GE MOBILE RADIO

MAINTENANCE MANUAL

MULTIPLE-TONE CHANNEL GUARD ENCODER 19D417862G1, 2

Maintenance Manual LBI30242E

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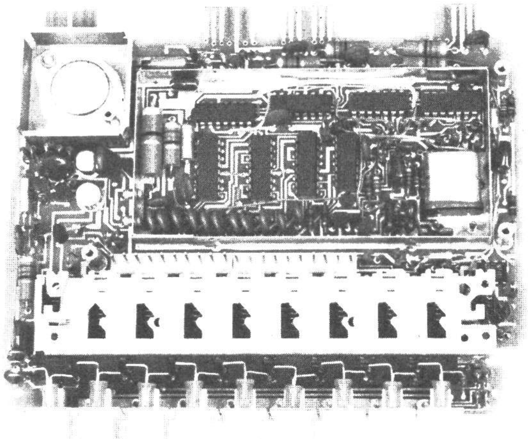
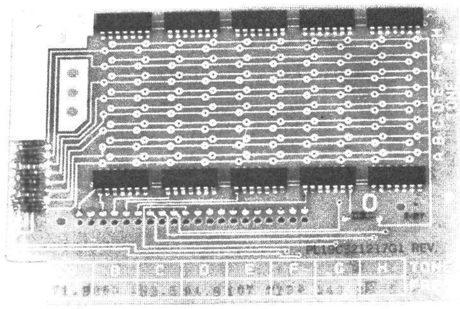


ENCODER BOARD



PROGRAM BOARD

CHANNEL GUARD ENCODER 19D417862G1, 2

SPECIFICATIONS *

Tone Frequencies	67 to 250 Hertz
Input Voltage	13.8 VDC ±20%
Current Drain	Less than 550 milliamperes (keyed) Less than 150 milliamperes (unkeyed)
Output Level	Greater than 1.5 volts RMS at 7.19 Hertz (de-emphasized at 6 dB per octave ±2 dB)
Output Distortion	Less than 1%
Frequency Stability	±0.005%
Temperature Range	-40° to +70°C. (-40°F to 158°F)
Encoder Response Time	30 milliseconds
Setability	±0.2%

*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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TABLES

WARNING

Although the highest DC voltage in the radio is supplied by the vehicle battery, high current may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns. KEEP AWAY FROM THESE CIRCUITS when the transmitter is energized!

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

DESCRIPTION

The General Electric multi-tone Channel Guard encoder uses digital/analog techniques to generate continuous tone controlled squelch system (CTCSS) frequencies. Encoder 19D417862G1 provides up to eight encoder tones, and Encoder 19D417862G2 provides up to two encoder tones. Any unused tone push-buttons are blocked by lockout rivets to prevent them from operating. The Encoder mounts in the option deck of the C-800 or C-900 Series Control Units.

Each Channel Guard Encoder consists of a program board mounted on top of the channel selector board. The program board may be programmed for all standard Channel Guard tone frequencies in accordance with EIA Standard RS-220. It may also be re-programmed in the field as required by simply filling in the old holes with solder and re-drilling new holes according to the Tone Programming Procedure. In addition, the Encoder can be programmed for any of the tone frequencies listed in Table II (see Table of Contents).

The channel selector board contains a Channel Guard (CG) control and up to eight pushbutton switches (A-H) to select one of the programmed Channel Guard tones for transmission.

When the CG pushbutton switch is pressed, power is applied to the component board and the CG light is at maximum brightness. The tone selector pushbuttons are backlighted at a somewhat lower level to indicate the unit is operable.

When a tone selector pushbutton (A-H) is pressed, the selected button will light at maximum brightness to indicate the tone selected for transmission. The tone selector pushbuttons are mechanically interlocked so that only one switch may be operated at a time.

TONE PROGRAMMING PROCEDURE

The 19C321217 Program Board provides frequency programming inputs to the Encoder. A total of eight Channel Guard tone frequencies may be programmed. Tone channels that are not programmed on the board produce a frequency of 54 Hz at the Encoder output.

The board is programmed by drilling out plated-through holes on the printed board. The holes form a matrix of eight columns (A-H) by ten hole-pairs. Each column represents a particular tone frequency and the drilled hole-pairs represent binary information bits (ones and zeros).

The board is normally programmed for standard Channel Guard frequencies; however, other 10-bit binary sequences may be programmed to obtain non-standard frequencies in special applications. Tone channels not to be used should not be programmed until needed.

PROGRAMMING PROCEDURE

1. Determine digital code for desired Channel Guard tone frequency from Table I. For example, if tone A is to be 97.4 Hertz, find this frequency in frequency column and determine digital code (1000111110) under hole-pair columns (1 through 10).

2. The tone location (columns A-H) are marked on the board (refer to Figure 1). The hole pairs in each column are also marked. For example, hole pairs for tone A are marked as follows: top hole pair is digit 10, followed down the column by digits 1, 9, 2, 8, 3, 7, 4, 6, 5. All tone columns are numbered in this manner except columns F and G. The top hole-pair in columns F and G is numbered digit 1, followed by 10, 2, 9, 3, 8, 4, 7, 5, 6.

3. If a binary "0" is required in the digit code, the left hole in a hole-pair is drilled out. If a binary "1" is required, the right hole in a hole-pair is drilled out. Refer to Figure 1.

4. Typical tone drilling procedure for tone A (Frequency selected is 97.4 Hertz).

   A. Binary code under digit 1 in the table for 97.4 Hz is binary "1". Using a .046-inch (#56) drill bit, drill out the right hole in hole-pair No. 1 (second hole-pair from the top of column A).

   B. Binary code under digit 2 in the table is binary "0". Drill out the left hole in hole-pair No. 2 (fourth hole-pair from the top of column A).

   C. Repeat for each digit until all ten holes have been drilled for tone A. Then proceed to program the other needed tone frequencies. Enter the programmed frequency into the appropriate block provided on the edge of the Program Board.

NOTE

Due to the fixed division ratios, the actual counted frequency will usually be slightly different from the nominal frequency, but always within ±0.2%.

TABLE I - Standard Channel Guard Frequencies

NOMINAL FREQUENCY In HZ	FREQUENCY DIGIT CODE NUMBER (HOLE-PAIR)									
	1	2	3	4	5	6	7	8	9	10
71.9	1	1	0	0	0	0	1	0	1	0
74.4	1	0	1	1	1	1	0	0	0	0
77.0	1	0	1	1	0	1	0	1	1	0
79.7	1	0	1	0	1	1	1	1	1	0
82.5	1	0	1	0	1	0	0	1	1	0
85.4	1	0	1	0	0	0	1	1	1	1
88.5	1	0	0	1	1	1	1	0	0	0
91.5	1	0	0	1	1	0	0	0	1	1
94.8	1	0	0	1	0	0	1	1	1	0
97.4	1	0	0	0	1	1	1	1	1	0
100.0	1	0	0	0	1	0	1	1	1	1
103.5	1	0	0	0	0	1	1	1	0	0
107.2	1	0	0	0	0	0	1	0	1	0
110.9	0	1	1	1	1	1	1	0	0	0
114.8	0	1	1	1	1	0	0	1	1	1
118.8	0	1	1	1	0	1	0	1	1	1
123.0	0	1	1	1	0	0	0	1	1	1
127.3	0	1	1	0	1	1	0	1	1	1
131.8	0	1	1	0	1	0	1	0	0	0
136.5	0	1	1	0	0	1	1	0	1	0
141.3	0	1	1	0	0	0	1	1	0	0
146.2	0	1	0	1	1	1	1	1	1	1
151.4	0	1	0	1	1	1	0	0	0	1
156.7	0	1	0	1	1	0	0	1	0	1
162.2	0	1	0	1	0	1	1	0	0	1
167.9	0	1	0	1	0	0	1	1	0	1
173.8	0	1	0	1	0	0	0	0	1	0
179.9	0	1	0	0	1	1	0	1	1	1
186.2	0	1	0	0	1	0	1	1	0	0
192.8	0	1	0	0	1	0	0	0	1	0
203.5	0	1	0	0	0	1	0	0	1	1
210.7	0	1	0	0	0	0	1	0	0	1

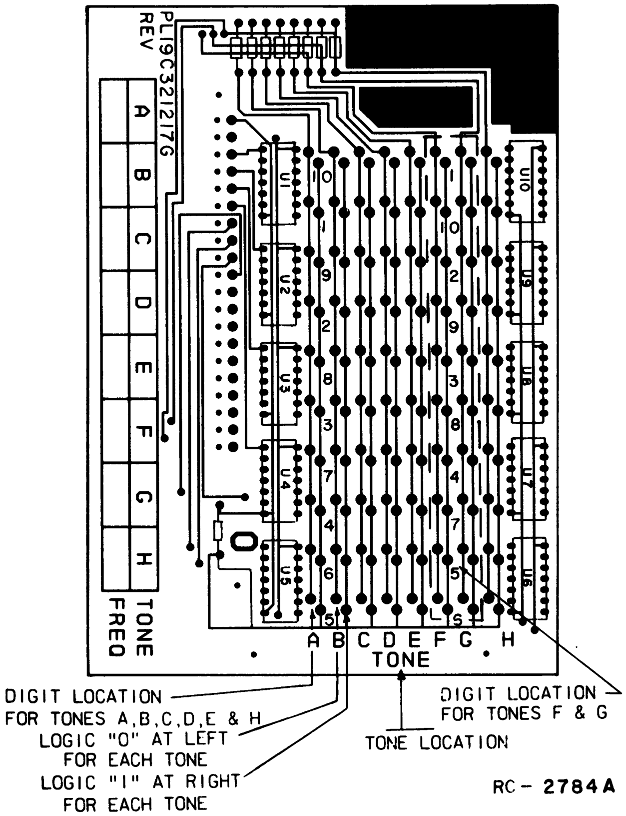


Figure 1 - Program Board Nomenclature

CIRCUIT ANALYSIS

The Channel Guard Multi-Tone Encoder consists of a 3.579 MHz crystal oscillator, a divide by 4 counter, a divide by N counter (N is determined by the ten bit binary code provided by the program board), a divide by 16 counter and a 4-bit adder. The circuitry to this point is pure digital in nature.

The output of the 4-bit adder is used to develop a stepped sine wave by means of a Walsh Function Generator and a summing amplifier. The summing amplifier also de-emphasizes the signal at 6 dB per octave. The signal is then coupled through an active harmonic filter to the encoder output.

CHANNEL GUARD BOARD

CRYSTAL OSCILLATOR

A transistorized Colpitts oscillator is used to generate the master frequency of 3.579 MHz. The oscillator crystal (Y1001) output feeds the base of oscillator Q1001. Feedback for the oscillator is developed across C1002/C1003. The oscillator output is coupled directly to buffer transistor Q1002.

DIVIDE BY 4 COUNTER

The oscillator signal is coupled through buffer amplifier Q1003 to frequency divider U1001, which divides the oscillator frequency by 4. The divider consists of two J-K flip-flops connected as a binary counter. Q1003 is turned on and off during each cycle of the oscillator frequency. As Q1003 turns on, the first flip-flop (U1001-A) changes state. The second cycle causes U1001-A to switch back to the "0" state. Thus two oscillator cycles switch U1001-A through one complete cycle.

When U1001-A switches from "1" to "0", the second flip-flop (U1001-B) changes state. Two cycles of U1001-A are required to switch U1001-B from "0" to "1" and back to "0". Therefore, four cycles of the oscillator output results in one cycle output of the divide by 4 counter. The resultant output frequency of U1001 is 894.886 kHz.

