

CIRCUIT DESCRIPTION

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APPENDIX 1D  
DWG ISSUE 7D

ELECTRONIC SWITCHING SYSTEMS  
NO. 101  
TONE GENERATORS CIRCUIT  
FOR SWITCH UNIT

CHANGES

D. Description of Changes

D.1 This circuit was reissued to change the rating to  
Mfr Disc.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-RJD-RVL

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Page 1  
1 Page

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NO.101  
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TABLE OF CONTENTS	PAGE
<u>SECTION I - GENERAL DESCRIPTION</u> . . . . .	1
<u>1. PURPOSE OF CIRCUIT</u> . . . . .	1
<u>2. GENERAL DESCRIPTION OF OPERATION.</u> . . . . .	1
<u>SECTION II - DETAILED DESCRIPTION</u> . . . . .	1
<u>1. AUDIBLE RINGBACK GENERATOR - FS 1</u> . . . . .	1
GENERAL . . . . .	1
OSCILLATOR OPERATION . . . . .	2
<u>2. 440-CYCLE GENERATOR - FS 2.</u> . . . . .	2
GENERAL . . . . .	2
TIME DIVISION SWITCH OPERATION. . . . .	2
<u>3. BUSY-TONE GENERATOR - FS 3</u> . . . . .	2
GENERAL . . . . .	2
OSCILLATOR OPERATION. . . . .	2
<u>4. DC RING SIGNAL SOURCE, RINGBACK</u> <u>TIME DIVISION SWITCHES - FS 1</u> . . . . .	2
GENERAL . . . . .	2
DC SOURCE . . . . .	2
TIME DIVISION SWITCHES . . . . .	3
<u>5. RING SYNCHRONIZER - FS 3.</u> . . . . .	3
GENERAL . . . . .	3
CIRCUIT OPERATION . . . . .	3
<u>6. BUSY-TONE INTERRUPTER AND</u> <u>TIME DIVISION SWITCHES FOR</u> <u>BUSY TONE</u> . . . . .	3
GENERAL . . . . .	3
INTERRUPTER OPERATION . . . . .	3
TIME DIVISION SWITCHES. . . . .	3
<u>SECTION III - REFERENCE DATA.</u> . . . . .	3
<u>1. WORKING LIMITS.</u> . . . . .	3
<u>2. FUNCTIONAL DESIGNATIONS</u> . . . . .	3
<u>3. FUNCTIONS</u> . . . . .	3

TABLE OF CONTENTS (Cont)	PAGE
<u>4. CONNECTING CIRCUITS</u> . . . . .	4
<u>5. ALARM INFORMATION</u> . . . . .	4
<u>6. MANUFACTURING TESTING</u> <u>REQUIREMENTS</u> . . . . .	4
<u>7. TAKING EQUIPMENT OUT OF SERVICE</u> . . . . .	4
<u>SECTION IV - REASONS FOR REISSUE.</u> . . . . .	4
<u>D. Description of Changes</u> . . . . .	4
<u>SECTION I - GENERAL DESCRIPTION</u>	
<u>1. PURPOSE OF CIRCUIT</u>	
1.01 The purpose of this circuit is to provide the tones used in the switch unit for station signaling. The tones supplied are audible ringback, fast and slow busy tones, and a special purpose 440-cycle tone.	
1.02 This circuit also supplies pulses used in the Line Circuit during station set ringing. These pulses are the dc signaling source and the ring synchronizer signal.	
<u>2. GENERAL DESCRIPTION OF OPERATION</u>	
2.01 The audible ringback generator and the fast and slow busy-tone generators each use two oscillators to produce the required signals. The 440-cycle generator uses a single oscillator. Each generator connects to a storage capacitor associated with a time division gate. Transmission of tones to trunk or line circuits takes place via time division and resonant transfer.	
2.02 When the time division gate associated with the dc signaling source is activated, a pulse is generated which is used in the Line Circuit to enable ringing. The ring synchronizer signal is obtained by amplifying a 12.5-kc signal obtained from the Switch Store Circuit.	
<u>SECTION II - DETAILED DESCRIPTION</u>	
<u>1. AUDIBLE RINGBACK GENERATOR - FS 1</u>	
GENERAL	
1.01 The audible ringback generator consists of two audio oscillators coupled together, via capacitors C3, C6, and transformer T1, to produce one output voltage	

with two frequency components. One frequency component is 480 cycles, the other is 440 cycles. When heard, these two tones combine to give the effect of a 440-cycle tone modulated at a 40-cycle rate.

