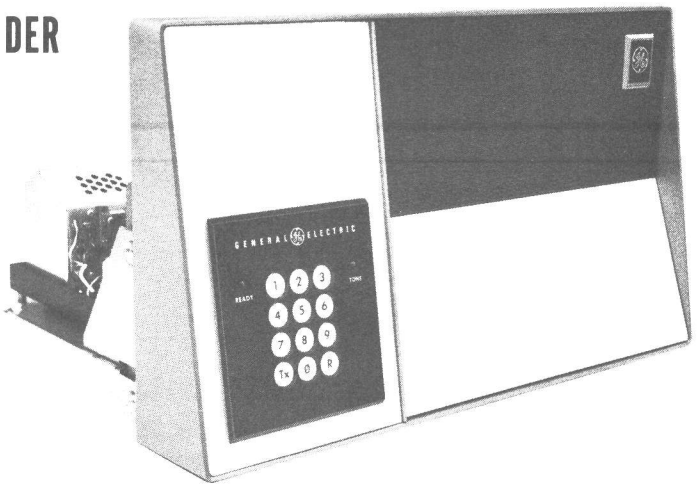
MOBILE RADIO

MAINTENANCE MANUAL

TYPE 99 TONE
SERIES 102 ENCODER



Maintenance Manual LBI-4407B

SERIES 102

SPECIFICATIONS *

SUPPLY VOLTAGE	117 VAC ±20%, 50/60 Hz
INPUT POWER	15 Watts
STANDBY VOLTAGE	12 VDC (nominal)
TEMPERATURE RANGE	-30°C to +60°C
HUMIDITY	90% at 50°C (EIA)
FREQUENCY STABILITY	0.1%
TONE OUTPUT LEVEL	0 to 100 mV (adjustable)
FREQUENCY RANGE	288 to 1433 Hz
STANDARD TONES AVAILABLE	31 (517.5 to 967.5 Hz)
FREQUENCY RESPONSE	±1 dB (from 288 to 1433 Hz)
Tx KEYING CURRENT	500 mA Maximum

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

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WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

The General Electric Type 99 Tone Encoder (Series 102) provide selective calling from base stations to mobiles, personal paging receivers, portable two-way units, or between base stations. The encoders utilize sequential tone signaling to permit INDIVIDUAL CALL, GROUP CALL and/or ALL CALL within a single communication system that is properly equipped with the required tone decoders.

The Series 102 encoder is designed for use in the turret right section of a Command Control Center. The components are mounted on a drawer-type chassis which can easily be removed from the turret for maintenance.

The encoder paging code selection panel consists of twelve, light-pressure switches. Status indication is provided by two light emitting diodes (LEDs), marked READY to signal the operator that the system is idle and prepared to accept a call, and TONE which flashes the moment code selection is complete and the desired call is being transmitted.

Transmitter keying is automatic. A manual transmit button is provided (marked TX) for remote transmitter keying independent of the encoding action. A switch marked R is used to reset the encoder or to cancel an incorrect or undesired code in progress.

The encoder has a self-contained power supply and voltage regulator. Plug-in interchangeable printed boards utilize integrated circuit logic packages to assure maximum flexibility and freedom from falsing. 16, 64, 100, 400 or 900 call capacity is available. A single RC feedback circuit package, along with a three-stage high gain DC amplifier provides all the required tone frequencies. Frequency selection is accomplished by changing the "R" value of the oscillator feedback loop.

TONE ASSIGNMENTS

A total of thirty one tones are available as standard. Others are available by special request. The tone assignments are made as follows:

TABLE 1 - TONE ASSIGNMENTS

Encoder Comb. Series	Number of digits used in Code	Call Capacity	Tone Assignments
102X1B	2	16	742.5 Hz plus Subgroup A
102Y1B	2	16	742.5 Hz plus Subgroup B
102Z1B	2	16	742.5 Hz plus Subgroup C
102X2B	3	64	742.5 Hz plus Subgroups A & B
102Y2B	3	64	742.5 Hz plus Subgroups B & C
102Z2B	3	64	742.5 Hz plus Subgroups A & C
102X3B	2	100	742.5 Hz plus Group A
102Y3B	2	100	742.5 Hz plus Group B
102Z3B	2	100	742.5 Hz plus Group C
102X4B	3	400	742.5 Hz plus Groups A & B
102Y4B	3	400	742.5 Hz plus Groups B & C
102Z4B	3	400	742.5 Hz plus Groups A & C
102X5B	3	900	742.5 Hz plus Groups A, B & C

TABLE 2 - FORMAT SELECTION

100's Digit Selected	Tone Bank (Group) Selected			
	For 1st Tone		For 2nd Tone	
	Bank	Tone Group Format: X Y Z	Bank	Tone Group Format: X Y Z
0*	1	A B A	1	A B A
1	2	B C C	1	A B A
2*	2	B C C	2	B C C
3	1	A B A	2	B C C
4*	3	C	3	C
5	3	C	1	A
6	3	C	2	B
7	1	A	3	C
8	2	B	3	C
9	Not Used			

* Diagonal Tone is substituted for 1st Tone when these digits are selected and 2nd and 3rd digits are identical.

The first digit in the paging code (hundreds digit in 64, 400 and 900 call codes) determines the tone sequence format by selecting the tone banks (tone groups) which will determine the actual tones which are selected by the tens and units digits. No format selection is required in the 16 and 100 call encoders. Table 2 indicates which tone banks are selected by each hundreds digit. If digit "3" is selected (Format X), the first tone will be selected from Bank 1 (Tone Group A) and the second tone will be selected from Bank 2 (Tone Group B). An example will explain this more clearly:

Example 1: When paging code "175" (Format X) is to be selected, the calling party selects digit "1". From Table 2, you can see that the "1" digit selects the first tone from Bank 2 (Tone Group B) and the second tone from Bank 1 (Tone Group A). The "7" and "5" digits select tones B7 and A5, respectively. So the first tone transmitted is tone B7 (517.5 Hz) and the second tone transmitted is A5 (892.5 Hz). You can find these tone frequencies from Table 3.

In the 64, 400 and 900 call systems, it is possible to select the same tone twice. If the first digit of the code is "0", "2", or "4", both tones will be selected from the same tone group. If the second and third code digits are identical, the Diagonal Tone frequency (742.5 Hz) will be substituted for the first tone.

The 16 and 64 call encoders select from tone subgroups as indicated in Table 1. Table 4 lists the tone frequencies making up these subgroups.

TABLE 3
TONE SELECT GROUP FREQUENCIES

Tone Group	Tone No.	Tone Frequency
A	A0	682.5 Hz
	A1	592.5 Hz
	A2	757.5 Hz
	A3	802.5 Hz
	A4	847.5 Hz
	A5	892.5 Hz
	A6	937.5 Hz
	A7	547.5 Hz
	A8	727.5 Hz
	A9	637.5 Hz
B	B0	652.5 Hz
	B1	607.5 Hz
	B2	787.5 Hz
	B3	832.5 Hz
	B4	877.5 Hz
	B5	922.5 Hz
	B6	967.5 Hz
	B7	517.5 Hz
	B8	562.5 Hz
	B9	697.5 Hz
C	C0	667.5 Hz
	C1	712.5 Hz
	C2	772.5 Hz
	C3	817.5 Hz
	C4	862.5 Hz
	C5	907.5 Hz
	C6	952.5 Hz
	C7	532.5 Hz
	C8	577.5 Hz
	C9	622.5 Hz
Diagonal Tone:		742.5 Hz

TABLE 4 - TONE
SELECT SUBGROUP FREQUENCIES

Tone Subgroup	Tone No.	Tone Frequency
A	A0	682.5 Hz
	A1	592.5 Hz
	A2	757.5 Hz
	A3	802.5 Hz
B	B0	652.5 Hz
	B1	607.5 Hz
	B2	787.5 Hz
	B3	832.5 Hz
C	C0	667.5 Hz
	C1	712.5 Hz
	C2	772.5 Hz
	C3	817.5 Hz
Diagonal Tone:		742.5 Hz

COMPONENT BOARD SELECTION

Table 5 is a Component Board Selection Matrix, designed to allow the serviceman to quickly determine the specific boards used in the particular encoder he is servicing.

To use the matrix, the serviceman determines the combination number of the encoder (marked on the chassis nameplate) and, using the 4th. and 5th. digits of the combination number, finds the board combination for his particular encoder from Table 5. This is accomplished by reading down the column corresponding to the 4th. and 5th. digits of the encoder combination number (for example, X1 or Z2, etc.), finding each dot in that column and reading to the left of each dot to find the specific component boards and their number.

TABLE 5 - COMPONENT BOARD SELECTION MATRIX

BOARD TITLE & NUMBER	4th & 5th Digits of Combination No.												
	X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3	X4	Y4	Z4	X5
OUTPUT SEQUENCE 19D416493G1	•	•	•	•	•	•	•	•	•	•	•	•	•
STORAGE 19D416314G1	•	•	•	•	•	•							
STORAGE 19D416320G1							•	•	•	•	•	•	•
INPUT MATRIX 19C320080G1	•	•	•	•	•	•							
INPUT MATRIX 19C320080G2							•	•	•	•	•	•	•
OSCILLATOR 19C320086G1	•	•	•	•	•	•	•	•	•	•	•	•	•
FREQUENCY SELECT 19D416469G1	•			•		•							
FREQUENCY SELECT 19D416469G2		•		•	•								
FREQUENCY SELECT 19D416469G3			•		•	•							
FREQUENCY SELECT 19D416469G4							•			•		•	•
FREQUENCY SELECT 19D416469G5								•		•	•		•
FREQUENCY SELECT 19D416469G6									•		•	•	•
FORMAT 19D416327G1	•	•	•				•	•	•				
FORMAT 19D416327G2				•	•	•							
FORMAT 19D416325G1										•	•	•	•

OPERATION

To page a receiver:

1. If the system is idle, the READY light on the encoder will be illuminated.

2. Sequentially depress the two (or three) pushbuttons on the panel corresponding to the assigned paging code of the receiver to be paged. When the tone code is being transmitted, the TONE light will flash.

CAUTION

Do not use a sharp-pointed instrument (such as a ball-point pen or pencil) to depress the pushbuttons as damage to the buttons will result.

3. The station transmitter will remain keyed for five seconds after the tone sequence is complete, allowing the operator to transmit a brief voice message. The encoder will then automatically reset and be ready for the next page at the end of this five second period.

NOTE

If it is desired to interrupt a page before completion, press the button marked R to reset the encoder.

4. To transmit a voice message without paging, use the Tx button on the panel as a normal PTT switch. Depressing the Tx button also resets the encoder if it is depressed at the end of the tone transmission but prior to automatic reset.

CIRCUIT ANALYSIS

Paging Code Selection (Figure 1)

When the operator depresses the switch on the encoder panel which corresponds to the first digit of the paging code, the closing of the switch contact connects the +4.8 VDC supply voltage to the base of the corresponding buffer transistor through a Switch-bounce suppressor RC network on the Input Matrix Board. For example, if the digit 5 switch is depressed, the supply voltage is applied to the base of Q6 on the Input Matrix Board, turning Q6 on.

When Q6 conducts, the collector goes to ground, applying a logic "0" to pin 4 of OR gate IC1-A and pin 10 of OR gate IC2-B. OR gate IC1-A codes the input to binary "1" at its output and IC2-B codes the input to binary "4" at its output. Binary "1" and binary "4" correspoind to the decimal 5 selected at the push switch. The binary coding is connected to the Storage Board and the Format Board. In 16 and 64 call encoder modes, only digits 0 through 3 are used for selecting the paging codes, uti-

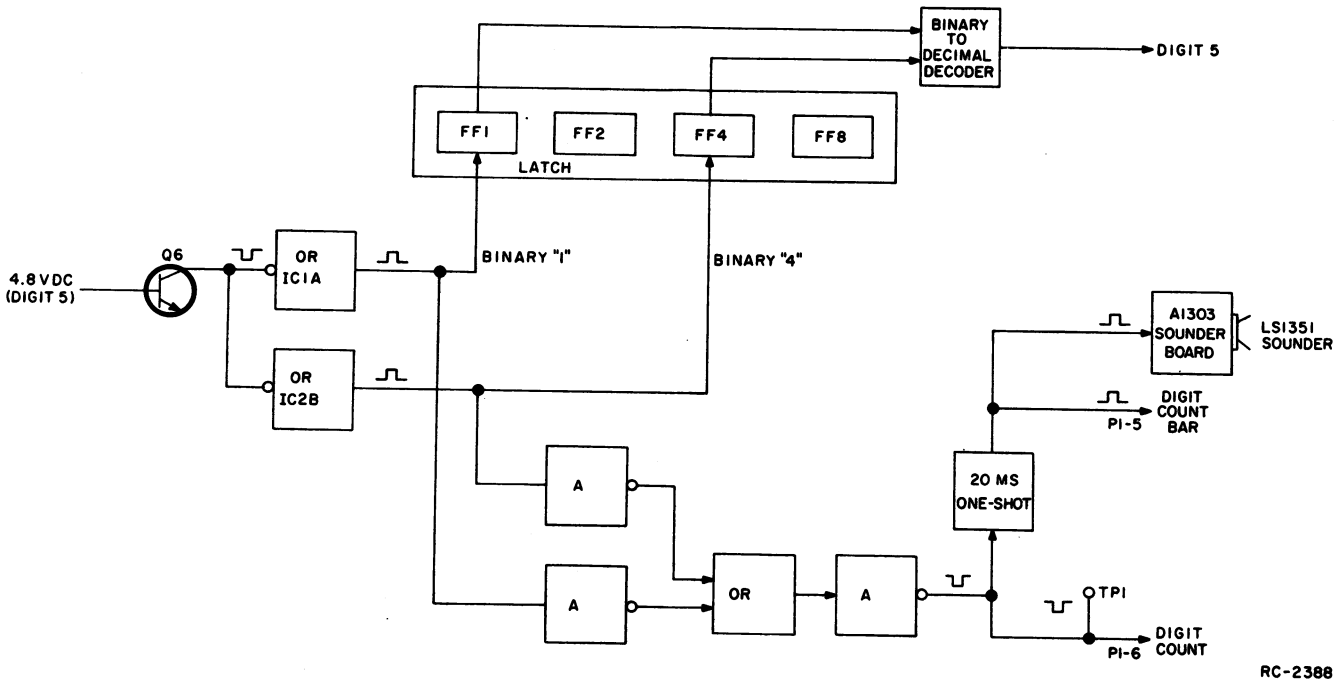


Figure 1 - Paging Code Selection

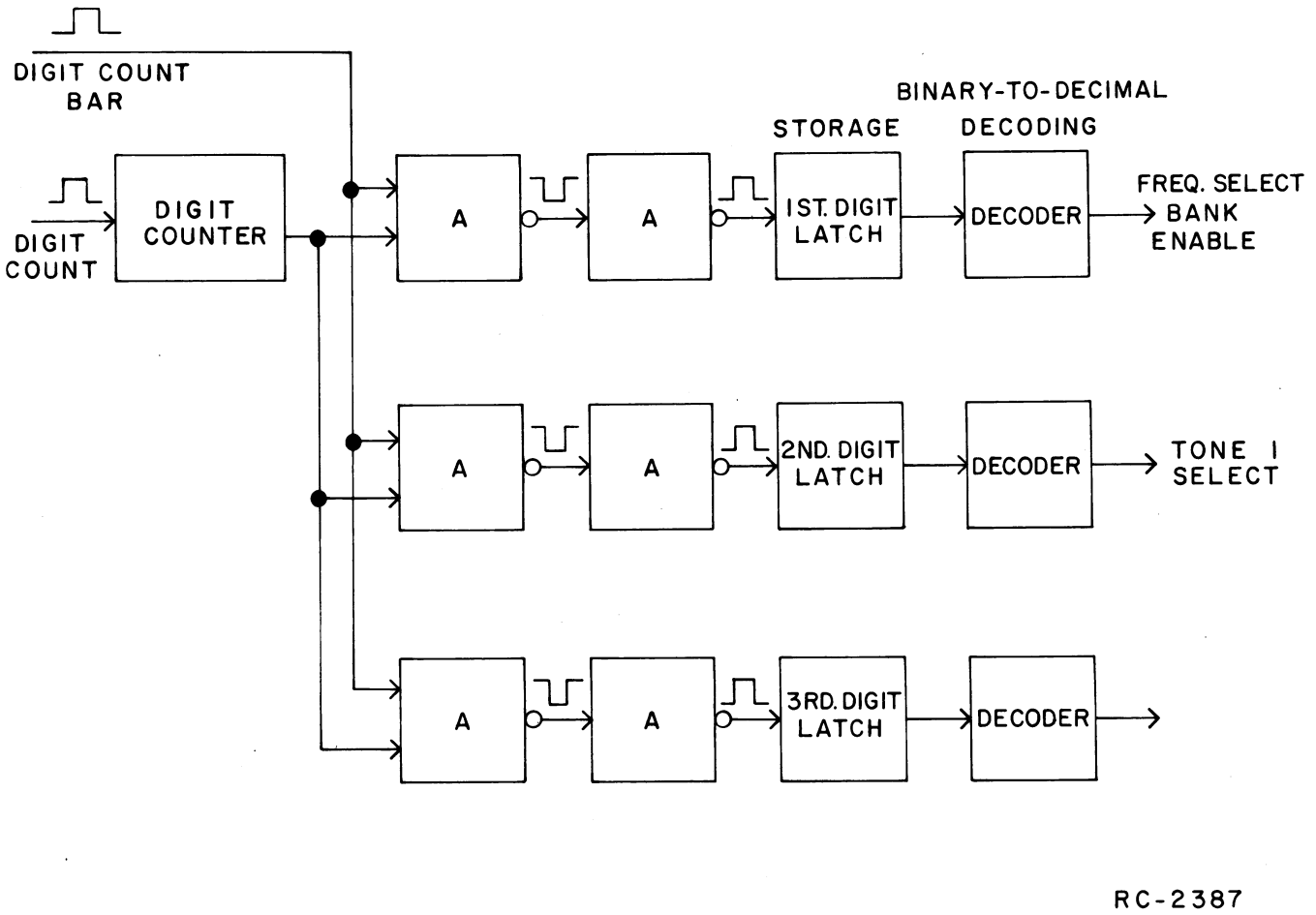


Figure 2 - Digit Counting and Storage

lizing binary "1" and binary "2". In the 100, 400 and 900 call encoders, all ten digits are used, utilizing binary "1", "2", "4", and "8".

The binary coded output of the OR gates is also applied to the 20 millisecond one-shot multivibrator which supplies pulses to the DIGIT COUNT lead P1-6. This information is also passed to the DIGIT COUNT BAR lead P1-5.

The logic "1" on the P1'5 lead is connected to the Sounder Board A1303 which reverse biases diode CR1, turning on the multivibrator (Q1-Q2). The multivibrator operates the beeper transducer LS1351 for the duration of the 20 millisecond one-shot. This gives a positive audible indication of the operation of the keyboard switch.

Digit Counting and Storage (Figure 2)

As each digit of the paging code is selected, the DIGIT COUNT output of the Input Matrix Board triggers DIGIT COUNTER flip flops IC1 and IC2 on the Format Board. The output of the counter is ANDed with the DIGIT COUNT BAR pulses to provide triggering to the LATCH circuits.

In the 64, 400 and 900 call encoders, three paging code digits must be counted. The first digit count triggers the 1ST DIGIT LATCH on the Format Board; the second and third digit counts trigger the 2nd and 3RD DIGIT LATCH circuits on the Storage Board. In the 16 and 100 call encoders, only two paging code digits are counted. The first digit counted triggers the 2ND DIGIT LATCH on the Storage Board and the second digit count triggers the 3RD DIGIT LATCH.

Storage of the binary digits is accomplished in the LATCH circuits (see Figure 11). The first paging code digit selected is gated to a Binary to Decimal Decoder and the decoded decimal selects the format (tone group and sequence) from the Frequency Select Board banks. The second and third digits selected determine

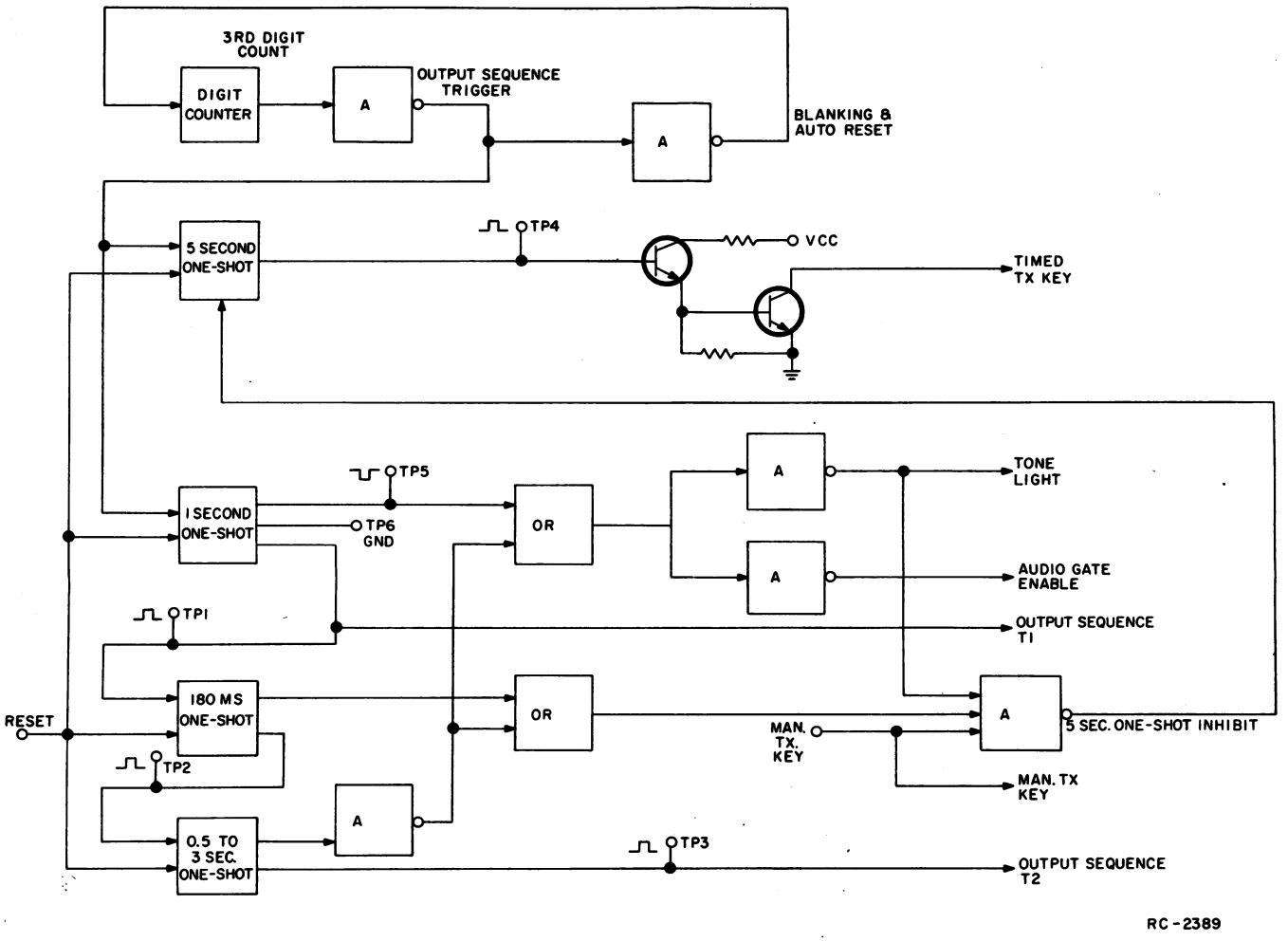


Figure 3 - Tone Sequence Triggering

the frequency of Tone No. 1 and Tone No. 2, respectively. For example, if the paging code digits are 1-3-5, the following tone selection takes place:

a. Paging code digit 1 is converted to binary "1" and stored in the 1ST DIGIT LATCH on the Format Board. The Binary to Decimal Decoder will convert the binary "1" to decimal "1" when the tone sequence is triggered, thus enabling Frequency Select Bank 2 and then Frequency Select Bank 1.

b. Paging code digit 3 is converted to binary "3" and stored in the 2ND DIGIT LATCH on the Storage Board. The Binary to Decimal Decoder will subsequently convert the binary "3" to decimal 3 which selects tone 3 from Frequency Select Bank 2. This will be the first tone transmitted in the paging sequence.

c. Paging code digit 5 is converted to binary "5" and stored in the 3RD DIGIT LATCH on the Storage Board. The BINARY TO DECIMAL DECODER will subsequently convert the binary "5" to decimal 5 which will select tone 5 from Frequency Select Board bank 1. This will be the second tone transmitted in the paging sequence.