DIVIDE BY N COUNTER

The Divide by N Counter is composed of U1002, U1003, U1004, and associated circuitry. These ICs are 4-bit counters with programmable data input leads for determining the value of N. These data input leads are programmed by the holes drilled in the Program Board matrix.

Each IC in the counter consists of four master-slave flip-flops. The outputs of the flip-flops are triggered by a low-to-high transition on the countdown clock input (pin 4). The programmed inputs on the data leads (pins 1, 9, 10, 15) preset the state of each counter when a load pulse occurs. When the counter counts to its lowest state, it puts out a pulse on the borrow lead (pin 13) and then proceeds to count down again from its highest state (16).

The programmed input leads to the counters correspond to the ten binary code numbers programmed into the Program Board. For example, if Channel Guard tone frequency 97.4 Hertz has been programmed, the binary code is 100011110. Reading the code from left to right corresponds to the input level on the digit program leads to the 4-bit counters. The input lead to U1004, pin 1 (digit No. 1) is a binary "1". The input lead to U1004, pin 15 (digit No. 2) is a binary "0". The input lead to U1003, pin 9 (digit No. 3) is a binary "0", and so on.

The output of each IC in the Divide by N Counter is the borrow lead (pin 13) which pulses once each time the counter is reset. This lead is connected to the next counter as its countdown clock lead (pin 4), causing that counter to count down one state on each input pulse. The output of U1004 is tied to the load lead (pin 11) of all three counters. Thus when the last count occurs, U1004 reaches state "0" and produces a pulse which loads each counter to its programmed state and then the countdown sequence repeats. The resultant division factor is N-1. The pulse frequency at the output of U1004 is 16 times the selected Channel Guard tone frequency. In our example of 97.4 Hertz, the pulse frequency at the output of U1004 would be 16 times 97.4, or 1.558 kHz.

WALSH FUNCTION GENERATOR

The desired tone output of the Encoder is obtained by converting the digital pulses developed by the countdown circuitry to a fair approximation of a sine wave. This is accomplished by the Walsh Function Generator. The Summing Amplifier combines the four Walsh Function Generator outputs and smoothes the waveform to produce a good sine wave.

The output of the Divide by N Counter is applied to a Divide by 16 Counter (U1005). Since the output of the Divide by N Counter is 16 times the selected tone frequency, the Divide by 16 Counter results in a pulsed output equal to the tone frequency. Each count (2, 4, 8, 16) of the 4-Bit Counter (U1005) is connected to individual input leads of the 4-Bit Adder U1006. These count leads are sequenced through the 16 binary states (0000 to 1111) in 16 input cycles. The four binary outputs of the adder are connected to a group of exclusive OR gates which form the Walsh Function Generator. The Generator produces digital waveforms from the 16 count states which, when summed, result in a staircase waveform approximating a sine wave.

The Walsh Function coefficients of a sine wave are given in the following table. Refer to Figure 2.

WALSH FUNCTION	SINE WAVE COEFFICIENT
1	0.637
3	-0.264
7	-0.127
5	-0.052

The resistive weighting network (R1011-R1021) sets the level of the output current for each input bit from the Walsh Function Generator. Capacitor C1030 AC couples the combined current to the Summing Amplifier (AR1001-A) which serves as a current to voltage converter. The resultant waveshape is shown in Figure 3. This is the result of adding waveform No. 1 (U1008-8) times 0.637 to waveform No. 3 (U1008-11) times -0.264 to waveform No. 5 (U1007-6) times -0.052 to waveform No. 7 (1007-8) times -0.127.

De-emphasis capacitor C1029 in the feedback loop of the Summing Amplifier provides a 6 dB/octave rolloff. The signal is then passed through the active harmonic filter AR1001-B, resulting in the desired sine wave output at the Channel Guard frequency selected.

SQUELCH TAIL ELIMINATION (STE)

Squelch Tail Elimination (STE) is accomplished by changing the phase of the modulating tone 135 degrees at the transmitter when the PTT switch is released and

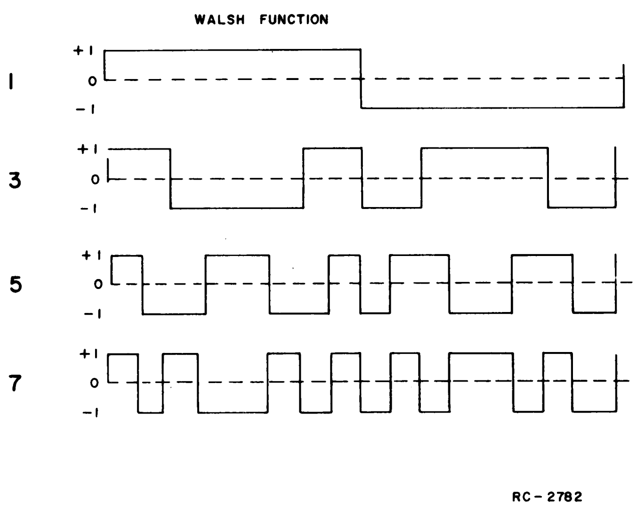


Figure 2 - Walsh Function Waveforms

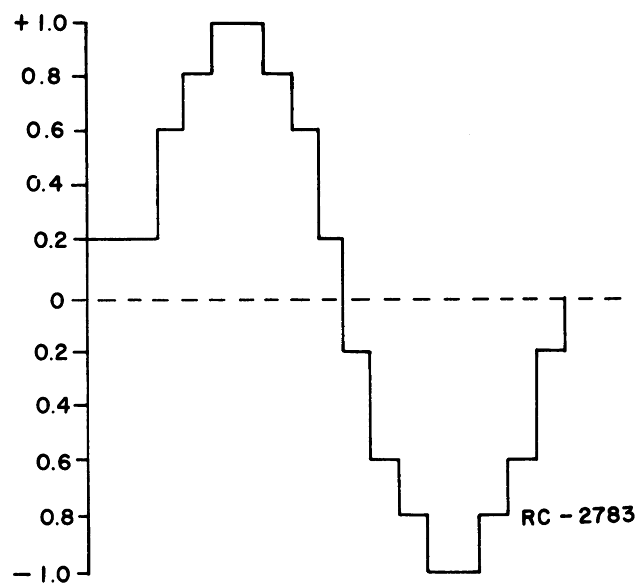


Figure 3 - Weighted Sum of Walsh Functions

simultaneously delaying the transmitter-carrier dropout for approximately 160 milliseconds. This allows sufficient time for the receiver to detect the phase shift in the transmitted tone and thus mute the receiver, eliminating the squelch tail. The delay in transmit carrier dropout is determined by the RC time constant of C1027 and R1028.

Initially, when the PTT switch is pressed, Q1008 is not conducting. A high is thus applied to pins 4 and 7 of the 4-Bit Adder U1006. Pins 11 and 16 of the Adder are permanently grounded. The resultant binary outputs of the Adder under these conditions is 6 counts ahead of the input from the 4-Bit Counter U1005. This means that a binary 6 (0110) is added to the input count. C1027 is charged to 10 volts. Q1005 is conducting which, in turn, holds Q1006 and Q1007 on.

When the PTT switch is released, Q1008 is turned on. Pins 4 and 7 of U1006 are now grounded. The resultant binary input (0000) at pins 4, 11, 7, and 16 of U1006 is now added to the binary input from the 4-Bit Counter. The output count is now equal to the input count. This results in a phase shift of the tone output sine wave equal to 135 degrees. (6 times 22.5) Since the digital count is 16 times the output tone frequency, each count thus represents 22.5 degrees.

With the PTT released, Q1005 cannot turn off until C1027 discharges to the level required to turn CR1003 on. After approximately 160 milliseconds (determined by the RC time constant of C1027 and R1028), CR1013 is turned on. Q1005 now turns off, turning off Q1007. This removes the ground from the DELAYED PTT lead P1005B-10.

5 VOLT REGULATOR & PTT CIRCUITS

The 5-volt regulator circuit includes Q1004, regulator IC VR1003 and associated components. Pressing in the CG pushbutton (push-Push) applies power to PTT Delay circuit and the 5-volt regulator through input choke L1007.

Q1004 is normally not conducting. Pressing the PTT switch turns on Q1007, causing its collector voltage to drop to near ground potential. This forward biases CR1002, causing Q1004 to start conducting, and applies the supply voltage to VR1003. The 5-volt regulator output is then applied to the logic circuits.

PROGRAM BOARD 19C321217G1

The Program Board consists of ten NAND gates (U1-U10), eight 1,000 ohm resistors (R1-R8), and one 100 ohm resistor (R9). One of the 1,000 ohm resistors is located in series with each of the tone channel select buses (A-H). The 100 ohm resistor is connected in the programming jumper bus.

If no programming has been initiated (no holes drilled in the board), all inputs to the NAND gates are high except the inputs connected to the selected tone channel bus. The selected bus is at ground, thus each gate input connected to this bus is low. The resultant output of each NAND gate is thus high; each program lead (DIGIT 1-10) is high. Under these conditions, the Encoder output is 54 Hertz.

For example, if the frequency selected for TONE CHANNEL A is 97.4 Hertz, refer to the TONE PROGRAMMING PROCEDURE section for the hole drilling instructions. Once Channel A has been programmed for 97.4 Hertz, the following outputs on the program DIGIT leads will result when Channel A is selected:

DIGIT 1 NAND Gate (U1) Output = High (Logical 1)
DIGIT 2 NAND Gate (U2) Output = Low (Logical 0)
DIGIT 3 NAND Gate (U3) Output = Low (Logical 0)
DIGIT 4 NAND Gate (U4) Output = Low (Logical 0)
DIGIT 5 NAND Gate (U5) Output = High (Logical 1)
DIGIT 6 NAND Gate (U6) Output = High (Logical 1)
DIGIT 7 NAND Gate (U7) Output = High (Logical 1)
DIGIT 8 NAND Gate (U8) Output = High (Logical 1)
DIGIT 9 NAND Gate (U9) Output = High (Logical 1)
DIGIT 10 NAND Gate (U10) Output = Low (Logical 0)

When the logical 1 hole is drilled out in a hole-pair, the 100 ohm resistor (R9) is effectively removed from that particular program input lead. This results in one of the input leads being low when that tone channel bus is selected. The result is a high output on pin 8 of that particular NAND gate.

When the logical 0 hole is drilled out in a hole pair, the 1,000 ohm resistor and the channel select bus are both isolated from that particular input lead to the NAND gate. The resultant output of that gate is thus always low when the channel is selected.

MAINTENANCE

The first step in troubleshooting the Encoder is to determine if the Encoder Board or the Program Board is causing the problem. Connect a counter between D2 (CG-HI) and D8 (GRD). Press in the pushbutton tone switches on each of the tone channel positions (A-H) and observe the frequency on the counter at each switch position. (Remember that non-programmed channels should reach 54 Hertz).

NOTE

> Due to the fixed division ratios, the actual counted frequency will usually be slightly different from the nominal frequency, but always within ±0.2%.

If all tone channels produce erroneous frequencies at the counter, the Encoder Board is at fault. If only one or two channels produce erroneous frequencies at the counter, the Program Board probably is at fault.

An optional extender board is available so that the Encoder can be serviced out of the control unit.

TROUBLESHOOTING THE ENCODER BOARD

Each counter is preset by the programming code to a 4-bit binary count which is loaded into the counter when U1004 counts down to zero (or is preset to 06 then receives a pulse on the "countdown" input).

After the load pulse occurs, each counter counts down from its preset (programmed) value to 0. A carry pulse is then generated which clocks the following counter. Each counter then continues to count down from 16 (the next count after 0 is 16) to 0 again. After the initial count down, the counter counts a full 16 counts to reach 0. The preset value affects only the first countdown period. All subsequent periods are a full 16 counts of the input pulse.

