling and called party during pre-empt.

3.20 To hold the outgoing switch train until calling party is on hook.

B. Incoming Calls

3.21 To ground the sleeve of the selector multiple.

3.22 To light the busy lamps (routine and precedence) until call is answered.

3.23 To light the routine and precedence busy lamps during precendence calls.

3.24 To seize the incoming selector.

3.25 To repeat the dial pulses from the signaling circuit of the distant end to the incoming selector.

3.26 To provide precedence audible ringing to the distant end until answer.

3.27 To provide routing to the attendant of a precedence call to a busy station or a precedence call unanswered by a station.

3.28 To transmit answer supervision to distant end.

3.29 To provide switchhook transfer to attendant.

3.30 To provide pad removal on calls to certain levels.

3.31 To absorb digits for directory numbers.

3.32 To light a line lamp steady for attendant and directory number calls.

3.33 To light a line lamp at 60 ipm for don't answer transfer to attendant.

3.34 To light a line lamp at 120 ipm for switchhook transfer to attendant.

3.35 To allow pre-emption by distant end at any time.

3.36 To release the incoming selector when attendant inserts cord.

3.37 To extinguish a line lamp when the attendant inserts a cord.

C. Other Functions

3.38 To provide an exchange of busy conditions with the access line and jack circuit for restoring air-ground and data trunks.

3.3 To provide a message register ground for all calls.

3.40 To provide an additional message register ground for all incoming calls.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key-sheet, the connecting information thereon is to be followed.

4.02 First Selector Circuit - SD-66359-01*.

4.03 Selector Connector Circuit - SD-65721-01*.

4.04 Incoming Selector - SD-65950-01*.

4.05 Incoming Connector - SD-66049-01*.

4.06 Traffic Register Circuit - SD-65774-01*.

4.07 24 V-4 Telephone Repeater Circuit - SD-97047-01.

4.08 DX Signaling Circuit - SD-95487-01.

4.09 E3B Signaling Circuit 2400 or 2600 Cycle. E and M Lead Supervision - SD-98124-02.

4.10 556 Cord, Telephone Dial, Buzzer, Ringing, and Battery Circuit - SD-65658-01*.

4.11 Cord Circuits 607A - SD-66707-01*, 607B - SD-65670-01*.

4.12 Access Line and Jack Circuit for Restoring Air-Ground and Data Trunks - SD-1G207-01.

4.13 Power Supply Circuit - SD-81337-01*.

* Typical

5. MANUFACTURING TESTING INFORMATION

5.01 The PBX access line circuit shall be capable of performing all the service functions specified in this circuit description and meeting all the requirements of the Circuit Requirements Table.

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