

CIRCUIT DESCRIPTION

CD-99303-01
ISSUE 5A
APPENDIX 1
DWG ISSUE 1990
DISTR CODE 1N99

12

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

D. Description of Changes

D.1 Battery feed information was removed from Circuit Note 101. This information was clarified in new Equipment Note 204 by adding information on ground lead connection. CAD 1 was revised accordingly.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3493-VM-FEF

NOTICE

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COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

		<u>Removed</u>	<u>Replaced By</u>
<u>B. Changes in Apparatus (Components)</u>			
B.1 In FS 1:			
<u>Removed</u>	<u>Replaced By</u>	R305 Resistor - KS-13490 L1 330 ohms	R305 Resistor - KS-20810 L1A 332 ohms
CR1, CR2 Diodes 446F (Option V)	CR1, CR2 Diodes 533F (Option V)	R306 Resistor - KS-13490 L1 300 ohms	R306 Resistor - KS-20810 L1A 301 ohms
		R307 Resistor - 237A 0.226 megohms (Option P)	R307 Resistor - KS-20616 L1A 0.226 megohms (Option P)
B.2 In FS 2:			
<u>Removed</u>	<u>Replaced By</u>	R308 Resistor - KS-13490 L1 51,000 ohms (Option P)	R308 Resistor - KS-20810 L1A 51,100 ohms (Option P)
R201, R206, R209, R214 Resistors - KS-13490 L1 62,000 ohms	R201, R206, R209, R214 Resistors - KS-20810 L1A 61,900 ohms	R309 Resistor - KS-13492 L1 1,100 ohms	R309 Resistor - KS-20289 L6C 1,100 ohms
R202, R207, R210, R215 Resistors - KS-13490 L1 20,000 ohms	R202, R207, R210, R215 Resistors - KS-20810 L1A 20,500 ohms	R310 Resistor - 237A 10,000 ohms (Option P)	R310 Resistor - KS-20616 L1A 10,000 ohms (Option P)
R203, R208, R211, R216 Resistors - KS-13490 L1 0.15 megohms	R203, R208, R211, R216 Resistors - KS-20810 L1A 0.147 megohms	R311 Resistor - 237A 1,470 ohms (Option P)	R311 Resistor - KS-20616 L1A 1,470 ohms (Option P)
R204, R205, R212, R213 Resistors - KS-13490 L1 390 ohms	R204, R205, R212, R213 Resistors - KS-20810 L1A 383 ohms	R312 Resistor - KS-13490 L1 22,000 ohms (Option P)	R312 Resistor - KS-20810 L1A 21,500 ohms (Option P)
Q201, Q202, Q203, Q204 Transistors - 29A	Q201, Q202, Q203, Q204 Transistors - 66S	R314, R315 Resistors - KS-13490 L1 1,000 ohms	R314, R315 Resistors - KS-20810 L1A 1,000 ohms
B.3 In FS 3:			
<u>Removed</u>	<u>Replaced By</u>	R316 Resistor - KS-13490 L1 30,000 ohms	R316 Resistor - KS-20810 L1A 30,100 ohms
CR301, CR304 Diodes 426M	CR301, CR304 Diodes 813 AF	R317 Resistor - KS-13490 L1 18,000 ohms	R317 Resistor - KS-20810 L1A 17,800 ohms
CR302, CR303 Diodes 446F	CR302, CR303 Diodes 533C	R318 Resistor - KS-13490 L1 33 ohms	R318 Resistor - KS-20810 L1A 33.2 ohms
R301, R304 Resistors - KS-13490 L1 2,000 ohms	R301, R304 Resistors - KS-20810 L1A 1,960 ohms	R319 Resistor - KS-13490 L1 360 ohms	R319 Resistor - KS-20810 L1A 361 ohms
R302, R303 Resistors - KS-13490 L1 13,000 ohms	R302, R303 Resistors - KS-20810 L1A 13,300 ohms		

<u>Removed</u>	<u>Replaced By</u>	<u>D. Description of Changes</u>
R320 Resistor - KS-13492 L1 1,500 ohms	R320 Resistor - KS-20289 L6C 1,470 ohms	D.1 In Circuit Note 101, Fusing Table, the footnote is corrected to show "signal" instead of "talk" battery. This correction brings the footnote into agreement with the -48 SIG battery indicated in the "Potential" column.
R321 Resistor - KS-13490 L1 1.0 megohms	R321 Resistor - KS-20810 L1A 1.0 megohms	D.2 In FS 1, 2, and 3 and App Fig. 1, 2, and 3, a number of circuit components (diodes, resistors, and transistors) are replaced by equivalents as part of the WE component standardization program. The changes are done on a lineout basis, without options.
Q301, Q302, Q303, Q304, Q305, Q306 Transistors - 29A	Q301, Q302, Q303, Q304, Q305, Q306 Transistors - 66S	