The 19A116180P48 counters have output pins on each stage of the 4-stage counter. These outputs are not used in this application but provide an excellent troubleshooting measurement point. The most significant digit output of each counter is pin 3, then pin 2, pin 6, and finally pin 7. U1004, pins 6 and 7 are low at all times. U1004, pin 2 is low all the time when the first programming digit is a binary "0". U1004, pin 3 is low all the time when the first and second programming digits are both binary "0".

When checking the counters, the oscilloscope is triggered on the load pulse (U1004, pin 13). The waveforms are then observed sequentially as follows: U1002-pin 3, U1002-pin 2, U1002-pin 6, U1002-pin 7; then U1003-pin 3, U1003-pin 2, U1003-pin 6, U1003-pin 7; then U1004-pin 3, U1004-pin 2. Square waves should be observed on each pin.

After each pulse, the first half cycle of each signal will be asymmetrical because the preset count determines the length of the period before the zero count. All subsequent cycles should be symmetrical. At some point during the checking sequence (depending on the selected frequency), the period of the square wave will exceed the period between the load pulses, resulting in an incomplete cycle being observed. This usually occurs at U1003, pins 6 or 7. The divide-by-two relationship to the previous waveform can still be observed. If at any point in the test sequence the proper waveform is not observed, the previous stage in that counter is probably defective.

A special test plug may be constructed by using a 19A116659P21 shell (12 pins) and 19A116781P5 contacts (for 16-20 AWG wire) or 19A116781P6 contacts (for 22-26 AWG wire). Eleven contacts are needed. Pin 1 is connected to pins 3 through 12. Plugging this test plug into J1001, pins 1-12 programs the Encoder to 54 Hertz. The waveform sequence shown in Figure 4 should be observed.

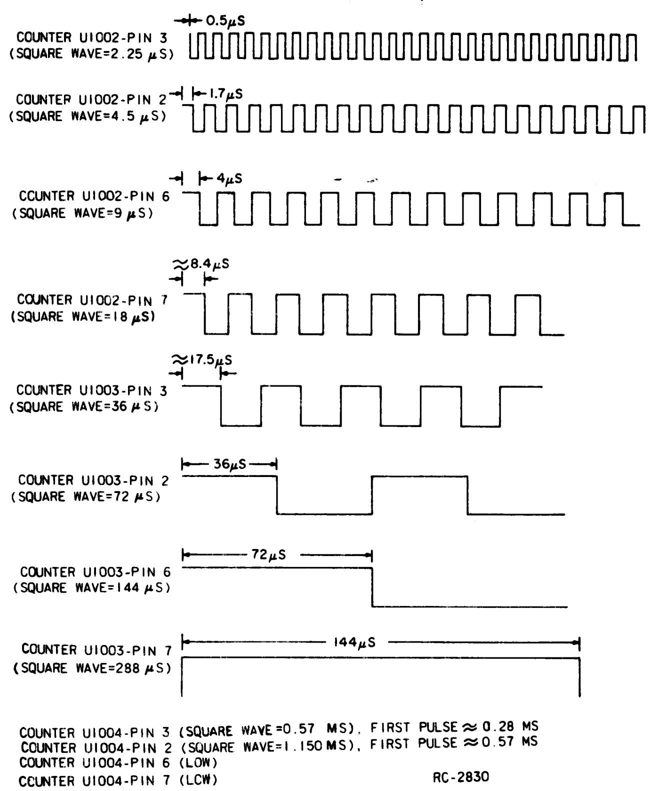


Figure 4 - Counter Waveform Sequence

TROUBLESHOOTING THE PROGRAM BOARD

1. Connect ground to P1-2 and +5 VDC to P1-1. Check P1-13 through P1-20 for +5 VDC.

2. Check P1-3 through P1-12 for a low or ground reading.

3. Connect ground to P1-13 (Tone A). Check all NAND gates connected to P1-13 that have the logical "0" jumper drilled out for a low output reading. For example, if H1 has been drilled, a low reading should be obtained at P1-12.

4. Check all NAND gates connected to P1-13 that have the logical "1" jumper drilled out for a high (+5 VDC) reading. For example, if H2 has been drilled, a high reading should be obtained at P1-12.

NOTE

If all checks are normal, the Program Board is working properly for TONE A.

5. Remove the ground from P1-13 and move it to P1-14 (TONE B). Repeat steps 3 and 4 for the hole numbers associated with TONE B.

6. Repeat the procedure for all tones suspected of being defective.

SYSTEM BOARD MODIFICATIONS

When the Encoder is used with either MASTR II or Executive II mobile radios, modifications of the applicable System board are required. For Executive II mobiles, instructions are contained in the System Board Maintenance Manual. For MASTR II mobiles, refer to the Modification Instructions as listed in the Table of Contents.

CG MODIFICATIONS FOR MASTR DELTA, -S APPLICATIONS

MASTR DELTA two-way radios use direct FM which requires a flat output frequency response from the encoder. This response is obtained by replacing C1029 with resistor R1 (22 K ohms).

FIELD INSTALLATION

Before installing the encoder board; it is necessary to cut a jumper on the control module. Refer to the Control Unit Maintenance Manual for instructions on removing the control module, and location of the jumper.

PROCEDURE

1. Remove the front panel of the control unit, and then remove the control module from the control unit as directed.

2. Remove or cut the jumper at point "M" between H91 and H92.

3. Replace the control module in the control unit as directed.

4. Insert the encoder module in the desired option deck and replace the front panel.

TABLE II - Other Field Programmable Channel Guard Frequencies

Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10
251.94	0011011110	225.53	0011111000	204.13	0100010010	186.43	0100101100
250.81	0011011111	224.62	0011111001	203.38	0100010011	185.82	0100101101
249.69	0011100000	223.72	0011111010	202.65	0100010100	185.20	0100101110
248.58	0011100001	222.83	0011111011	201.91	0100010101	184.59	0100101111
247.48	0011100010	221.95	0011111100	201.19	0100010110	183.98	0100110000
246.39	0011100011	221.07	0011111101	200.47	0100010111	183.38	0100110001
245.31	0011100100	220.20	0011111110	199.75	0100011000	182.78	0100110010
244.24	0011100101	219.33	0011111111	199.04	0100011001	182.18	0100110011
243.18	0011100110	218.48	0100000000	198.33	0100011010	181.59	0100110100
242.12	0011100111	217.63	0100000001	197.63	0100011011	181.00	0100110101
241.08	0011101000	216.78	0100000010	196.94	0100011100	180.42	0100110110
240.04	0011101001	215.95	0100000011	196.25	0100011101	179.84	0100110111
239.02	0011101010	215.12	0100000100	195.56	0100011110	179.26	0100111000
238.00	0011101011	214.29	0100000101	194.88	0100011111	178.69	0100111001
236.99	0011101100	213.47	0100000110	194.20	0100100000	178.12	0100111010
235.99	0011101101	212.66	0100000111	193.53	0100100001	177.56	0100111011
235.00	0011101110	211.86	0100001000	192.86	0100100010	176.99	0100111100
234.02	0011101111	211.06	0100001001	192.20	0100100011	176.44	0100111101
233.04	0011110000	210.26	0100001010	191.54	0100100100	175.88	0100111110
232.08	0011110001	209.48	0100001011	190.89	0100100101	175.33	0100111111
231.12	0011110010	208.70	0100001100	190.24	0100100110	174.78	0101000000
230.17	0011110011	207.92	0100001101	189.59	0100100111	174.24	0101000001
229.22	0011110100	207.15	0100001110	188.95	0100101000	173.70	0101000010
228.29	0011110101	206.39	0100001111	188.32	0100101001	173.16	0101000011
227.36	0011110110	205.63	0100010000	187.69	0100101010	172.62	0101000100
226.44	0011110111	204.87	0100010001	187.06	0100101011	172.09	0101000101

