6

ELECTRONIC SWITCHING SYSTEMS

NO. 3

SUPERIMPOSED RINGING CIRCUIT

CHANGES

D. Description of Changes

D.1 Changed Circuit Note 101.

D.2 Added CAD 1, unit symbol.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5363-DJS-EN

ELECTRONIC SWITCHING SYSTEMS

NO. 3

SUPERIMPOSED RINGING CIRCUIT

TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The principal purpose of this circuit is to provide six superimposed ringing (SR) circuits, each of which is capable of providing ringing for customers with polarized ringers. Such ringers are used for 4-party full-selective and 8-party semiselective service. This circuit will also provide revertive ringing to these lines. The ringing voltage comes from a continuous-ringing supply with processor-controlled interruptions on a per-circuit basis.

2. GENERAL DESCRIPTION OF OPERATION

2.01 When a call is to a party line with polarized ringers, the processor will select an SR circuit to ring the called-customer line. Using a continuous-ringing supply, the SR 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. To provide 4-party full-selective ringing, the SR circuit is connected to two ringing potentials (superimposing batteries -48V and +48V). The SR circuit will send either ringing polarity to the line via a processor-controlled relay.

SECTION II - DETAILED DESCRIPTION

1. GENERAL

1.01 When a customer party line is to be rung, the processor will locate and connect an idle SR circuit to the line via a network path through a bypassed junctor. The SR circuit is placed in the pretrip test (tip or ring) state and the line is tested for either tip or ring low resistance to ground or a low tip-to-ring bridging resistance. The pretrip test is performed to determine that the customer is not off-hook when an attempt to ring the line is made because an immediate answer would occur and false charging might result.

1.02 After passing the pretrip test, ringing of proper code and polarity (under processor control) is applied to the line. To verify that the customer line is being rung, the ringing current to the line is monitored. A failure of ac ringing continuity will be detected by a scan point not saturating, and a second attempt to ring the line with another SR circuit will be made. If a second ac-ringing-continuity failure occurs, the line will be rung as if no failure occurred, but the fact that it did fail will be recorded by the processor.

1.03 Because this circuit rings polarized ringers, an additional safety precaution must be taken. A sensitive safety-trip detector is used to monitor the trip current. The safety-trip detector will trip ringing when the dc loop current (dc plus rectified 20 Hz) exceeds the safety limit of 24 mA (low-resistance faults). This dc safety limit corresponds to the 50-mA-RMS-ac safety limit and allows for the ringing of three ringers of the same polarity on the same side of the line.

1.04 Upon customer answer, ringing is autonomously tripped by an electronic trip detector 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 SR circuit and complete the talking path to the called customer.

TABLE A

SUMMARY OF SIGNALS FOR
8-PARTY SEMI-SELECTIVE SERVICE

RINGING CYCLE IN SECONDS	VOLTAGE	LEAD SELECTION	PARTY CALLED
RI = 2	-48 Vdc	R	1
SI = 4		T	2
	+48 Vdc	R	3
		T	4
RI = 1	-48 Vdc	R	5
SI = 1		T	6
RI = 1	-48 Vdc	R	7
SI = 3		T	8

Note: RI is the ringing interval.
SI is the silent interval.

RINGING SIGNALS

2.01 The ringing signal consists of a 20-Hz 86-V RMS voltage superimposed on a +48 Vdc or -48 Vdc voltage. The SR circuit can connect this signal to either the tip or ring lead. The two choices of polarities and the two choices of lead selection combine to give four combinations of ringing signals, thus allowing for distinctively ringing each party of a 4-party full-selective line. By controlling the length of time the ringing signal is applied to the line, the processor generates two codes of ringing. This allows the number of ringing signals to double so that semiselective service can be provided to eight parties. This is semiselective because the alerting directed to one party will be heard by that party and one other. Which of the two parties the call is directed to is determined by the parties themselves, by listening for a distinctive code. Table A shows a summary of the signals.

3. CONTROL OF CIRCUIT

3.01 The superimposed ringing circuit (SR) has four state relays (A, B, C, and D) which are controlled by the distributor circuit. Relays A, B, C, and D provide the states necessary to process a particular call. The processor determines the state required and, via the distributor circuit, operates the appropriate relay or relays.

3.02 The relays, driven by -48V, have a 1000-ohm resistor, with one break contact 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. In order 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 -48V with the anode of the diode to -48V.