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3321-WF-AB

CIRCUIT DESCRIPTION

CD-99303-01
ISSUE 5A
APPENDIX 5D
DWG ISSUE 17D
DISTN CODE IN99

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

D. Description of Changes

D.1 This circuit is reissued to show corrections to the Feature Option Circuit, Note 102, as the result of a drafting error. These changes consist of adding back to the circuit note options X and Y, and removing option V.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3321-WF-AB

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

D. Description of Changes

D.1 Circuit Note 102 is revised to show that option W, "Mfr Disc.", is removed from the note and that the basic circuit feature is reworded.

D.2 Circuit Note 104 is revised to show that all "A" classification changes are removed, since "A" type changes should not be listed in this note. Reference to Issue 13B is removed because Issue 14A reclassified all the changes made on Issue 13B. An entry in this note is made for Issue 16D to show that option U is rated "Mfr Disc." and reference is made to added Circuit Note 108.

D.3 All references to options R and S, added on Issue 13B, are removed from Circuit Note 104, the Option Index, FS3, and App Fig. 3. This change is necessary because of the reclassification of Issue 13B to an "A" class of change on Issue 14.

D.4 Circuit Note 107 is expanded to explain the removal of options R and S.

D.5 Circuit Note 108 is added to record the rating of option U prior to this issue.

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DEPT 3321-WF-AB

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

F. Changes in Description of Operation

B. Changes in Apparatus (Components)

B.1 In FS3, App Fig. 3:

<u>Removed</u>	<u>Replaced By</u>
Resistor R307, 0.22 megohm, KS-13490, L1	Resistor R307, 0.226 megohm, 237A (or equivalent)
Resistor R308, 10,000 ohms, KS-13490, L1	Resistor R308, 51,000 ohms, KS-13490, L1
Resistor R310, 10,000 ohms, KS-13490, L1	Resistor R310, 10,000 ohms, 237A (or equivalent)
Resistor R311, 150 ohms, KS-13490, L1	Resistor R311, 1470 ohms, 237A (or equivalent)
Resistor R312, 2000 ohms, KS-13490, L1	Resistor R312, 22,000 ohms, KS-13490, L1

F.1 In 5. of SECTION III, add the following:

5.02 The preamplifier circuit of FS3 shall be capable of meeting the following requirement:

Voltage from collector of Q303 to terminal C of P302 shall be +3.5 Vdc minimum to +17.5 Vdc maximum with relay ST released.

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DEPT 3321-EVK/VEM-AB

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

D. Description of Changes

D.1 This change revises the change classification designated as "B" for Issue 13 of this circuit and upgrades it to Issue 14A.

D.2 In Circuit Note 104, Issue 14A is added.

D.3 Circuit Note 107 is added.

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DEPT 3321-EVK-AB

COMMON SYSTEMS
400A TONE GENERATOR CIRCUIT

CHANGES

E. Changes in Apparatus (Components)

B.1 In FS3, App Fig. 3:

Removed

Resistor R317, 0.2 megohm,
1/2-watt, KS-13490,L1,
option S

Resistor R321, 43,000 ohms,
1/2-watt, KS-13490,L1,
option S

Replaced By

Resistor R317, 18,000 ohms,
1/2-watt, KS-13490,L1,
option R

Resistor R321, 1.0 megohm,
1/2-watt, KS-13490,L1,
option R

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DEPT 3321-EVK-AB

COMMON SYSTEMS
 400A TONE GENERATOR CIRCUIT

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit provides facilities for generating a distinctive tone signal which is applied to a subscriber line on which the handset has been left off-hook. The acoustic output of the receiver is intended to alert the subscriber to replace the handset on-hook.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The circuit consists of four oscillators, a pulse generator, amplifiers, and a tone level alarm.

2.02 The oscillators provide frequencies of 1400, 2060, 2450, and 2600 Hz. The outputs of these oscillators are of equal amplitude and are linearly combined to synthesize the desired tone.

2.03 A pulse generator circuit alternately applies and removes the oscillator supply voltage, thus producing a pulsing of the combined signal.

2.04 Amplification of the pulsed signal is provided by a KS-19221, List 1 power amplifier provided as part of this circuit.

2.05 A tone alarm circuit indicates an alarm condition when the tone signal falls below a predetermined level, or fails completely, and during power failure.