#### OSCILLATOR OPERATION

1.02 One of the oscillators, comprising transistors Q1, Q2, and associated circuits, is tuned to 440 cycles. The frequency is determined by resonant circuit L1, C1, and C2. The feedback path used to maintain oscillation is R4 from the emitter of Q2 to the center tap of L1. The amplitude of oscillation is regulated by varistor RT1 which is in shunt with feedback resistor R4. Transistors Q1 and Q2 are operated as emitter-followers, with R5 the emitter load of Q1 and R7 the emitter load of Q2. Diode CR2 is a zener diode which is used, in conjunction with resistors R1, R2, and R3, to set the proper bias for the transistors.

1.03 The second oscillator, comprising Q3, Q4, and associated circuits, is similar to the first except that the value of the capacitor in the resonant circuit is changed to produce a 480-cycle output.

1.04 The output of the first oscillator (Q1, Q2, etc) is taken directly from the emitter of Q2. The output of the second oscillator is taken from the junction of R13 and R14. After the two signals are combined in T1, the levels of each, as measured at terminal 5 of T1, will be nearly equal.

#### 2. 440-CYCLE GENERATOR - FS 2

##### GENERAL

2.01 This generator consists of a single audio oscillator whose frequency of oscillation is 440 cycles. The operation of this oscillator is identical to the operation of the oscillators discussed in 1.02 and 1.03.

2.02 The output of the 440-cycle oscillator is coupled, via C3, to an output storage capacitance comprising C4 and C5 in parallel. The signal stored on the output capacitance is applied to talking bus 1, or talking bus 2 when one of the time division switches is operated.

##### TIME DIVISION SWITCH OPERATION

2.03 The time division switch associated with talking bus 1 is comprised of diodes CR4, CR5, and transformer T1. The talking bus 2 switch is comprised of diodes CR6, CR7, and transformer T2. Two translator inputs are provided for each switch, thus enabling the circuit to be accessed as either the A or B party. Diodes CR1, CR2, CR8, and CR9 are part of the translator circuit and isolate the translator inputs.

2.04 The time division switches operate when a pulse is applied to a transformer primary by the translator circuit. The voltage appearing on the secondary terminals (9 and 12) is of sufficient amplitude to break down the two PNP diodes in series. The diodes go into a low-impedance state for the duration of the drive pulse. At this time, energy is transferred from the storage capacitors to the talking bus and then to the line or trunk circuit receiving 440-cycle tone. Resistors R8 and R9 provide damping of the drive pulses. Resistors R10 and R11 limit the signal current through the time division switches and improve the impedance characteristic of the circuit.

#### 3. BUSY-TONE GENERATOR - FS 3

##### GENERAL

3.01 The busy-tone generator consists of two audio oscillators coupled together, via capacitors C3, C6, and transformer T1, to produce one output voltage with two frequency components. One frequency component is 480 cycles, the other is 620 cycles. The combined tones give the effect of 480 cycles modulated at a 140-cycle rate. Two busy-tone generators are provided, one for slow busy and one for fast busy.

##### OSCILLATOR OPERATION

3.02 Transistors Q1, Q2, and associated circuits produce 480 cycles. Transistors Q3, Q4, and associated circuits produce 620 cycles. Except for the difference in frequency, the circuit is substantially the same as described in 1.02 to 1.04.

#### 4. DC RING SIGNAL SOURCE, RINGBACK TIME DIVISION SWITCHES - FS 1

##### GENERAL

4.01 In order to enable ringing, a dc signal is sent, via a time division connection, to the Line Circuit it is desired to ring. This dc originates from a circuit containing a time division switch, a storage capacitor, and a dc signal source.

4.02 The combined tone output of the audible ringback generator connects directly to the storage capacitor consisting of C3 and C4 in parallel. The signal stored on the capacitor is applied to the talking bus whenever the time division gate is operated.

##### DC SOURCE

4.03 The dc source is simply a voltage divider consisting of R1 and R2 which reduces the 12-volt supply to the desired 3 volts.

## TIME DIVISION SWITCHES

4.04 Diodes CR3, CR4, and transformer T1 comprise the time division switch used to send the dc enable signal to start ringing. The operation of the time division switch is the same as described in 2.04. Resistor R3 provides damping of the drive pulse. Diode CR1 is used to isolate the translator outputs.

4.05 Diodes CR5, CR6, and transformer T2 comprise the time division switch used to transmit the audible ringback signal to the Line Circuit of the calling party.