In the two-digit paging code systems (16 and 100 call), the first digit counted is connected via the NAND gates directly to the 2ND DIGIT LATCH on the Storage Board, the second digit counted is connected to the 3RD DIGIT LATCH.

Tone Sequence Triggering (Figure 3)

When the DIGIT COUNTER has detected the third digit (the second digit in the two-digit systems), the IC4-A NAND gate on the Format Board supplies a trigger pulse

to the OUTPUT SEQUENCE TRIGGER lead P2-1. This trigger is connected to P1-13 on the Output Sequence Board. The OUTPUT SEQUENCE TRIGGER operates the 5-Second Tx One Shot to key on the station transmitter. The OUTPUT SEQUENCE TRIGGER is also inverted at IC5-A and applied to the BLANKING AND AUTO RESET lead P1-10. The trigger also operates the 1-Second Tone 1 One Shot. The BLANKING AND AUTO RESET output prevents further encoding of paging digits until after the tone sequence has been transmitted and the encoder is reset.

The 1-Second Tone 1 One Shot reads out the stored format and Tone 1 information from the Format and Storage Boards; turns on the TONE light on the encoder switch panel and opens the Audio Gate on the A1301 Mother Board.

At the completion of the first tone transmission, the 1-SECOND ONE-SHOT returns to its normal state. This initiates the 180 MILLISECOND PAUSE ONE-SHOT. The purpose of this pause is to avoid falsing in the tone decoders in the paged receiver(s). The return of this multivibrator to normal initiates the T2 ONE-SHOT to transmit the second tone T2. The T2 ONE-SHOT timing is adjustable from 0.5 to 3 seconds to provide suitable timing for different signaling systems.

At the end of the five second transmit period, the 5 Second Tx One Shot returns to its normal state, providing a pulse to the BLANKING AND AUTO RESET circuit to trigger the 20 Millisecond One Shot on the Input Matrix Board, applying a trigger pulse to the RESET line and an Output to the READY LIGHT GATE IC-4B which, in turn, turns on the READY light on the encoder keyboard. The encoder is now ready for encoding a new paging sequence. If the Tx button is depressed after transmission of T2 but prior to the time-out of the 5 second transmit period, Q5 on the Output Sequence Board is turned on, keying the transmitter and resetting the encoder.

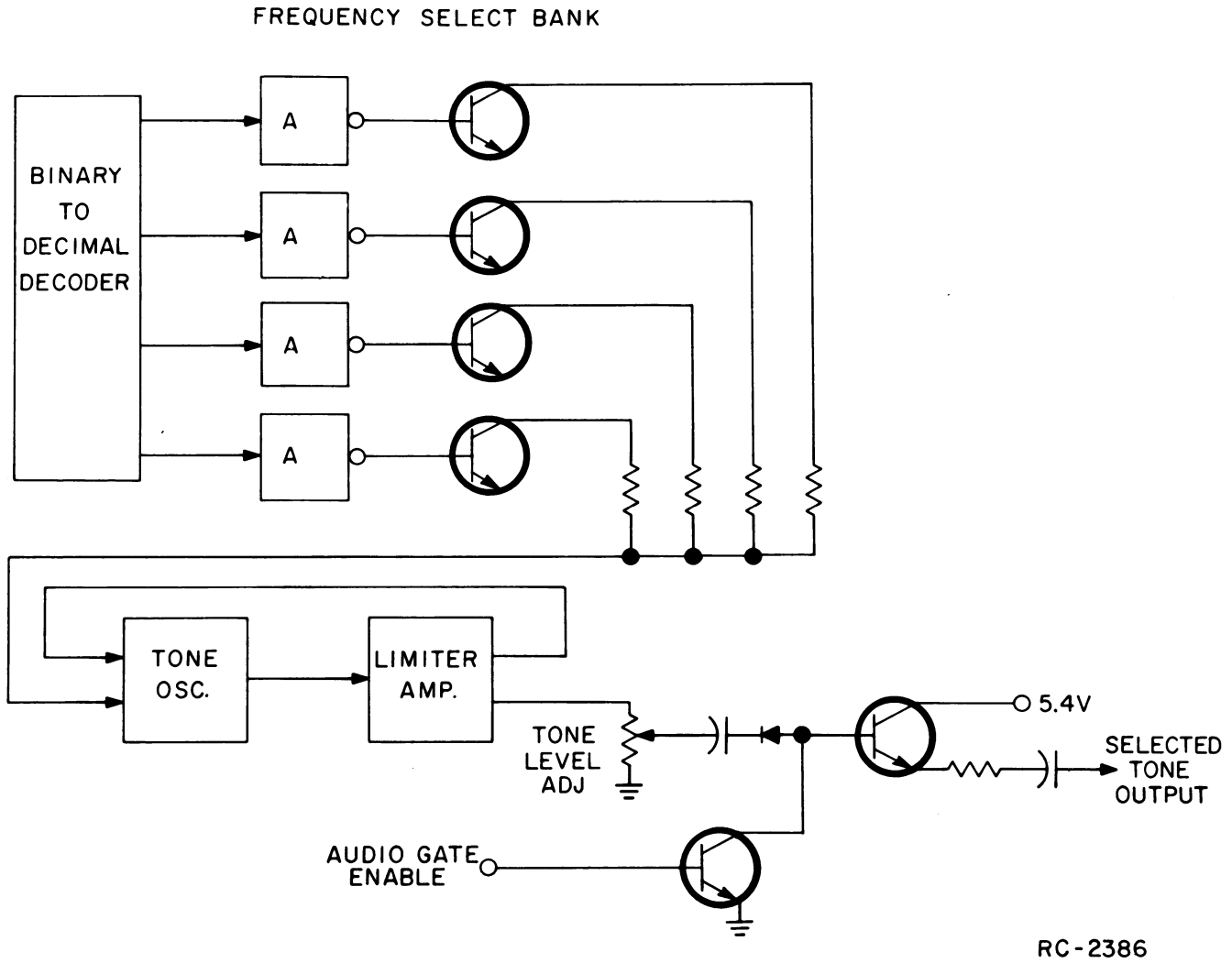


Figure 4 - Tone Frequency Selection

If the operator wishes to interrupt the paging sequence prior to its completion, he depresses the switch marked R on the key board. This turns on Q11 on the Input Matrix Board. The logic "0" output from Q11 resets the one-shot multivibrators on the Output Sequence Boards, resets the DIGIT COUNTER on the Format Board, and resets the DIAGONAL TONE flip-flop on the Storage Board if this flip-flop has been triggered. The READY light on the encoder keyboard is also turned on.

If the Tx switch on the encoder panel is depressed, Q12 on the Input Matrix Board will be turned on, turning on Q5 on the Output Sequence Board. Conduction of Q5 turns on Q8 which, in turn, keys the station transmitter. The transmitter may now be keyed using the Tx push button as a PTT switch.

Tone Frequency Selection (Figure 4)

The Tone Oscillator Board consists of an RC feedback circuit package and a high-gain DC amplifier and limiter. The frequency selective network consists of C1-C4, R4-R6 and the R value selected from the Frequency Select bank. The high-gain DC amplifier (IC-1) is buffered on each end by emitter followers to provide high input impedance and low output impedance. The output of the amplifier is coupled through another amplifier and limiter to provide positive feedback to the frequency determining network.

Frequency selection is determined by switching in any of the resistors (R1-R96 and the trimming resistors on IC-1) on the Frequency Select Board. Once the proper frequency select banks have been determined by decoding the first digit of the paging code, the transistor switches on the Frequency Select Board (Q3-Q12) that correspond to the second and third digits in the paging code are turned on. The corresponding resistors are thus connected through P1-1 on the Frequency Select Board and P1-6 on the Oscillator Board to the frequency-determining circuit of the oscillator. The frequency of the Oscillator is altered as these resistors are sequentially switched

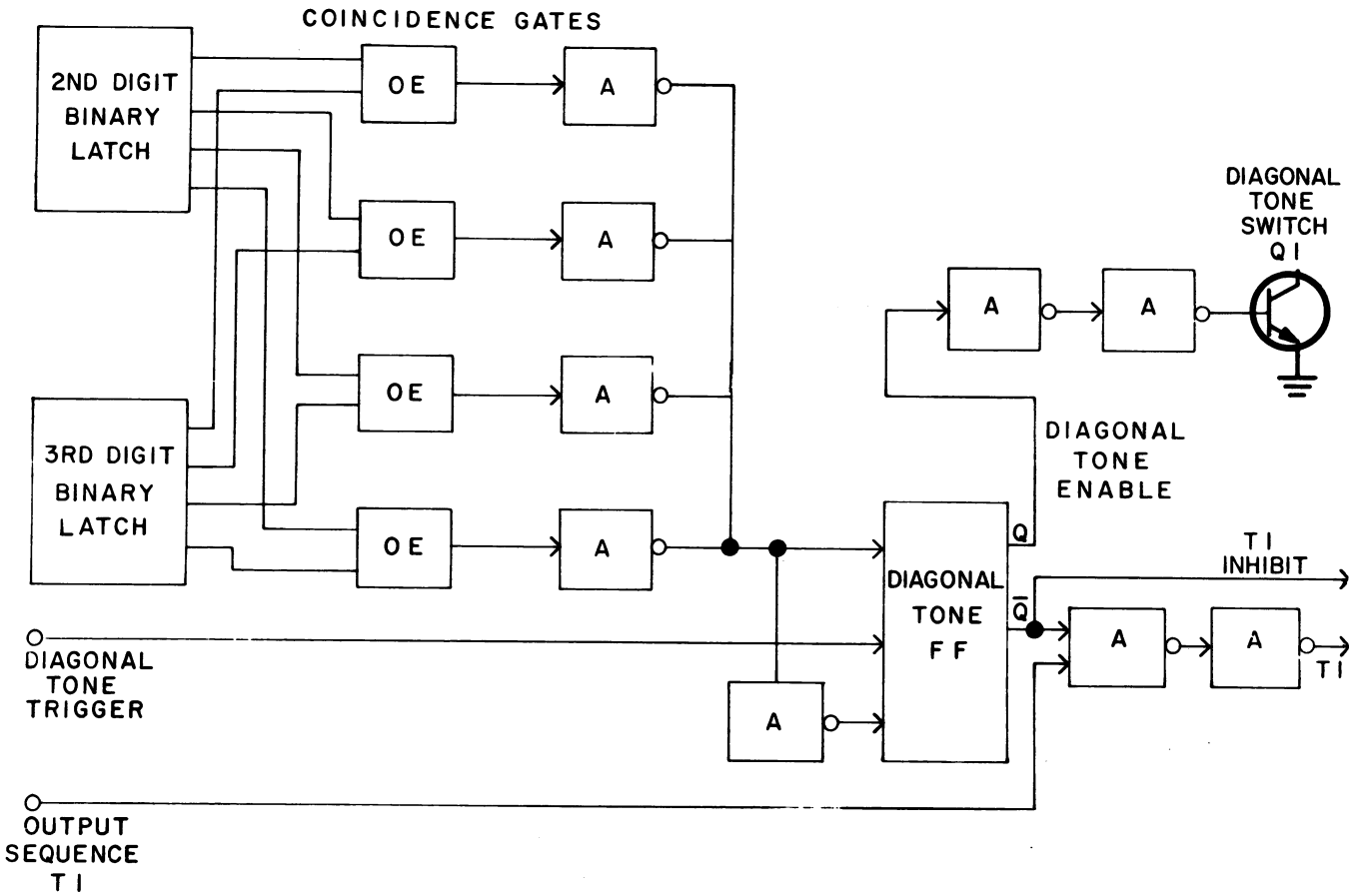


Figure 5 - Diagonal Tone Selection

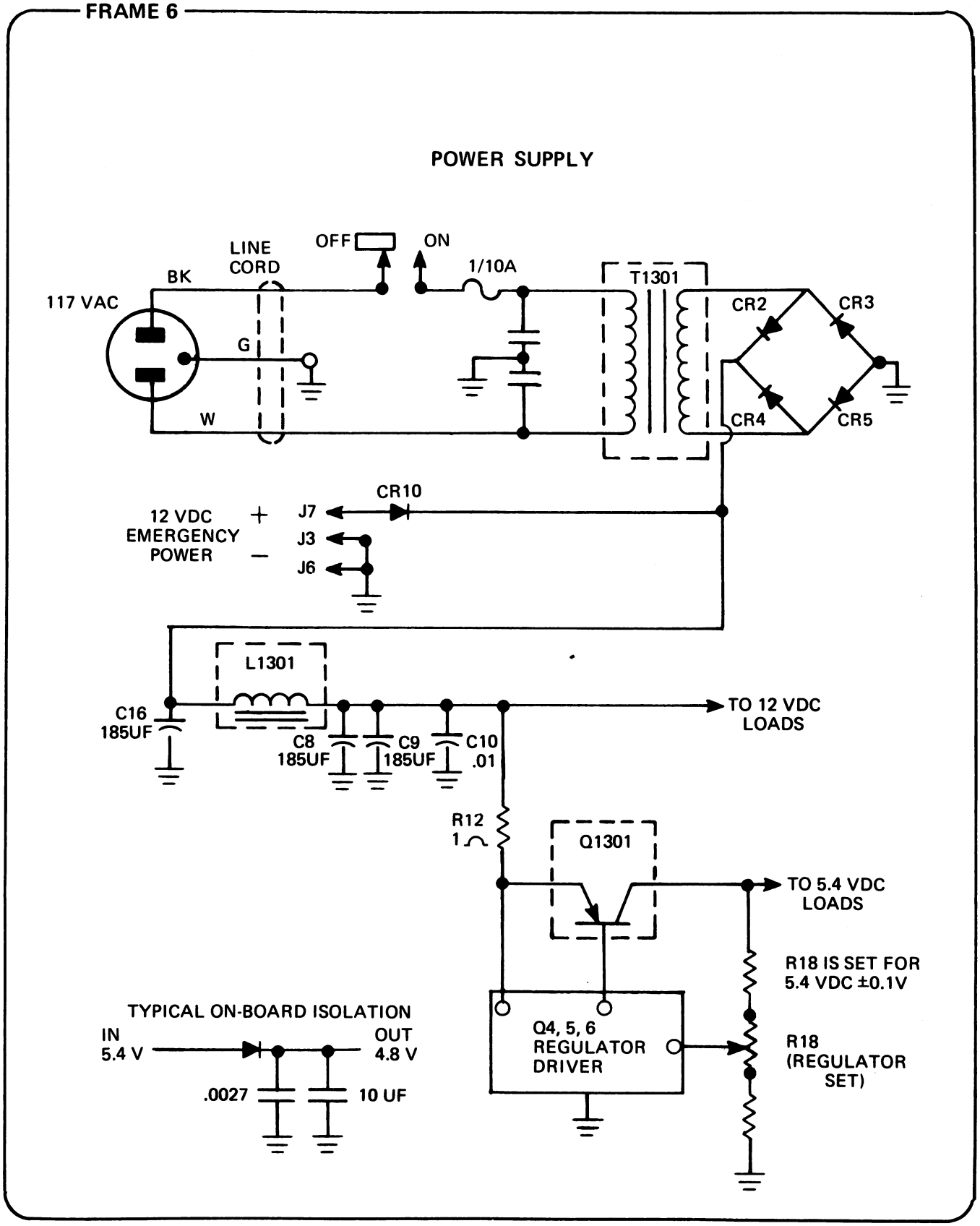


Figure 6 - Power Supply

in by the sequence gates on the Format Board. The selected tone signal is connected from P1-4 on the Oscillator Board to the input of the AUDIO GATE on the A1301 Mother Board. The tone level is adjusted at this point by TONE LEVEL ADJUST control R1. The AUDIO GATE CR1 is enabled by turning off Q1 from the Output Sequence Board. The tone is fed to J12 and to the station transmitter.

Diagonal Tone Selection (Figure 5)

In the 64, 400 and 900 call systems, it is possible to select the same tone frequency twice during a paging sequence. If the first digit of the code is "0", "2", or "4", the TONE BANK and SEQUENCE GATES will select both tones from the same bank. If the second and third paging code digits are identical, the same tone frequency would be selected for both sequence tones.

To avoid this situation, the diagonal tone frequency (742.5 Hz) is substituted automatically for the first tone in the paging sequence when these conditions are present. The Binary Latches are connected to the Diagonal Tone Exclusive OR Coincidence Gates. The output of these gates enables the Diagonal Tone Flip-Flop on the Storage Board when the situation described above is present. The DIAGONAL TONE FLIP-FLOP TRIGGER pulse occurs when the OUTPUT SEQUENCE TRIGGER arrives at the Output Sequence Board. The Diagonal Tone Flip-Flop is set and the Q output (terminal 6) switches the Tone Oscillator to the diagonal tone frequency. The $\overline{Q}$ output of the Diagonal Tone Flip-Flop (terminal 5) inhibits the T1 Tone Gates to prevent Tone 1 from being selected. Upon completion of the first tone transmission period, the tone sequence proceeds in the normal manner.

Power Supply and 5.4 Volt Regulator (Figure 6)

The power supply operates from a source of 117 VAC and is fused at 1/10 ampere by slow-blow fuse F1. Slide switch S1301 connects the source to the power supply transformer T1301. The transformer connects to the bridge rectifier CR2-CR5 which provides an output to the Pi-filter composed of C16, L1301, C8 and C9. The unregulated 12 VDC output is connected to the Sounder Board (A1303) and to the output of the 5.4 Volt regulator.

The 5.4 Volt regulator is controlled by a differential amplifier composed of Q5 and Q6, zener diode VR1 and potentiometer R18. An increase in conduction of Q6 will result in a decrease in conduction of Q5. VR1 holds the base of Q5 at the proper reference voltage. The setting of R18 determines the base bias of Q6.

When current is first applied to the regulator, Q5 is turned on. Conduction of Q5 turns on Q4, providing a low resistance path for the base current of PNP power transistor Q1301.

If the output of the regulator increases Q6 conducts more, causing Q5 to conduct less. This allows less base current through Q1301 and Q4, causing the output of the regulator to remain at the proper 5.4 VDC. If the output tends to decrease Q6 conducts less, causing Q5 to conduct more. This allows more base current to flow through Q1301 and Q4, causing the regulator to remain at the proper 5.4 VDC. Diodes CR6 and CR7 limit current through the emitter-base junction of Q1301, protecting the power transistor from current surges from the power source.

Emergency Battery Operation

Provision is made for operating the encoder from a customer supplied 12-Volt battery in the event of an AC power failure. The emergency battery connects to J7 and J6 (ground) on A1301.

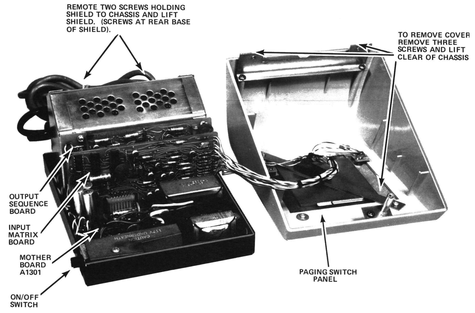
Under normal operating conditions, CR10 is reverse biased by the encoder supply voltage, preventing any drain on the battery. An AC power failure removes the reverse bias on CR10, and the battery voltage is automatically applied to the encoder.

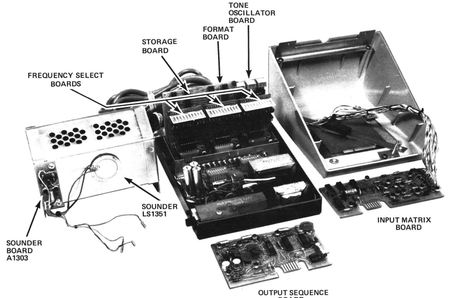
Transmitter Relay Keying

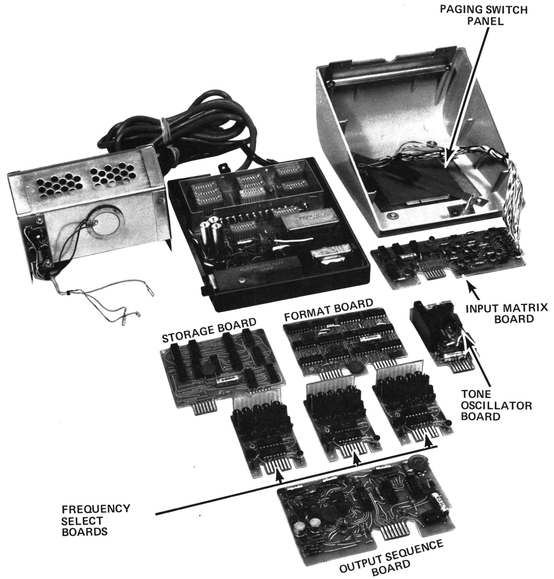
Transmitter keying is accomplished in the encoder by means of transistor switching up to 500 mA. This requires a positive supply voltage at the associated remote control unit relay to successfully operate the transmitter. For keying applications where polarity or voltage requirements prevent the use of the transistor switch, the customer may add a relay to the encoder keying circuit. The relay (K1) wiring is shown in dotted lines on the Interconnection Diagram 19R621793. A GE Catalog Number 3SCS5004F5 relay or Teledyne Catalog Number 712D-12 relay is recommended.