SECTION II - DETAILED DESCRIPTION

1. CIRCUIT UNITS

GENERAL

1.01 The 400A tone generator operates for the duration of a ground closure on lead ST to the connecting circuit. Lead ST grounded operates relay ST. Relay ST operated:

- (a) Removes a short circuit from across transistor Q302, and its emitter resistor-capacitor, which allows its collector to increase in potential (positive) turning transistor Q301 on.
- (b) Enables the tone alarm circuit to monitor the output of the power amplifier.

1.02 The pulse generator provides a pulsing output voltage for use as a collector supply voltage by the tone oscillators. The oscillators produce bursts of tone corresponding in duration to the applied pulsing collector voltage. The outputs of the tone oscillators are fed from each oscillator circuit through isolating resistors and are linearly combined at the potentiometer input to the preamplifier, thus combining the pulsing tones while avoiding interference between the oscillators.

1.03 The output of the preamplifier is applied to the input of the KS-19221, List 1 power amplifier, and the amplified signal appears on leads T and R.

1.04 The tone signal appearing at the primary of the output transformer is amplified and rectified in the tone alarm circuit. The resulting dc voltage is applied to the base of transistor Q306, providing bias voltage to hold the transistor in the nonconducting state. Relay TA releases, providing an alarm indication if the tone falls below a predetermined level, or fails completely, and during power failure. The tone level to which the alarm circuit will respond corresponds to a reading of approximately +1 as read on a volume indicating meter.

OSCILLATORS

1.05 The four individual oscillator circuits are identical in circuit arrangement but differ in component values of the frequency determining elements. The frequencies generated are 1400, 2060, 2450, and 2600 Hz. The basic oscillator is a modified Hartley circuit containing an inductor and capacitor to determine the frequency of oscillation. A 150,000-ohm resistor provides isolation of the oscillator tank circuits from each other.

1.06 A pulsing collector supply voltage for the oscillators is provided by the pulse generator circuit. The oscillators supply tones only for the duration of the applied pulse of collector voltage, thus generating pulsing tones.

PULSE GENERATOR

1.07 The pulse generator is a multivibrator that provides a pulsing supply voltage to the oscillator circuits. The free running frequency is determined by cross-coupling capacitors C301 and C302 and cross-coupling resistors R302 and R303. Resistors R301 and R304 serve as load resistors.

1.08 The output pulses (at the emitter of transistor Q301) have a peak amplitude of 2.5 volts with equal on and off times of 100 ms.

1.09 The pulse generator and the preamplifier are both located on the same printed wiring board and share the same collector supply voltage, which is derived from zener diode CR304 and resistor R309.

PREAMPLIFIER

1.10 The preamplifier is composed of two direct coupled transistors, Q303 and Q304, which provide the necessary gain for the power amplifier input.

1.11 The input to the preamplifier is the combined output of the individual oscillators. A potentiometer, R313, is provided so

that the level of the tone signal may be adjusted. Capacitor C305 serves to block direct current from the oscillators. Resistors R307, R310, and R311 serve to bias and provide thermal stabilization for transistor Q303. Resistor R308 serves as a load resistor for Q303 and a bias resistor for Q304. The output of the preamplifier is taken from resistor R312 and is applied to the KS-19221, List 1 power amplifier.

tone alarm

1.12 Tone alarm relay TA is normally operated, and an alarm condition will be indicated by the release of this relay. Relay TA will release either when transistor Q306 conducts and shunts the relay coil or when there is loss of battery internally in the pulse-generator plug-in unit. When either of these conditions exists and option V is provided, the no-voltage alarm lamp DS1 will light indicating malfunction of the circuit. This occurs when ground is connected through the closed contacts of the released relay TA and causes current to flow through the CR1 diode and the lamp. Diode CR2 prevents any current of the external alarm circuits from flowing through the no-voltage alarm circuit. Transistor Q306 is kept from conducting by application of a negative potential at its base derived in one of the two methods, depending on the circuit status.

1.13 During the standby condition (relay ST released), transistor Q306 is held in the nonconducting state by negative voltage applied to its base terminal through a normally closed contact on relay ST. During normal operation (relay ST operated), transistor Q306 is held in the nonconducting state by a negative voltage derived from rectification of the tone signal. This is accomplished as follows. When relay ST is operated, a pulsing tone signal appears at the output of the power amplifier and is applied through coupling capacitor C308 to transistor Q305, which acts as an amplifier. Resistors R317, R318, and R321 provide bias for transistor Q305. Zener diode CR301 maintains an operating potential of 22 volts for transistor Q305. The output of transistor Q305 is rectified by diode CR302, providing a negative potential at the base of transistor Q306 sufficient to keep the transistor cut off. Filtering of the rectified signal is provided by C309. During tone failure, capacitor C309 will discharge, removing the cutoff bias voltage from transistor Q306. When tone failure occurs, transistor Q306 will conduct, shunting relay TA and causing relay TA to release.