4.06 Ring and ringback time division switches are used in alternate time intervals. At any given time slot scan, either a ring or a ringback switch may be used. Inductor L1 limits the switch current to the proper value.

5. RING SYNCHRONIZER - FS 3

## GENERAL

5.01 The ring synchronizer circuit input (terminal 12) is a 12.5-kc pulse obtained from the switch store. This signal is amplified and used to operate the ringing circuits on line cards. For increased reliability, two ring sync circuits are provided per switch unit.

## CIRCUIT OPERATION

5.02 The input circuit, consisting of CR9, CR10, Q3, R9, R10, R11, and R7, comprises a standard LLL to TRL interface circuit. The balance of the circuit, comprising Q2, Q4, Q5, and related components, is a standard unregulated high fan out circuit, except capacitors C4 and C5 have been included to slow the rate of rise of the pulse front. Capacitor C6 is used to couple to the ring sync bus.

6. BUSY-TONE INTERRUPTER AND TIME DIVISION SWITCHES FOR BUSY TONE

## GENERAL

6.01 The output of the busy-tone generator is coupled to storage capacitors C1 and C2, via capacitor C3, and the busy-tone interrupter (Q1 and associated circuitry). The signal stored on the capacitors is applied to the talking bus whenever a time division switch is operated.

## INTERRUPTER OPERATION

6.02 The fast busy-tone interrupter operates at a 120-ipm rate and the slow busy-tone interrupter operates at a 60-ipm rate. This is accomplished by Q1 acting as a common emitter switch. Resistors R3 and R8 set the proper biasing conditions for Q1 while

resistor R4 limits the current drains on the 60- and  $\frac{1}{2}$ 20-ipm sources. Transistor Q1 turns on when its base is driven positive by the interrupt signal, and the busy tone appearing at the collector is connected through to capacitor C3. Diode CR11 passes the negative-going portion of this signal.

## TIME DIVISION SWITCHES

6.03 The time division switch for bus 1 consists of diodes CR7, CR8, and transformer T2. The bus 2 switch consists of diodes CR1, CR2, and transformer T1. The operation of the time division switches is the same as described in 2.04. Resistors R1 and R2 are used to damp transformers T1 and T2, respectively, and diodes CR3 through CR6 isolate the translator outputs. Resistors R17 and R18 limit the signal current through the time division gates and improve the impedance characteristic of the circuit.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 The three supply voltages, +12 volts, +24 volts, and -48 volts, shall be within limits of +10.8 to +13.2 volts, +20.4 to +26.4 volts, and -45 to -52 volts, respectively.

1.02 The drive pulses from the translators must have a duration of  $1.9 \pm 0.02$  usec and be of sufficient amplitude to induce a voltage of at least 50 volts in the secondary of the time division switch transformer.

1.03 The output level of the audible ringback generator, measured across a 900-ohm termination, is 92 DBRN C  $\pm 2$  db. This is equivalent to 68 DBRN C  $\pm 2$  db measured at the output of a terminated Line Circuit.

1.04 The output level of the busy-tone generator, measured across a 900-ohm termination, is 94 DBRN C  $\pm 2$  db. This is equivalent to 63 DBRN C  $\pm 2$  db measured at the output of a terminated Line Circuit.

1.05 The level at the output of a terminated Line Circuit receiving 440-cycle tone is 65 DBRN C  $\pm 2$  db.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 Provides sources for dc-ring enable signal, audible ring-back tone, busy tone, 440-cycle tone, and ring-synchronizer voltage.

4. CONNECTING CIRCUITS

- (a) Line Circuit - SD-1H006-01 (typical).
- (b) Line Number Translator Circuit - SD-1H004-01 (typical).
- (c) Attendant Circuit - SD-1H014-01.
- (d) Switch Store Circuit - SD-1H003-01 (typical).
- (e) Ringing Generator Circuit - SD-1H022-01.
- (f) Bus Clamp and Interbus Switch Circuit - SD-1H010-01.

5. ALARM INFORMATION

- 5.01 No alarms are provided for this circuit.

6. MANUFACTURING TESTING REQUIREMENTS

- 6.01 Testing information for this circuit is contained in X-77156, Sections CPS 245, CPS 261, CPS 262, CPS 269, and CPS 289.

7. TAKING EQUIPMENT OUT OF SERVICE

- 7.01 No provisions are made for taking the tone generator circuit out of service at the switch unit.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

- D.1 Effective this issue the circuit rating is changed to A&M Only.

BELL TELEPHONE LABORATORIES, INCORPORATED

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