INSTALLATION

The encoder is mounted in the turret-right section of the Command Control Center and is connected to the Compression Board A801 or A851 by the 19B219512G1 cable. Refer to the Drawer Assembly Outline Diagram 19R621947 for connector terminations of this cable. The three conductor AC power cable should be connected to the nearest convenient 117 VAC outlet on the control center. The power ON-OFF switch on the side of the encoder should be left in the ON position and power to the encoder controlled by the Command Control Center main power switch.







TEST EQUIPMENT REQUIRED

1. VOM, similar to Triplett Model 631.
2. Audio Counter with a suitable gate time for counting 590 Hz at one second or less. Eldorado Model 1635, or equivalent.
3. AC VTVM, similar to Triplett Model 850.
4. Distortion Analyzer, Heath IM-12 or equivalent.

TEST PROCEDURE

A. Connect VTVM and Counter to J4 (Tone Output) and J6 (GND) on A1301 to monitor the tone frequency and level.

B. Connect the AC plug to a convenient outlet and slide switch S1301 to the ON position. The voltage at the case of Q1301 should read 5.4 Volts ±0.1 VDC, on the VOM. This is the regulator output. If the reading varies from 5.4 VDC ±0.1, adjust R18 on Mother Board. If no voltage is present at the Q1301 case, check the Slo-blo 1/10 amp. fuse located under the CAUTION cover. If fuse is okay, check regulator input voltage at L1301. This voltage should be 12 VDC as read on the VOM.

C. Tone Encode Test

1. Depress the R (RESET) switch on the encoder panel. The READY light should be illuminated. The READY LED is controlled by the Format Board and the Input Matrix Board.
2. Depress the Tx switch on the encoder panel. A reading of 0.5 VDC should be obtained at J2 on A1301 with the VOM. The keying voltage is controlled by the Output Sequence Board and the Input Matrix Board.
3. On 16 and 100 call encoders, depress digits 00 on the encoder panel. On 64, 400 and 900 call encoders, depress digits 000. An audible "beep" should be heard as each digit is encoded. This is controlled by the Input Matrix Board and Sounder Board A1303. The READY light should go out as the first digit is encoded. The last digit encoded should start the tone sequence and key the transmitter.
4. The TONE light should turn on for one second, turn off momentarily, and then turn on for another one second interval. The second tone interval may be adjusted from 0.5 to 3 seconds with R9 on the Output Sequence Board. The tone sequencing is controlled by the Output Sequence Board, the Format Board and the Input Matrix Board.
5. At the beginning of the tone 1 sequence, the reading at J1 on A1301 should drop to 0.5 VDC and remain at this level during the entire tone transmission sequence.
6. Depressing the Tx switch or another paralleled PTT switch at end of the tone sequence period will reset the encoder. Otherwise, the encoder will reset automatically approximately 5 seconds after the end of the tone sequence.

D. Tone Frequency Test

1. Connect a clip lead between TP5 and TP6 on the Output Sequence Board. This will lock the circuit on Tone 1 period.
2. Determine tone format from the combination number of the encoder, and using the appropriate tone selection chart, verify each tone frequency. Encode the digit shown on the chart and check the corresponding frequency on the counter. (Omit the 1st digit in the 16 and 100 call Units.) The tone frequency should be within ±0.1% of the frequency shown in the chart. If no tone is present, either the oscillator or the Mother Board (A1301) is at fault. The tone oscillator always runs at approximately 120 Hz if no tone is selected and, therefore, tone should always be present at J4 when TP5 and TP6 are connected together.
3. If all tone frequencies check wrong and all are on the high side of the correct frequency, check the Oscillator, Frequency Select, Format or Storage Boards. If all frequencies are wrong and are on the low side of the correct frequency, check the Oscillator Board. If all but one frequency are wrong, a Frequency Select Board is at fault. If all frequencies are correct but out of order, refer to the Format Test in E below. A close inspection of the pattern of correct and incorrect frequencies will often lead to a particular trouble location. For example; loss of binary function or incorrect frequencies only from a single Tone Select Bank.
4. Remove clip lead from TP5 and TP6.

E. Format Test

1. No format test is required for the 16 and 100 call encoders.
2. On 64, 400 and 900 call encoders, select the proper format from the chart for the format and call capacity of the unit being tested. Encode the digits indicated in the chart. As the unit sequences, verify the proper tone format.

The counter should be set for a faster gate time (0.1 second) to read the tone. The tone test performed under D verified the proper tone frequencies. The current test is for determining the proper order of tones. If the tones are out of order, check the Format or Input Matrix Boards.

F. Diagonal Tone Test

1. Connect a clip lead between TP5 and TP6 on the Output Sequence Board. Reset the encoder. Encode the 16 or 100 call encoder using digits 11. Encode the 64, 400 or 900 call encoder using digits 011. The tone output at J4 should be 742.5 Hz ±0.1%. This function is controlled by the Oscillator Board, the Format Board and the Input Matrix Board.

G. Tone Quality Test

1. The tone level should measure 100 mv rms, adjustable by R1 on A1301.
2. Tone distortion should be less than 5% (degrades from highest to lowest frequency).
3. Output level should be ±2 dB referenced from highest frequency used in unit under test.

H. Troubleshooting

1. If encoder sequences without being encoded (runs freely), check power supply regulator for spikes which could be caused by an overload, or poor connection.
2. If beeper runs continuously, check control voltage from Input Matrix Board.
3. If no response is encountered when digits are encoded, check Output Sequence Board or Input Matrix Board.
4. If two beeps are heard and two digits are encoded when only one digit has been selected, check Input Matrix Board or for faulty selector switch.

TONE FREQUENCY TEST CHARTS

100,400,900, CALL ENCODERS

FORMAT X

ENCODE			ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	592.5	2	1	607.5	4	1	712.5
	2	757.5		2	787.5		2	772.5
	3	802.5		3	832.5		3	817.5
	4	847.5		4	877.5		4	862.5
	5	892.5		5	922.5		5	907.5
	6	937.5		6	967.5		6	952.5
	7	547.5		7	517.5		7	532.5
	8	727.5		8	562.5		8	577.5
	9	637.5		9	697.5		9	622.5
	0	682.5		0	652.5		0	667.5

100 Call

400 Call

900 Call

16,64 CALL ENCODERS

FORMAT X

ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	592.5	2	1	607.5
	2	757.5		2	787.5
	3	802.5		3	832.5
	0	682.5		0	652.5

16 Call

64 Call

FORMAT Y

CALL CAPACITY 100, 400

ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	607.5	2	1	712.5
	2	787.5		2	772.5
	3	832.5		3	817.5
	4	877.5		4	862.5
	5	922.5		5	907.5
	6	967.5		6	952.5
	7	517.5		7	532.5
	8	562.5		8	577.5
	9	697.5		9	622.5
	0	652.5		0	667.5

100 Call

400 Call

FORMAT Y

CALL CAPACITY 16, 64

ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	607.5	2	1	712.5
	2	787.5		2	772.5
	3	832.5		3	817.5
	0	652.5		0	667.5

16 Call

64 Call

FORMAT Z

CALL CAPACITY 400

ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	592.5	0	1	712.5
	2	757.5		2	772.5
	3	802.5		3	817.5
	4	847.5		4	862.5
	5	892.5		5	907.5
	6	937.5		6	952.5
	7	547.5		7	532.5
	8	727.5		8	577.5
	9	637.5		9	622.5
	0	682.5		0	667.5

CALL CAPACITY 100

ENCODE		
1st Digit	2nd Digit	FREQ.
0	1	712.5
	2	772.5
	3	817.5
	4	862.5
	5	907.5
	6	952.5
	7	532.5
	8	577.5
	9	622.5
	0	667.5

FORMAT Z

CALL CAPACITY 64

ENCODE			ENCODE		
1st Digit	2nd Digit	FREQ.	1st Digit	2nd Digit	FREQ.
0	1	592.5	0	1	712.5
	2	757.5		2	772.5
	3	802.5		3	817.5
	0	682.5		0	667.5

CALL CAPACITY 16

ENCODE		
1st Digit	2nd Digit	FREQ.
0	1	712.5
	2	772.5
	3	817.5
	0	667.5

FORMAT TEST CHARTS

FORMAT X

CALL CAPACITY 64, 400

ENCODE	1st TONE	2nd TONE
012	592	757
112	607	757
212	607	787
312	592	787

FORMAT Y

CALL CAPACITY 64, 400

ENCODE	1st TONE	2nd TONE
012	607	787
112	712	787
212	712	772
312	607	772

FORMAT Z

CALL CAPACITY 64, 400

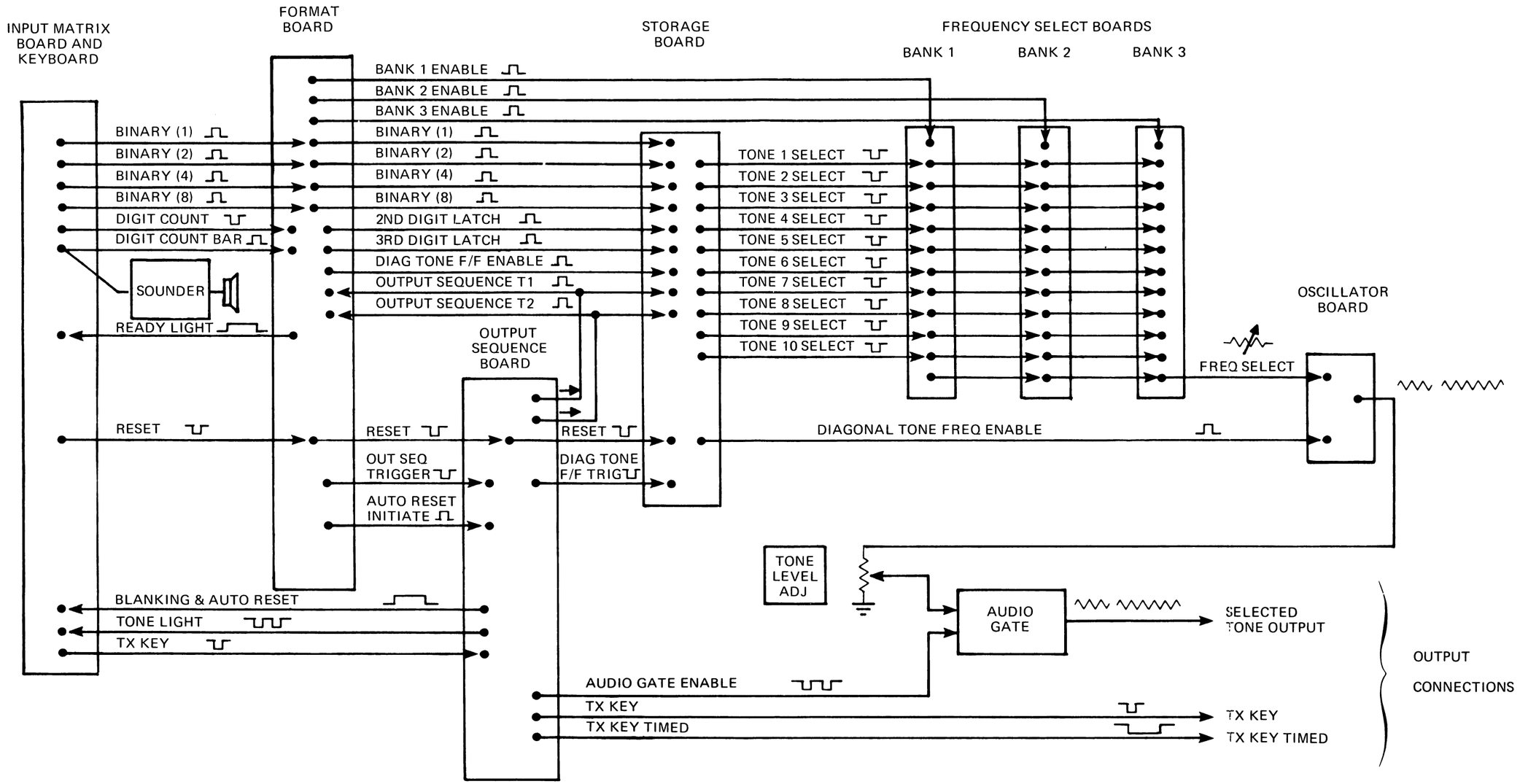
ENCODE	1st TONE	2nd TONE
012	592	757
112	712	757
212	712	772
312	592	772

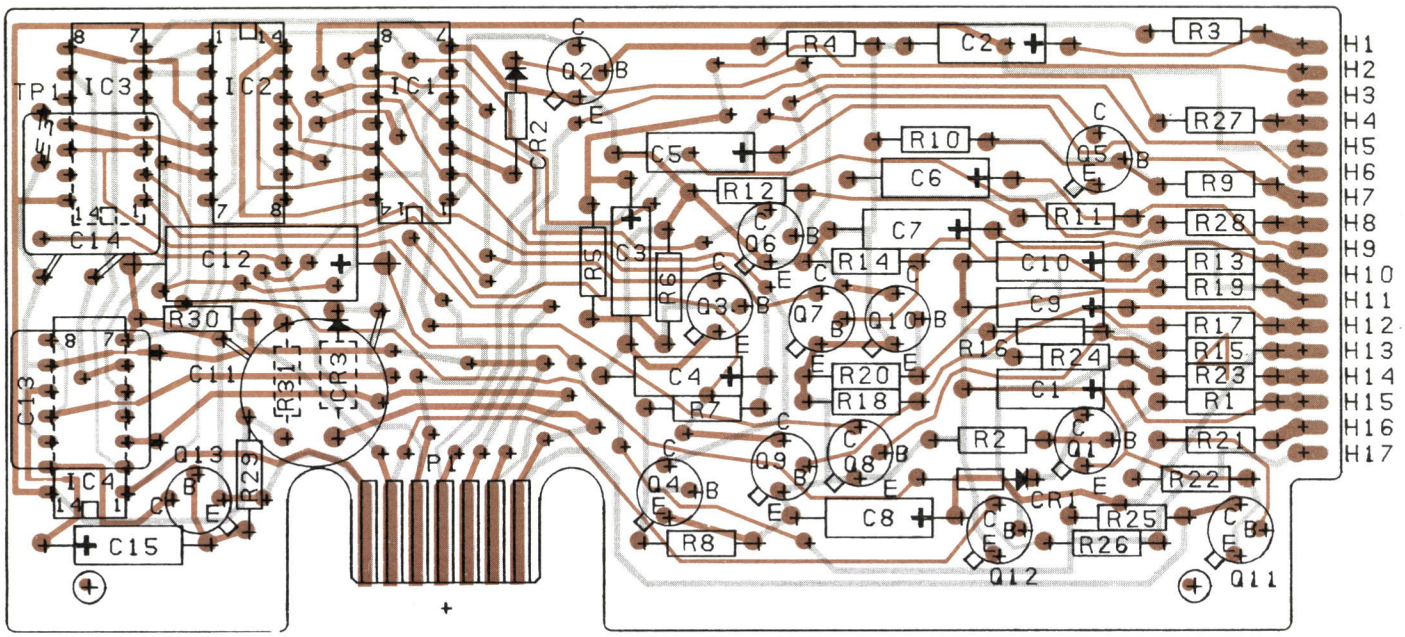
FORMAT X

CALL CAPACITY 900

ENCODE	1st TONE	2nd TONE
012	592	757
112	607	757
212	607	787
312	592	787
412	712	772
512	712	757
612	712	787
712	592	772
812	607	772

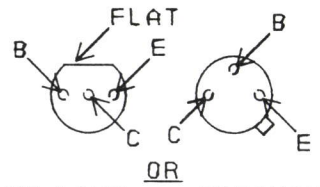
SEQUENCE CHART SERIES 101 & 102 TYPE 99 ENCODERS





(19C320481, Rev. 3)
(19C320035, Sh. 1, Rev. 4)
(19C320035, Sh. 2, Rev. 6)

LEAD IDENTIFICATION
FOR Q1 THRU Q13

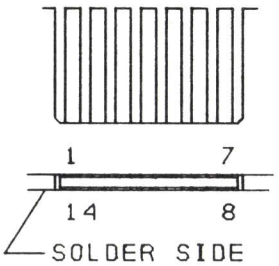


OR

IN-LINE TRIANGULAR

TOP VIEW

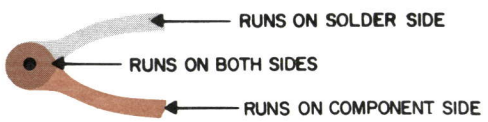
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



SOLDER SIDE
TYP. NUMBERING OF
CONTACT FINGERS.

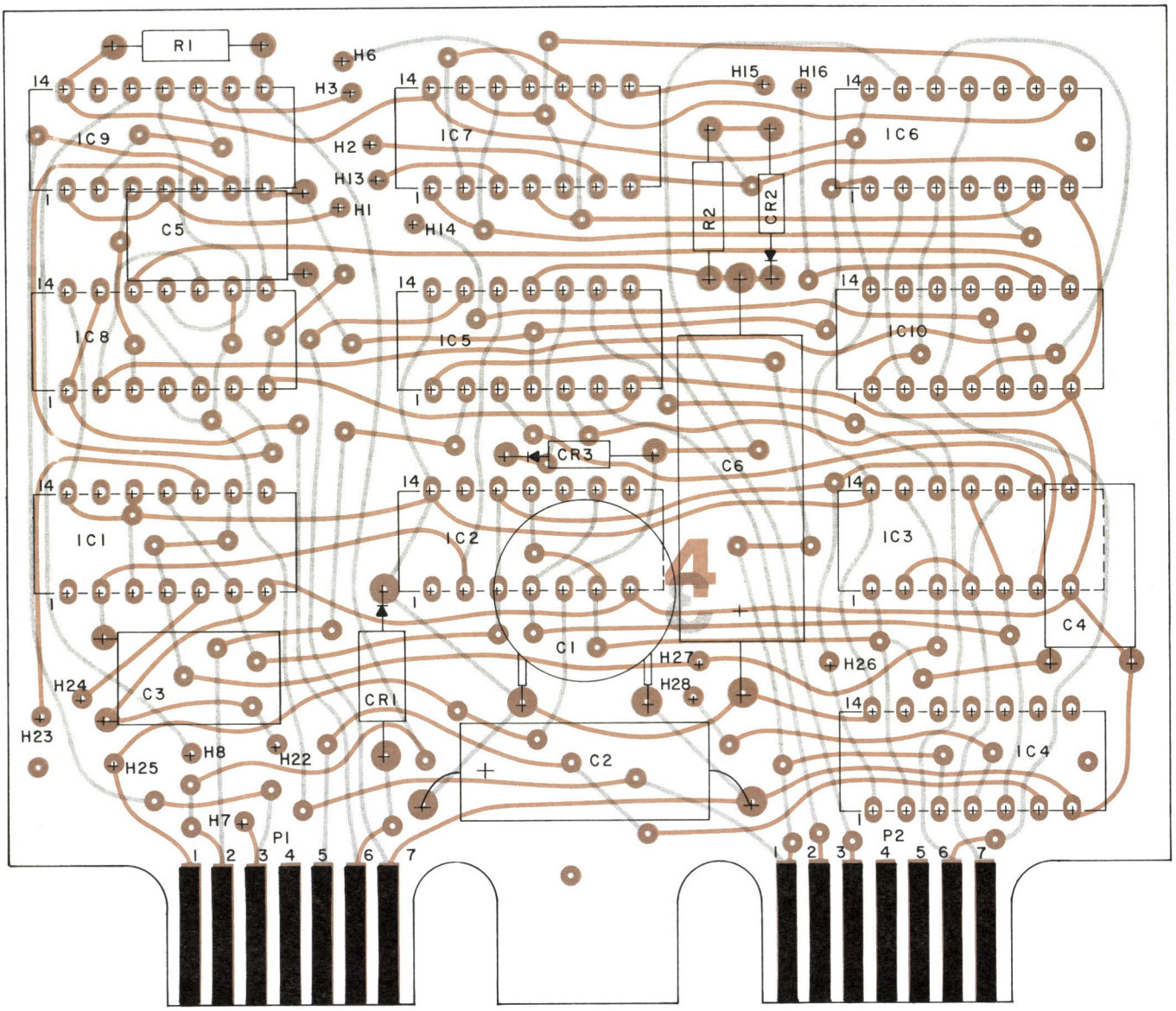
DETAIL "A"

DF-5042



OUTLINE DIAGRAM

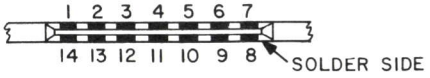
INPUT MATRIX BOARD
19C320080G1 & G2



(19D416997, Rev. 2)
(19D416322, Sh. 1, Rev. 4)
(19D416322, Sh. 2, Rev. 3)

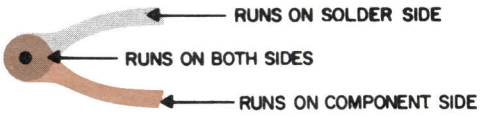
JUMPER CHART					
GROUP 1		GROUP 2		GROUP 3	
FROM	TO	FROM	TO	FROM	TO
H23	H25	H1	H2	H24	H25
H26	H28	H3	H6	H27	H28
		H7	H8	H7	H22
		H13	H14		
		H15	H16		
		H24	H25		
		H27	H28		