1.14 As described previously, negative potential is provided to the base of transistor Q306 to prevent tone alarm relay TA from releasing during the standby condition (relay ST released). A strap connection, option Z, provides this feature. Removal of the strap connection will cause relay TA to release

when relay ST releases, as well as when tone failure occurs.

2. TEST PROCEDURE

2.01 The following test procedure has been included to assist in trouble shooting a defective tone generator and is not intended for adjustment or system alignment purposes. For alignment purposes following installation or maintenance, the preamplifier gain control shall be adjusted to produce an output at leads T and R of +11 as read on a volume indicating meter. The voltage readings specified in the following test procedure are based on a level setting of +11 at leads T and R. In the event another level setting is used, the readings for preamplifier and amplifier output must be changed accordingly.

PREPARATION

2.02 Voltage measurements referred to in this section are to be made with an electronic voltmeter such as Ballantine model 300 or Hewlett-Packard 400 type.

2.03 Tests should be performed in the order listed.

2.04 Battery supply on terminal 41 (-) TB1, and ground (+) on terminal 44 (TB1).

2.05 With option 2 provided, relay TA operates; with option 2 not provided, relay TA remains nonoperated.

2.06 Ground on terminal 47 (TB1) operates relay ST. Relay TA will operate if tone level is adequate.

PULSE GENERATOR

2.07 With relay ST operated, the pulse generator provides a pulsing (approximately 5 pps) supply voltage to the oscillators. Measured between terminal 13 (TB1) and ground terminal 44 (TB1), the output of the pulse generator causes a pulsating reading with a value greater than 1.0 volt.

OSCILLATORS

2.08 With the appropriate pulsing supply voltage, each of the four oscillators shall produce a pulsating reading with an average value greater than 1.0 volt measured separately between terminals 14, 15, 24, and 25 (TB1) and ground terminal 44 (TB1).

2.09 The outputs of the four oscillators are combined into a single pulsing signal to produce a pulsating reading with an average value greater than 0.01 volt measured between terminal 12 (TB1) and ground terminal 44 (TB1).

PREAMPLIFIER

2.10 The combined pulsing signal output from the oscillator is amplified in the preamplifier to produce a pulsating reading with an average reading greater than 0.05 volt measured between terminal 11 (TB1) and ground terminal 44 (TB1).

AMPLIFIER (KS-19221, LIST 1)

2.11 The pulsing signal output from the preamplifier is amplified in the power amplifier to produce a pulsating reading of +11 as read on a volume indicating meter between terminals 17 (TB1) and 27 (TB1).

SECTION III - REFERENCE DATA

1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

2.01 Apparatus

<u>Designation</u>	<u>Meaning</u>
ST	Start
TA	Tone Alarm

2.02 Other designations are for reference only and have no functional meaning.

3. FUNCTIONS

3.01 Four oscillators for generating 1400, 2060, 2450, and 2600 Hz tones.

3.02 A free running multivibrator to provide a pulsing supply voltage for the oscillators to obtain tone outputs pulsing at a rate of 5 pps.

3.03 A preamplifier to amplify the pulsing tone for application to a power amplifier.

3.04 A power amplifier to amplify the pulsing tone to a sufficient level for simultaneous application to several circuits.

3.05 A relay for remote start control of the oscillators and amplifiers.

3.06 A tone level detector for detecting tone failure.

4. CONNECTING CIRCUITS

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

- (a) Common Systems - Timer Circuit, 5A
Timer - SD-99304-01.
- (b) Step-by-Step Permanent Signal Holding
Trunk Circuit - SD-32370-01.
- (c) Crossbar No. 1 Sender Make-Busy Frame
Permanent Signal Holding Trunk Circuit
- SD-25418-01.
- (d) Panel or Crossbar No. 1 Permanent
Signal Holding Trunk Circuit -
SD-95554-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 In Circuit Note 104, option U, which was rated Mfr Disc., is now reinstated and rated AT&TCo Standard.

B. Change in Apparatus (Components)

B.1 In FS1, the drafting symbol for circuit continuity between the battery (-48 volts) and terminal N of J2 is added.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the functions specified in 3. FUNCTIONS.

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DEPT 3321-EVK-FFR