3.03 The SR states are shown in Table B. When the SR circuit is in the idle or pretrip test (ring), all relays are released and scan point 0 (SC0) is connected to the tip and ring, thus sending battery on the ring and ground on the tip. Operating the B relay only reverses tip and ring. Operating the D relay only applies silent interval state trip battery. Operating the A and D relays applies ringing interval state ringing potential. Operating the C relay removes the negative ringing potentials (-TRP and -ACDC) and applies positive ringing potentials (+TRP and +ACDC).

SEQUENCES OF OPERATION

3.04 Table C shows typical state sequences of operation for the circuit. See BSP 233-151-105 for more details.

TABLE B

SR STATES

RELAYS C AND D	RELAYS A AND B: A RELEASED B RELEASED	A OPERATED B RELEASED	A OPERATED B OPERATED	A RELEASED B OPERATED
C RELEASED D RELEASED	0000 Pretrip (Ring)	0001 NU	0011 NU	0010 Pretrip (Tip)
C OPERATED D RELEASED	0100 NU	0101 NU	0111 NU	0110 NU
C OPERATED D OPERATED	1100 Silent Interval (Ring the Ring +ACDC)	1101 Ringing Interval (Ring the Ring +ACDC)	1111 Ringing Interval (Ring the Tip +ACDC)	1110 Silent Interval (Ring the Tip +ACDC)
C RELEASED D OPERATED	1000 Silent Interval (Ring the Ring -ACDC)	1001 Ringing Interval (Ring the Ring -ACDC)	1011 Ringing Interval (Ring the Tip -ACDC)	1010 Silent Interval (Ring the Tip -ACDC)

4. CIRCUIT OPERATION

RING PARTY LINES (POSITIVE OR NEGATIVE RINGING)

4.01 After a calling customer has dialed the called customer number, the processor will identify the called line and locate and connect* an idle SR circuit to it via a network path. Before ringing the line, a pretrip 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 pretrip failure.

4.02 After passing the pretrip test, the customer line can be rung. Relays A and D are operated to provide ringing interval (ring the ring -ACDC) or relays A, C, and D are operated to provide ringing interval (ring the ring +ACDC) depending on which party is to be rung. SC0 will now indicate customer answer. Ringing potential is provided to the circuit from a continuous-ringing supply. Relay A of the SR circuit will provide ringing interruptions. By providing the ringing interruptions at the circuit, immediate ringing can be applied and the various ringing codes can be generated by the same SR circuit. The ringing current is

* If the called party has polarized ringers

TABLE C

TYPICAL STATE SEQUENCES

LINE	STATE SEQUENCE
Party 1 (-Ring)	0000,1000,[1001,1000],[1001,1000],[••• Ring Trip],1000,0000
Party 4 (+Tip)	0000,0010,0110,1110,[1111,1110],[1111,1110], [•••Ring Trip],1110,1000,0000

None: [ ] is the ringing cycle.

provided, for negative ringing, through the 5B contact of relay RT (3B for positive ringing), 3M contact of relay A (5M for positive ringing), 5B contact of relay C (5M for positive ringing), resistor R10, 1M contact of relay A, diode CR8 (CR5 for positive ringing), primary winding of relay RD, diode CR6 (CR7 for positive ringing), 3B contact of relay B, ring lead, customer loop (ringer), tip lead, 5B contact of relay B, 3M contact of relay D, and resistor R5 to ground.

4.03 To prevent hazardous currents in the customer loop when ringing polarized ringers to ground, a safety-trip detector (bridging-resistor R10) monitors the dc loop current. The trip threshold of the detector is tightly controlled at 24-mA direct current. This level will allow three polarized ringers to be rung on the line and still maintain the 50-mA-RMS-ac safety limit on short loops. On long loops, the loop resistance will limit the RMS alternating current to below 50-mA RMS. The safety-trip detector is basically a bridge circuit and a differential comparator. The bridge circuit is balanced against a preset loop resistance and will be minimally affected by the variations in office battery voltage. The comparator consists of an attenuator, a low-pass filter, a differential amplifier with constant current source, a schmidt trigger, and a relay driver. The differential amplifier is adjusted by the use of precision resistors (0.25 percent) to a trip point within an accuracy of ±100 ohms. The amplifier will also maintain the same input impedance at both inputs to prevent in-phase voltages from interfering with the normal operation of the amplifier. The schmidt trigger will provide abrupt operate and release pulses to the relay driver in response to the slow output changes from the filter to the amplifier. The relay driver will operate relay RT to remove ringing potential from the line and indicate ring trip to the processor by operating scan point 0 (SC0). The low-pass filter removes not only the 20-Hz ringing component from the dc voltage across resistor R10 but also removes any 60-Hz longitudinals that may be present.