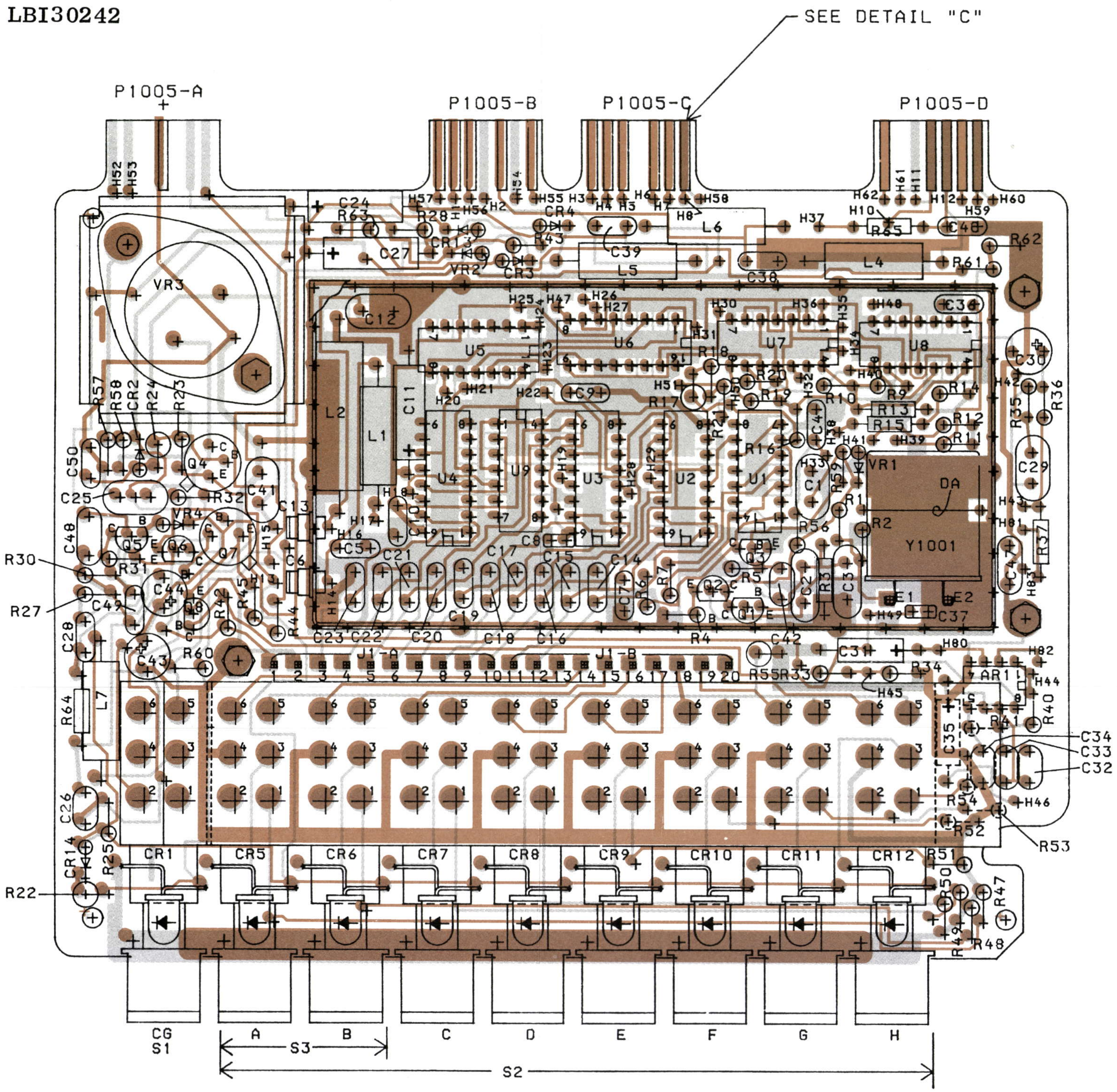
TABLE II - CONTINUED

Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10
171.57	0101000110	142.68	0110001000	122.12	0111001010	106.74	1000001100
171.04	0101000111	142.32	0110001001	121.85	0111001011	106.53	1000001101
170.52	0101001000	141.96	0110001010	121.59	0111001100	106.33	1000001110
170.00	0101001001	141.60	0110001011	121.32	0111001101	106.13	1000001111
169.49	0101001010	141.24	0110001100	121.06	0111001110	105.93	1000010000
168.97	0101001011	140.88	0110001101	120.80	0111001111	105.73	1000010001
168.47	0101001100	140.53	0110001110	120.54	0111010000	105.53	1000010010
167.96	0101001101	140.18	0110001111	120.28	0111010001	105.33	1000010011
167.46	0101001110	139.83	0110010000	120.02	0111010010	105.13	1000010100
166.96	0101001111	139.48	0110010001	119.77	0111010011	104.94	1000010101
166.46	0101010000	139.13	0110010010	119.51	0111010100	104.74	1000010110
165.97	0101010001	138.79	0110010011	119.25	0111010101	104.54	1000010111
165.47	0101010010	138.44	0110010100	119.00	0111010110	104.35	1000011000
164.99	0101010011	138.10	0110010101	118.75	0111010111	104.15	1000011001
164.50	0101010100	137.76	0110010110	118.50	0111011000	103.96	1000011010
164.02	0101010101	137.42	0110010111	118.25	0111011001	103.77	1000011011
163.54	0101010110	137.08	0110011000	118.00	0111011010	103.57	1000011100
163.06	0101010111	136.75	0110011001	117.75	0111011011	103.38	1000011101
162.59	0101011000	136.42	0110011010	117.50	0111011100	103.19	1000011110
162.12	0101011001	136.08	0110011011	117.25	0111011101	103.00	1000011111
161.65	0101011010	135.75	0110011100	117.01	0111011110	102.81	1000100000
161.18	0101011011	135.42	0110011101	116.76	0111011111	102.62	1000100001
160.72	0101011100	135.10	0110011110	116.52	0111100000	102.44	1000100010
160.26	0101011101	134.77	0110011111	116.28	0111100001	102.25	1000100011
159.80	0101011110	134.45	0110100000	116.04	0111100010	102.06	1000100100
159.35	0101011111	134.13	0110100001	115.80	0111100011	101.88	1000100101
158.89	0101100000	133.80	0110100010	115.56	0111100100	101.69	1000100110
158.44	0101100001	133.49	0110100011	115.32	0111100101	101.51	1000100111
158.00	0101100010	133.17	0110100100	115.08	0111100110	101.32	1000101000
157.55	0101100011	132.85	0110100101	114.85	0111100111	101.14	1000101001
157.11	0101100100	132.54	0110100110	114.61	0111101000	100.96	1000101010
156.67	0101100101	132.22	0110100111	114.38	0111101001	100.78	1000101011
156.23	0101100110	131.91	0110101000	114.14	0111101010	100.59	1000101100
155.79	0101100111	131.60	0110101001	113.91	0111101011	100.41	1000101101
155.36	0101101000	131.29	0110101010	113.68	0111101100	100.23	1000101110
154.93	0101101001	130.98	0110101011	113.45	0111101101	100.05	1000101111
154.50	0101101010	130.68	0110101100	113.22	0111101110	99.88	1000110000
154.08	0101101011	130.37	0110101101	112.99	0111101111	99.70	1000110001
153.65	0101101100	130.07	0110101110	112.76	0111110000	99.52	1000110010
153.23	0101101101	129.77	0110101111	112.54	0111110001	99.34	1000110011
152.82	0101101110	129.47	0110110000	112.31	0111110010	99.17	1000110100
152.40	0101101111	129.17	0110110001	112.08	0111110011	98.99	1000110101
151.98	0101110000	128.87	0110110010	111.86	0111110100	98.82	1000110110
151.57	0101110001	128.58	0110110011	111.64	0111110101	98.64	1000110111
151.16	0101110010	128.28	0110110100	111.42	0111110110	98.47	1000111000
150.76	0101110011	127.99	0110110101	111.19	0111110111	98.30	1000111001
150.35	0101110100	127.69	0110110110	110.97	0111111000	98.12	1000111010
149.95	0101110101	127.40	0110110111	110.75	0111111001	97.95	1000111011
149.55	0101110110	127.11	0110111000	110.53	0111111010	97.78	1000111100
149.15	0101110111	126.83	0110111001	110.32	0111111011	97.61	1000111101
148.75	0101111000	126.54	0110111010	110.10	0111111100	97.44	1000111110
148.36	0101111001	126.25	0110111011	109.88	0111111101	97.27	1000111111
147.96	0101111010	125.97	0110111100	109.67	0111111110	97.10	1001000000
147.57	0101111011	125.69	0110111101	109.45	0111111111	96.93	1001000001
147.19	0101111100	125.40	0110111110	109.24	1000000000	96.77	1001000010
146.80	0101111101	125.12	0110111111	109.03	1000000001	96.60	1001000011
146.41	0101111110	124.84	0111000000	108.81	1000000010	96.43	1001000100
146.03	0101111111	124.57	0111000001	108.60	1000000011	96.27	1001000101
145.65	0110000000	124.29	0111000010	108.39	1000000100	96.10	1001000110
145.27	0110000001	124.01	0111000011	108.18	1000000101	95.94	1001000111
144.90	0110000010	123.74	0111000100	107.97	1000000110	95.77	1001001000
144.52	0110000011	123.47	0111000101	107.77	1000000111	95.61	1001001001
144.15	0110000100	123.19	0111000110	107.56	1000001000	95.44	1001001010
143.78	0110000101	122.92	0111000111	107.35	1000001001	95.28	1001001011
143.41	0110000110	122.65	0111001000	107.15	1000001010	95.12	1001001100
143.04	0110000111	122.39	0111001001	106.94	1000001011	94.96	1001001101

TABLE II - CONTINUED

Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10	Freq.	Code 1 — 10
94.80	1001001110	85.78	1010001100	78.33	1011001010	72.08	1100001000
94.64	1001001111	85.65	1010001101	78.22	1011001011	71.98	1100001001
94.48	1001010000	85.52	1010001110	78.12	1011001100	71.89	1100001010
94.32	1001010001	85.39	1010001111	78.01	1011001101	71.80	1100001011
94.16	1001010010	85.26	1010010000	77.90	1011001110	71.71	1100001100
94.00	1001010011	85.13	1010010001	77.79	1011001111	71.61	1100001101
93.84	1001010100	85.00	1010010010	77.68	1011010000	71.52	1100001110
93.69	1001010101	84.87	1010010011	77.57	1011010001	71.43	1100001111
93.53	1001010110	84.74	1010010100	77.47	1011010010	71.34	1100010000
93.37	1001010111	84.61	1010010101	77.36	1011010011	71.25	1100010001
93.22	1001011000	84.49	1010010110	77.25	1011010100	71.16	1100010010
93.06	1001011001	84.36	1010010111	77.15	1011010101	71.07	1100010011
92.91	1001011010	84.23	1010011000	77.04	1011010110	70.98	1100010100
92.75	1001011011	84.11	1010011001	76.93	1011010111	70.89	1100010101
92.60	1001011100	83.98	1010011010	76.83	1011011000	70.80	1100010110
92.45	1001011101	83.85	1010011011	76.72	1011011001	70.71	1100010111
92.29	1001011110	83.73	1010011100	76.62	1011011010	70.62	1100011000
92.14	1001011111	83.60	1010011101	76.51	1011011011	70.53	1100011001
91.99	1001100000	83.48	1010011110	76.41	1011011100	70.44	1100011010
91.84	1001100001	83.35	1010011111	76.30	1011011101	70.35	1100011011
91.69	1001100010	83.23	1010100000	76.20	1011011110	70.26	1100011100
91.54	1001100011	83.11	1010100001	76.10	1011011111	70.18	1100011101
91.39	1001100100	82.98	1010100010	75.99	1011100000	70.09	1100011110
91.24	1001100101	82.86	1010100011	75.89	1011100001	70.00	1100011111
91.09	1001100110	82.74	1010100100	75.79	1011100010	69.91	1100100000
90.94	1001100111	82.62	1010100101	75.68	1011100011	69.83	1100100001
90.80	1001101000	82.49	1010100110	75.58	1011100100	69.74	1100100010
90.65	1001101001	82.37	1010100111	75.48	1011100101	69.65	1100100011
90.50	1001101010	82.25	1010101000	75.38	1011100110	69.57	1100100100
90.36	1001101011	82.13	1010101001	75.28	1011100111	69.48	1100100101
90.21	1001101100	82.01	1010101010	75.18	1011101000	69.39	1100100110
90.07	1001101101	81.89	1010101011	75.07	1011101001	69.31	1100100111
89.92	1001101110	81.77	1010101100	74.97	1011101010	69.22	1100101000
89.78	1001101111	81.65	1010101101	74.87	1011101011	69.14	1100101001
89.63	1001110000	81.53	1010101110	74.77	1011101100	69.05	1100101010
89.49	1001110001	81.41	1010101111	74.67	1011101101	68.96	1100101011
89.35	1001110010	81.29	1010110000	74.57	1011101110	68.88	1100101100
89.20	1001110011	81.18	1010110001	74.47	1011101111	68.80	1100101101
89.06	1001110100	81.06	1010110010	74.38	1011110000	68.71	1100101110
88.92	1001110101	80.94	1010110011	74.28	1011110001	68.63	1100101111
88.78	1001110110	80.82	1010110100	74.18	1011110010	68.54	1100110000
88.64	1001110111	80.71	1010110101	74.08	1011110011	68.46	1100110001
88.50	1001111000	80.59	1010110110	73.98	1011110100	68.37	1100110010
88.36	1001111001	80.48	1010110111	73.88	1011110101	68.29	1100110011
88.22	1001111010	80.36	1010111000	73.79	1011110110	68.21	1100110100
88.08	1001111011	80.24	1010111001	73.69	1011110111	68.12	1100110101
87.94	1001111100	80.13	1010111010	73.59	1011111000	68.04	1100110110
87.80	1001111101	80.01	1010111011	73.50	1011111001	67.96	1100110111
87.67	1001111110	79.90	1010111100	73.40	1011111010	67.88	1100111000
87.53	1001111111	79.79	1010111101	73.30	1011111011	67.79	1100111001
87.39	1010000000	79.67	1010111110	73.21	1011111100	67.71	1100111010
87.25	1010000001	79.56	1010111111	73.11	1011111101	67.63	1100111011
87.12	1010000010	79.45	1011000000	73.02	1011111110	67.55	1100111100
86.98	1010000011	79.33	1011000001	72.92	1011111111	67.47	1100111101
86.85	1010000100	79.22	1011000010	72.83	1100000000	67.39	1100111110
86.71	1010000101	79.11	1011000011	72.73	1100000001	67.30	1100111111
86.58	1010000110	79.00	1011000100	72.64	1100000010	67.22	1101000000
86.45	1010000111	78.89	1011000101	72.54	1100000011	67.14	1101000001
86.31	1010001000	78.78	1011000110	72.45	1100000100	67.06	1101000010
86.18	1010001001	78.66	1011000111	72.35	1100000101	66.98	1101000011
86.05	1010001010	78.55	1011001000	72.26	1100000110		
85.91	1010001011	78.44	1011001001	72.17	1100000111		