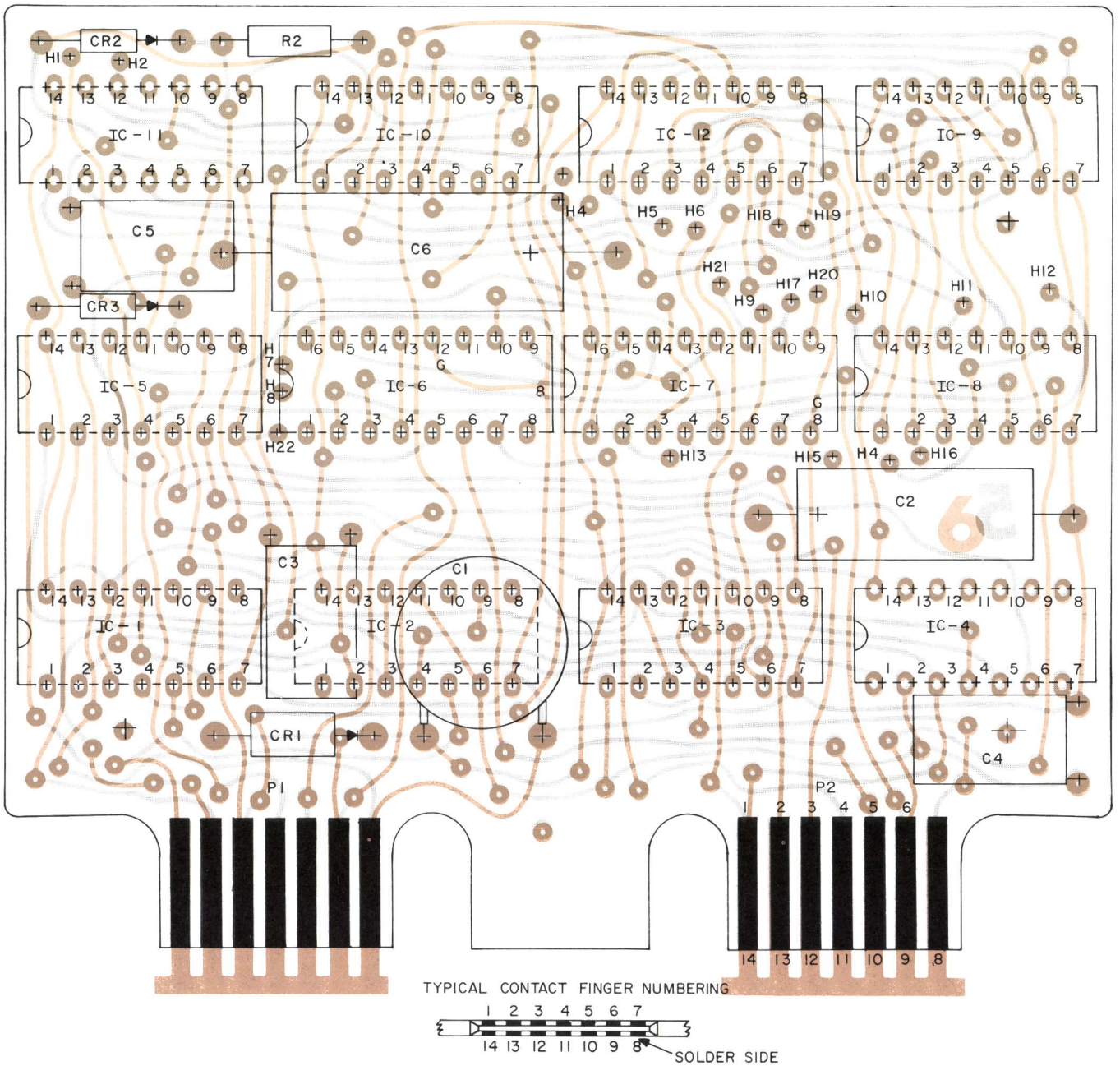
TYPICAL CONTACT FINGER NUMBERING



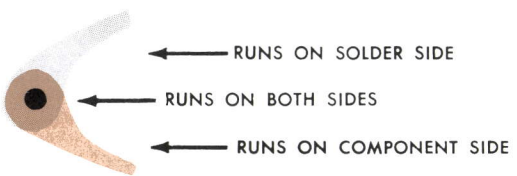
OUTLINE DIAGRAM

FORMAT BOARD (16, 64 & 100 CALL)
19D416327G1 & G2



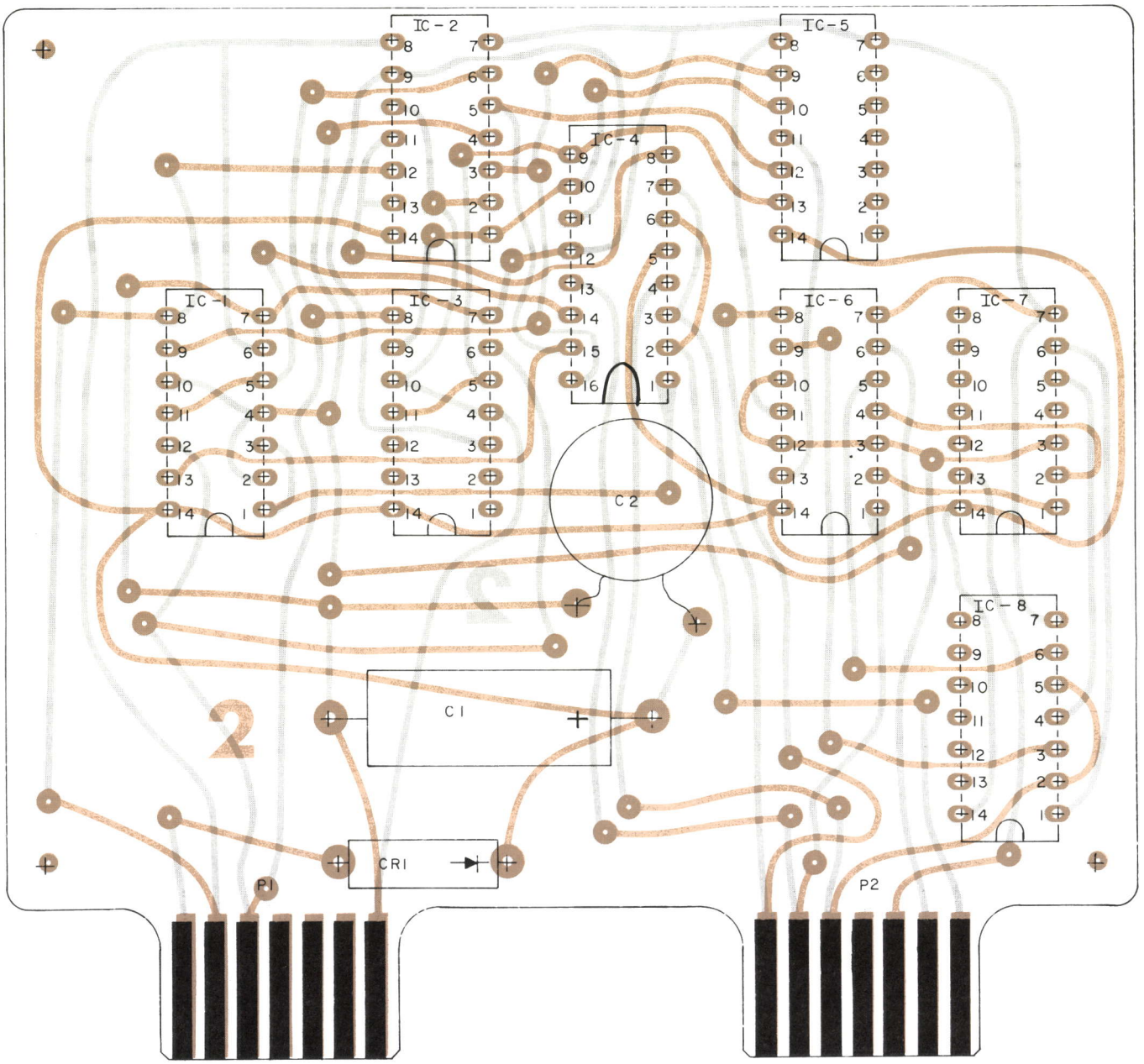


(19D416982, Rev. 2)
(19D416323, Sh. 1, Rev. 6)
(19D416323, Sh. 2, Rev. 5)



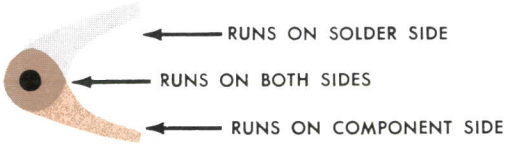
OUTLINE DIAGRAM

FORMAT BOARD (400 & 900 CALL) 19D416325G1



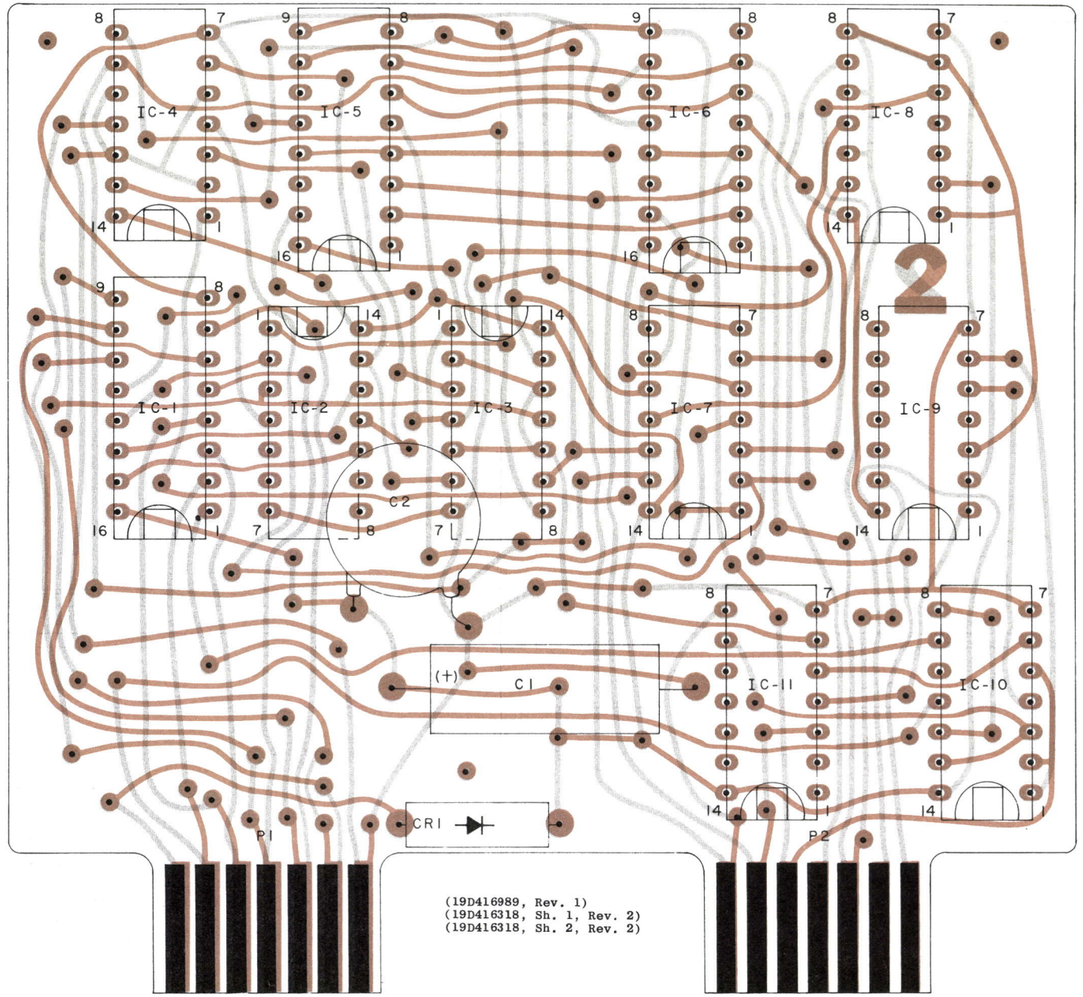
TYPICAL CONTACT FINGER NUMBERING

(19D416981, Rev. 1)
(19D416312, Sh. 1, Rev. 2)
(19D416312, Sh. 2, Rev. 2)



OUTLINE DIAGRAM

STORAGE BOARD (16 & 64 CALL)
19D416314G1



(19D416989, Rev. 1)
(19D416318, Sh. 1, Rev. 2)
(19D416318, Sh. 2, Rev. 2)

TYPICAL CONTACT FINGER NUMBERING

1 2 3 4 5 6 7

14 13 12 11 10 9 8 SOLDER SIDE

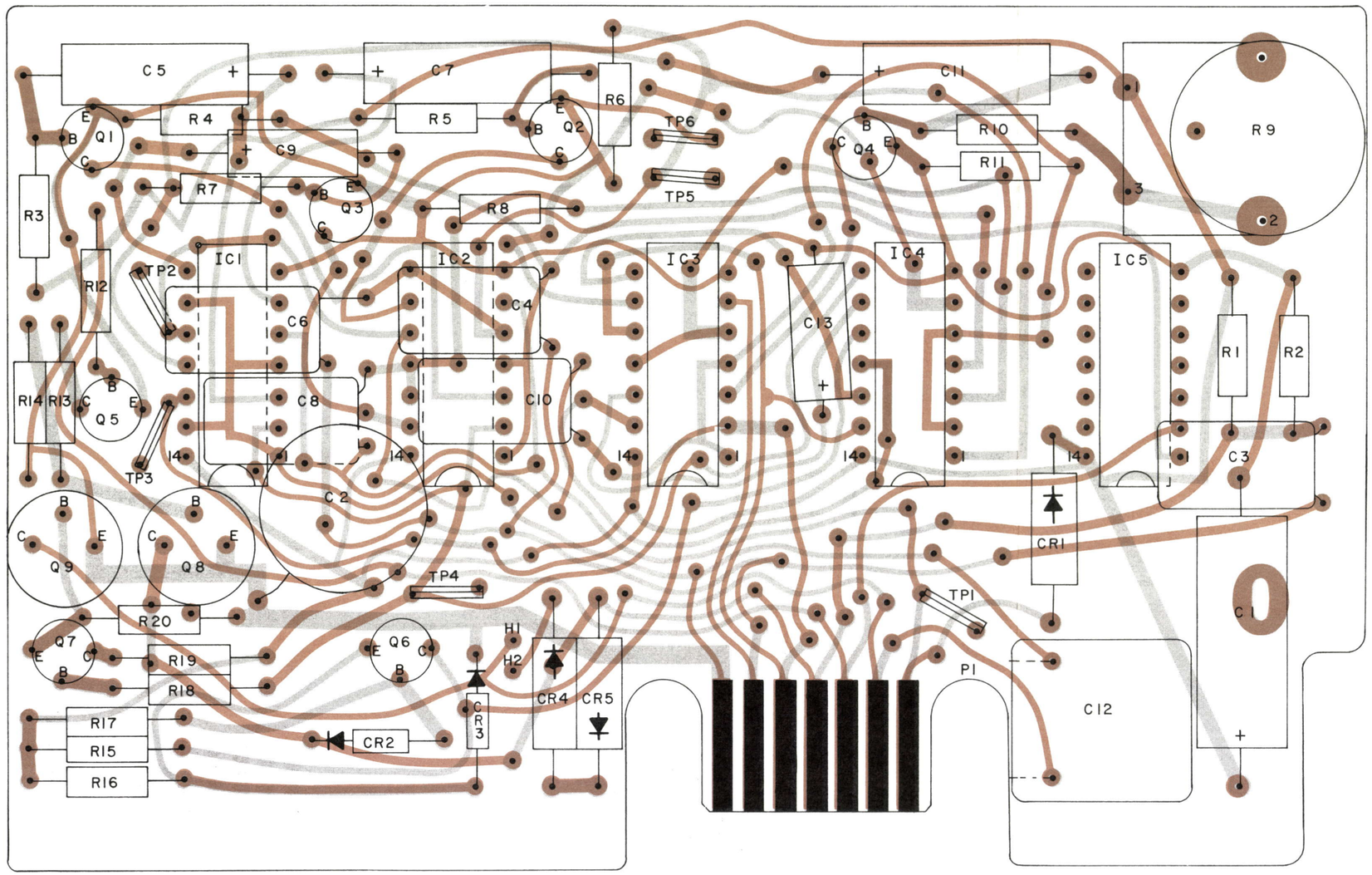
RUNS ON SOLDER SIDE

RUNS ON BOTH SIDES

RUNS ON COMPONENT SIDE

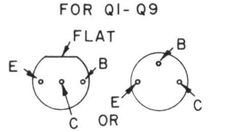
OUTLINE DIAGRAM

STORAGE BOARD
(100-900 CALL)
19D416320G1

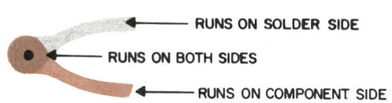


(19D416990, Rev. 1)
(19D416482, Sh. 1, Rev. 0)
(19D416482, Sh. 2, Rev. 0)

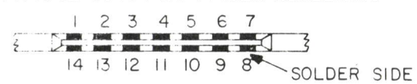
LEAD IDENTIFICATION
FOR Q1-Q9



NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

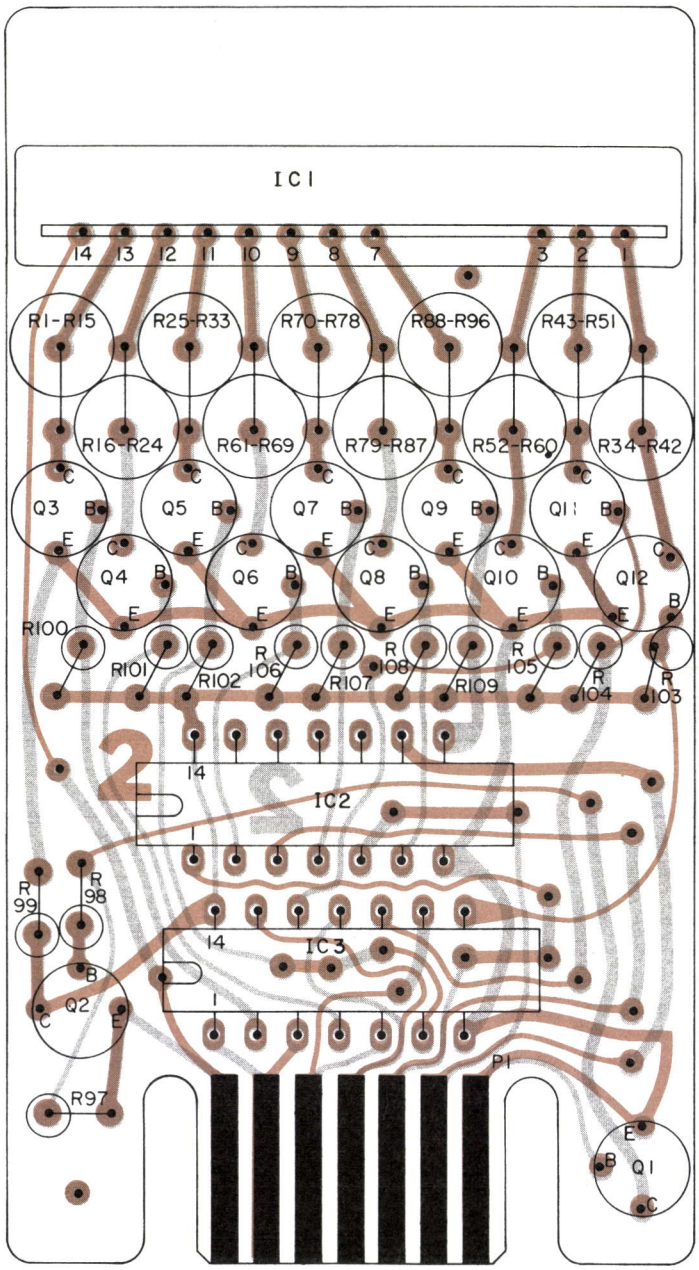


TYPICAL CONTRACT FINGER NUMBERING

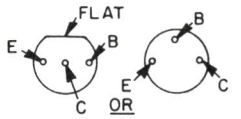


OUTLINE DIAGRAM

OUTPUT SEQUENCE BOARD
19D416493G1



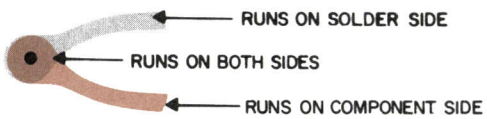
LEAD IDENTIFICATION FOR Q1-Q13



IN-LINE TRIANGULAR
VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19C320476, Rev. 2)
(19D416453, Sh. 1, Rev. 2)
(19D416453, Sh. 2, Rev. 2)

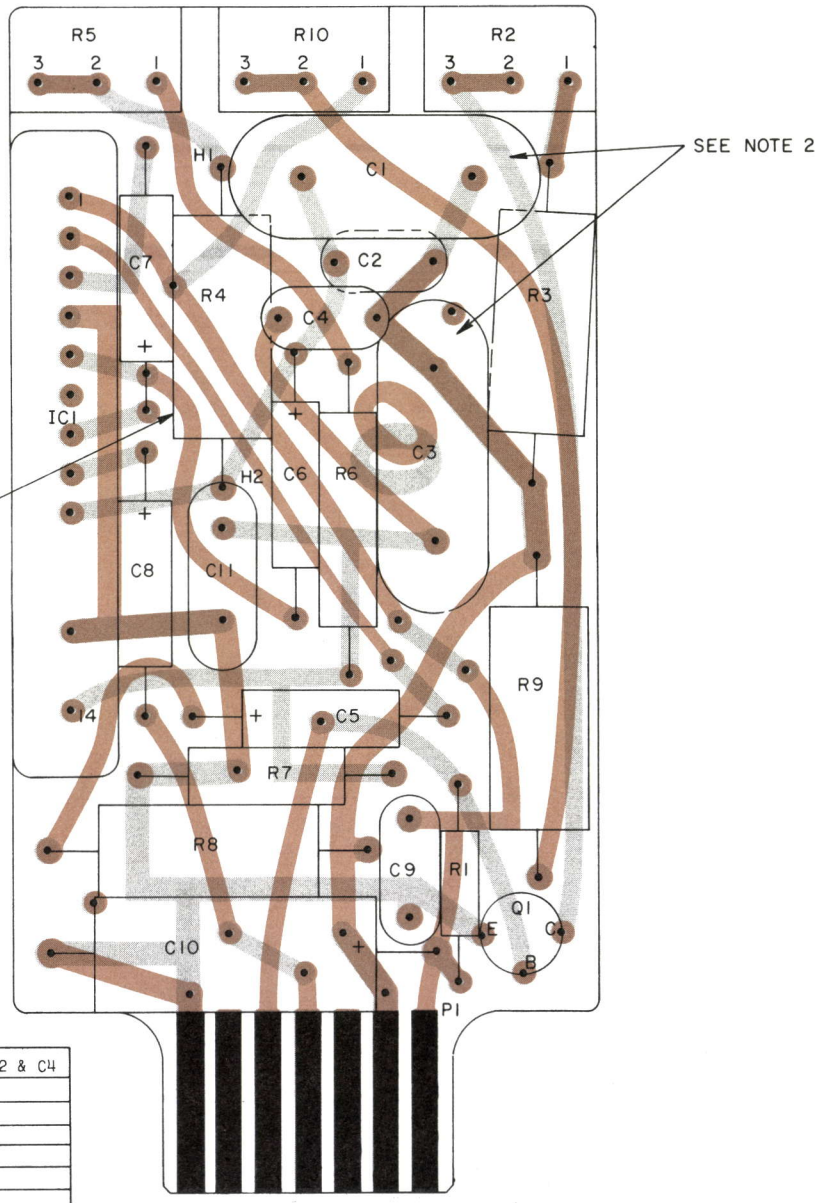


OUTLINE DIAGRAM

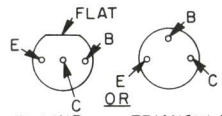
FREQUENCY SELECT BOARD
19D416469G1-G6

NOTE 1. TO INSURE PROPER TRACKING OF OUTPUT FREQUENCY, IT WILL BE NECESSARY TO SELECT THE PROPER PRECISION RESISTOR FROM A GROUP OF RESISTORS WHEN REPLACING R4. SEE OSCILLATOR PARTS LIST.

