

CIRCUIT DESCRIPTION

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9

ELECTRONIC SWITCHING SYSTEMS

NO. 3

CUSTOMER DIAL PULSE RECEIVER  
AND REGULAR RINGING  
CIRCUIT

CHANGES

D. Description of Changes

- D.1 Changed Circuit Note 101.
- D.2 Changed Equipment Note 204.
- D.3 Corrected drawing errors.
- D.4 Added CAD1 unit symbol.

BELL TELEPHONE LABORATORIES, INCORPORATED

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CUSTOMER DIAL PULSE RECEIVER  
 AND REGULAR RINGING  
 CIRCUIT

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<u>1. PURPOSE OF CIRCUIT</u> . . . . .	1	1.01 The principle purpose of this unit is to provide the following:
<u>2. GENERAL DESCRIPTION OF OPERATION</u> . . . . .	1	(a) Four customer dial pulse receivers (CDPRs), each of which is capable of receiving dial pulses generated by the dials of customer subsets or PBXs, and passing the information on to the processor via the scanner circuit.
<u>SECTION II - DETAILED DESCRIPTION</u> . . . . .	2	(b) Three regular ring (RR) circuits each of which is capable of providing ringing for single-party, 2-party, PBX, coin, 8-party coded, 2-party revertive, 4-party semiselective revertive, and 8-party coded revertive lines from a continuous ringing supply with processor controlled interruptions on a per-circuit basis.
<u>1. GENERAL DESCRIPTION</u> . . . . .	2	<u>2. GENERAL DESCRIPTION OF OPERATION</u>
<u>2. DETAILED DESCRIPTION</u> . . . . .	2	2.01 A CDPR is connected to a customer line upon recognition of an origination by the processor. Dial tone is then provided to the customer as a start-dialing signal. Dial pulses are detected by an electronic detector circuit and passed to the processor via a scan point.
<u>3. OPERATIONS PRIVATE: 4- OR 8-PARTY LINE</u> . . . . .	2	2.02 The processor will select a regular ringing circuit to ring the called customer line. Using a continuous-ringing supply, this circuit will send ringing bursts to the customer via a processor-controlled relay. The control of the ringing cycle at the circuit allows for immediate ringing to the customer, and program-controllable coded ringing from the same circuit.
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SECTION II - DETAILED DESCRIPTION

CUSTOMER DIAL PULSE RECEIVER CIRCUIT

1. GENERAL DESCRIPTION

1.01 When a customer goes off-hook, the line attending scan point is activated by the flow of current in the customer loop. The processor will recognize this as a request to place a call. The processor then locates and connects an idle customer dial pulse receiver to the line via a network path. Dial tone is then returned to the customer as a start dialing signal.

1.02 After the first pulse of the first digit has been received, dial tone is removed. As the dial pulses are being sent, the dial-pulse detector will collect these pulses and pass them on to the processor via a scan point. The processor will determine which digit is being dialed by counting the number of times the scan point is operated and released (ie, the presence or absence of a pulse).

1.03 Upon completion of dialing, the CDPR is returned to the idle (or toll diversion) state and is disconnected from the customer line. The customer is then connected via a network path, to the called customer as determined by the dialed digits.

1.04 If the calling party is a 2-party line, a 2-party test is performed on the line before dial tone is returned, and repeated after all digits are received to determine the calling party.

1.05 If the calling party is a dial-tone-first coin line, a coin-in-the-slot test is performed for charge calls after all digits are collected.

1.06 A toll-diversion signal is returned to a PBX, when required, by placing a battery and ground reversal on the tip and ring.

2. DETAILED DESCRIPTION

CONTROL OF CIRCUIT

2.01 The CDPR has two state relays, A and B, which are controlled by the distributor circuit. Relays A and B provide the states necessary to process a particular call. The processor determines the state required, and via the peripheral decoder circuit, operates the appropriate relay.

2.02 The relays driven by -48 volts have a 1000-ohm resistor with one of its break contacts in parallel with it, in series with the coil, to initially provide rapid operate. This arrangement also limits the maximum current through the

distribute point when the relay is operated. To limit the transient-voltage spike when the relay is released and to dissipate the relay-coil energy when released, a diode is connected from the distribute point to -48 volts. The anode of the diode is connected to -48 volts.

2.03 A pictorial representation of the CDPR states is shown in Table A.

TABLE A  
CDPR STATE TABLE

A			
00	01	11	10
Idle/Toll Diversion	2-Party Coin Test	Receive Digits	Dial Tone
B			

2.04 When the CDPR is in the idle- or toll-diversion state, all relays are released, the dial pulse detector (DPD) power is removed, and battery and ground is provided on the tip and ring, respectively (reverse battery condition). Operating only the A relay powers up the DP detector and provides a 2-party or coin test. Operating the B relay powers up the DP detector to receive digits and provides dial tone. Operating both relays A and B powers up the DP detector to receive digits and no dial tone is provided.

