POWER SYSTEMS
SIGNALING CIRCUIT
404 (A,B,C,&D) & 405 (A,B,C&D)
DIAL TONE GENERATORS
FOR PBX
"TOUCH-TONE" CALLING

CHANGES

B. Changes in Apparatus (Components)

B.1 Removed	Replaced By
Resistor R13 145A, 20kΩ CPS3	Resistor R13 KS-20810,L1A, 20kΩ CPS3
Resistor R14 145A, 3160Ω CPS3	Resistor R14 KS-20810,L1A, 3160Ω CPS3
Resistor R24 145A, 20kΩ CPS4	Resistor R24 KS-20810,L1A, 20kΩ CPS4
Resistor R25 145A, 3160Ω CPS4	Resistor R25 KS-20810,L1A, 3160Ω CPS4

D. Description of Changes

D.1 Replaced the 145A code for R13, R14 on CPS 3 and for R24, R25 resistors on CPS4 by KS-20810, L1A code. The 145A code was rated "Mfr Disc." No record of the removed code will be maintained. Note 5 was added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2451-MTE-JHW

CIRCUIT DESCRIPTION

CD-81719-01
ISSUE 4A
APPENDIX 3D
DWG ISSUE 10D
DISTN CODE 1M99

POWER SYSTEMS
SIGNALING CIRCUIT
404 (A,B,C & D) & 405 (A,B,C & D)
DIAL TONE GENERATOR
FOR PBX
"TOUCH TONE" CALLING

CHANGES

B. Changes in Apparatus

B.1 Removed	Replaced By
RT1 Thermistor, 1D CPS 3	RT1 Thermistor, 8E, CPS3
RT1 Thermistor, 1D CPS 4	RT2 Thermistor, 8E, CPS 4
S1 Switch, KS-19636L5	S1 Switch, KS-19963L6

D. Description of Changes

D.1 Circuit Note 103 is modified.

D.2 Rating "MFR DISC." is removed from 404A and 404B in Supporting Information Table.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2426-COR

WE DEPT 83250-MRH-JK

POWER SYSTEMS
SIGNALING CIRCUIT
404 (A,B,C,&D) & 405 (A,B,C&D)
DIAL TONE GENERATORS
FOR PBX
"TOUCH-TONE" CALLING

CHANGES

B. Changes in Apparatus

B.1 Removed	Replaced By
R1 Resistor, CPS1A KS-14603, L2A, 787Ω	R1 Resistor, CPS1A KS-20289, L5A, 787Ω
R1 Resistor, CPS1B KS-14603, L2A, 787Ω	R1 Resistor, CPS1B KS-20289, L5A, 787Ω
R7 Resistor, CPS2A KS-14603, L2A, 787Ω	R7 Resistor, CPS2A KS-20289, L5A, 787Ω
R7 Resistor, CPS2B KS-14603, L2A, 787Ω	R7 Resistor, CPS2B KS-20289, L5A, 787Ω
R4 Resistor, CPS1A KS-16313, L6A, 34800Ω	R4 Resistor, CPS1A KS-20810, L1A, 34800Ω
R5 Resistor, CPS1A KS-16313, L6A, 18700Ω	R5 Resistor, CPS1A KS-20810, L1A, 18700Ω
R4 Resistor, CPS1B KS-16313, L6A, 27100Ω	R4 Resistor, CPS1B KS-20810, L1A, 27100Ω
R5 Resistor, CPS1B KS-16313, L6A, 16700Ω	R5 Resistor, CPS1B KS-20810, L1A, 16700Ω
R10 Resistor, CPS2A KS-16313, L6A, 48700Ω	R10 Resistor, CPS2A KS-20810, L1A, 48700Ω