NOTE 2. TO INSURE GOOD FREQUENCY STABILITY WITH TEMPERATURE, IT WILL BE NECESSARY TO MATCH THE TEMPERATURE COMPENSATION CAPACITORS AGAINST THE FREQUENCY DETERMINING CAPACITORS WHEN REPLACING ANY OF THESE CAPACITORS. THE TEMPERATURE COEFFICIENT OF C2 MUST MATCH THAT OF C1. THE TEMPERATURE COEFFICIENT OF C4 MUST MATCH THAT OF C3. THE TEMPERATURE COEFFICIENT OF C1 AND C3 MUST BE THE SAME.



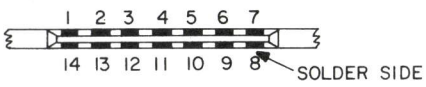
LEAD IDENTIFICATION FOR Q1



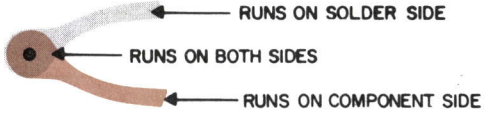
LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

C1 AND C3 TEMPERATURE COEFFICIENT CODE	PART NO. OF C2 & C4
BAND 0	5496203P20
BAND 1	5496203P20
BAND 2	5496203P120
BAND 3	5496203P220
BAND 4	5496203P220
BAND 5	5496203P320
BAND 6	5496203P420

TYPICAL CONTACT FINGER NUMBERING

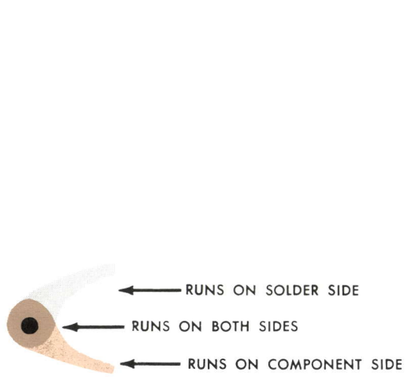


(19C320482, Rev. 1)
(19D416447, Sh. 1, Rev. 0)
(19D416447, Sh. 2, Rev. 0)

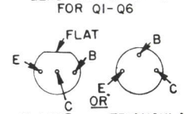


OUTLINE DIAGRAM

OSCILLATOR BOARD
19C320086G1



LEAD IDENTIFICATION
FOR Q1-Q6

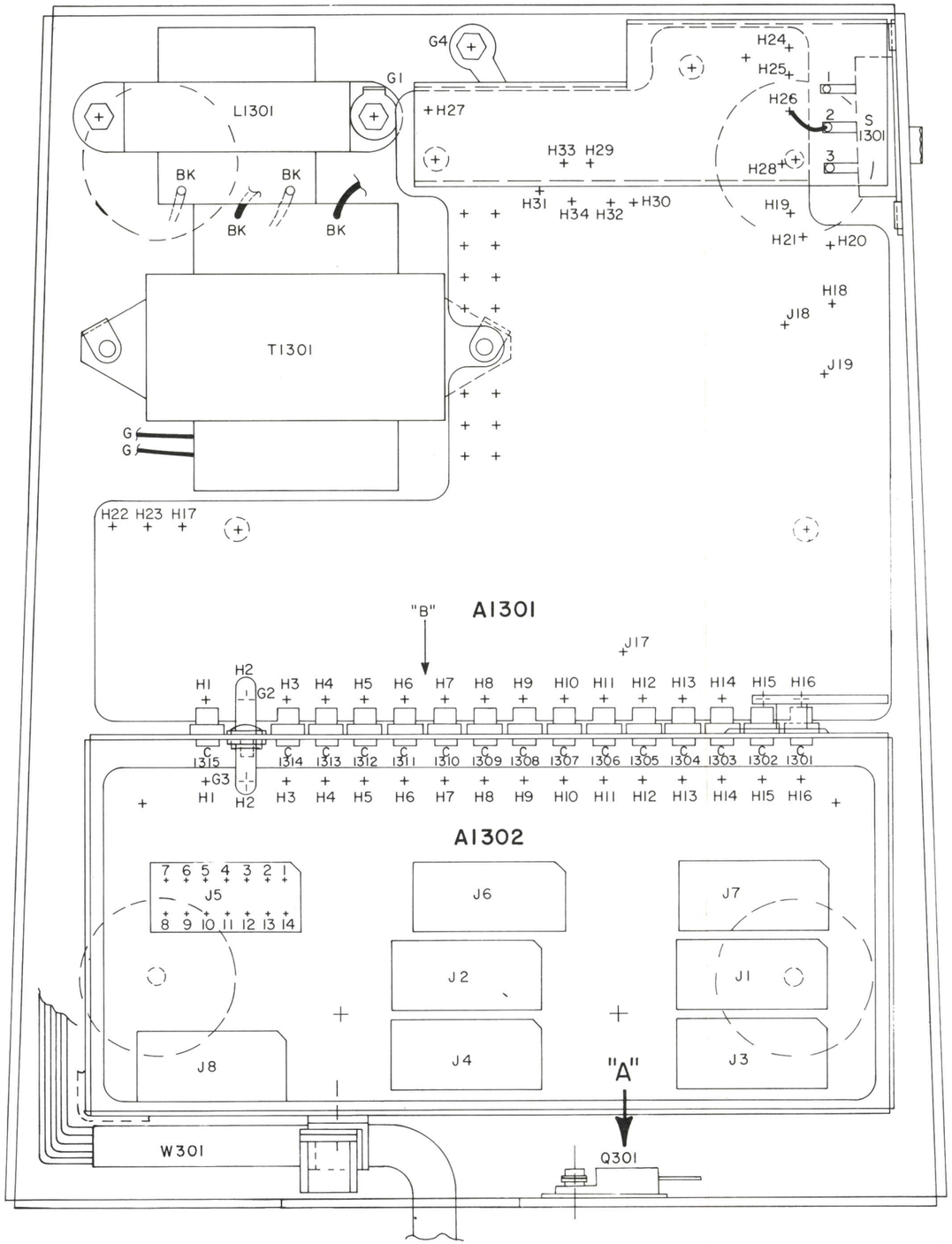


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19D416984, Rev. 2)
(19D416462, Sh. 1, Rev. 6)
(19D416462, Sh. 2, Rev. 5)

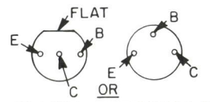
OUTLINE DIAGRAM

MOTHER BOARD (A1301)

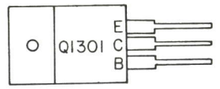


(19D416998, Rev. 2)

LEAD IDENTIFICATION
FOR Q1 & Q2

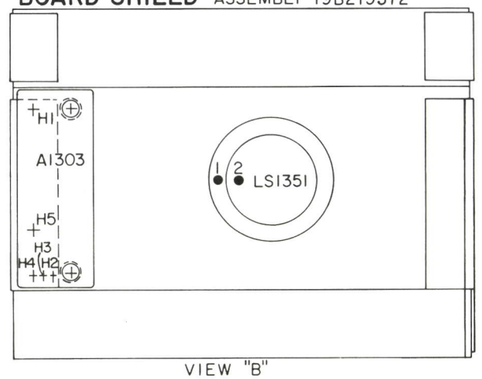


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



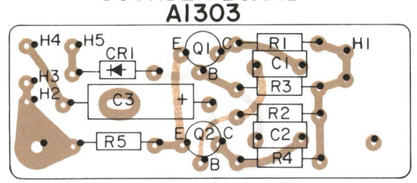
VIEW AT "A"

BOARD SHIELD ASSEMBLY 19B219572

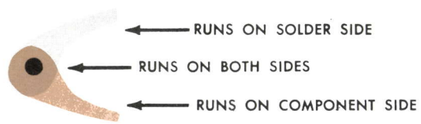


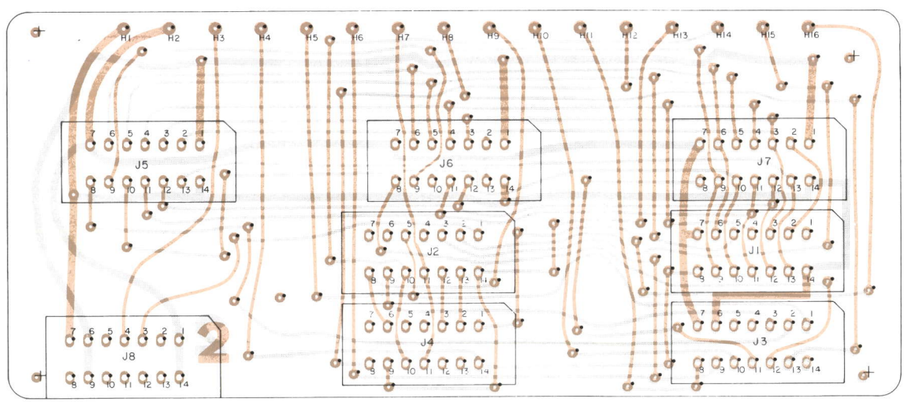
VIEW "B"

SOUNDER BOARD
A1303



(19D416998, Rev. 2)
(19B219539, Sh. 1, Rev. 0)
(19B219539, Sh. 2, Rev. 0)



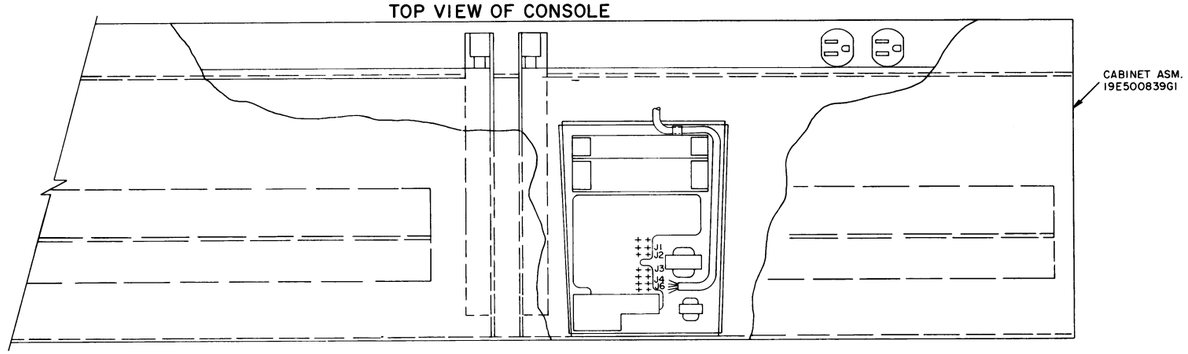


(19D417545, Rev. 0)
(19D416467, Sh. 1, Rev. 2)
(19D416467, Sh. 2, Rev. 2)

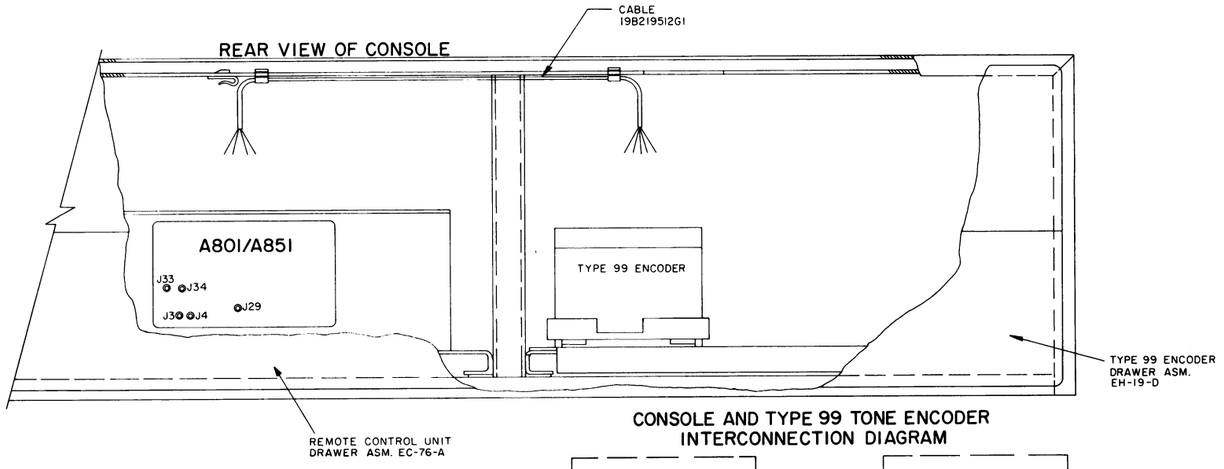
OUTLINE DIAGRAM

ENCODER BASE ASSEMBLY

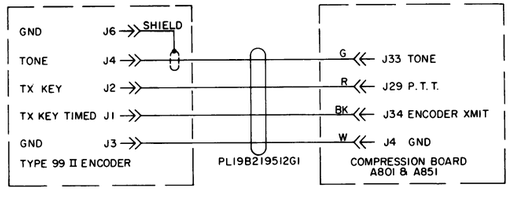
TOP VIEW OF CONSOLE



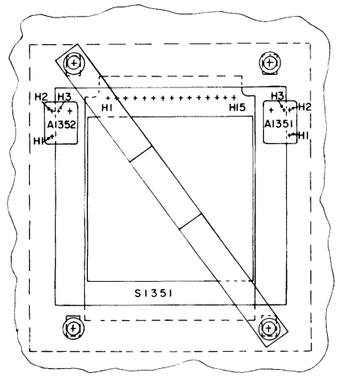
REAR VIEW OF CONSOLE



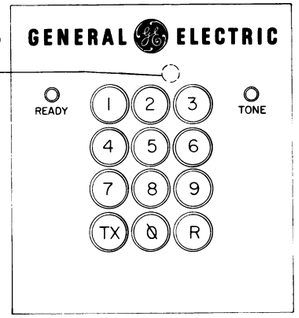
CONSOLE AND TYPE 99 TONE ENCODER INTERCONNECTION DIAGRAM

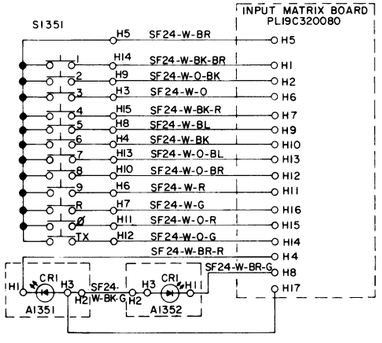


REAR VIEW OF PAGING SWITCH ASSEMBLY

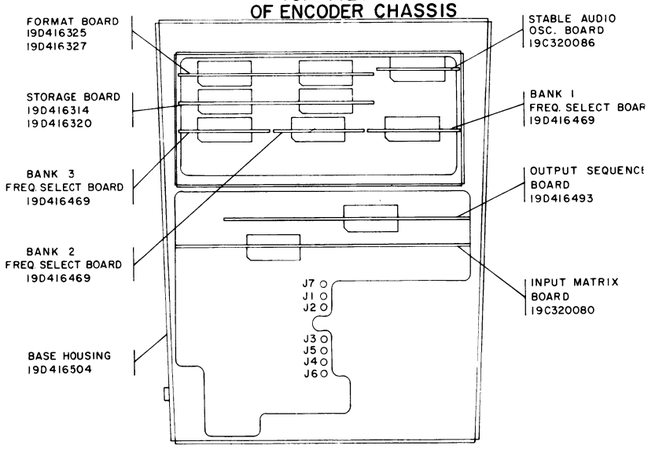


THE 19A116676P1 SWITCH (S1351) INCLUDES A 19A116726P2 SPRING WHICH IS LOCATED BETWEEN S1351 AND THE FRONT DRESS PLATES 19B219560G1 & G2. THE LARGER DIAMETER END OF THIS SPRING FITS IN THIS DEPRESSION ON THE DRESS PLATE WITH THE SMALLER DIAMETER END MATING WITH S1351.





TOP VIEW OF ENCODER CHASSIS



OUTLINE DIAGRAM

DRAWER ASSEMBLY TYPE 99 TONE

(19R621947, Rev. 2)

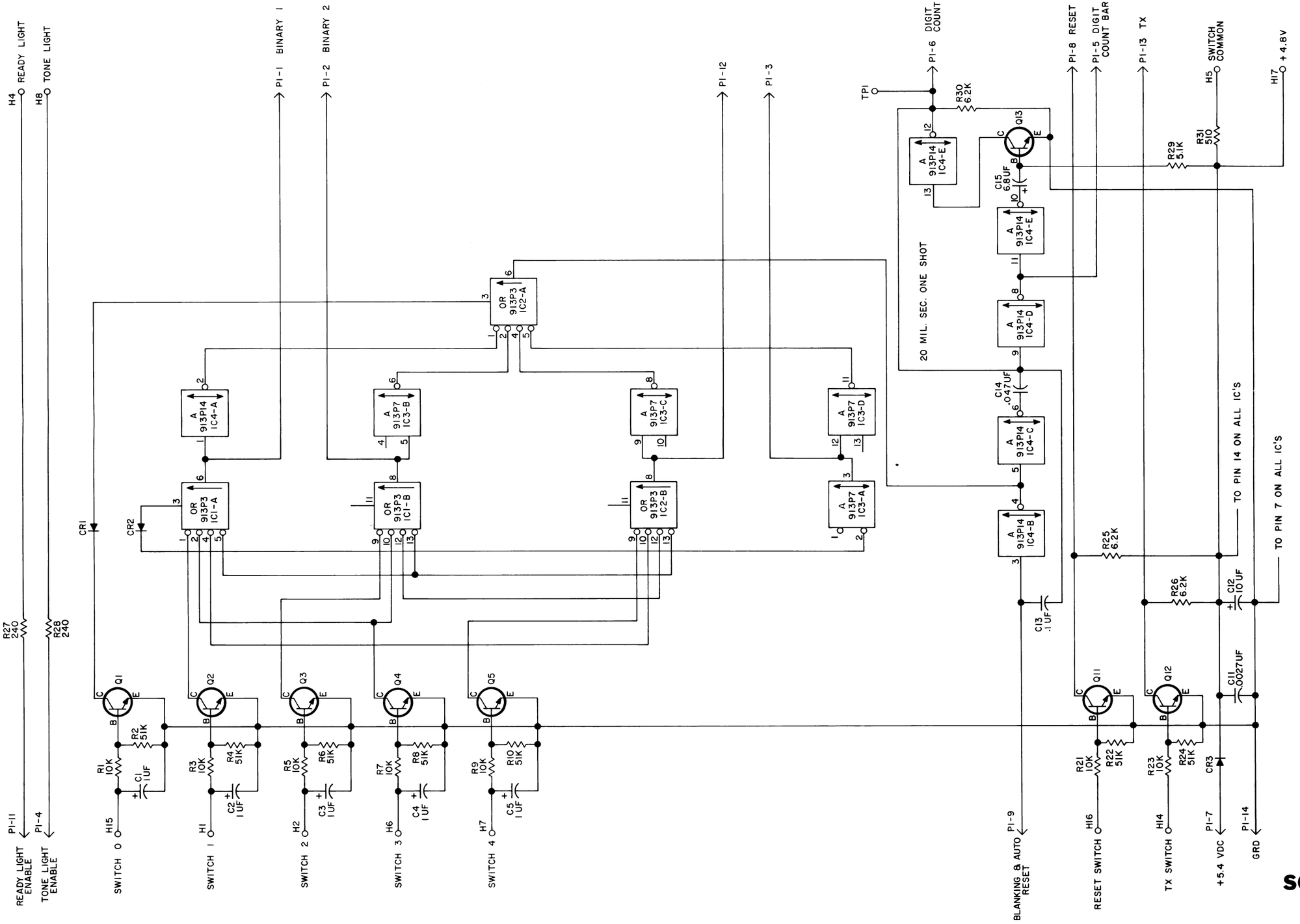
PARTS LIST

LBI-4424

TYPE 99 II TONE ENCODER
PANEL ASSEMBLY
19D416546G1

SYMBOL	GE PART NO.	DESCRIPTION
A1351		COMPONENT BOARD 19B219499G1
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	19A116678P1	Diode, light emitting: sim to HP5082-4403.
A1352		COMPONENT BOARD 19B219499G2
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	19A116678P1	Diode, light emitting: sim to HP5082-4403.
		- - - - - - - - - - - SWITCHES - - - - - - - - -
S1351	19A116726P1	Push: 12 poles, normally open; sim to Datanetics DC-404.
		- - - - - - - - - - MISCELLANEOUS - - - - - - -
	19C320127G1	Plate.
	19B219560G1	Switch plate. (BEIGE).
	19B219519G1	Support. (Secures S1351 to Plate).
	19A129463P6	Harness.
	19B201074P204	Tap screw: No 4-40 x 1/4. (Secures A1351 and A1352 to Plate. Switch plate to Plate).
	N400P65C6	Flatwasher: No. 4. (Secures Switch plate to Plate).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



(19D416549, Rev. 4)