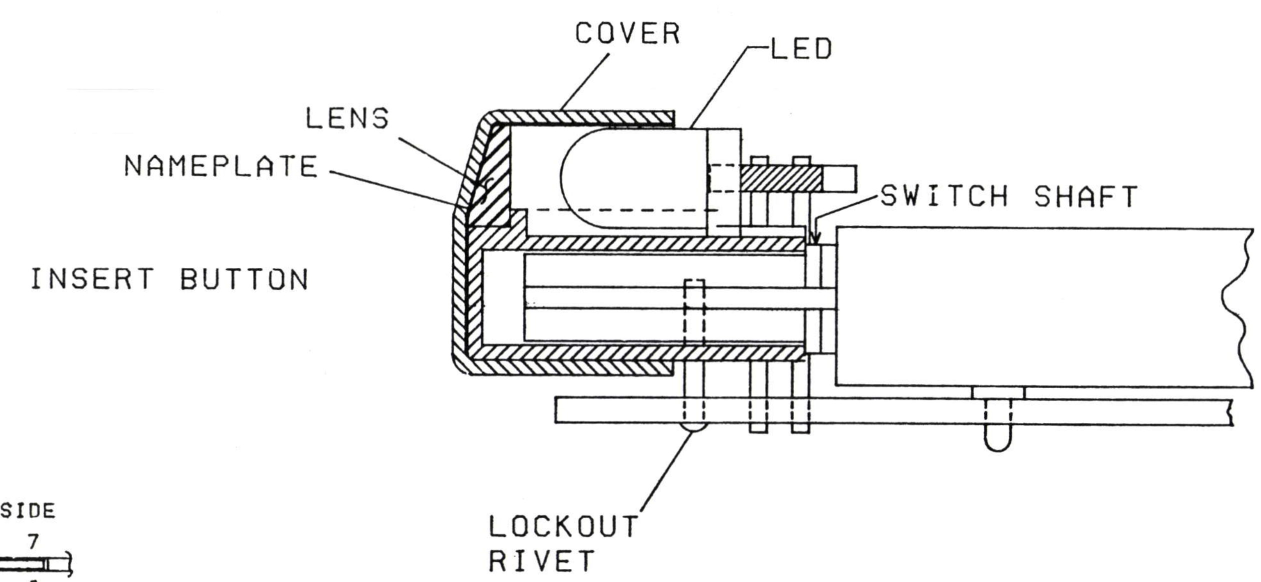
(DIGIT 1)



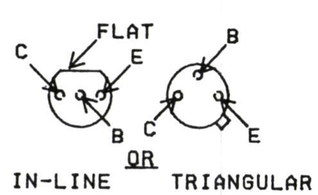
(19D424466, Rev. 12)
(19A144131, Sh. 1, Rev. 1)
(19A144131, Sh. 2, Rev. 1)

NOTE:
1. REMOVE OR CUT LETTERED JUMPER "M" ON CONTROL MODULE WHEN INSTALLING MULTI-TONE ENCODER IN CONTROL UNIT. REFER TO CONTROL UNIT MANUEL FOR JUMPER INDENTIFICATION.
2. ALL COMPONENT DESIGNATIONS ARE ABBREVIATED ADC 1000 TO NUMBER SHOWN: CR5 IS CR1005, R21 IS R1021, ECT.

CONNECTION CHART			
FROM	TO	WIRE	REMARKS
H13	H14	DA	THRU C1006 & SOLDER TO C1006
H15	H16	DA	THRU C1013 & SOLDER TO C1013
H17	H33	ST26-R	
H18	H19	ST22-W	
H20	H47	DA	
H21	H22	DA	
H23	H24	DA	
H25	H34	ST22-W	
H26	H48	ST26-R	
H28	H29	DA	
H30	H36	DA	
H31	H49	ST26-R	
H35	H50	DA	
H37	H46	ST26-R	
H38	H51	DM	2 WIRES IN H38.
H38	H39	DM	
H40	H41	DA	
H42	H44	DA	
H43	H45	DA	
H27	H32	ST26-R	
H80	H81	DA	SLEEVE
H82	H83	DA	SLEEVE



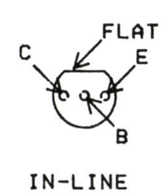
LEAD IDENTIFICATION
FOR Q4 & Q7



TOP VIEW

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

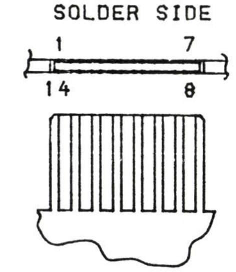
LEAD IDENTIFICATION
FOR Q1-Q3,Q5,Q6&Q8



TOP VIEW

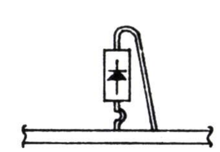
NOTE:
CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

SOLDER SIDE

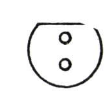


TYP. NUMBERING OF CONTACT FINGERS.

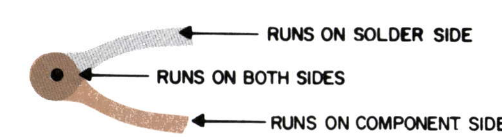
DETAIL "C"



TYP. MOUNTING FOR CR2-CR4 & CR13 & CR14 ORIENT CRIMPED LEAD TOWARD OTHER LEAD



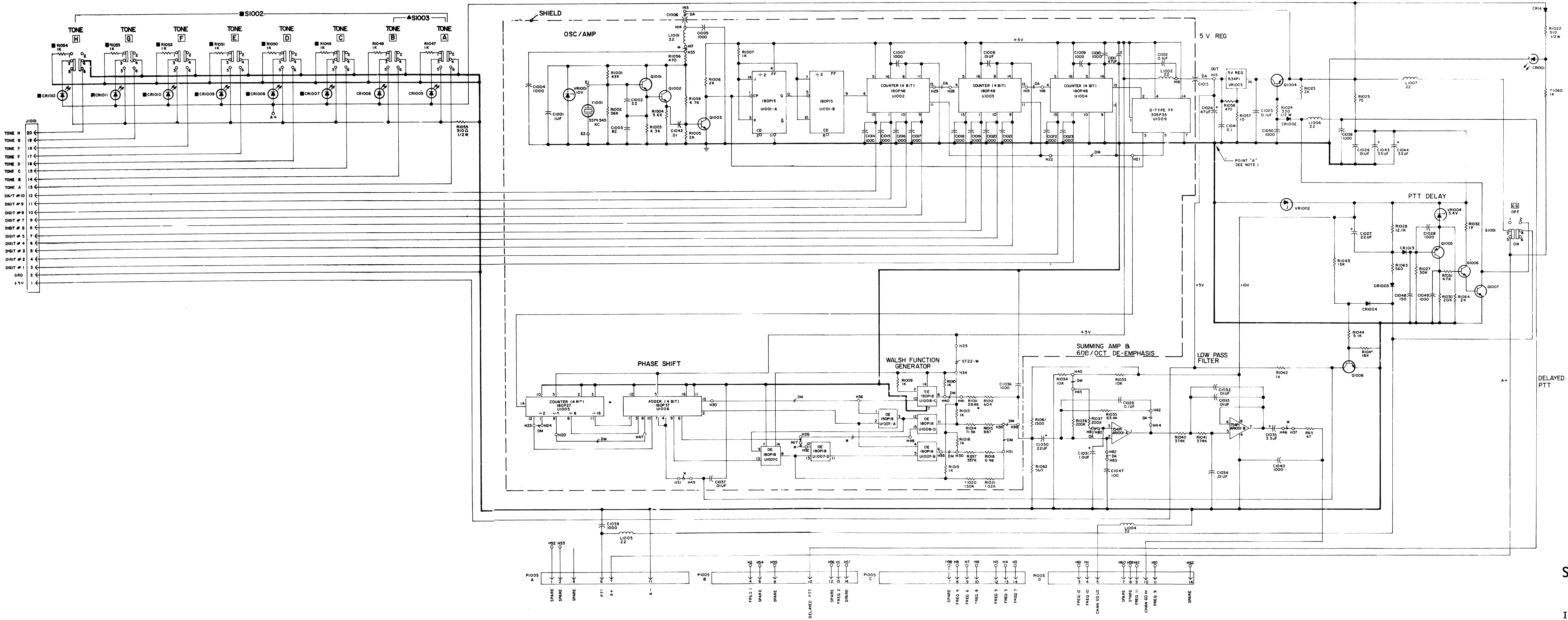
LEAD IDENTIFICATION FOR CR1,CR5 THRU CR12



1-AN71920 3-AN72200 5-AN80230 7-AN80788
2-AN72082 4-AN80058 6-AN79653

OUTLINE DIAGRAM

ENCODER BOARD



NOTES:
1. GROUND COMMON AT "POINT A" ONLY.
2 ■ INDICATES USED IN GROUP 1 ONLY
3 ▲ INDICATES USED IN GROUP 2 ONLY

* ST26-R

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.

MODEL NO	REV LETTER	
19D417862G1	J	8-FREQ
19D417862G2	J	2-FREQ

(19R640932, Rev. 15)

SCHEMATIC DIAGRAM
ENCODER BOARD

PARTS LIST

LBI30243E

MULTI-FREQUENCY CHANNEL GUARD ENCODER
19D417862G1 8 TONE
19D417862G2 2 TONE
REV J

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
AR1001	19A116754P1	Linear: Dual In-Line 8-Pin Minidip package; sim to T1, SN72558 NSC.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1001	19A143477P26	Polyester: .1 uF ±20%, 50 VDCW.
C1002	5490008P11	Silver mica: 22 pF ±5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C1003	5490008P25	Silver mica: 82 pF ±5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C1004 and C1005	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1006	19A116699P2	Ceramic, feed thru: 1000 pF ±20%, 250 VDCW.
C1007	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1008	19A116192P1	Ceramic: 0.01 uF ±20%, 50 VDCW; sim to Erie 8121 Special.
C1009 and C1010	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1011	5496267P2	Tantalum: 47 uF ±20%, 6 VDCW; sim to Sprague Type 150D.
C1012	19A143477P26	Polyester: .1 uF ±20%, 50 VDCW.
C1013	19A116699P2	Ceramic, feed thru: 1000 pF ±20%, 250 VDCW.
C1014 thru C1023	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1024	5496267P2	Tantalum: 47 uF ±20%, 6 VDCW; sim to Sprague Type 150D.
C1025	19A143477P26	Polyester: .1 uF ±20%, 50 VDCW.
C1026	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C1027	5496267P410	Tantalum: 22 uF ±5%, 15 VDCW, sim. to Sprague Type 150D.
C1028	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1029	19A702059P13	Polyester: 0.1 uF ±5%, 50 VDCW.
C1030	19A701534P8	Tantalum: 0.47 uF ±20%, 35 VDCW.
C1031	5496267P17	Tantalum: 1.0 uF ±20%, 35 VDCW; sim to Sprague Type 150D.
C1032 thru C1034	19A702059P7	Polyester: .01 uF ±5%, 50 VDCW.
C1035	5496267P9	Tantalum: 3.3 uF ±20%, 15 VDCW; sim to Sprague Type 150D.
C1036	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1037	19A116192P1	Ceramic: 0.01 uF ±20%, 50 VDCW; sim to Erie 8121 Special.
C1038 thru C1040	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C1041	19A143477P26	Polyester: .1 uF ±20%, 50 VDCW.
C1042	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C1043 and C1044	19A143486P5	Tantalum: 33 uF ±20%, 10 VDCW.
C1045*	19A116655P13	Ceramic disc: 470 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		In REV A-C:
	5496203P341	Ceramic disc: 150 pF ±10%, 500 VDCW, temp coef -4700 PPM. Added by REV A.
C1046*	19A116656P471J	Ceramic disc: 47 pF ±5%, 500 VDCW, temp coef 0 PPM. Added by REV E.
C1047*	5496203P33	Ceramic disc: 100 pF ±10%, 500 VDCW, temp coef -2200 PPM. Added by REV E.
C1048*	19A116655P8	Ceramic disc: 150 pF ±10%, 1000 VDCW; sim to RMC Type JF Discap. Added by REV F.
C1049* and C1050*	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW. Added by REV F.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1001	19A134354P7	Diode, optoelectronic: yellow: sim to Hew. Packard 5082-4555.
CR1002 thru CR1004	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR1005 thru CR1012	19A134354P7	Diode, optoelectronic: yellow: sim to Hew. Packard 5082-4555.
CR1013	19A115100P1	Silicon: sim to Type 1N458A.
CR1014	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR1015*	19A116052P1	Silicon, hot carrier: Fwd drop .350 volts max. Added by REV D.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1 and E2	19A701785P1	Contact, electrical; sim to Molex 08-50-0404.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1001-A and J1001-B		Connector. Includes:
	19A116659P27	Shell.
	19A701785P2	Contact, electrical. (Quantity 20).
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1001	7488079P47	Coil, RF: 22 uH 10%, 1.2 ohms DC res. max; sim. to Jeffers 4422-8.
L1002	7488079P65	Coil, RF: 22 uH 10%, .30 ohms DC res. max; sim. to Jeffers 4420-1.
L1004 thru L1007	7488079P47	Coil, RF: 22 uH 10%, 1.2 ohms DC res. max; sim. to Jeffers 4422-8.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1001 thru Q1003	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1004	19A115562P2	Silicon, PNP; sim to Type 2N2904A.
Q1005	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1006	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1007	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q1008	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1001	3R152P433J	Composition: 43K ohms ±5%, 1/4 w.
R1002	19A702110P58	Deposited carbon: 56K ohms ±5%, 1/4 w.
R1003	3R152P432J	Composition: 4.3K ohms ±5%, 1/4 w.
R1004	19A702110P46	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R1005 and R1006	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1007	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1009 and R1010	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1011	19A701250P346	Metal film: 29.4K ohms ±1%, 1/4 w.
R1012	19C314256P26040	Metal film: 604 ohms ±1%, 1/4 w.
R1013	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R1014	19A701250P383	Metal film: 71.5K ohms ±1%, 1/4 w.
R1015	19C314256P28870	Metal film: 887 ohms ±1%, 1/4 w.
R1016	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1017	19C314256P33573	Metal film: 357K ohms ±1%, 1/2 w.
R1018	19A701250P282	Metal film: 6.98K ohms ±1%, 1/4 w.
R1019	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1020	19A701250P418	Metal film: 150K ohms ±1%, 1/4 w.
R1021	19A701250P202	Metal film: 1.02K ohms ±1%, 1/4 w.
R1022	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R1023	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1024*	19A700113P51	Composition: 330 ohms ±5%, 1/2 w.
		Earlier than REV A:
	3R152P561J	Composition: 560 ohms ±5%, 1/4 w.
R1025	19A700106P36	Composition: 75 ohms ±5%, 1/4 w.
R1027	3R152P303J	Composition: 30K ohms ±5%, 1/4 w.
R1028*	19AA701250P309	Metal film: 12.1K ohms ±1%, 1/4 w.
		In REV A & earlier:
	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
R1030*	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
		In REV A & earlier:
	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1031	19A702110P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R1032	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1033 and R1034	19A702110P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R1035	19A701250P378	Metal film: 63.4K ohms ±1%, 1/4 w.
R1036 and R1037	3R152P204J	Composition: 200K ohms ±5%, 1/4 w.
R1040 and R1041	19A701250P356	Metal film: 37.4K ohms ±1%, 1/4 w.
R1042	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1043	3R152P133J	Composition: 13K ohms ±5%, 1/4 w.
R1044	3R152P512J	Composition: 5.1K ohms ±5%, 1/4 w.
R1045	19A702110P52	Deposited carbon: 18K ohms ±5%, 1/4 w.
R1047 thru R1054	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1055	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R1056	19A702110P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R1057	19A702110P13	Deposited carbon: 10 ohms ±5%, 1/4 w.
R1058	19A702110P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R1059	19A702110P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R1060	19A702110P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R1061	19A702110P39	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R1062 and R1063	19A702110P34	Deposited carbon: 560 ohms ±5%, 1/4 w.
R1064*	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
		In REV A & earlier:
	3R152P563J	Composition: 56K ohms ±5%, 1/4 w.
R1065	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R1066*	19A700106P87	Composition: 10K ohms ±5%, 1/4 w. Added by REV D.
		- - - - - - - - - - - SWITCHES - - - - - - - - - - -
S1001	19B233625G8	Push: PDT, 1 station, alternate action, 1.1 amps @ 14 VDC. (Includes insert button).
S1002	19B233625G6	Push: 2PDT, 8 stations, 1.1 amps @ 14 VDC. (Includes insert button).
S1003	19B233625G4	Push: 2PDT, contacts rated 1.1 amps at 14 VDC; sim to Switchcraft 255-1213A. (Includes insert button).
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1001*	19A134305P34	Digital: DUAL J-K FLIP FLOPS WITH CLEAR.
		In REV B & earlier:
	19A116180P15	Digital: DUAL J-K MASTER-SLAVE FLIP-FLOP.
U1002* thru U1004*	19A134305P81	Digital: SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER.
		In REV B & earlier:
	19A116180P48	Digital: SYNCHRONOUS 4-BIT UP/DOWN COUNTER.
U1005*	19A134305P45	Digital: 4-BIT BINARY COUNTER.
		In REV B & earlier:
	19A116180P27	Digital: 4-BIT BINARY COUNTER.
U1006*	19A134305P39	Digital: 4-BIT BINARY FULL ADDERS WITH FAST CARRY.
		In REV B & earlier:
	19A116180P37	Digital; 4-BIT FULL ADDER.
U1007* and U1008*	19A134305P41	Digital: QUAD 2-INPUT EXCLUSIVE OR GATES.
		In REV B & earlier:
	19A116180P18	Digital: QUAD 2-INPUT EXCLUSIVE-OR GATE.
U1009	19A134305P35	Digital. DUAL D-TYPE POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESENT AND CLEAR.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1001 and VR1002	4036887P11	Silicon, zener.
VR1003	19A116834P1	Linear: 35 volt regulator, 20 watts; sim to MICROAMP 209K.
VR1004	4036887P5	Zener: 500 mW, 5.4 v. nominal.
		- - - - - - - - - - - OSCILLATORS - - - - - - - - - -
Y1001	19A702599G1	Quartz: Frequency 3579.545 kHz.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B226613G4	Shield. (Vertical to component board).
	19C321373P1	Shield.
	19A130354G1	Cover. (Located over shield).
	19B226398P2	Heat sink. (Used with VR1003).
	19A130148P1	Insulator. (Used with VR1003).
	19A701332P4	Insulator, washer: nylon. (Used with Q1004, Q1007).
	7142162P117	Spacer: No. 4-40 x 3/16. (Located on printed board).
	7142162P70	Hex nut. No. 4-40 x 1/4. (Located at VR1003).
	19A115010P3	Contact: Brass; sim to Malco Tool Mfg 13A009-11. (Used with CR1001, CR1005-CR1012).
	19C321004P1	Lens. (Used with CR1001, CR1005-CR1012).
	19B226334P1	Cover. (Used with CR1001, CR1005-CR1012).
	NP276459P1	Nameplate. (CG).
	NP276459P2	Nameplate. (A).
	NP276459P3	Nameplate. (B).
	NP276459P4	Nameplate. (C).
	NP276459P5	Nameplate. (D).
	NP276459P6	Nameplate. (E).
	NP276459P7	Nameplate. (F).
	NP276459P8	Nameplate. (G).
	NP276459P9	Nameplate. (H).
	19B200525P6	Lockout rivet. (Used with dummy push button).

SYMBOL	GE PART NO.	DESCRIPTION
		ASSOCIATED PARTS
		8 TONE CG ENCODER KIT 19A148057G1
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.

*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 - Channel Guard Board 19D417862G1, 2
To improve operation. Changed R1624. Added C1045.

REV. B - To prevent spontaneous transmitter keying. Changed R1028, R1030 and R1064.

REV. C - To reduce current through Q1004. Changed U1001-U1008.

REV. D - To ensure transmission of correct channel guard tone. Added CR1015 and R1066. Changed C1045.

REV. E - To ensure transmission of correct channel guard tone. Added C1046.

REV. F - To improve operation in high RF environment. Added C1047 thru C1050.

REV. G - To prevent encoder from generating an incorrect tone, and to incorporate new tone select switches.
Deleted: C1045, 19A116655P13 - Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.

In Rev. A-C: 5496203P341 - Ceramic disc: 150 pf ±10%, 500 VDCW, temp coef -4700 PPM.

C1046, 19A116656P47J1 - Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef 0 PPM.

CR1015, 19A116052P1 - Diode, hot carrier: Fwd. drop .350 volts max.

R1066, 19A700106P87 - Composition: 10K ohms ±5%, 1/4 W.

Changed S1001, S1002 and S1003.

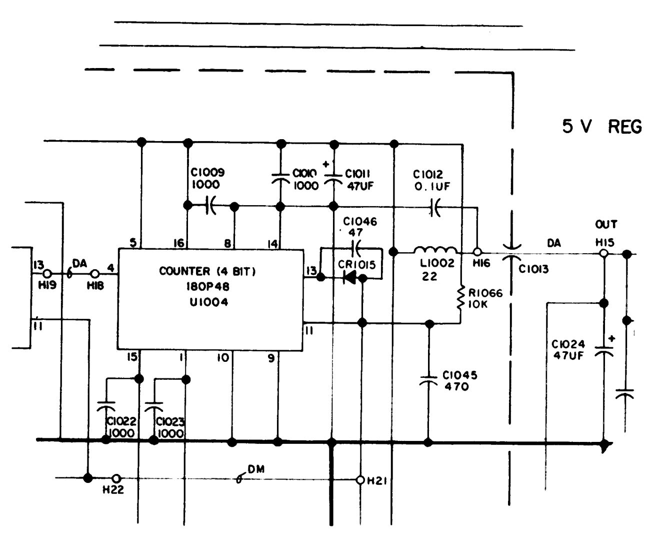
S1001 was 19B209563P8 - Push: 2 PDT, 1 station, alternate action, 1.1 amps at 14 VDC.

S1002 was 19B209563P6 - Push: 2 PDT, 8 stations, 1.1 amps at 14 VDC.

S1003 was 19B209563P4 - Push: 2 PDT, 2 stations, 1.1 amps at 14 VDC.

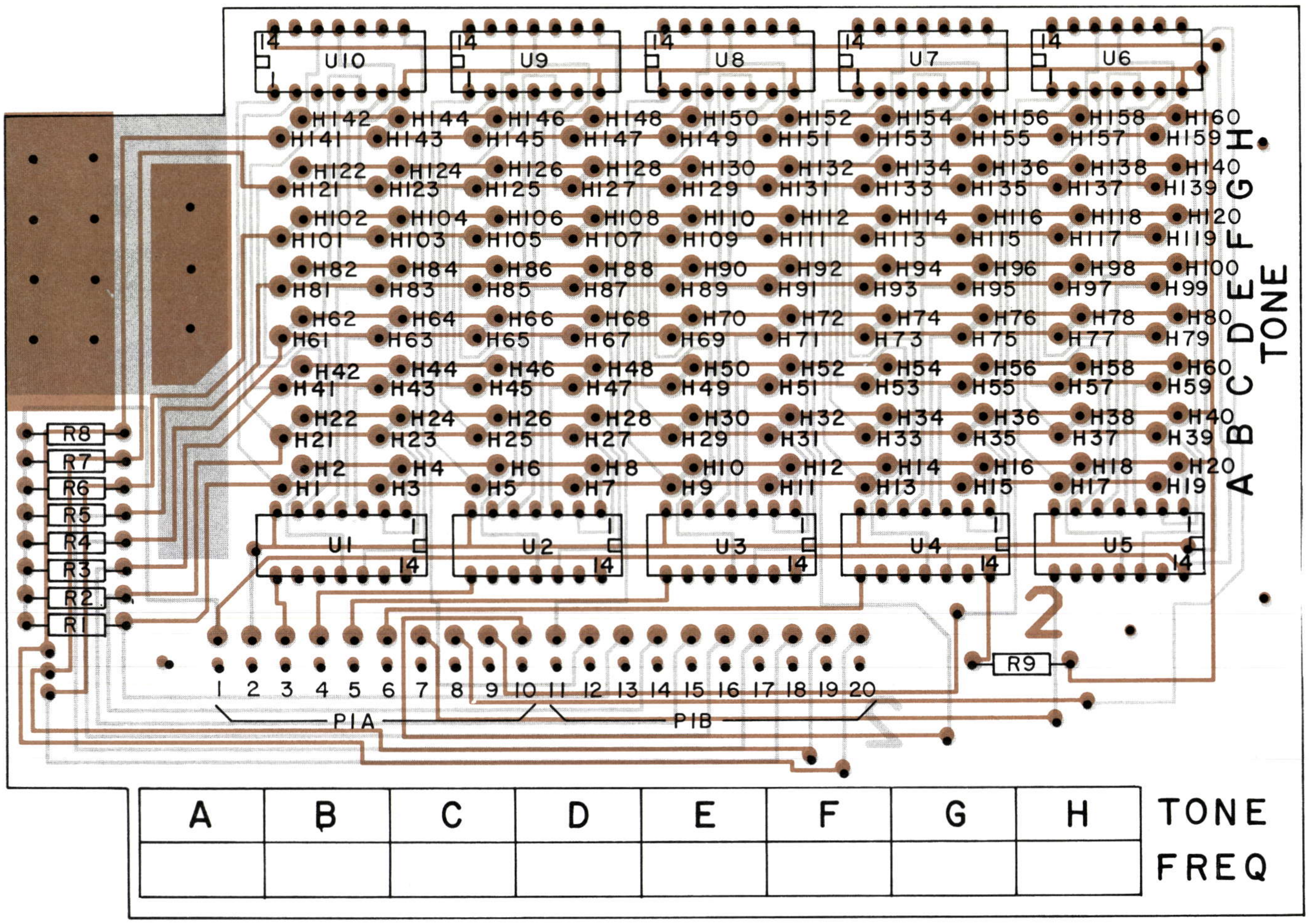
Added U1009.

OLD SCHEMATIC WAS:

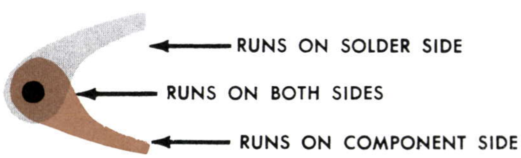


REV. H - To improve performance in RF environment. Changed CR1013. CR1013 was 19A115250P1 - Silicon, fast receovery, 225 mA, 50 PIV.

REV. J - To improve frequency stability. Disconnect U1009-3 from the $\bar{Q}$ output of U1001 and reconnect it to U1001-1.

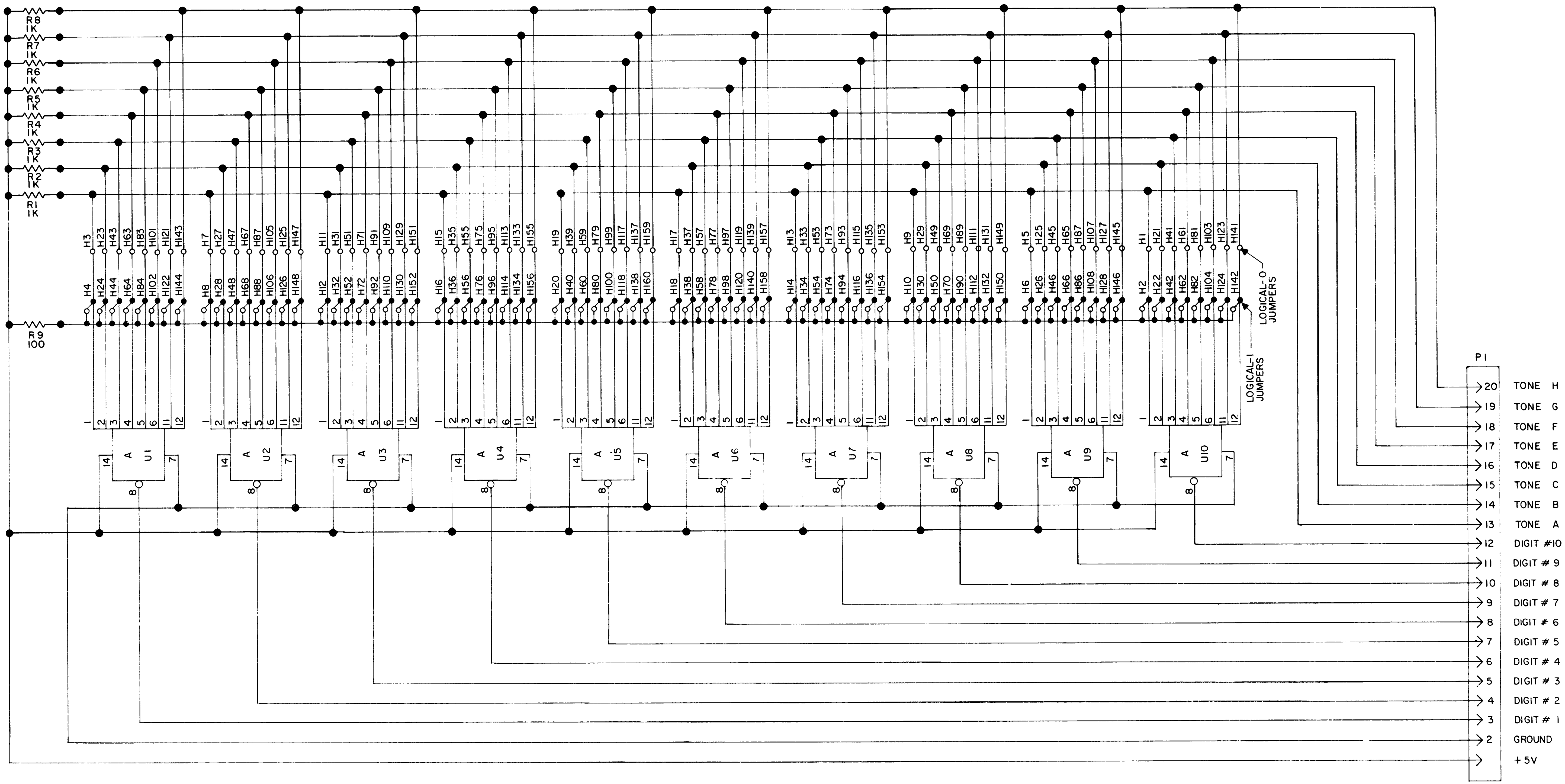


(19C321822, Rev. 1)
(19B226546, Sh. 2, Rev. 2)
(19B226546, Sh. 3, Rev. 2)



OUTLINE DIAGRAM

PROGRAM BOARD



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

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.

MODEL NO	REV LETTER
19C321217G1	

(19D417861, Rev. 2)

SCHEMATIC DIAGRAM

PROGRAM BOARD

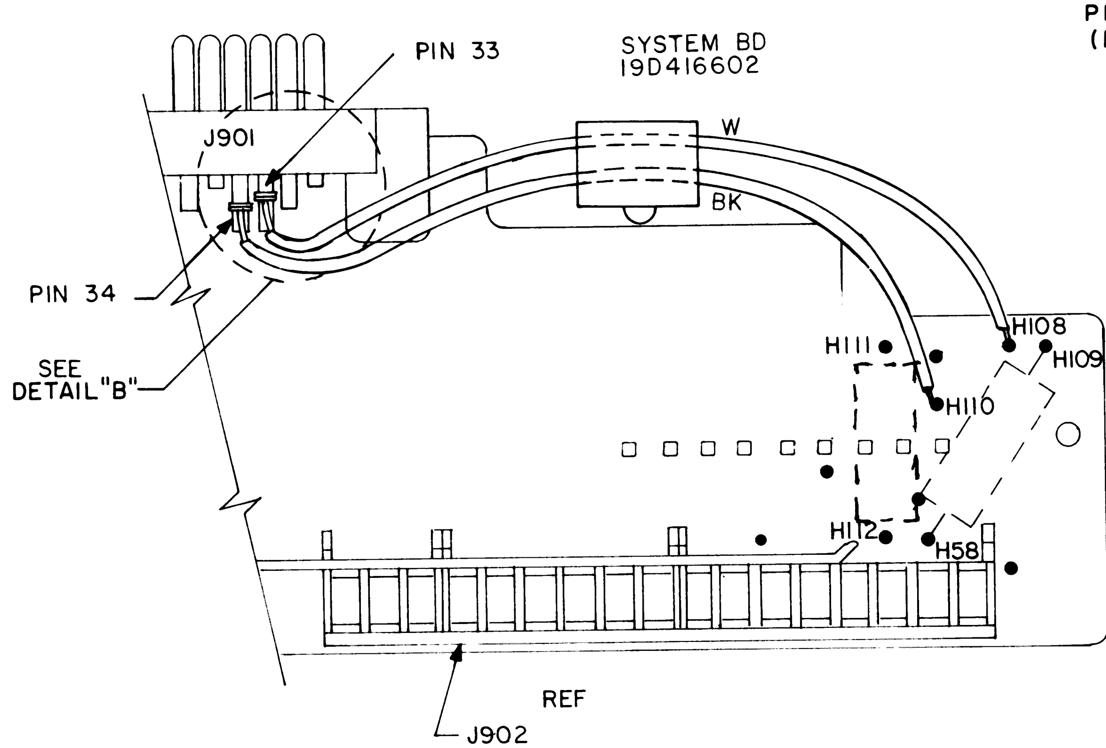
PARTS LIST

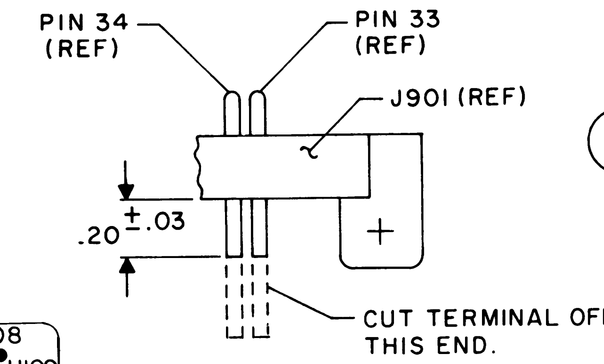
LB14973A

MULTI-TONE CHANNEL GUARD PROGRAM BOARD
19C321217G1

SYMBOL	GE PART NO.	DESCRIPTION
		----------- PLUGS -----------
P1A and P1B	19A116659P63	Connector, printed wiring: 10 contacts; sim to Molex 09-52-3103.
		---------- RESISTORS ----------
R1 thru R8	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R9	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
		-------- INTEGRATED CIRCUITS --------
U1 thru U10	19A116180P6	Digital, 8-Input Nand Gate: Identification No. 7430.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES





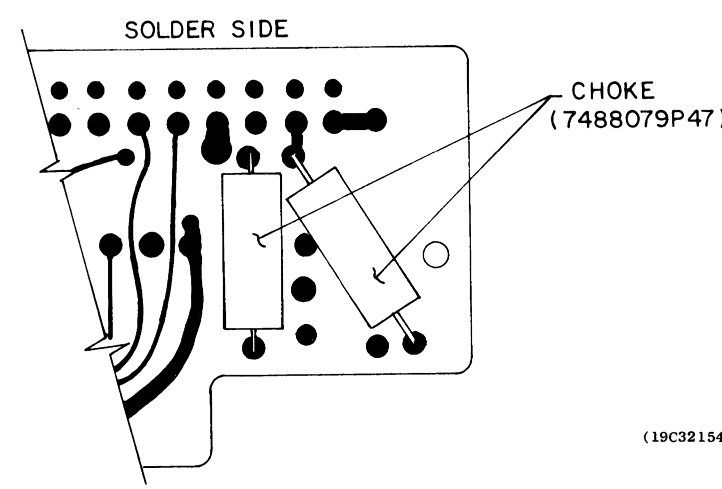
DETAIL "B"

(SEE NOTE 3)

(1)

INSTALLATION INSTRUCTIONS FOR KIT 19A130544G1 IN THE MASTR II MOBILE TO ADAPT THE RADIO FOR USE WITH THE EXTERNAL MULTI-TONE CHANNEL GUARD ENCODER (19D417862).

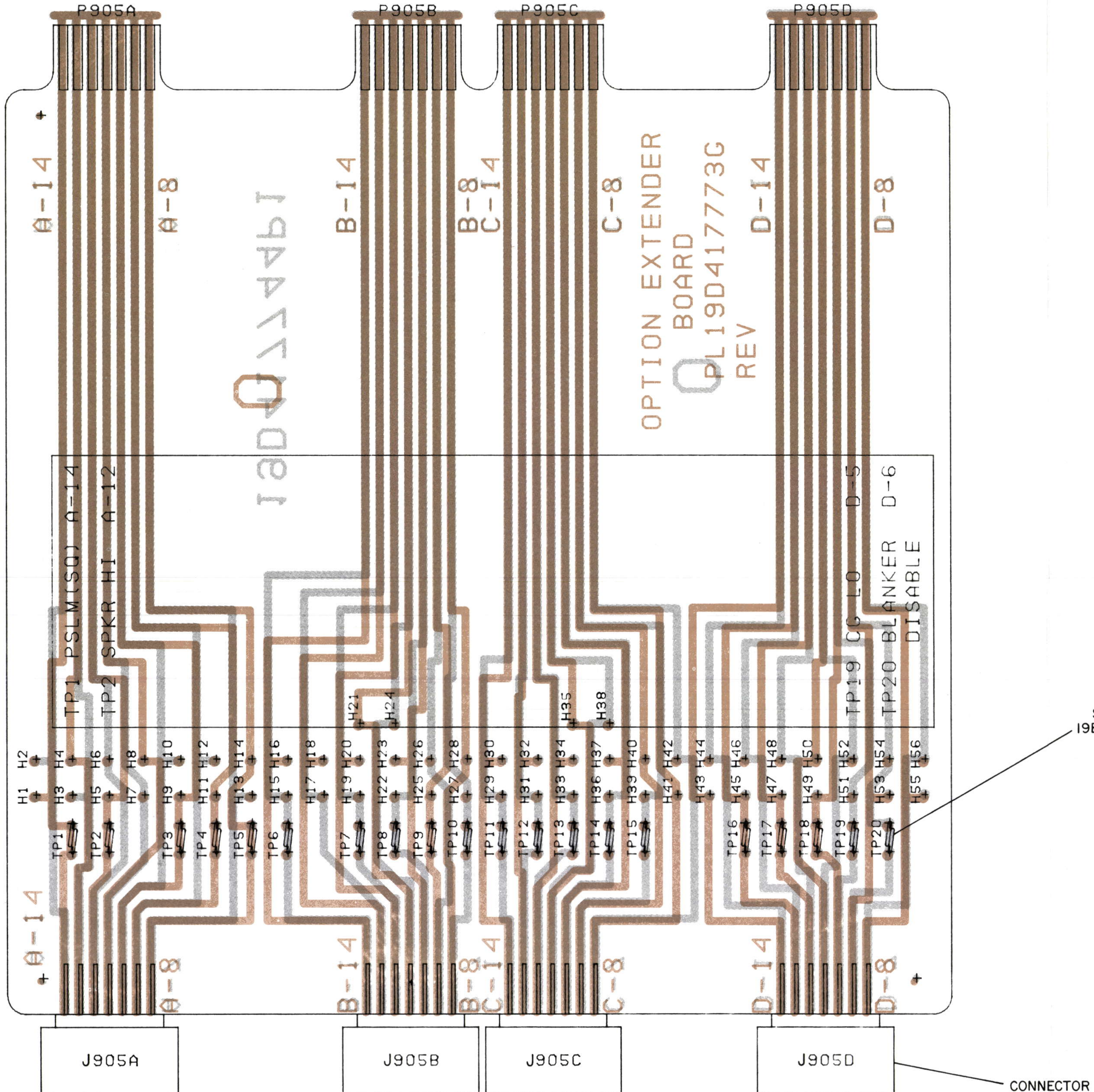
1. REMOVE TOP AND BOTTOM COVERS FROM THE RADIO PACKAGE. IF A SYSTEMS PACKAGE ("E" PACKAGE), LOOSEN RETAININC SCREW AND SWING OUT HINGED BOTTOM LAYER.
2. INSTALL TWO CHOKES 7488079P47 AS SHOWN IN DETAIL A ON SOLDER SIDE OF BOARD & SOLDER.
3. INSERT 19A116669P1 CONTACTS FROM FRONT SIDE OF CONNECTOR INTO PIN SLCTS 33 & 34 OF J901. THEN TWIST THE PIN APPROX. 60° AND CUT OFF PER DETAIL "B".
4. CONNECT SF24-W LEAD SUPPLIED FROM J901-33 TO H108. CONNECT SF24-BK LEAD FROM J901-34 TO H110.
5. ASSEMBLE IN REVERSE ORDER.

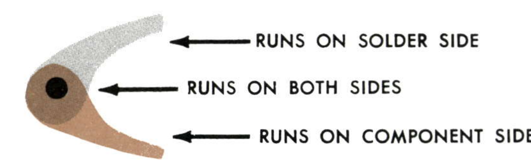


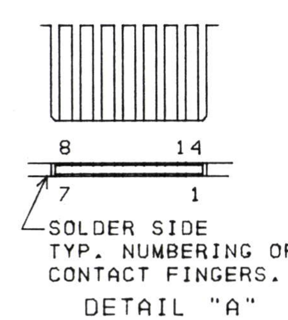
DETAIL "A"

(19C321549, Rev. 3)

SYSTEM BOARD MODIFICATIONS



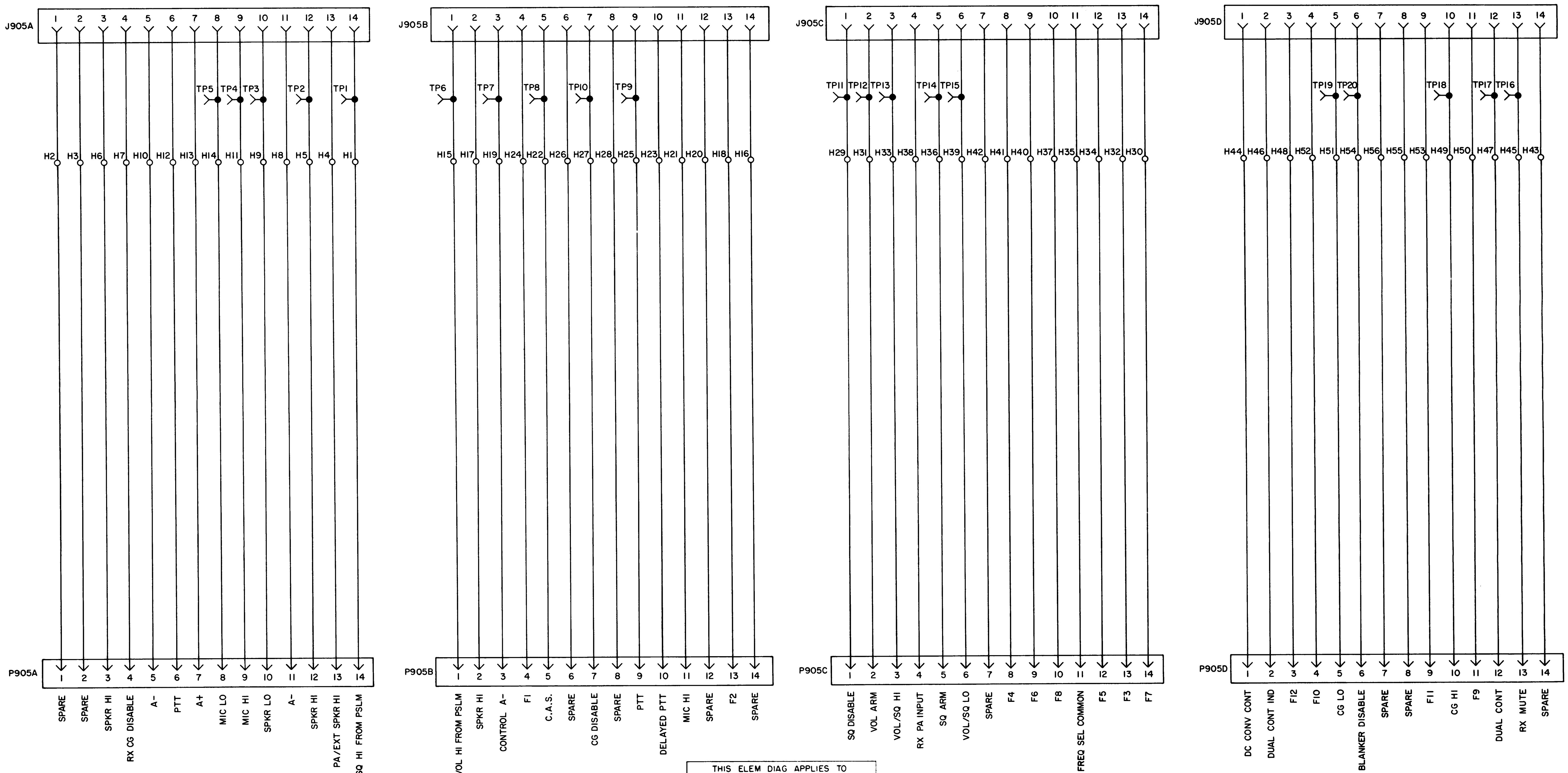




OUTLINE DIAGRAM

EXTENDER BOARD

(19D424211, Rev. 0)
(19B226451, Sh. 2, Rev. 0)
(19B226451, Sh. 3, Rev. 0)



THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417773	

(19R622088, Rev. 1)

SCHEMATIC DIAGRAM

EXTENDER BOARD

Issue 1