Removed	Replaced By
R11 Resistor, CPS2B KS-16313, L6A, 15000Ω	R11 Resistor, CPS2B KS-20810, L1A, 15000Ω
C11 Capacitor, CPS3 KS-19107, L5, 2.2uF	C11 Capacitor, CPS3 KS-20736, L8, 2.2uF
C13 Capacitor, CPS4 KS-19107, L5, 2.2uF	C13 Capacitor, CPS4 KS-20736, L8, 2.2uF
R3 Resistor, CPS1A, Z Option, 106A, 5360Ω	R3 Resistor, CPS1A, Z Option, KS-20810, L1A, 5360Ω
R3 Resistor, CPS1B, Y Option, 106A, 5490Ω	R3 Resistor, CPS1B, Y Option, KS-20810, L1A, 5490Ω
R9 Resistor, CPS2A, Z Option, 106A, 5110Ω	R9 Resistor, CPS2A, Z Option, KS-20810, L1A, 511Ω
R9 Resistor, CPS2B, Y Option, 106A, 4930Ω	R9 Resistor, CPS2B, Y Option, KS-20810, L1A, 4930Ω

D. Description of Changes

D.1 Circuit note 103 was modified.

D.2 On SD sheet J4 a drafting error was corrected in Manufacturing References.

D.3 Title was changed.

D.4 Circuit note 104 was modified.

D.5 Page H1 was added.

BELL TELEPHONE LABORATORIES, INCORPORATED

BTL DEPT 2433-DHS
WE DEPT 81450-DCS-RB

POWER SYSTEMS
SIGNALING CIRCUIT
DIAL TONE GENERATOR
FOR PBX
"TOUCH-TONE" CALLING

CHANGES

A. Changed and Added Functions

A.1 For use in central offices "N" option is added to provide a major alarm indication from the 10B monitor.

B. Changes in Apparatus

B.1

Removed	Replaced By
C11 Capacitor, 601A, 4μF - FS 4, CPS 3, "T" Option	C11 Capacitor, KS-19107, L5, 2.2μF - FS 4, CPS 3, "S" Option
C13 Capacitor, 601A, 4μF - FS 4, CPS 4, "T" Option	C13 Capacitor, KS-19107, L5, 2.2μF - FS 4, CPS 4, "S" Option
GT Relay, MB3 - FS 4, CPS 3, "R" Option	GT Relay, MB3-A - FS 4, CPS 3, "Q" Option
HLVM1 Relay, MA3 - FS 4, CPS 3, "R" Option	HLVM1 Relay, MA3-A - FS 4, CPS 4, "Q" Option
TF Relay, MB3 - FS 4, CPS 4, "R" Option	TF Relay, MB3-A - FS 4, CPS 4, "Q" Option
HLVM2 Relay, MA3 - FS 4, CPS 4, "R" Option	HLVM2 Relay, MA3-A - FS 4, CPS 4, "Q" Option

D. Description of Changes

D.1 Circuit Notes 102 and 103 were expanded.

D.2 Equipment Note 204 is rated "Mfr. Disc."

D.3 Equipment Note 205 is added.

D.4 A major alarm indication is provided by the tone monitor via "D" lead, when used in central offices per "N" Option.

D.5 In FS 4, "D" lead is added.

D.6 In FS 8, the "D" lead is shown connected to terminal 11 of P3 per "N" Option.

F. Changes in Description of Operation

SECTION I - GENERAL DESCRIPTION

F.1 Add following at end of 2.05:

When used in central office application a major alarm is provided if both generators fail.

SECTION II - DETAILED DESCRIPTION

F.2 Add the following at end of 4.07:

When used in central office application, if both generators fail a major alarm is provided by way of the "D" lead which provides a ground through the 4-make contact of HLVM1 and HLVM2 relays respectively.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5144-JGS-JJS-EAA

POWER SYSTEMS
SIGNALING CIRCUIT
DIAL TONE GENERATOR
FOR PBX
"TOUCH-TONE" CALLING

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 To provide dial tone for TOUCH-TONE® calling in crossbar, step-by-step and the 800A PBXs.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The 350 Hz frequency generator is shown in FS 1. The various bias voltages required in the frequency generator are provided by the shunt voltage regulator shown in FS 1. Therefore, the frequency generator is a complete entity, in that it produces a 350 Hz sine-wave output from a -48V dc input.

2.02 The 440 Hz frequency generator is shown in FS 2. The various bias voltages required in the frequency generator are provided by the shunt voltage regulator shown in FS 2. Therefore, the frequency generator is a complete entity, in that it produces a 440 Hz sine-wave output from a -48V dc input.

2.03 The outputs of the two frequency generators, one operating at 350 Hz and the other at 440 Hz, are added in the summing circuit, shown in FS 3, to produce the desired dial tone. Fig. FS 1 thru FS 3 constitute a single dial tone generator and is coded as a 404A or 404C tone generator for crossbar PBXs and a 404B or 404D tone generator for step-by-step PBXs. When duplicate dial tone generators (only 404B or 404D) are furnished, both generators operate continuously, but only the regular generator GEN 1 feeds the load.

2.04 Duplicate tone monitors are shown in FS 4. There is one voltage monitor for each dial tone generator (only when two dial tone generators are furnished). The monitor will operate a relay if the output voltage should go high or low.

2.05 The automatic transfer circuit for the dial tone generators is also shown in FS 4. This circuit transfers the load to the spare generator GEN 2 in case the regular generator fails. It provides an audio and a visual alarm if either or both of the regular and spare generators fail. The automatic transfer circuit FS 4 and the tone monitors FS 4 constitute a single 10A or 10B tone monitor.

2.06 Two separate -48V battery supply fuses, TTA and TTB, are required to provide power to the 350 Hz frequency generator and the 440 Hz frequency generator respectively. When duplicate dial tone generators are furnished five fuses are required; two TTA fuses, two TTB fuses, and one F3 fuse to provide power to the tone monitors and the transfer circuit. Each -48V battery lead has its own ground lead paired with it.

SECTION II - DETAILED DESCRIPTION

1. 350 Hz FREQUENCY GENERATOR - FS 1

1.01 The -13V and -26V voltages are derived from the zener diode shunt voltage regulator, consisting of CR1 and CR2 zener diodes, R1 series resistor, and C2 and C3 capacitors. The zener diodes are 13V ±5 percent, so the -13V will be in the range 12.3 to 13.7V and the -26V will be in the range 24.7 to 27.3V.

1.02 The adjustable bias voltage which supplies the bias to the Q1 and Q2 oscillator transistors is adjusted to provide approximately the voltage value shown in FS 1, with respect to the -13 volt output, depending on the option furnished. This is accomplished by adjusting the BIAS ADJ 1 potentiometer.

1.03 The Q1 and Q3 transistors are connected in the Darlington compound connection for the purpose of obtaining an equivalent transistor having a current gain α very close to unity (minimum combined α = 0.9996 for minimum individual α = 0.98). The equivalent transistor thereby derived is used as the first stage Hartley oscillator transistor. The oscillator has a second stage consisting of Q3 and Q4 transistors connected as a class B amplifier. Part of the output of this amplifier is used to provide positive feedback through R3 resistor to sustain oscillations. The R4 and R5 resistors provide temperature stabilization to compensate for the effects of I_{cbo}. The L1 inductor and C4 capacitor are connected in parallel and represent the oscillator tank circuit which is designed to oscillate at 350 Hz. The amplitude limiting and thus the magnitude of output voltage is controlled by the adjustable bias voltage applied to the collectors of Q1 and Q2 transistors. The output of the frequency generator is a 350 Hz sine-wave with a total harmonic distortion content at least 45 dB down from the fundamental.

2. 440 Hz FREQUENCY GENERATOR - FS 2

2.01 The description of the 440 Hz frequency generator is identical to that given for the 350 Hz frequency except for the frequency of oscillation 440 Hz which is obtained by using a lower inductance value in the tank circuit inductor, the resistance value of several resistors, and the component designation numbers.