SEQUENCES OF OPERATION

2.05 The following are typical state sequences of operation for this circuit. See BSP 233-151-105 for more details.

Line	State Sequence *
Private, 4- or 8-party	00,10,[11,***,11],00
2-party, coin	00,01,10,[11,***,11],01,00

2.06 The normal return to the idle state may be bypassed during extremely heavy traffic.

3. OPERATIONS PRIVATE: 4- OR 8-PARTY LINE

3.01 A customer originating a call goes off-hook and the scan point associated with that line will be energized by the loop current. The processor, recognizing the off-hook as a request for service, will locate an idle CDPR.

3.02 The CDPR is placed in the receive-digits state (Relays A and B operated) to power up the dial-pulse

\* [ ] Receive digits

detector. The processor then connects the CDPR to the customer line via a network path through a bypassed junctor. With relays A and B operated, a direct current should flow from ground through resistor R21 (matches resistor R25 to provide longitudinal balance for the tip-ring), one winding of the dial-tone transformer T1, 3M contact of relay B, the customer tip to ring loop, 1M contact of relay B, another winding of T1, 2M contact of relay B, and resistor R25 to -48 volts, the current in the tip to ring loop should exceed 6 mA. When a minimum of 6 mA flows in the tip-to-ring loop, the dial-pulse detector will operate the dial-pulse scan point, SC0. When SC0 operates, dc continuity between the customer and the CDPR exists.

3.03 The A relay is now released to place the CDPR in the dial-tone state. Dial-tone is provided to the customer via transformer, T1, 3M, and 1M contacts of relay B, and the customer line. The presence of dial-tone is interpreted by the customer as a start-dialing signal.

3.04 As the customer dials, a contact in the dial will interrupt the tip-to-ring direct current. This opening and closing of the dial contact (the interrupting of the tip-to-ring direct current) will be detected by the dial-pulse detector, and translated into an operate or release pulse, at the dial-pulse scan point, SC0.

3.05 After the first pulse is received, the processor operates the A relay to remove dial tone and to place the CDPR in the receive-digits state, until the completion of dialing.

3.06 The processor will scan the DP scan point, SC0 every 10 ms to receive the dial pulses. One operate and release of SC0 is read as a dial pulse. By counting the number of times SC0 operates and releases with respect to time, (the interdigit time is much greater than the intradigit-pulse time), the digits dialed can be interpreted.

3.07 When all digits are received, the CDPR is idled and the calling customer is connected via a network path to the called customer as determined by the dialed digits.

3.08 To recognize dial pulses on a tip-and-ring with high 60-cycle ac noise, the dial-pulse detector circuit is designed with high (18db) 60-cycle noise rejection capability.

#### 4. OPERATION: 2-PARTY LINES

4.01 When one customer of a 2-party line is placing a call, that customer must be identified for billing purposes. To determine which party is placing the call, the tip-party station will always provide a

tip ground when off-hook. The CDPR will look for the presence or absence of this ground via the DP detector circuit to identify which customer is placing the call, the tip or ring party, respectively.

4.02 The CDPR is then placed in the dial-tone state and the call is processed as if it were from a private line, until the completion of dialing when the 2-party test is repeated.

#### 5. CUSTOMER DIAL PULSE RECEIVER

##### OPERATION: COIN LINES

5.01 When a coin-line customer is placing a call, a coin-in-the-slot test is performed. The coin phone will return resistive ground on the tip when a coin is inserted in the phone. The call will be processed as a 2-party line looking for the tip-ground condition. (If the coin line is ground start, origination is not initiated until a coin is inserted.) The CDPR will limit the tip current to 20 mA (requirement of the dial-tone-first coin phones) when performing the 2-party or coin test.

5.02 The CDPR is then placed in the dial-tone state and the call is processed as if it were from a private line.

5.03 After all digits are received a coin-in-the-slot test is performed unless the call is free (no change, usually an emergency).

##### OPERATION: TOLL DIVERSION

5.04 When the CDPR is connected to a PBX line requiring a tip-ring battery reversal at the end of dialing, the CDPR will return battery and ground reversal on tip and ring, respectively, when the circuit is returned to the idle- or toll-diversion state after all digits are received.