SCHEMATIC DIAGRAM

INPUT MATRIX BOARD
(16-64 CALL) 19C320080G1

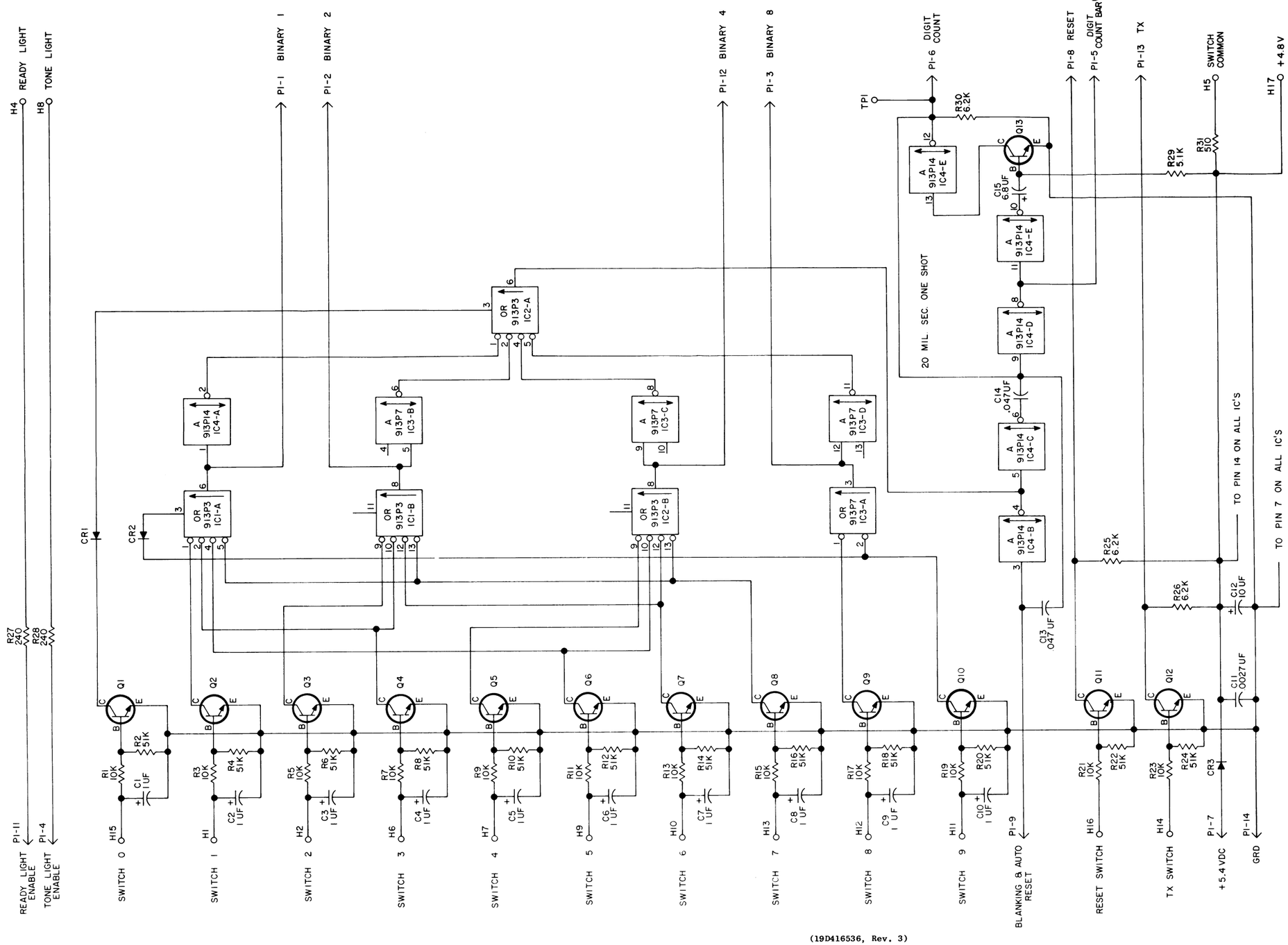
PARTS LIST

LBI-4412B

INPUT MATRIX BOARD
TYPE 99 II TONE
19C320080G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1 thru C5	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C11	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C12	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C13*	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
		Earlier than REV A:
	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C14	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C15	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115250P1	Silicon.
CR3	4037822P1	Silicon.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
UC1 and UC2	19A115913P3	Digital, Dual Buffer; sim to Fairchild DTL 932.
UC3	19A115913P7	Digital, Quad 2-Input Gate; sim to Fairchild DTL 946.
UC4	19A115913P14	Digital, Hex Inverter; sim to Fairchild DTL 936.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1		(Part of printed wiring board 19C320034P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 thru Q5	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q11 thru Q13	19A115889P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - RESISTORS - - - - - - - -
R1	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R2	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R3	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R4	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R5	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R6	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R7	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R8	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R9	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R10	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R21	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R22	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R23	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R24	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R25 and R26	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R27 and R28	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R29	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R30	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R31	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
		- - - - - - - - - TEST POINTS - - - - - - - -
TP1	19B211379P1	Spring (Test Point).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



(19D416536, Rev. 3)

SCHEMATIC DIAGRAM

INPUT MATRIX BOARD
(100-900 CALL) 19C320080G2

Issue 2

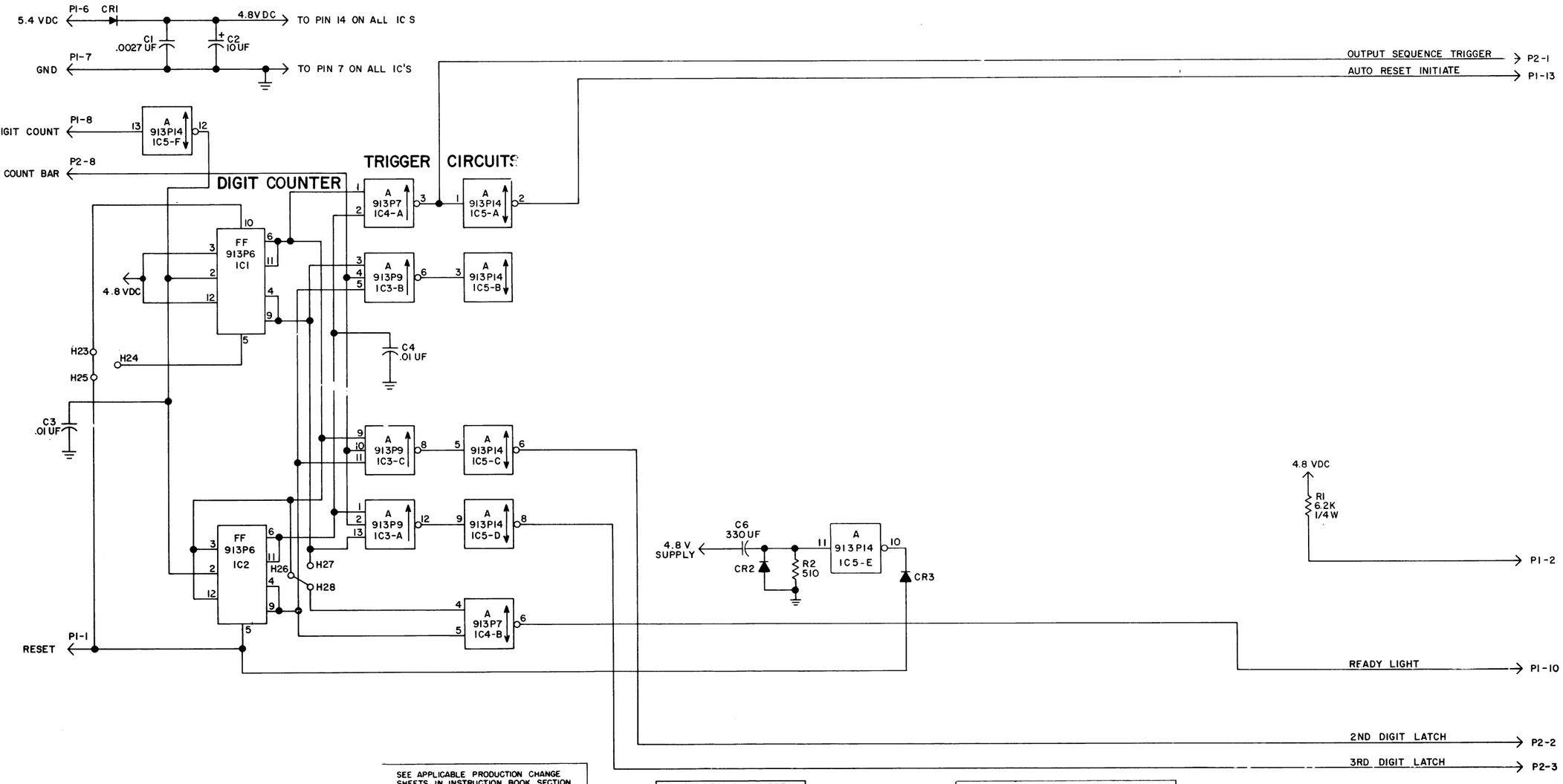
PARTS LIST

LBI-4415A

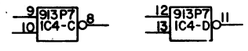
INPUT MATRIX BOARD
TYPE 99 II TONE
19C320080G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1 thru C10	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C11	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C12	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C13 and C14	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C15	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to
		- - - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1 and CR2	19A115250P1	Silicon.
CR3	4037822P1	Silicon.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
IC1 and IC2	19A115913P3	Monolithic, Dual Buffer; sim to Fairchild DTL 932.
IC3	19A115913P7	Monolithic, Quad 2-Input Gate; sim to Fairchild DTL 946.
IC4	19A115913P14	Monolithic, Hex Inverter; sim to Fairchild DTL 936.
		- - - - - - - - - - - PLUGS - - - - - - - - -
P1		(Part of printed wiring board 19C320034P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 thru Q13	19A115889P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - - RESISTORS - - - - - - -
R1	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R2	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R3	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R4	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R5	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R6	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R7	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R8	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R9	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R10	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R11	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R12	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R13	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R14	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R15	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R16	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R18	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R19	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R20	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R21	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R22	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R23	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R24	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R25 and R26	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R27 and R28	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R29	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R30	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R31	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
		- - - - - - - - - TEST POINTS - - - - - - - -
TP1	19B211379P1	Spring (Test Point).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



SPARE IC'S



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D416327G1	A

CONNECTION CHART		
FROM	TO	WIRE
H23	H25	DM
H26	H28	DM

NOTE:

THESE CONNECTIONS ON GP. I ONLY

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

FORMAT BOARD (16 & 100 CALL)
19D416327G1

(19D416553, Rev. 4)

PARTS LIST

LBI4410B

FORMAT BOARD
TYPE 99 II TONE
19D416327G1

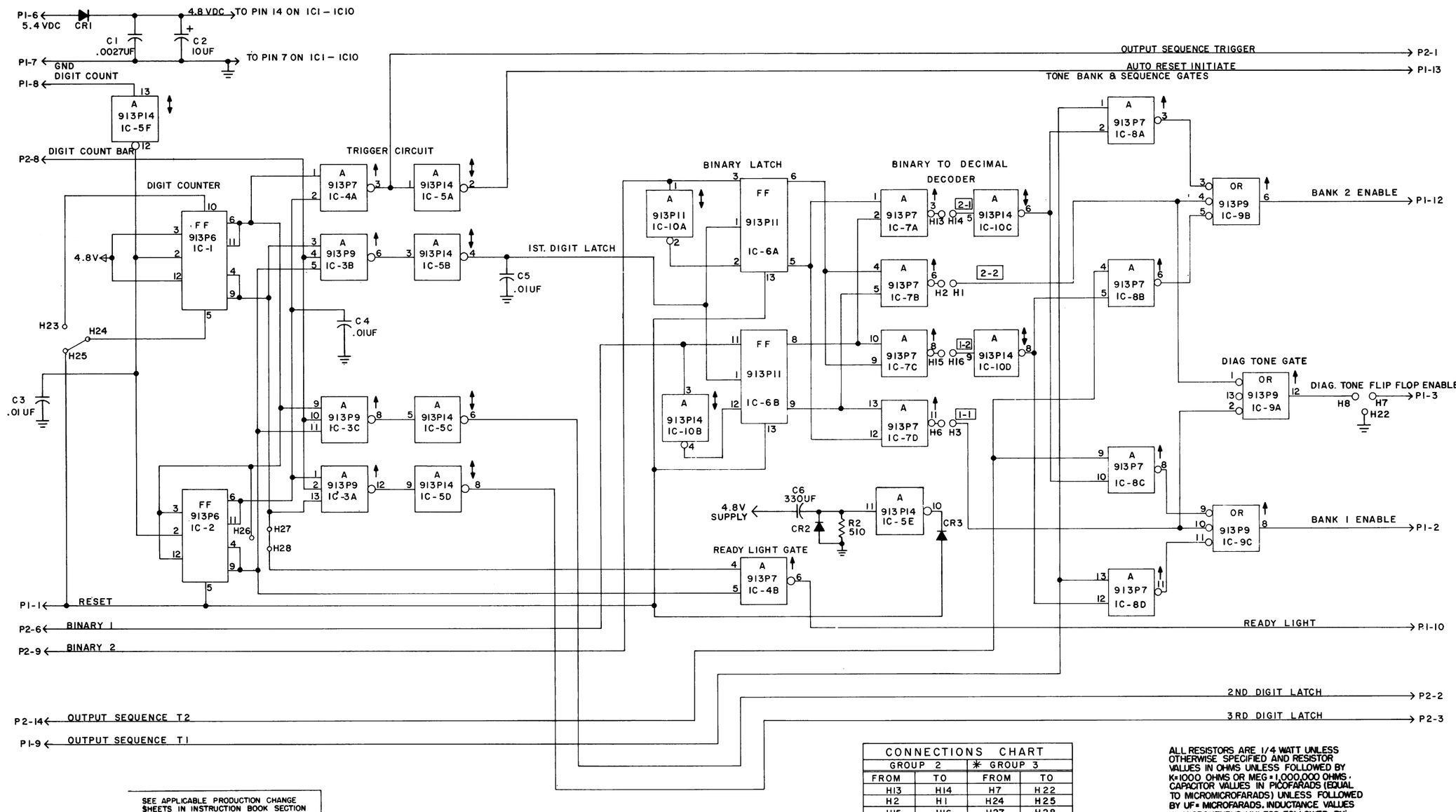
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C3 and C4	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C6*	5496267P4	Tantalum: 330 µf ±20%, 6 VDCW; sim to Sprague Type 150D. Added by REV A.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	4037822P1	Silicon, 1000 mA, 400 PIV.
CR2* and CR3*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV A.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1 and IC2	19A115913P6	Digital, Clocked Flip-Flop: Identification No. 945.
IC3	19A115913P9	Digital, Triple 3-Input Gate: Identification No. 962.
IC4	19A115913P7	Digital, Quad 2-Input Gate: Identification No. 946.
IC5	19A115913P14	Digital, Hex Inverter: Identification No. 936.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1 and P2		(Part of printed wiring board 19D416321P1).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R2*	3R152P511J	Composition: 510 ohms ±5%, 1/4 w. Added by REV A.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To stop the encoder from encoding with power line fluctuations. Added C6, CR2, CR3 and R2.



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D41632762	A
PL19D41632763	A

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SPARE INTEGRATED CIRCUITS

913P14 IC-10E

913P14 IC-10F

913P7 IC-4C

913P7 IC-4D

CONNECTIONS CHART

GROUP 2		✳ GROUP 3	
FROM	TO	FROM	TO
H13	H14	H7	H22
H2	H1	H24	H25
H15	H16	H27	H28
H6	H3		
H24	H25		
H27	H28		
H8	H7		

✳ REFER TO MOD. INSTRUCTION 19C320128 FOR JUMPER CONNECTIONS. ALL CONNECTIONS ARE DM WIRE.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

FORMAT BOARD (64 CALL)
19D416327G2

(19D416332, Rev. 6)

PARTS LIST

LBI4421C

FORMAT BOARD
TYPE 99 II TONE
19D416327G2

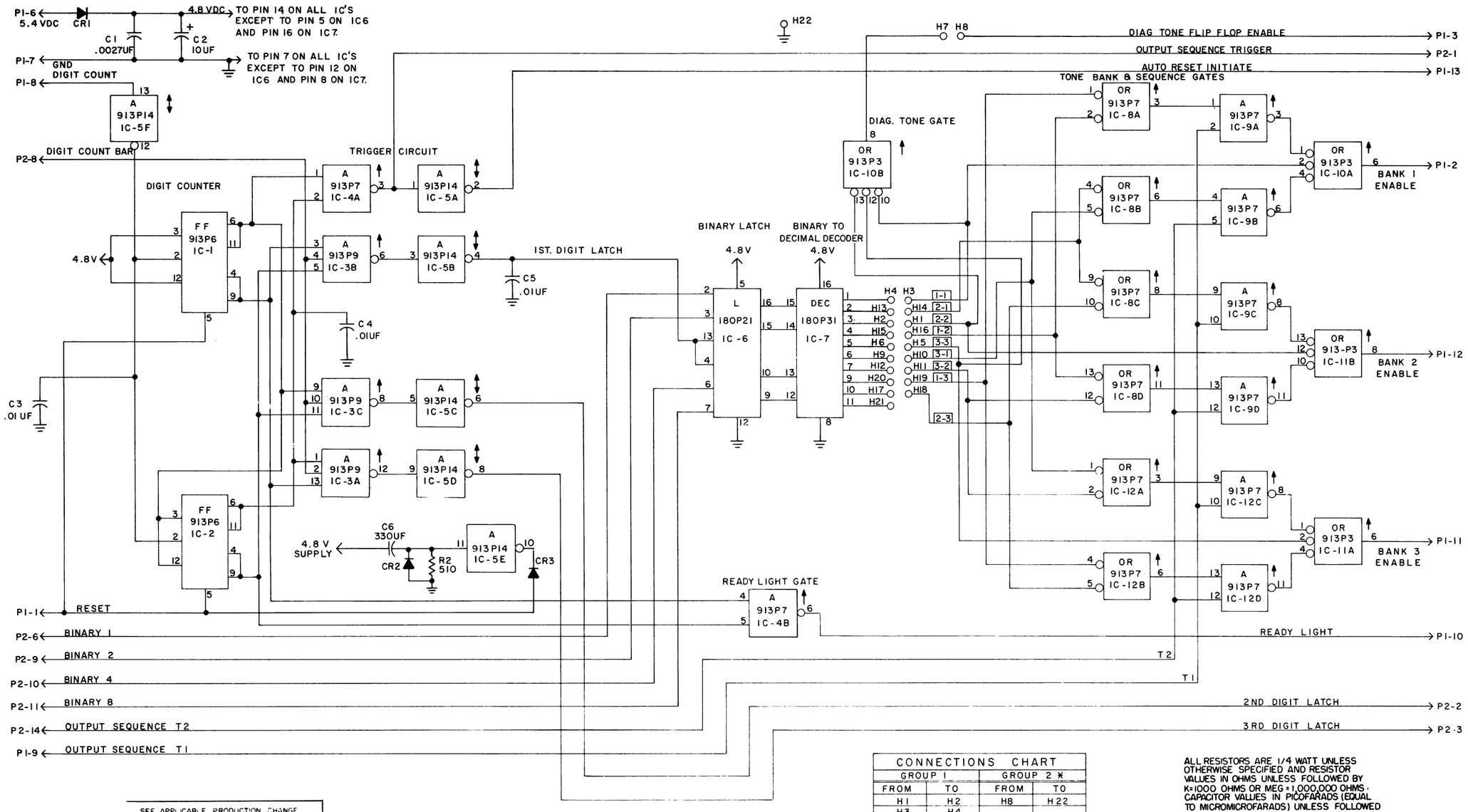
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C3 thru C5	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C6*	5496267P4	Tantalum: 330 µf ±20%, 6 VDCW; sim to Sprague Type 150D. Added by REV A.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4037822P1	Silicon, 1000 mA, 400 PIV.
CR2* and CR3*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV A.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1 and IC2	19A115913P6	Digital, Clocked J-K/R-S Flip-Flop: Identification No. 945.
IC3	19A115913P9	Digital, Triple 3-Input Nand Gate: Identification No. 962.
IC4	19A115913P7	Digital, Quad 2-Input Nand Gate: Identification No. 946.
IC5	19A115913P14	Digital, Hex Inverter: Identification No. 936.
IC6	19A115913P11	Digital, Dual J-K Flip-Flop: Identification No. 097.
IC7 and IC8	19A115913P7	Digital, Quad 2-Input Nand Gate: Identification No. 946.
IC9	19A115913P9	Digital, Triple 3-Input Nand Gate: Identification No. 962.
IC10	19A115913P14	Digital, Hex Inverter: Identification No. 936.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 and P2		(Part of printed wiring board 19D416321P1).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R2*	3R152P511J	Composition: 510 ohms ±5%, 1/4 w. Added by REV A.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To stop the encoder from encoding with power line fluctuations. Added C6, CR2, CR3 and R2.

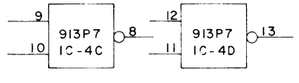


SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PLI9D416325G1	B
PLI9D416325G2	B

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SPARE IC'S



CONNECTIONS CHART

GROUP 1		GROUP 2 *	
FROM	TO	FROM	TO
H1	H2	H8	H22
H3	H4		
H5	H6		
H7	H8		
H9	H10		
H11	H12		
H13	H14		
H15	H16		
H17	H18		
H19	H20		

"ALL CONNECTIONS ARE DM WIRE"
*REFER TO MOD INSTRUCTION 19C320129 FOR JUMPER CONNECTIONS.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

(19D416326, Rev. 9)

SCHEMATIC DIAGRAM

FORMAT BOARD (400 & 900 CALL)
19D416325G1

Issue 4

PARTS LIST

LBI4425C

FORMAT BOARD
TYPE 99 II TONE
19D416325G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C3 thru C5	19A1.6080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C6*	5496267P4	Tantalum: 330 µf ±20%, 6 VDCW; sim to Sprague Type 150D. Added by REV B.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4037822P1	Silicon, 1000 mA, 400 PIV.
CR2* and CR3*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV B.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1 and IC2	19A115913P6	Digital, Clocked J-K/R-S Flip-Flop: Identification No. 945.
IC3	19A115913P9	Digital, Triple 3-Input Nand Gate: Identification No. 962.
IC4	19A115913P7	Digital, Quad 2-Input Nand Gate: Identification No. 946.
IC5	19A115913P.4	Digital, Hex Inverter: Identification No. 936.
IC6	19A116180P21	Digital, 4-Bit Bistable Latch: Identification No. 7475.
IC7	19A116180P31	Digital, BCD-TO-Decimal Decoder/Driver: Identification No. 74145.
IC8 and IC9	19A115913P7	Digital, Quad 2-Input Nand Gate: Identification No. 946.
IC10 and IC11	19A115913P3	Digital, Expandable Dual 4-Input Nand Buffer: Identification No. 932.
IC12	19A115913P7	Digital, Quad 2-Input Nand Gate: Identification No. 946.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1 and P2		(Part of printed wiring board 19D416324P1).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R2*	3R152P511J	Composition: 510 ohms ±5%, 1/4 w. Added by REV B.