4.04 To verify that the line is being rung, the ringing current is monitored by ac-continuity detector RD. Relay RD is a 2-winding magnetic-latching mercury relay. The secondary winding is back biased by the voltage divider resistors R11 and R12 and the coil resistance from -48V. The secondary is biased so that when the ringing current, which flows through the primary, drives a 40-KOHM or smaller impedance, the relay will operate. When ringing continuity exists, relay RD will operate. The contact of relay RD will operate relay S and contact 6M of relay S will operate scan point 1 (SC1), thus indicating ringing continuity. The primary winding of relay RD is connected to a full-wave diode bridge (CR5 through CR8). The bridge circuit directs the ringing current through the primary in the poled direction for both polarities of ringing (-ACDC, +ACDC). Zener diode CR9 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 the silent interval occurs, the 2B contact of relay A will release relay RD for the next ringing interval.

4.05 To detect customer answer, an electronic trip detector bridges resistor R5 (with a high impedance). The detector filters out the 20-Hz ringing and looks for a dc-voltage drop across resistor R5. When the customer answers, direct current will flow and a voltage will be developed across resistor R5. The trip detector will sense this voltage and trip ringing by operating relay RT. When relay RT operates, ringing is removed from the line and SC0 operates, thus indicating customer answer.

4.06 To prevent reringing the line should the customer answer and hang up before the processor idles the SR circuit and/or if the processors fail and the customer answers and hangs up (talking path would not be completed), the trip detector is locked operated by a dc holding current through contact 2M of the RT relay. The locking path can only be released by the idling of the circuit.

TIP PARITY LINES (POSITIVE OR NEGATIVE RINGING)

4.07 Ringing tip party lines is the same as ringing ring party lines except that relay B is operated and the tip and ring are reversed.

ABANDONMENTS

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

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Minimum Insulation Resistance:
10,000 ohms.
Battery limits: -42.75 to -52.50V.
Earth potential: ±3 V.
Tripping range: 3000 ohms for the external loop.

1.02 For the ringing ranges see BSP 500-114-100.

2. FUNCTIONAL DESIGNATIONS

2.01 Associated Scanner Ferrods

Designation	Meaning
SC0	Pretrip test, ring trip
SC1	AC ringing continuity

2.02 Circuit States

Designation	Meaning
NU	Not used

2.03 Relays

Designation	Meaning
A	Apply ringing
B	Reverse T & R
C	Apply positive ringing
D	Apply ringing
RT	Ring trip
RD	AC continuity detector
S	Continuity

2.04 Ringing Potentials

Designation	Meaning
-ACDC	86 V RMS 20-Hz on -48 Vdc
+ACDC	86 V RMS 20-Hz on +48 Vdc
-TRP	-48 Vdc
+TRP	+48 Vdc
RGRD	Ring ground

3. FUNCTIONS

3.01 Provides a pretrip test for line condition.

3.02 Provides an ac ringing continuity check to determine that the line is being rung.

3.03 Provides the ringing potentials with the various ringing codes to alert customers of a call on polarized lines.

3.04 Provides means to autonomously trip ringing to prevent ringing the customer in the ear and to prevent reringing the customer line if the processors fail.

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4. CONNECTING CIRCUITS

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

(a) Master Scanner Matrix 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 - SD-82255-01.

5. MANUFACTURING TESTING REQUIREMENTS

Intermediate Requirements

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

End Requirements

5.02 This circuit should be tested to verify that it is wired in accordance with the schematic and wiring drawings, that the 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

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

6.02 This circuit is also fused individually with one fuse to the -TRP (-48V) battery supply, one fuse to the +TRP (+48V) battery supply, one fuse to the negative ringing potential (86V RMS 20-Hz on -48V superimposing) supply and one fuse to the positive ringing potential (86V RMS 20-Hz on +48V superimposing) supply. If either or all 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 IM-3H000 and OM-3H000.