#### 6. REGULAR RINGING CIRCUIT

##### GENERAL DESCRIPTION

6.01 When a customer line is to be rung, the processor will locate and connect an idle regular ringing circuit to the line via a network path. The regular ringing circuit is placed in the pre-trip test (tip or ring) state, and the line is tested for either tip or ring low resistance to ground, or a low-bridging resistance tip-to-ring. The pre-trip test is performed to determine that the customer is not off-hook. Any attempt to ring the line could result in an immediate answer and false charging could occur.

6.02 After passing the pre-trip test, ringing of the proper code (under processor control) is applied to the line. To verify that the customer line is being rung, the

TABLE B  
RR STATE TABLE

		A	
000	Pre-Trip Test (Ring)	010	Pre-Trip Test (Ring)
011	NU	001	NU
100	Silent Interval (Ring the Ring)	110	Silent Interval (Ring the Tip)
111	Ringing Interval (Ring the Tip)	101	Ringing Interval (Ring the Ring)

ringing current to the line is monitored. A failure of the ac-ringing continuity will be detected by a scan point not saturating and a second attempt to ring the line with another regular ringing circuit will be made. If a second ac-ringing continuity failure occurs, the line will be rung as if no failure had occurred.

6.03 Upon customer answer, ringing is autonomously tripped by an electronic trip detector circuit to avoid ringing the customer in the ear, and a scan point is operated to inform the processor of customer answer. The processor will then idle the regular ringing circuit, and complete the talking path to the called customer.

CONTROL OF CIRCUIT

6.04 The regular ringing circuit (RR) has three state relays, A, B, and C which are controlled by the distributor circuit. Relays A, B, and C provide the states necessary to process a particular call. The processor determines the state required and via the peripheral decoder circuit, operates the appropriate relay(s).

6.05 The relays, driven by -48 volts, have a 1000-ohm resistor, with one of its break contacts in parallel with it, in series with the coil to initially provide rapid operate. This arrangement also limits the maximum current through the distribute point when the relay is operated. To limit the transient-voltage spike when the relay is released, and to dissipate the relay-coil energy when released, a diode is connected from the distribute point to -48 volts. The anode of the diode is connected to -48 volts.

6.06 A pictorial representation of the RR states is shown in Table B. When the RR is in the idle- or pre-trip test (ring), all relays are released, scan point 0 (SC0) is connected to the tip and ring sending battery on ring, ground on tip. Operating the B relay only reverses the tip and ring. Operating the C relay only applies silent-interval state trip battery.

Operating the A and C relays applies ringing-interval state ringing potential.

SEQUENCES OF OPERATION

6.07 The following are typical state sequences of operation of the circuit. See BSP 233-151-105 for more details.

Line	State Sequence*
Individual, Ring-Side Party Lines	Idle, 000, [ 101, 100 ], [ 101, 100, ]***Ring Trip, 000
Tip-Side Party Lines	Idle, 010, [ 111, 110 ], [ 111, 110, ]***Ring Trip, 000
Ground Start Lines	Idle, 010, 000, [ 101, 100 ], [ 101, 100, ]*****Ring Trip, 000

OPERATION: PRIVATE AND RING PARTY LINES

6.08 After a calling customer has dialed the called customer number, the processor will identify the called line, and locate and connect an idle regular ringing (RR) circuit to it via a network path through a bypassed junctor. Before ringing the line, a pre-trip test (ring) is performed. The line is tested for low resistance to ground (fault) or tip to ring (customer off-hook). Scan point 0 (SC0) will operate on a pre-trip failure.

6.09 After passing the pre-trip test the customer line can be rung. Relays A and C are operated to provide ringing interval (ring the ring). SC0 will now indicate customer answer. Ringing potential is provided to the circuit from a continuous-ringing supply. Relay A in the RR circuit will provide ringing interruptions. By providing the ringing interruptions at the circuit, immediate ringing can be applied and the various

\* [ ] Ringing interval

ringing codes can be generated using the same RR circuit. The ringing current (when ringing a private line) is provided through the 2B contact of relay RT, 3M contact of relay A, resistor R25, 1M contact of relay A, primary winding of relay RT, 5B contact of relay B, ring lead, customer loop (ringer), tip lead, 3B contact of relay B, 3M contact of relay C, repeat coil L to ground.

6.10 To verify that the line is being rung, the ringing current is monitored by an ac-continuity detector, RD. Relay RD is a two winding, magnetic latching mercury relay. The secondary winding is back biased by the voltage divider, resistors R19, R20, and the coil resistance from -48 volts. The secondary winding is biased, such that when the ringing current which flows through the primary drives a 40 KOHM or less impedance, the relay will operate. When ringing continuity exists, relay RD will operate. The RD contact will operate relay S and contact 6M of relay S will operate SC1, indicating ringing continuity. The 1M contact of relay S will short out the primary winding of relay RD to prevent the relay from being released when ringing current reverses (next 1/2 cycle of 20 Hz). Protection diode CR4 across the primary of relay RD will limit the maximum current through the winding. Relay RD will remain latched for the remainder of the ringing burst. When silent interval occurs, the 6B contact of relay A will release relay RD for the next ringing interval.

6.11 To detect customer answer, an electronic-trip detector filters out the 20-Hz ringing and looks for a dc-voltage drop across resistor R25. When the line is being rung, no direct current will be flowing, and the trip detector (TD) will be biased off by the dc-superimposing battery of the ringing potential or the silent-interval trip battery (which are the same). When the customer answers, dc current will flow and a voltage will be developed across resistor R25. The TD will sense this voltage and trip ringing by operating relay RT. When relay RT operates, ringing is removed from the line and SC0 operates, indicating customer answer.

6.12 To prevent reringing the line, should the customer answer and hang up before the processor idles the RR circuit, and/or if the processor fails and the customer answers and hangs up (talking path would not be completed), the trip detector is locked operated by a dc-holding current. This current flows from trip battery through the 3B contact of relay A (if answer occurred during silent interval, or 2M contact of relay RT and the 3M contact of relay A if answer occurred during ringing interval), resistor R25, 1B contact of relay A (if answer occurred during

silent interval, or 1M contact of relay A if answer occurred during ringing interval), 3M contact of relay RT, resistor R18, repeat coil L to ground. The locking path can only be released by the idling of the circuit.

6.13 Repeat coil L provides a low impedance for 20-Hz ringing but protects the circuit against lightning strikes, and with network Z1, reduces the transient-voltage spikes which occur when ringing is tripped.

## 7. REGULAR RINGING CIRCUIT

### OPERATION: TIP-PARTY LINES

7.01 Ringing tip party lines is the same as ringing private and ring-party lines, except that relay B is operated and the tip-and-ring is reversed.

### OPERATION: GROUND - START LINES

7.02 Ringing ground start lines is the same as ringing private and ring-party lines, except that a pre-trip test (tip) is performed instead of a pre-trip test (ring).

## 8. REGULAR RINGING CIRCUIT

### OPERATION: ABANDONMENTS

8.01 If the calling customer abandons the call before the called customer answers, the processor idles the RP circuit. When the RR idles, ground and -48 volts are applied to the tip and ring, respectively, to change the line charge (ringing potential applies a high charge to line capacity) to a lower level, which is less likely to cause current flow when the line ferrod is restored. The RR circuit is then removed from the line, and the line ferrod is restored.

## SECTION III - REFERENCE DATA

### 1. WORKING LIMITS

#### CUSTOMER DIAL PULSE RECEIVER (See Table C) REGULAR RINGING CIRCUIT

Voltage Range	-42.75 volts to -52.5 volts
Insulation Resistance	10,000
Earth Potential	+3 volts
Tripping Range	3,000 ohms external loop
Ringing Ranges:	See BSP 500-114-100

TABLE C  
LINE AND TRUNKS

REQUIREMENTS	DIALING			
	7.5-12 PPS DIALS		7.5-21 PPS DIALS	
	CUSTOMER LOOPS INCL COIN AND 2-PARTY	PBX EXT LINES	PBX ATT LINES	2-PARTY OR COIN TEST (NOTE B)
Circuit Voltage Limits	53.5-55.5 V	53.5-55.5 V	53.5-55.5 V	53.5-55.5 V
Max Ext Ckt Loop Res	2000 ohms	2000 ohms	1650 ohms	2700 ohms
Max Line or Trk Conductor Res	1800 ohms	1800 ohms	1550 ohms	2500 ohms
Min Ins Res	10,000 ohms	10,000 ohms	15,000 ohms	15,000 ohms
Allowable Rated Bridged Capacity at Subsets	2.2 UF (Note A)	-	-	-
Allowable Capacity to Grd or Either Side of Line	2.5 UF	-	-	-
Max Earth Potential	+3V	-	-	+3V
Max 60-Hz Longitudinal Voltage (Note C)	50V RMS	50V RMS	25V RMS (Note D)	35V RMS

- Note A.** Allowable bridge capacity for side tone coin collector with antiside tone subset is 3 UF.
- B.** The maximum allowable resistance of the ringer in the tip-party subset or coin-telephone test ground is 4000 ohms. Coin-telephone test ground must have a minimum of 981 ohms to limit test current to 20 mA.
- C.** Longitudinal voltages are to be measured in the following manner: The tip and ring leads at the central office are connected together and grounded through a 500-ohm resistor. The RMS voltage measured across the 500-ohm resistor is defined as the longitudinal voltage.
- D.** This only applies to the 6F-and 6G-type operator dials (percent break varies from 62- to 66-percent). The 2-, 4-, and 5-type operation dials (percent break varies from 62- to 70-percent), which are rated Mfr Disc., may cause dialing errors with longitudinal voltages as low as 12-volts RMS.

**2. FUNCTIONAL DESIGNATIONS**

**CUSTOMER DIAL PULSE RECEIVER**

**2.01 Associated Scanner Ferrrods**

Designation	Meaning
SC0	Dial Pulse

**REGULAR RING CIRCUIT**

**2.02 Associated Ferrrods**

Designation	Meaning
SC0	Pre-Trip Test, Ring Trip
SC1	AC-Ringing Continuity

**2.03 Circuit States**

**CUSTOMER DIAL PULSE RECEIVER  
REGULAR RINGING CIRCUIT**

Designation	Meaning
NU	Not Used

**2.04 Relays**

**CUSTOMER DIAL PULSE RECEIVER**

Designation	Meaning
A, B	These relays are alphabetically designated for program reference

REGULAR RINGING CIRCUIT

Designation    Meaning

A,B,C            These relays are  
                  alphabetically designated  
                  for program reference

3. FUNCTIONS

CUSTOMER DIAL PULSE RECEIVER

3.01 Performs a tip party test for 2-party customers.

3.02 Performs a coin-in-the-slot test for coin lines.

3.03 Provides dial tone to customers for a start dial signal.

3.04 Receives dial pulses from customer subsets or PEXs.

3.05 Provides battery and ground reversal on tip and ring for toll-diversion signal.

REGULAR RINGING CIRCUIT

3.06 Performs a pre-trip test for the line condition.

3.07 Performs an ac-ringing continuity check to determine that the line is being rung.

3.08 Provides ringing potential with the various ringing codes to alert the customer of a call.

3.09 Autonomously trips ringing to prevent ringing the customer in the ear and prevents reringing the customer line if the processor fails.

4. CONNECTING CIRCUITS

CUSTOMER DIAL PULSE RECEIVER

4.01 When this circuit is listed on a keysheet, the connecting information thereon should be followed.

- (a) Master Scanner Circuit - SD-3H140-01.
- (b) Distribute            Point            Circuit -  
                  SD-3H150-01.
- (c) Junctor and Junctor Control Circuit -  
                  SD-3H200-01.
- (d) 881A Ringing and Tone Plant Circuit -  
                  SD-82255-01.
- (e) Touch-Tone Calling Detector Circuit -  
                  SD-3H401-01.

REGULAR RINGING CIRCUIT

- (f) Master Scanner Circuit - SD-3H140-01.
- (g) Distribute            Point            Circuit -  
                  SD-3H150-01.
- (h) Junctor and Junctor Control Circuit -  
                  SD-3H200-01.
- (i) 881A Ringing and Tone Plant Circuit -  
                  SD-82255-01.

5. MANUFACTURING TESTING REQUIREMENTS

CUSTOMER DIAL PULSE RECEIVER

REGULAR RINGING CIRCUIT

Intermediate Requirements

5.01 Before circuit packs are inserted in the unit, the unit should be verified that it is wired in accordance with the schematic and wiring drawings to prevent damage to the circuit pack.

End Requirements

5.02 This circuit should be tested to verify that it is wired in accordance with the schematic and wiring drawings, that requirements of the circuit requirements table are met, and that the circuit is capable of performing all functions stated in this circuit description.

6. ALARM INFORMATION

CUSTOMER DIAL PULSE RECEIVER

6.01 This circuit is fused individually with one fuse to the -48 volt signal supply and one to the -48 volt boosted battery supply. If either or both fuses blow, it will cause an FA relay in the frame that it is mounted on to operate an alarm.

REGULAR RINGING CIRCUIT

6.02 This circuit is fused individually with one fuse to the -48 volt signal supply and one to the -48 volt boosted talk supply. If either or both fuses blow, it will cause an FA relay in the frame that it is mounted on to operate an alarm.

6.03 This circuit is also fused individually with one fuse to the trip (-48V) battery supply and one to the ringing potential (86 volt RMS of 20 Hz, -48 volt superimposing) supply, associated with the ringing and tone plant. If either or both fuses blow, it will cause an FA relay to operate a ringing distribution alarm.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 Information on taking this circuit out of service can be found in the IM-3H000 and OM-3H000.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 Provided complete CD information.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5341-DJS-LEG