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COMMON SYSTEMS
SIGNAL GENERATOR CIRCUIT
FOR SUPPLYING FREQUENCIES
TO KEYSETS ARRANGED TO PULSE
2/6 AND 4x4 FREQUENCIES

CHANGES

B. Changes in Apparatus (Components)

B.1 Superseded	Superseded By
Resistors B1-B8, R2, R3, R4, and R6 - 145A or 221A App Fig. 1	Resistors B1-B8, R2, R3, R4, and R6 KS-20810,L1A, App Fig. 1

D. Description of Changes

D.1 In App Fig. 1, the 221A resistors are rated Mfr Disc, replaced by the KS-20810, L1A-type resistors.

D.2 Reference to the resistor change is added to Note 103.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4131-JAC-EGS

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SECTION I - GENERAL DESCRIPTION

1. GENERAL METHOD OF OPERATION

1.01 The signal generator circuit is a set of eight transistor oscillators providing the signal frequencies for the transmission of 2/6 or 4-by-4 signaling.

1.02 Since the signal generator is provided on a circuit per signal output basis, it is not equipped with a frequency failure alarm reserve oscillator or automatic oscillator transfer on failure.

1.03 A set of eight (4 by 4) or six frequencies (2/6) from 697 to 1633 or 700 to 1700 Hz, respectively, are generated at a level of approximately 2.35 ±0.15 volts into an 1100-ohm load at terminal 5 of the output transformer. The B- output resistors (plus the shunt resistor across the coupling coil in the associated circuit) prevent overloading of the individual outputs and cause the individual frequencies to be applied to a 600- or 900-ohm transmission line at a nominal level of -8 dBm (option Z) or -6 dBm (option Y).

SECTION II - DETAILED DESCRIPTION

1. START OF GENERATOR

1.01 Power for the operation of the eight transistor oscillators of the signal generator circuit is derived from a single source through a voltage-divider network. Regulation is preformed by the VR diode when option V is provided (-48 volts) and by the VR1 diode and T9 transistor when option T is provided (+24 volts). The voltage at terminal A42 remains at a constant voltage within the limits of the battery. The FC capacitors filter the voltage at the collector circuit tap (A32 or A47); this prevents feedback into the common supply from causing the oscillator frequencies to shift constantly.

1.02 When option X is provided, no warm-up time is required since power is constantly applied. With option W, 80-ms warm-up time should be allowed to provide proper frequencies and output levels.

1.03 When external starting is required, option W is used. For loop starting, leads ST and ST1 are used. For ground starting, only lead G is used.

2. GENERATION OF FREQUENCIES

2.01 The transistor operates as a current amplifier. A change in current in the emitter will cause a larger change in current in the collector when operating with the normal voltage between the collector and the base. Voltage amplification is also obtained since the emitter circuit is much lower in impedance than the collector. The emitter current and the collector current are in phase with each other.

2.02 Sufficient amplification is obtained from a transistor for it to be used to drive a tuned circuit and, therefore, to act as an oscillator. In the arrangement used in this circuit, energy is fed from a winding inductively coupled to the tuned circuit consisting of the transformer winding and capacitor C- or D- to the emitter. The transformer is designed so that the collector is connected to the point of proper impedance on the tuned circuit. Bias current for the emitter is obtained by connecting the base to a low negative voltage. The dc voltage for the emitter is supplied through part of the tuned circuit.

2.03 When power is applied to the circuit, a voltage appears at the transistors. The voltage across the tuned circuit will build up to the point where the power losses in the tuned circuit at the various loads connected to it will equal the power supplied by the transistor. Since the power obtainable for a transistor decreases sharply as the peak of the ac voltage applied to the collector closely approaches that of the dc voltage between the collector and the base, the output stabilizes at this point and is approximately the same for all transistors. The output level is also fairly independent of the load applied so long as the ability of the transistor to supply power is not exceeded.

2.04 The B- resistors in the output leads are provided to improve the impedance match with the trunk. The cross-connection points on the voltage divider are made so that the proper output voltage will be available. The potentiometers P- control the amount of feedback so that the output level can be controlled. The power supplied by an oscillator to a trunk or to a 600- or 900-ohm load connected to the output of the transformer in the associated connecting circuit is -8 ±1 dBm (option Z) or -6 ±1 dBm (option Y). The voltage at the output of the oscillator is approximately 2.4 volts rms and varies little with load.

3. OUTPUT FREQUENCIES

4-BY-4 SIGNALING

3.01 When the associated connecting circuit requires the 4-by-4 frequencies, ground will be omitted from the TR lead and relay TR will remain normal.

3.02 Eight frequencies of 697 to 1633 Hz are used. These eight frequencies are arranged in two sets of four frequencies each; thus, the term 4 by 4, although each digit or signal pulsed is composed of one frequency from each set and is actually a 2-out-of-8 type code. The frequencies and their assignments are as shown in Table A.

TABLE A

Digit	Frequencies: 697	770	852	941	1209	1336	1477	1633
	Oscillator Designation: 1	7	8	2	3	4	5	6
0				x		x		
1	x				x			
2	x					x		
3	x						x	
4		x			x			
5		x				x		
6		x					x	
7			x		x			
8			x			x		
9			x				x	

3.03 The 1633-Hz frequency is presently a spare, but the ultimate plan for the 4-by-4 code includes the use of all eight frequencies.

2/6 SIGNALING

3.04 When the associated connecting circuit requires the 2/6 frequencies, ground will be present on lead TR and relay TR will operate. Relay TR operated switches from the C- designated capacitors to the D- designated capacitors in oscillators 2 to 6. The D- designated capacitors determine the frequencies used for the 2/6 code. In oscillator 1, the CD1 capacitor is used for both the 2/6 and 4-by-4 frequencies. Only the CA1 and DA1 capacitors, if furnished, are switched. The capacitors and, in turn, the frequencies of oscillators 7 and 8 are not changed when relay TR operates; however, since these two frequencies are not used in the 2/6 code, the associated circuit will not utilize the outputs of oscillators 7 and 8.

3.05 Six frequencies of 700 to 1700 Hz in steps of 200 Hz are used. The first five are assigned on a 2-out-of-5 basis to the digits 0 to 9; the sixth is used in combination with others of the first five for a gate opener or keypulse signal and for a start- or end-of-pulse signal. Since a total of six frequencies is used, the terminology 2/6 (2 out of 6) is used in place of the more familiar 2/5 (2 out of 5) terminology. The frequencies and their assignments are as shown in Table B.

TABLE B

Digit	Frequencies					
	700	900	1100	1300	1500	1700
	Oscillator Designation					
	1	2	3	4	5	6
0				x	x	
1	x	x				
2	x		x			
3		x	x			
4	x			x		
5		x		x		
6			x	x		
7	x				x	
8		x			x	
9			x		x	
Key Pulse			x			x
Start Pulse					x	x

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Voltage Limits

Voltage	Minimum	Maximum
-48	-45	-50
	-42.75	-52.5
+24	+20.75	+27.00

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 To provide 697-, 770-, 852-, 941-, 1209-, 1336-, 1477-, and 1633-Hz ±1 percent frequencies for a single signaling circuit for pulsing on a 4-by-4 basis.

3.02 To provide 700-, 900-, 1100-, 1300-, 1500-, and 1700-Hz ±1 percent frequencies for a single signaling circuit for pulsing on a 2/6 basis.

3.03 To provide the individual signal frequencies to a 600- or 900-ohm load (through suitable padding and a transformer) at a level of -8 ±1 dBm (option Z) or -6 ±1 dBm (option Y).

3.04 To have the cross-modulation products of any two frequencies fed into a linear load be at a level not higher than -36 dBm.

4. CONNECTING CIRCUITS

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

(a) Toll Testboard No. 19A - Position Circuit - SD-56499-01.

(b) Switchboard No. 5C or 5D - MF Keyset Circuit - SD-68539-01.

(c) Local Test Desk No. 14 MF Keyset Circuit - SD-95570-01.

(d) Testboard No. 21A - Position Circuit - SD-56544-01.

(e) Testboard No. 22A - Position Circuit - SD-99403-01.

(f) Test Position No. 50A - Test and Telephone Circuit - SD-1C203-01.

(g) Position Circuit - SD-1B193-01.

(h) Local Test Desk No. 15B and Testboard No. 23B - MF Keyset Circuit - SD-1C464-01.

(i) Testboard No. 23B - Position Circuit - Miscellaneous Test Position - SD-1C469-01.

5. MANUFACTURING TESTING REQUIREMENTS

ADJUSTMENT OF FREQUENCY GENERATOR OUTPUT LEVEL

5.01 The output level of the individual oscillators should be measured and adjusted in accordance with Information Note 302.

ADJUSTMENT OF OSCILLATOR FREQUENCY

5.02 The frequency of the individual oscillators should be measured and adjusted in accordance with Information Note 303B.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 When the signal generator circuit is to be removed from service for calibration or repair, the associated position should be vacated.

7. ALARM INFORMATION

7.01 If the fuse alarm functions, the associated position should be vacated until the trouble is cleared and the fuse replaced.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 Circuit Note 102 is changed to show connection of testboards No. 22A and 23B for option Z and the local test desk No. 15B for option Y.

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