3. SUMMING CIRCUIT - FS 3

3.01 The sine-wave outputs from the two frequency generators described above are fed into a summing circuit FS 3 to produce the desired TOUCH-TONE dial tone signal. The resulting dial tone signal wave form resembles an amplitude modulated signal but in fact contains no modulation products, because it is produced by the phenomena of beating two frequencies with each other. The amplitude of the dial tone signal varies as the difference frequency and both frequencies are present within the envelope, however, there are no product or sum frequency components. The summing circuit consists of a three winding transformer T1, C10A and C10B blocking capacitors, a C9 distortion reducing capacitor, and a R6 resistor. The output of the 350 Hz frequency generator is fed into terminal 1 of primary winding (1-2) of T1 transformer, and the output of the 440 Hz, is fed into terminal 6 of primary winding (5-6). Terminals 2 and 5 are ac coupled by two, 2000 µF electrolytic, blocking capacitors. Therefore, under normal operating conditions, the output of one frequency generator passes through a primary winding, two capacitors, a second primary winding and then into the other frequency generator in order to return to ground and in turn to its own ac ground -13V dc. The R6 resistor has no effect on the output voltage produced under normal operating conditions because of its relatively high impedance to ground compared to the ground return impedance presented by the other frequency generator. The C9 capacitor also has no effect on the output voltage under normal operating conditions, because its impedance is relatively high compared to the primary windings of T1 transformer and C10A and C10B capacitors. The C9 capacitor reduces the harmonic distortion produced by the T1 transformer by tuning out the transformer excitation currents. However, in the event of a circuit failure in one of the generators or transformer primary windings, the impedance of the ground return for the other generator would be affected and possibly become infinite, thereby tending to cause a partial or complete dial tone failure. The R6 resistor serves to avoid a complete dial tone failure. This is accomplished by providing a reliable ground return through R6 resistor for the surviving frequency generator.

3.02 The worst case occurs when the circuit failure opens the ground return. The summing circuit then changes its mode of operation and the output of the surviving frequency generator passes through only one primary winding, one blocking capacitor and R6 resistor in order to return to ground. The output of the surviving frequency generator also passes through C9 capacitor, the other primary winding, the other blocking capacitor and R6 resistor to ground. This signal path contributes about 12 percent of the output voltage.

3.03 Under these conditions the dial tone consists of one frequency (either 350 Hz or 440 Hz) and the transformer turns ratio changes from about 3.2:1 to 1.6:1. The output voltage provided under trouble conditions is determined by the value of R6 resistor and the change in the transformer turns ratio. The R6 resistor and the transformer primary winding associated with the surviving frequency generator represent a voltage divider. Therefore, under trouble conditions a wide range of (single frequency) output voltage level may be obtained by design. This involves choosing the proper resistance value for R6 resistor. The dial tone signal output is single-sided and unbalanced with the tone superimposed on ground and appears across terminals 7 and 8 of T1 transformer.

3.04 The tone generator is self-protecting, in that, an accidental short circuit applied across terminals 7 and 8 of T1 transformer will not result in any damage.

4. TONE MONITOR - FS 4

4.01 The tone monitor circuit is provided only when duplicate dial tone generators are furnished in large step-by-step PBXs, and this combination of tone generators and monitor circuit coded as a 405A or 405B tone generator. Under this provision one tone voltage monitor is provided for each of the generators. Both monitors are identical, therefore, the operation of only one of the monitors will be given. The test signal TT4 is fed in through the HLV LEV 1 potentiometer to a voltage doubler rectifier made up of CR5 and CR6 diodes and C11 and C12 capacitors. The resulting dc signal, with the polarity shown, is fed to the base of Q9 transistor, which is the signal half of a differential amplifier. The base to emitter junction of Q9 is forward biased so that collector current flows through R19 resistor to -25V. The base of Q10 transistor is clamped, with respect to ground, at about 1.6V by CR7 zener diode, and the voltage divider across it, made up of R16 resistor and the HLV REF 1 potentiometer. Thus, Q10 transistor is also forward biased, so collector current flows through R20 resistor to -25V. A bridge arrangement is formed by Q9 and Q10 transistors and R19 and R20 resistors. The HLVM1 relay winding is connected across the bridge. When the dial tone signal is at its nominal level, the relay winding has approximately 2V across it, with polarity plus to minus from TP13 and TP14. This initial unbalance is necessary in order to obtain alarm limits that are summetrical with the nominal dial tone level. The circuit unbalance is obtained by adjusting the base drive to Q9 transistor by means of the HLV LEV 1 potentiometer.

4.02 The -25V is derived from -48V by a zener diode shunt voltage regulator. The regulator consists of R22 resistor, CR8 zener diode and RV1 thru RV3 varistors. The varistors are strapped out as required in order to provide a closer tolerance on the -25V than is provided by the ±5 percent -24 volt zener diode.

4.03 If the TT4 voltage should become high, the voltage across C12 capacitor will become higher, increasing the base drive to Q9 transistor and thus, increasing its collector current and decreasing its collector to emitter voltage. The increase of Q9 transistor collector current will increase the voltage drop across R18 resistor. This voltage is plus to minus from ground to the emitter of Q10 transistor. The forward bias for Q10 transistor will decrease, due to the increased voltage drop across R18 resistor, and therefore, decrease its collector current and increase its collector to emitter voltage. If the collector to emitter voltage of Q9 transistor decreases and that of Q10 transistor increases, there will be an increase in the voltage unbalance across the HLVM1 relay. When the unbalance becomes great enough, the HLVM1 relay will operate.

4.04 In a similar manner if the TTR voltage should become low, Q9 transistor will start to turn off (increase its collector to emitter voltage). With the resulting reduction in its collector current, the voltage drop across R18 will become smaller. The result is that the forward bias to Q10 will increase. The increase of base current to Q10 will increase its collector current and decrease its collector to emitter voltage. Since the voltage across Q9 is increasing . and that across Q10 is decreasing, the resulting unbalance of voltage across the HLVM1 relay will cause it to operate.

4.05 When the voltage monitor HLVM1 relay operates, a holding ground through the 2-break contact on the HLVM1 relay is removed so that GT relay can operate. The 1-make contact closes a ground to HLVM1 lamp which then lights. When the voltage monitor HLVM2 relay operate, a holding ground through the 2-break contact on the HLVM2 relay is removed so that TF relay can operate. The 1-make contact closes a ground to the HLVM2 lamp which then lights.

4.06 Under normal operating conditions, with GEN 1 supplying the load, GT relay is released. It is shunted down to ground through its low 5-break contact, the "AUTO" position contact of the S1 TRFR switch and the number 2-break contact of HLVM1 relay. If HLVM1 relay in monitor 1 should operate due to a trouble in the GEN 1 regular generator, the holding ground will be removed. The GT relay will then operate through GT resistor and the RT1 thermistor. The RT1 thermistor will delay the operate of the GT relay about 2 seconds and then it is shorted out by the 4-make contact on GT relay when GT relay operates. When the GT relay operates, the lead transfers to GEN 2, the GT lamp lights and the parallel holding ground for the TF relay, provided by the GT relay 6-break contact is removed. Also the GT relay locks up in the operated position due to its own 5-break contact. The TF relay will operate through TF resistor and RT 2 thermistor. The RT2 thermistor will delay the operate of the TF relay by about 2 seconds and then it will be shorted out by the 4-make contact on the TF relay when TF relay operates. When the TF relay operates, it provides a ground, through its 3-make contact over the "CAP" lead to the MISC ALM CKT to provide a minor visual alarm. It also provides a ground through its 2-make contact over the "F" lead to the alarm circuit to provide a minor alarm. After the trouble has been cleared the circuit can be restored by momentarily operating the S2 RST switch, which shunts down the GT relay and places it back under the control of the monitor 1 relay. The load may be manually transferred to GEN 2 by operating the S1 TRFR switch and restored by momentarily operating the S2 RST switch. Although the 6-break contact of the GT relay which shunts down the TF relay is removed by the operation of the S1 TRFR switch. No visual or audible alarm will occur because the S1 TRFR switch provides a set of contacts to parallel the 6-break contact of the GT relay. However, when the S1 TRFR switch is put back to its "NOR" position the GT relay remains operated, so no more than 1.5 to 2 seconds shall elapse before operating the S2 RST switch, to reshunt down the GT relay, which shunts down the TF relay or else an alarm will occur.

4.07 The TF relay is normally shunted down to ground by the 2-break contact on the HLVM2 relay in series with the 6-break contact on the GT relay. If GEN 1 is operating normally and GEN 2 should fail, operating the HLVM2 relay, TF relay will operate and provide the minor alarms described above in 4.06.

5. ROUTINE VOLTAGE CHECKS

Generators

5.01 These generators are factory adjusted and normally should not require field adjustment. The following voltage measurements will verify the factory adjustment. The test equipment required to perform the tests described below are as follows:

(a) One KS-14510, L1 volt-ohm-milliammeter (VOM), 3V ac scale or equivalent.

(b) Remove all supply and discharge fuses.

(c) Install TTA input fuse feeding the 350 Hz frequency generator.

(d) Verify that 1.30 to 1.55V "Z" options and 1.60 to 1.85V "Y" option, exists between TP11 and TP4 pin jacks.

(e) Remove the TTA fuse feeding the 350 Hz frequency generator and insert the TTB fuse feeding the 440 Hz frequency generator.

(f) Verify that 0.95 to 1.20V "Z" option and 1.60 to 1.85V "Y" option, exists between TP11 and TP4 pin jacks.

(g) Install the TTA fuse feeding the 350 Hz frequency generator.

(h) Verify that 1.50 to 1.75V "Z" option and 2.05 to 2.30V "Y" option, exists between TP11 and TP4 pin jacks.

Note: If duplicate generators are furnished, the above tests should be performed on each unit.

Monitors

5.02 These monitors are factory adjusted and normally should not require field adjustment. The following voltage measurements will verify the factory adjustment. Insert fuse designation F3. Remove the TTA input fuse feeding the 350 Hz frequency generator of the regular generator. Verify that the HLVM1 and GT lamp lights. To verify that the spare generator is now feeding the load:

(a) Connect the VOM meter to the tone distributing circuit and verify that the voltage is between 2.05 and 2.30V.

(b) Install TTA input fuse feeding the 350 Hz frequency generator.

(c) Operate the S2 RST switch to restore the circuit to the regular generator.

(d) The HLVM1 and GT lamps should extinguish.

(e) Verify that the voltage is between 2.05 and 2.30V.

(f) Operate the S1 GEN TRFR switch to bring in the spare generator.

(g) Remove the TTA input fuse feeding the spare 350 Hz frequency generator.

(h) Verify that the HLVM2 lamp lights.

(i) Operate the S2 RST switch to restore the circuit to the regular generator.

(j) The HLVM2 lamp should extinguish.

6. ADJUSTMENTS

6.01 If the generators do not meet the voltage measurements as outlined in 5.01, then they must be adjusted per the following procedure:

(a) Insert a resistor in the vicinity of 35 kΩ to 50 kΩ between TR8 and TP10 pin jacks.

(b) Connect a thermocouple voltmeter with a 3-volt scale (Weston Model 622 or equivalent), between TP11 and TP4 pin jacks.

(c) Adjust the BIAS ADJ 1 potentiometer to provide 1.41-volt rms for the "Z" option and 1.70-volt rms for the "Y" option.

(d) Remove the resistor from TP8 and TP10 pin jacks and insert it between TP3 and TP5 pin jacks.

(e) Adjust BIAS ADJ 2 potentiometer to provide 1.06-volt rms for the "Z" option and 1.70-volt rms for the "Y" option.

(f) Remove the resistor from TP3 and TP5 pin jacks.

(g) The voltage measured shall be 1.75 ±0.01 volt rms for the "Z" option and 2.40 +0, -0.03 volt rms for the "Y" option.

6.02 If the monitors do not meet the voltage measurements outlined in 5.02, then they must be adjusted per the following procedure:

(a) Verify that 2.40 +0, -0.03 volt rms exists between TP11 and TP4 pin jacks, using a thermocouple meter that is described in 6.01.

(b) Adjust HLV REF 1 potentiometer to provide 1.60-volt dc between pin jacks, TP12 "-" lead and TP15 "+" lead for monitor 1, between pin jacks, TP16 "-" lead and TP15 "+" lead for monitor 2 (use KS-14510, L1 VOM or equivalent, set on 3V scale).

(c) Turn HLV LEV 1 potentiometer completely clockwise and connect the VOM (set on the 12V scale) between TP13 and TP14 pin jacks for monitor 1, and TP17 and TP18 for monitor 2, observing that the "+" lead of the VOM is inserted in TP13 or TP17 pin jack.

(d) Slowly turn HLV LEV 1 potentiometer counterclockwise until the VOM reads approximately 2.0V, then change meter to 3V scale for a final reading of 2.0V.

(e) Reverify the 2.40 +0, -0.03 volt rms reading between TP11 and TP4 pin jack with the thermocouple voltmeter.

(f) Leave the thermocouple voltmeter connected and slowly turn the BIAS ADJ 1 potentiometer counterclockwise until the HLVM1 relay operates and note the output voltage reading. The relay shall operate within the limits of 1.85 to 2.04V rms.

(g) Slowly turn the BIAS ADJ 1 potentiometer clockwise until the output voltage is 2.40 +0, -0.03 volt rms. The relay should be released. Repeat this procedure for monitor 2.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 DC Input:

-44 to -52.6V maximum current drain 0.40 amperes.

1.02 Output:

(a) TT1:

350 Hz - 1.41V rms
440 Hz - 1.06V rms
Combined - 1.75V ±12 percent rms
Maximum load 24 connections of
Z = 800Ω -60° each

(b) TT4:

350 Hz - 1.58V rms
440 Hz - 1.58V rms
Combined - 2.24V ±9 percent rms
Maximum load 108 connections of
Z - 330Ω -55° each

(c) TT1 & TT4 Frequency:

350 Hz, 440 Hz ±1 percent

1.03 Ambient Temperature:

0° to 60°C

1.04 Harmonic Distortion: Total harmonic distortion content 40 dB down from the fundamental tone level.

2. FUNCTIONAL DESIGNATIONS

None

3. FUNCTIONS

3.01 This circuit is designed to perform the following functions:

(a) To provide dial tone for small PBXs (less than 200 lines) from a single dial tone generator with built in redundancy for improved reliability with minimum expense.

(b) To provide dial tone for large PBXs on an optional basis either from a single dial tone generator or from duplicate dial tone generators with provision for automatic transfer to the spare generator in case of failure of the regular generator.

(c) To provide a high-low voltage, tone monitor on the output of each generator (only when duplicate generators are furnished) which will initiate an automatic transfer for the regular generator.

(d) To provide for a manual transfer from the regular generator to the spare generator by operating a switch.

(e) To provide for a manual reset from the spare generator to the regular generator by operating a switch.

(f) To provide alarms indicating failure of either regular or spare generator (only when duplicate generators are furnished).

4. CONNECTING CIRCUITS

None

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus

B.1

Removed	Replaced By
GT, TF Resistors, KS-8512,L3A, 1200Ω - FS 4 & APP Fig. 4 & 6	GT, TF Resistors, KS-8512,L4A, 825Ω - FS 4 & APP Fig. 4 & 6

D. Description of Changes

D.1 The change in value of the GT and TF resistors provides for more reliable operation of the GT and TF relays at -44V battery voltage.

D.2 The record of change notes in CPS 1 thru CPS 4 have been brought up to date for issue 6B.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5454-JGS-CSK-EAA