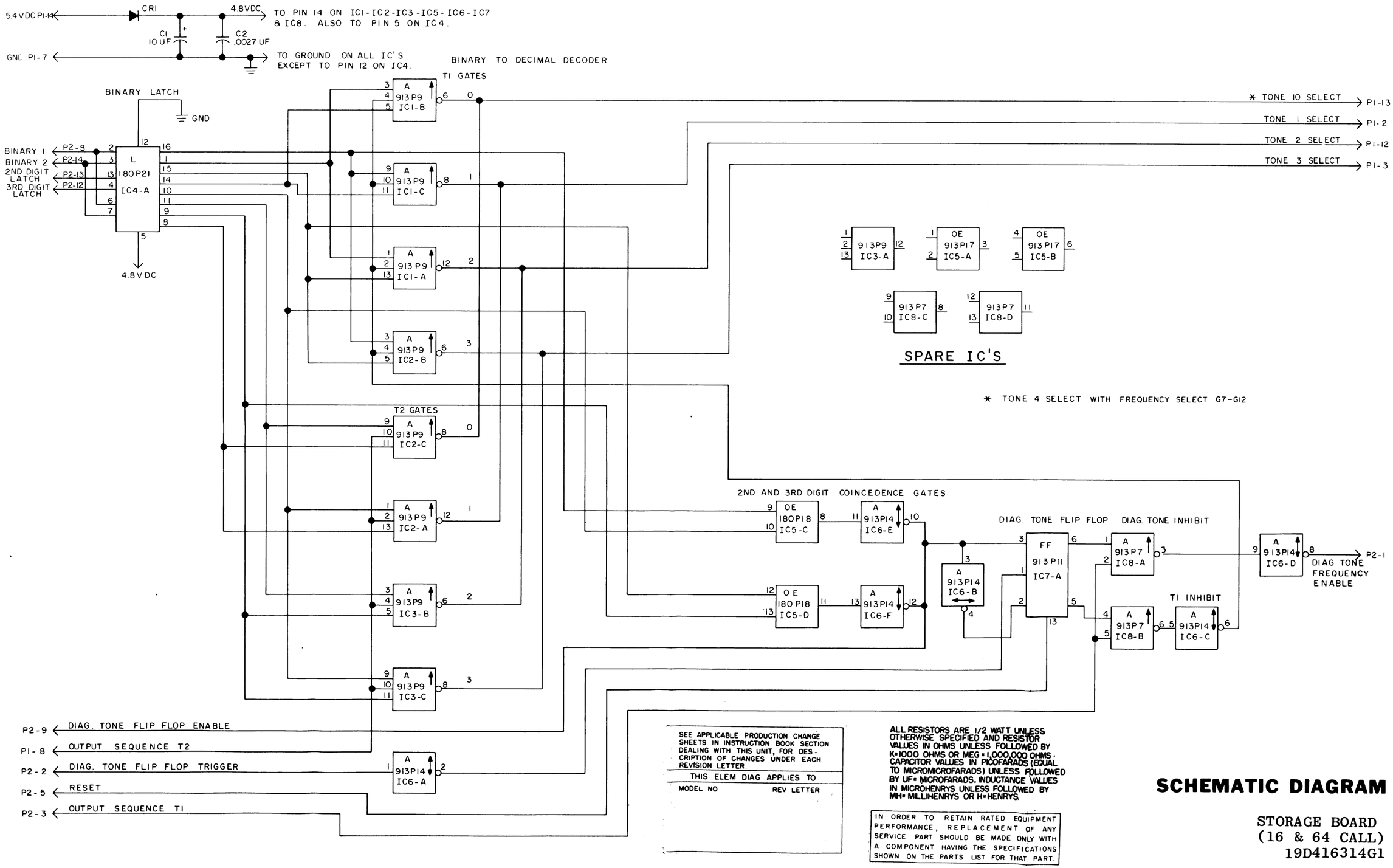
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To provide the same tone bank for selecting both tones. Changed connections to U10B.

REV. B - To stop the encoder from encoding with power line fluctuations. Added C6, CR2, CR3 and R2.



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO REV LETTER

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SCHEMATIC DIAGRAM

STORAGE BOARD
(16 & 64 CALL)
19D416314G1

(19D416317, Rev. 2)

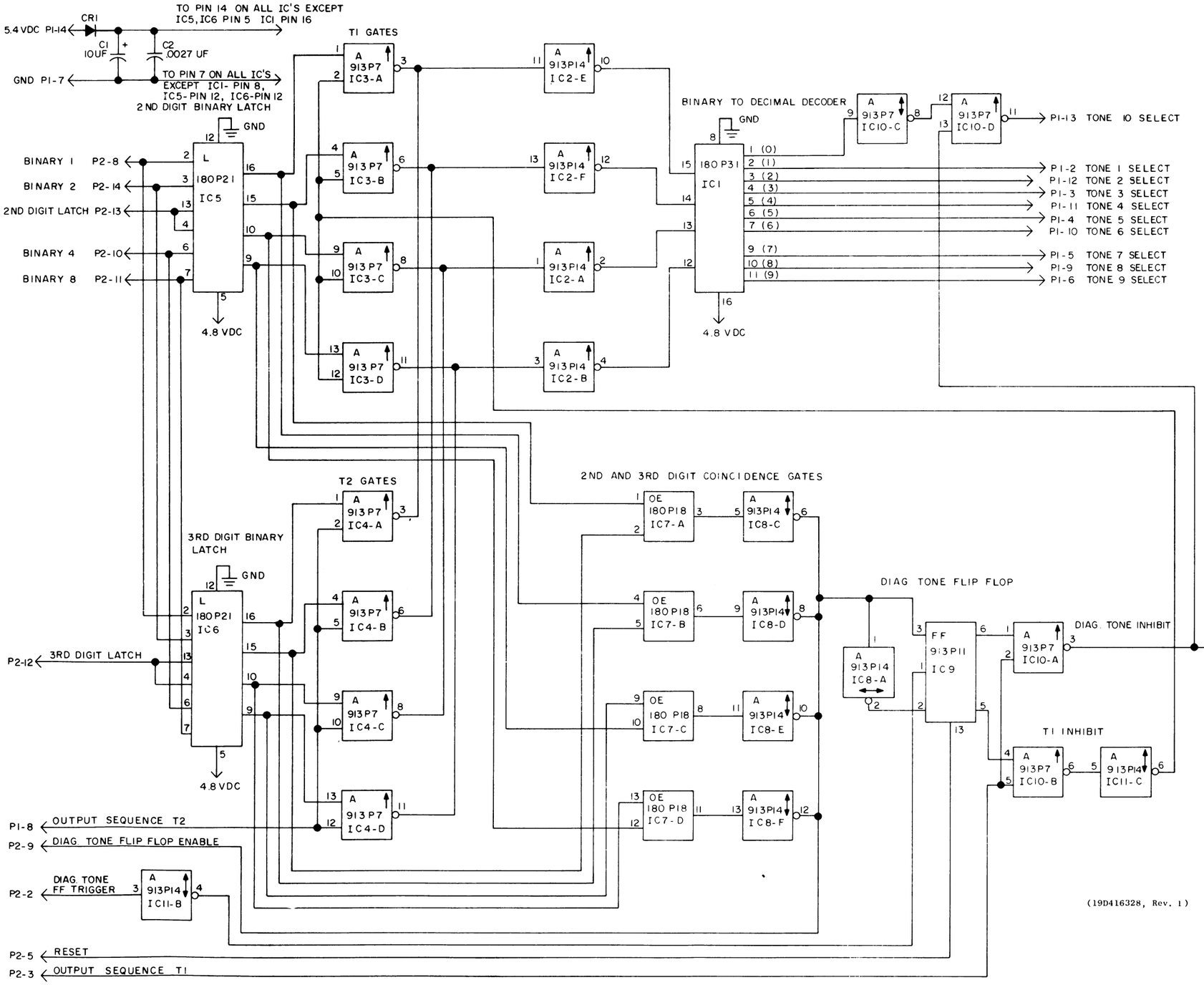
PARTS LIST

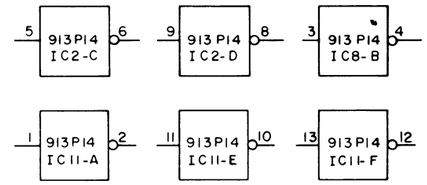
LBI-4418

STORAGE BOARD
TYPE 99 II TONE
19D416314G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C2	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4037822P1	Silicon.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1 thru IC3	19A115913P9	Monolithic, Triple 3-Input Gate; sim to Fairchild DTL 962.
IC4	19A116180P21	Monolithic, 4-Bit Bistable Latch; sim to Texas Instrument Type SN7475N.
IC5	19A116180P18	Monolithic, Quad 2-Input Exclusive-or Gate; sim to Texas Instrument Type SN7486N.
IC6	19A115913P14	Monolithic, Hex Inverter; sim to Fairchild DTL 936.
IC7	19A115913P11	Monolithic, Dual 945 Flip-Flop; sim to Fairchild DTL 097.
IC8	19A115913P7	Monolithic, Quad 2-Input Gate; sim to Fairchild DTL 946.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1 and P2		(Part of printed wiring board 19D416313P1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES





SPARE IC'S

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

(19D416328, Rev. 1)

SCHEMATIC DIAGRAM

STORAGE BOARD
(100-900 CALL)
19D416320G1

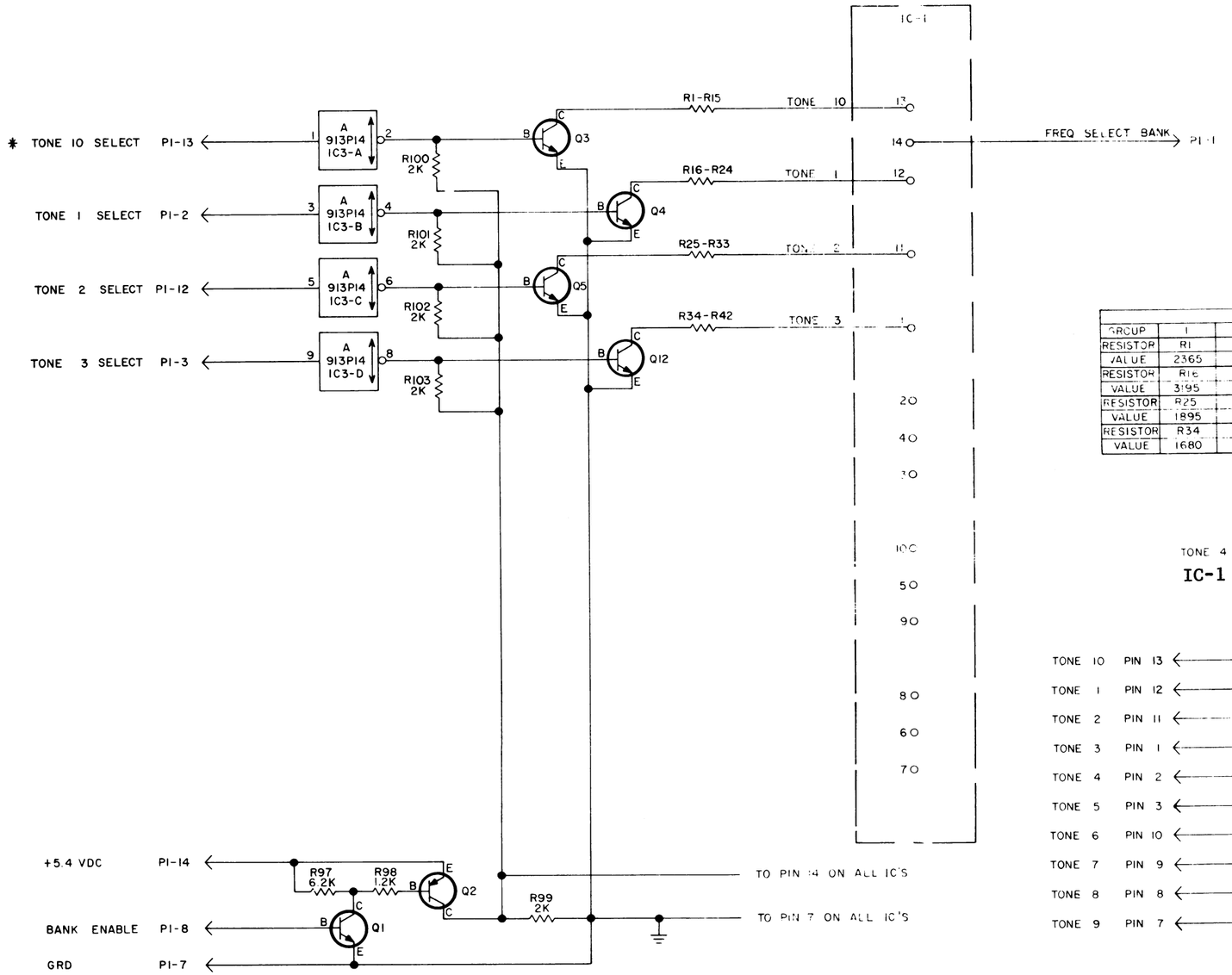
PARTS LIST

LBI-4419

STORAGE BOARD
TYPE 99 II TONE
19D416320G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C2	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW: sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4037822P1	Silicon.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1	19A116180P31	Monolithic, BCD-TO-Decimal Decoder Driver: sim to Texas Instrument Type SN74145N.
IC2	19A115913P14	Monolithic, Hex Inverter: sim to Fairchild DTL 936.
IC3 and IC4	19A115913P7	Monolithic, Quad 2-Input Gate: sim to Fairchild DTL 946.
IC5 and IC6	19A116180P21	Monolithic, 4-Bit Bistable Latch: sim to Texas Instrument Type SN7475N.
IC7	19A116180P18	Monolithic, Quad 2-Input Exclusive-or Gate: sim to Texas Instrument Type SN7486N.
IC8	19A115913P14	Monolithic, Hex Inverter: sim to Fairchild DTL 936.
IC9	19A115913P11	Monolithic, Dual 945 Flip-Flop: sim to Fairchild DTL 097.
IC10	19A115913P7	Monolithic, Quad 2-Input Gate: sim to Fairchild DTL 946.
IC11	19A115913P14	Monolithic, Hex Inverter: sim to Fairchild DTL 936.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1 and P2		(Part of printed wiring board 19D416319P1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

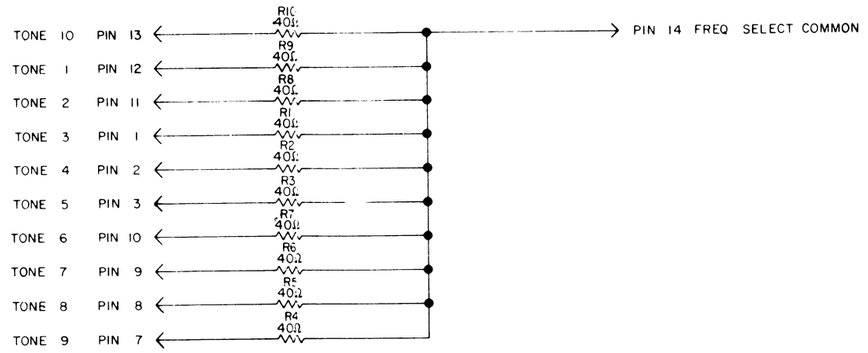


FREQ SELECT BD.
GP 1-3
GP 7-12

RESISTOR CHART									
GROUP	1	2	3	7	8	9	10	11	12
RESISTOR	R1	R2	R3	R10	R11	R12	R13	R14	R15
VALUE	2365	2600	2480	7005	2195	12930	7440	2325	650
RESISTOR	R16	R17	R18	R19	R20	R21	R22	R23	R24
VALUE	3195	3030	3160	10045	3100	15715	10695	3285	775
RESISTOR	R25	R26	R27	R28	R29	R30	R31	R32	R33
VALUE	1895	1745	1820	8915	2755	14710	9490	2920	730
RESISTOR	R34	R35	R36	R37	R38	R39	R40	R41	R42
VALUE	1680	1555	1615	7900	2460	13785	8390	2600	690

TONE 4 SELECT IN GROUP 7-12

IC-1 (TRIMMED TO VALUE AFTER ASSEMBLY TO FREQUENCY SELECT BOARD)



(19B219517, Rev. 1)

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART

(19D416550, Rev. 3)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS

SCHEMATIC DIAGRAM

FREQUENCY SELECT (4 FREQUENCY)
19D416469G1-G3

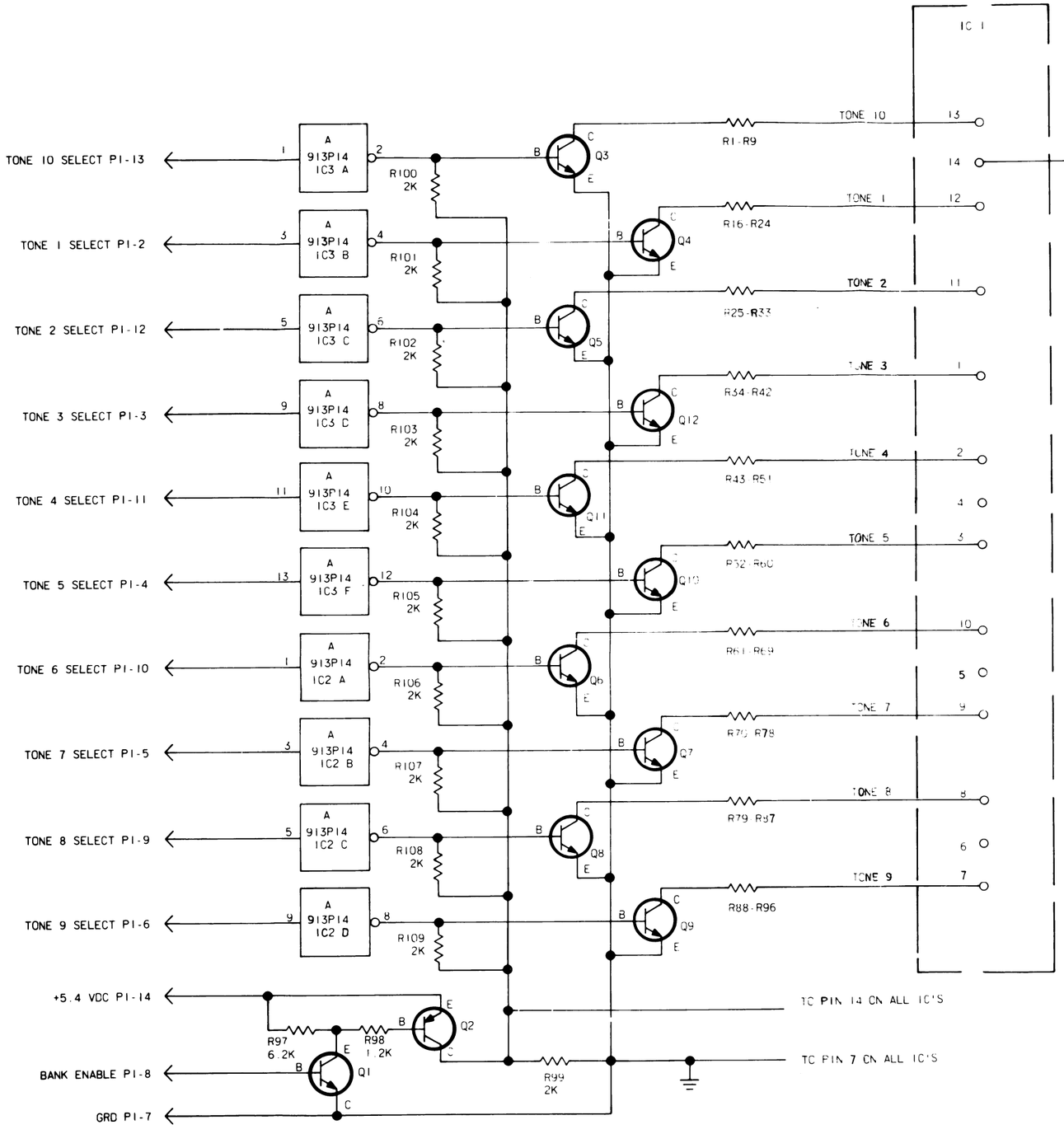
PARTS LIST

LBI4414A

FREQUENCY SELECT BOARD
TYPE 99 II TONE
19D416469G1-G3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1		Frequency Select I.C. Included in Freq. Select Board.
IC3	19A115913P14	Digital, Hex Inverter: Identification No. 936.
		- - - - - - - - - - - - PLUGS - - - - - - - - -
P1		(Part of printed wiring board 19D416454P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A115889P1	Silicon, NPN.
Q2	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q3 thru Q5	19A129207P1	Silicon, NPN.
Q12	19A129207P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R1	19A116690P2365	Wirewound: 2365 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R2	19A116690P2600	Wirewound: 2600 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R3	19A116690P2480	Wirewound: 2480 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R16	19A116690P3195	Wirewound: 3195 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R17	19A116690P3030	Wirewound: 3030 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R18	19A116690P2160	Wirewound: 2160 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R25	19A116690P1895	Wirewound: 1895 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R26	19A116690P1745	Wirewound: 1745 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R27	19A116690P1820	Wirewound: 1820 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R34	19A116690P1680	Wirewound: 1680 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R35	19A116690P1555	Wirewound: 1555 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R36	19A116690P1615	Wirewound: 1615 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R97	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R98	3R152P122J	Composition: 1200 ohms ±5%, 1/4 w.
R99 thru R103	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



RESISTOR CHART									
CIRCUIT	4	5		13	14	15	16	17	18
RESISTOR	R1	R2	R3	R4	R5	R6	R7	R8	R9
VALUE	2365	2600	2480	11390	5480	875	12130	3685	825
RESISTOR	R16	R17	R18	R19	R20	R21	R22	R23	R24
VALUE	3740	3030	1960	10045	3100	5715	10695	3265	775
RESISTOR	R25	R26	R27	R28	R29	R30	R31	R32	R33
VALUE	1895	1745	1620	8515	2755	1147	9490	2920	730
RESISTOR	R34	R35	R36	R37	R38	R39	R40	R41	R42
VALUE	1580	1555	1415	7900	2490	13785	8390	2500	690
RESISTOR	R43	R44	R45	R46	R47	R48	R49	R50	R51
VALUE	1495	1390	1440	7315	2305	12930	7440	2325	650
RESISTOR	R52	R53	R54	R55	R56	R57	R58	R59	R60
VALUE	1340	1250	1295	6220	1955	1165	6600	2070	615
RESISTOR	R61	R62	R63	R64	R65	R66	R67	R68	R69
VALUE	1215	1130	1170	5635	1745	1100	5865	1845	580
RESISTOR	R70	R71	R72	R73	R74	R75	R76	R77	R78
VALUE	3775	1260	1205	3420	1555	1040	5220	1645	515
RESISTOR	R79	R80	R81	R82	R83	R84	R85	R86	R87
VALUE	2070	3565	6375	4380	1385	980	4640	1465	515
RESISTOR	R88	R89	R90	R91	R92	R93	R94	R95	R96
VALUE	2730	2260	2870	3920	1235	925	4135	1310	487

RESISTOR'S SHOWN IN CHART ARE 0.25 WATT, VALUES SHOWN ARE IN OHMS

IC-1 (TRIMMED TO VALUE AFTER ASSEMBLY TO FREQUENCY BOARD)

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PLI9D416469G13	A

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

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(19D416541, Rev. 4)

SCHEMATIC DIAGRAM

FREQUENCY SELECT BOARD
10-FREQUENCY 19D416469G4-G6

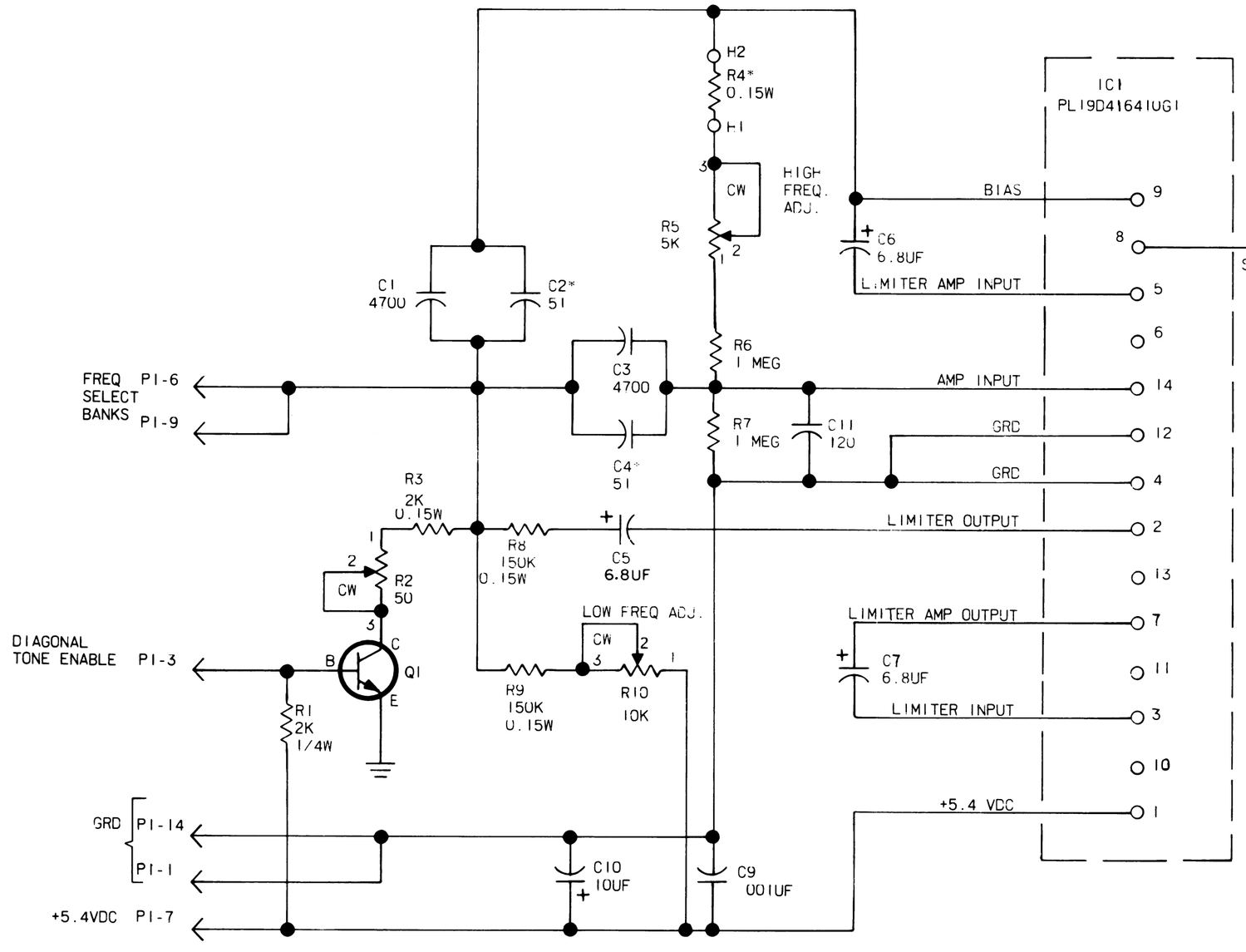
PARTS LIST

LBI4416A

FREQUENCY SELECT BOARD
TYPE 99 II TONE
19D416469G4-G6

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
IC1		Frequency Select I.C. Included in Freq. Select Board.
IC2 and IC3	19A115913P14	Digital, Hex Inverter: Identification No. 936
		- - - - - - - - - - - - - PLUGS - - - - - - - - - -
P1		(Part of printed wiring board 19D416454P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q2	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q3 thru Q12	19A129207P1	Silicon, NPN.
		- - - - - - - - - - - - RESISTORS - - - - - - - - -
R1	19A116690P2365	Wirewound: 2365 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R2	19A116690P2600	Wirewound: 2600 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R3	19A116690P2480	Wirewound: 2480 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R16	19A116690P3195	Wirewound: 3195 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R17	19A116690P3030	Wirewound: 3030 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R18	19A116690P2160	Wirewound: 2160 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R34	19A116690P1680	Wirewound: 1680 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R35	19A116690P1555	Wirewound: 1555 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R36	19A116690P1615	Wirewound: 1615 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R43	19A116690P1495	Wirewound: 1495 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R44	19A116690P1390	Wirewound: 1390 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R45	19A116690P1440	Wirewound: 1440 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R52	19A116690P1340	Wirewound: 1340 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R53	19A116690P1250	Wirewound: 1250 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R54	19A116690P1295	Wirewound: 1295 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R61	19A116690P1210	Wirewound: 1210 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R62	19A116690P1130	Wirewound: 1130 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R63	19A116690P1170	Wirewound: 1170 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R70	19A116690P3775	Wirewound: 3775 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R71	19A116690P4260	Wirewound: 4260 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R72	19A116690P4005	Wirewound: 4005 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R79	19A116690P2070	Wirewound: 2070 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R80	19A116690P3565	Wirewound: 3565 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R81	19A116690P3375	Wirewound: 3375 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R88	19A116690P2730	Wirewound: 2730 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R89	19A116690P2260	Wirewound: 2260 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R90	19A116690P2870	Wirewound: 2870 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R97	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R98	3R152P122J	Composition: 1200 ohms ±5%, 1/4 w.
R99 thru R109	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



(19C320123, Rev. 2)

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

SCHEMATIC DIAGRAM

OSCILLATOR BOARD
19C320086G1

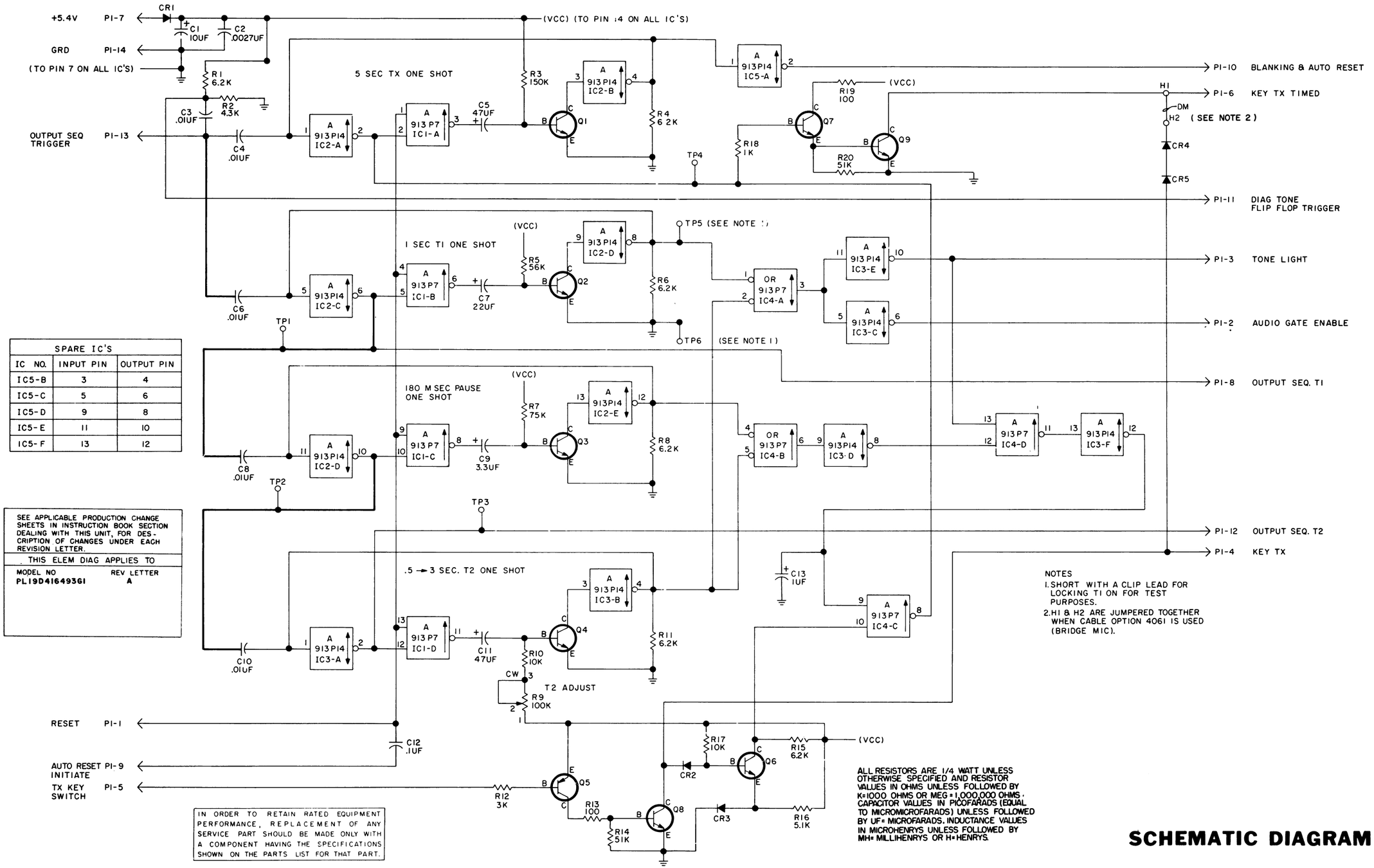
PARTS LIST

LBI-4413B

OSCILLATOR BOARD
TYPE 99 II TONE
19C320086G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116058P4	Silver, mica: 4700 pf ±.5%, 100 VDCW; sim to Electro Motive Type DM20.
C2A	5496203P20	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C2B	5496203P120	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -3300 PPM.
C2C	5496203P220	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -4200 PPM.
C2D	5496203P320	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -4700 PPM.
C2E	5496203P420	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -5600 PPM.
C3	19A116058P4	Silver, mica: 4700 pf ±.5%, 100 VDCW; sim to Electro Motive Type DM20.
C4A	5496203P20	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C4B	5496203P120	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -3300 PPM.
C4C	5496203P220	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -4200 PPM.
C4D	5496203P320	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -4700 PPM.
C4E	5496203P420	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -5600 PPM.
C5 thru C8	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C9	5494481P11	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C10	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C11	7489162P29	Silver mica: 120 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
UC1	19D416410G1	Stable Audio Oscillator.
		- - - - - - - - - - PLUGS - - - - - - - - -
P1		(Part of printed wiring board 19D416448P1).
		- - - - - - - - - - TRANSISTORS - - - - - - -
Q1	19A129207P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - -
R1	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R2	19A116559P110	Variable, cermet: 50 ohms ±20%, .5 w; sim to CTS Series 360.
R3	19A116690P2000	Wirewound: 2000 ohms ±0.1%, 0.15 w; sim to Mills Type MR-100-2A.
R4A	19A116094P4020	Wirewound: 4020 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4B	19A116094P8060	Wirewound: 8060 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4C	19A116094P12000	Wirewound: 12,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4D	19A116094P16000	Wirewound: 16,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4E	19A116094P20000	Wirewound: 20,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4F	19A116094P24000	Wirewound: 24,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4G	19A116094P28000	Wirewound: 28,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4H	19A116094P32000	Wirewound: 32,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4J	19A116094P36100	Wirewound: 36,100 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R4K	19A116094P40200	Wirewound: 40,200 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R5	19A116559P102	Variable, cermet: 5000 ohms ±20%, .5 w; sim to CTS Series 360.
R6	19A116624P1	Metal film: 1 megohm ±0.1%, 1/2 w; sim to IRC Type CCA-T9.
R7	19A116278P501	Metal film: 1 megohm ±2%, 1/2 w.
R8 and R9	19A116094P 150000	Wirewound: 150,000 ohms ±1%, 0.15 w; sim to RCL Type 7010.
R10	19A116559P106	Variable, cermet: 10,000 ohms ±20%, .5 w; sim to CTS Series 360.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



SPARE IC'S		
IC NO.	INPUT PIN	OUTPUT PIN
IC5-B	3	4
IC5-C	5	6
IC5-D	9	8
IC5-E	11	10
IC5-F	13	12

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19D416493G1	A

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

NOTES

1. SHORT WITH A CLIP LEAD FOR LOCKING TI ON FOR TEST PURPOSES.
2. H1 & H2 ARE JUMPERED TOGETHER WHEN CABLE OPTION 4061 IS USED (BRIDGE MIC).

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H= HENRYS.

(19D416534, Rev. 7)

DF-5042

SCHEMATIC DIAGRAM

OUTPUT SEQUENCE BOARD
19D416493G1

PARTS LIST

LBI4417A

OUTPUT SEQUENCE BOARD
TYPE 99 II TONE
19D416493G1

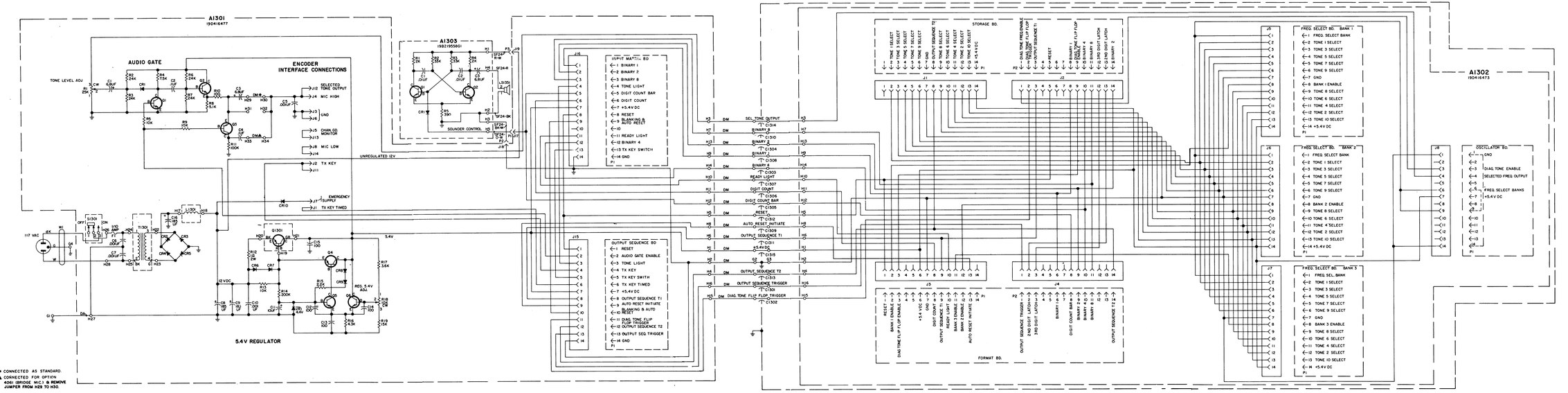
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C2	5494481P27	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C3 and C4	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C5	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C6	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C7	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C8	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C9	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C10	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C11	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C12	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C13	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	4037822P1	Silicon, 1000 mA, 400 PIV.
CR2 and CR3	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR4 and CR5	4037822P1	Silicon, 1000 mA, 400 PIV.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC1	19A115913P7	Digital, Quad 2-Input Gate: Identification No. 946.
IC2 and IC3	19A115913P14	Digital, Hex Inverter: Identification No. 936.
IC4	19A115913P7	Digital, Quad 2-Input Gate: Identification No. 946.
IC5	19A115913P14	Digital, Hex Inverter: Identification No. 936.
		- - - - - - - - - - - PLUGS - - - - - - - - -
P1		(Part of printed wiring board 19D416483P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 thru Q4	19A115889P1	Silicon, NPN.
Q5	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q6 and Q7	19A115889P1	Silicon, NPN.
Q8* and Q9*	19A134437P1	Silicon, NPN; sim to Type 2N5786.
		In REV A & earlier:
	19A115300P4	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R2	3R152P432J	Composition: 4.3K ohms ±5%, 1/4 w.
R3	3R152P154J	Composition: 150K ohms ±5%, 1/4 w.
R4	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R5	3R152P563J	Composition: 56K ohms ±5%, 1/4 w.
R6	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R7	3R152P753J	Composition: 75K ohms ±5%, 1/4 w.
R8	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R9	19B209358P9	Variable, carbon film: approx 3K to 100K ohms ±20%, 0.25 w; sim to CTS Type U-201.
R10	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R11	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R12	3R152P302J	Composition: 3K ohms ±5%, 1/4 w.
R13	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R14	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R15	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w.
R16	3R152P512J	Composition: 5.1K ohms ±5%, 1/4 w.
R17	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R18	3R152P102J	Composition: 1K ohms ±5%, 1/4 w.
R19	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R20	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - -
TP1 thru TP6	19B211379P1	Spring (Test Point).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q8, Q9).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To provide transistors with higher gain. Replaced Q8 and Q9.



* CONNECTED AS STANDARD.
▲ CONNECTED FOR OPTION 40AI (BRIDGE MIC.) & REMOVE JUMPER FROM H28 TO H30.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED. RMF INDICATES METAL FILM RESISTOR. UNLESS FOLLOWED BY K OR M, VALUES ARE IN OHMS. CAPACITOR VALUES W/ NO SPECIFIED ISSUE, TO MICROMICROFARADS UNLESS FOLLOWED BY UF= MICROFARADS, INDUCTANCE VALUES IN MICROHENRYS, UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SUPPLEMENT FOR INFORMATION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PLI904650401	
PLI904684701	A

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19B621793, Rev. 10)

INTERCONNECTION DIAGRAM

MOTHER BOARD A1301, COMPONENT BOARD A1302 AND SOUNDER BOARD A1303

PARTS LIST

LBI-4420B

TYPE 99 II TONE ENCODER
BASE ASSEMBLY
19D416504G1

SYMBOL	GE PART NO.	DESCRIPTION
A1301		MOTHER BOARD 19D416477G1
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C2	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C3	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C4	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C5 thru C7	5494481P31	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C8 and C9	19A115680P13	Electrolytic: 185 µf +150% -10%, 21 VDCW; sim to Mallory Type TTX.
C10	5494481P11	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C11	19A115680P8	Electrolytic: 10 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C12 thru C15	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C16	19A115*-0P13	Electrolytic: 185 µf +150% -10%, 21 VDCW; sim to Mallory Type TTX.
		- - - - - - - - - DIODES AND RECTIFIERS - - - -
CR1	19A115250P1	Silicon.
CR2 thru CR5	4037822P1	Silicon.
CR6 thru CR9	19A115250P1	Silicon.
CR10	4037822P1	Silicon.
		- - - - - - - - - - FUSES - - - - - - - - - -
F1	7487942P8	Slow blowing; 1/10 amp at 250 v; sim to Bussman MTL-1/10.
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J1 thru J14	4033513P2	Contact, electrical: sim to Bead Chain L93-2.
J15 and J16	19A116446P5	Connector, printed wiring: 14 contacts.
J17 thru J19	4033513P2	Contact, electrical: sim to Bead Chain L93-2.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 and Q2	19A115889P1	Silicon, NPN.
Q3 and Q4	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q5 and Q6	19A115889P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - -
R1	19B209358P107	Variable, carbon film: approx 75 to 25,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R2 and R3	3R152P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R4	3R152P753J	Composition: 7500 ohms ±5%, 1/4 w.
R5	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R6 and R7	3R152P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R8	3R152P513J	Composition: 5100 ohms ±5%, 1/4 w.
R9	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R10	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R11	3R152P104J	Composition: 100,000 ohms ±5%, 1/4 w.
R12	19A115416P9	Wirewound: 1.00 ohms ±1%, 2 w; sim to Dale Type RS-2B.
R13	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R14	3R12P204J	Composition: 200,000 ohms ±5%, 1/4 w.
R15	3R152P222J	Composition: 2200 ohms ±5%, 1/4 w.
R16	3R152P432J	Composition: 4300 ohms ±5%, 1/4 w.
R17	3R152P362J	Composition: 3600 ohms ±5%, 1/4 w.
R18	19B209354P106	Variable, carbon film: approx 75 to 10,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R19	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
		- - - - - - - - - VOLTAGE REGULATORS - - - - -
VR1	4036887P4	Silicon, Zener.
A1302		COMPONENT BOARD 19D416473G1
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J1 thru J8	19A116446P5	Connector, printed wiring, one-part.
		SHIELD ASSEMBLY 19B219572G1
A1303		SCHEMES BOARD 19B219556G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C3	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	19A115250P1	Silicon.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P3	4029840P2	Contact, electrical: sim to Amp 42827-2.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 and Q2	19A115889P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P203J	Composition: 2000 ohms ±5%, 1/4 w.
R2 and R3	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R4	3R152P203J	Composition: 2000 ohms ±5%, 1/4 w.
R5	3R152P391J	Composition: 390 ohms ±5%, 1/4 w.
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS1351	19A116730P1	Transducer, Piezoelectric.
L1301	549093691	- - - - - - - - - - INDUCTORS - - - - - - - - - - Reactor: .02 h min, 1.3 ohms ±10% DC res, 1.5 VDC operating.
Q1301	19A116375P1	- - - - - - - - - - TRANSISTORS - - - - - - - - Silicon, PNP.
S1301	19B209261P8	- - - - - - - - - - SWITCHES - - - - - - - - - - Slide: DPDT, 2 poles, 2 positions, .5 amp VDC or 3 amps VAC at 125 v; sim to Switchcraft 46206L.
T1301	19A116685P2	- - - - - - - - - - TRANSFORMERS - - - - - - - - Power, step-down: PRI: 117 VRMS, 50/60 Hz. Sec: 9.8 VDC 245 at 650 ma, 60 Hz.
W1301	19A116740P2	- - - - - - - - - - CABLES - - - - - - - - - - Power: approx 8 feet long.
		SHIELD ASSEMBLY 19B219480G1
C1301 thru C1315	19A116699P2	- - - - - - - - - - CAPACITORS - - - - - - - - - - Ceramic, feed-thru: 1000 pf ±20%, 250 VDCW; sim to Aerovox Style EF-3.
		- - - - - - - - - - MISCELLANEOUS - - - - - -
	19C330105G1	Base.
	19B219473G1	Cover.
	19B219480G1	Shield. (Contains A1302).
	19A116023P1	Insulated plate. (Used with Q1301).
	19A116022P1	Insulated bushing. (Used with Q1301).
	4029851P5	Cable clamp: sim to Weckesser 1/4-4-128. (Used with W1301).
	4029851P9	Cable clamp: sim to Weckesser 1/2-4-128. (Located in front of A1302).
	19B201074P206	Tap screw: No. 4-40 x 3/8. (Used with cable clamps).
	4032480P1	Nut, sheet spring: sim to Vector Electronic Co. No. 440. (Used with S1301, T1301).
	MS0P900692	Tap screw: No. 4-40 x 3/8. (Secures Q1301, S1301, T1301).
	19A115990P1	Rubber bumper. (Used as feet for Base Assembly).
	19B200525P304	Rivet, tubular. (Secures Rubber bumper to Base).
	19A116688P1	Fuse clip: sim to littlefuse, Inc. 102062. (Used with F1 on A1301- order 2 for each fuse).
	19C330108G1	Shield. (For LS1351).
	19A120175P17	Insulator. (Located on LS1351 shield).
	4035656P67	Spacer, threaded. (Used with A1303).
	4033198P12	Eyelet, metal. (Located under A1303 on shield).

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To stop tone faleing due to improper battery standby operation.
Changed CR10 connection.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES