

## FOR

## CHANNEL GUARD ENCODER AND TYPE 90 ENCODER

## (OPTIONS 4463 AND 4464)

## CONTENTS

|   |    |
|---|----|
| Description .....   | 1  |
| Circuit Analysis .....  | 1  |
| Schematic & Outline Diagrams:<br>(Includes Parts List & Production Changes) |    |
| Channel Guard Encoder .....   | 4  |
| Type 90 Encoder .....   | 6  |
| Troubleshooting Procedure:  |    |
| Channel Guard Encoder .....   | 9  |
| Type 90 Encoder .....   | 10 |

## DESCRIPTION

Channel Guard Encoder Models 4EH21A12 & 13 and Type 90 Encoder Models 4EH20A12 & 13 are tone options available for use with 8 frequency PE Model radios. Both Channel Guard and Type 90 Encoders use Selective Amplifier IC's for the frequency (tone) selective circuit. The Selective Amplifier consists of a Wien bridge circuit with an operational amplifier for controlling the encoder frequency stability. Included with both encoders is Tone Board 19B219505G1, which permits selection of tone and transmitter Channel combinations through the connection of diodes.

## CIRCUIT ANALYSIS

## CHANNEL GUARD ENCODER

Encoder Models 4EH21A12 (one-tone) and 4EH21A13 (two-tone) operate on tone frequencies in the 71.9 to 203.5 Hz range. The two-tone encoder consists of Limiter Module A601 and two Selective Amplifier modules A602 and A603. The single-tone encoder assembly utilizes a Limiter module and only one Selective Amplifier module.

The Channel Guard Encoder is controlled by the location of diodes on Tone Board 19B219505G1. The placement of a diode on the Tone Board enables the frequency selector switch to apply +5.4 Volts to the Limiter-Switch module and one of the Selective Amplifier modules, causing the module to oscillate on encode tone frequency A or B. The Limiter Circuit keeps the input to the Selective Amplifier constant to maintain the required frequency and level stability.

Whenever the transmitter is keyed, the encoder tone at Pin 9 of the Limiter module is applied to the transmitter oscillator module.

An example of the procedure used to determine diode connections on the Tone Board is as follows. If Tone B is to be used on transmitter Channel F3, locate F3 on the chart (See chart on Outline Diagram). Go down the column to a diode. The diode in column B indicates the holes (H15, H31) between which it is to be assembled and the direction of assembly. The same procedure is applicable for other combinations of tones and transmitter channels. Diodes are not required on channels where no tone is desired.

## TYPE 90 ENCODER

Type 90 Encoder Models 4EH20A12 (one-tone) and 4EH20A13 (two-tone) are pulsed tone encoders for operating on two tone frequencies in the 1000 to 3000 Hz range. The assembly consists of Limiter A601 and Selective Amplifiers A602 and A603. The single-tone encoder consists of the Limiter and a single selective Amplifier module. The Limiter module contains a Tone burst Timer circuit and a limiter circuit for each Selective Amplifier module. The limiter circuit keeps the input to the selective Amplifier modules constant to maintain the required frequency and level stability.

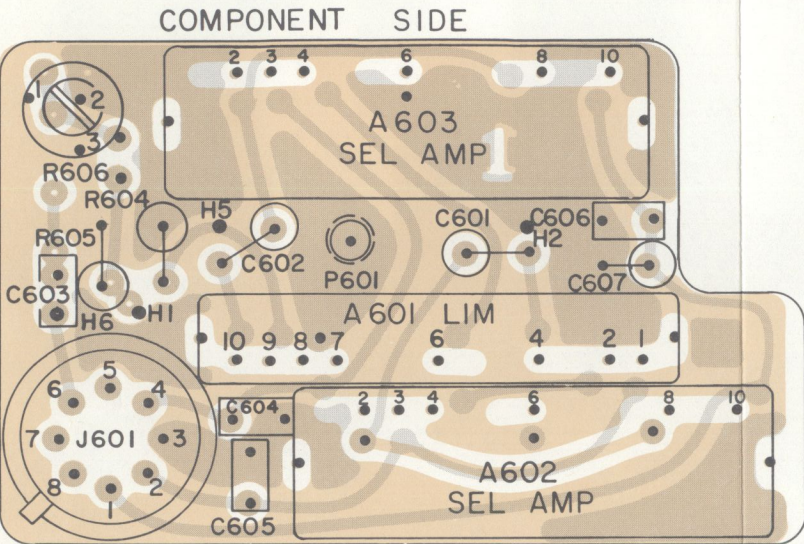
Keying the transmitter and applying power to the modules causes the Selective Amplifier to start oscillating at the desired tone frequency, and also starts the tone burst timer circuit. The burst timer provides a tone output for approximately one second. The encode tone is coupled through Encode Tone Adjust R603 to the transmitter audio module on the System Board. R603 is set for  $\pm 3$  KHz deviation.

The Type 90 Encoder is controlled by the location of diodes on Tone Board 19B219505G1. The placement of a diode on the Tone Board enables the frequency selector switch to apply +5.4 Volts to the Limiter-Switch module and one of the Selective Amplifier modules, causing the module to oscillate on encode tone frequency A or B.

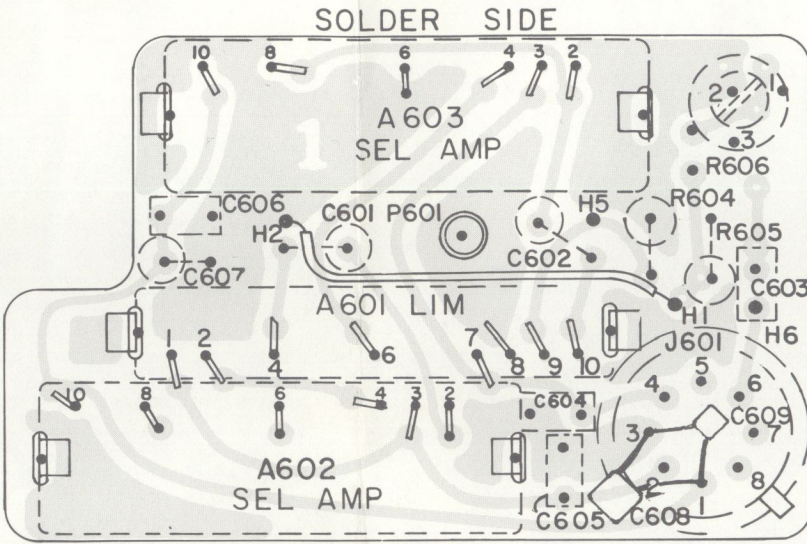
An example of the procedure used to determine diode connections on the Tone Board is as follows. If Tone B is to be used on transmitter Channel F3, locate F3 on the chart (See chart on Outline Diagram). Go down the column to a diode. The diode in column B indicates the holes (H15, H31) between which it is to be assembled and the direction of assembly. The same procedure is applicable for other combinations of tones and transmitter channels. Diodes are not required on channels where no tone is desired.



CHANNEL GUARD BOARD

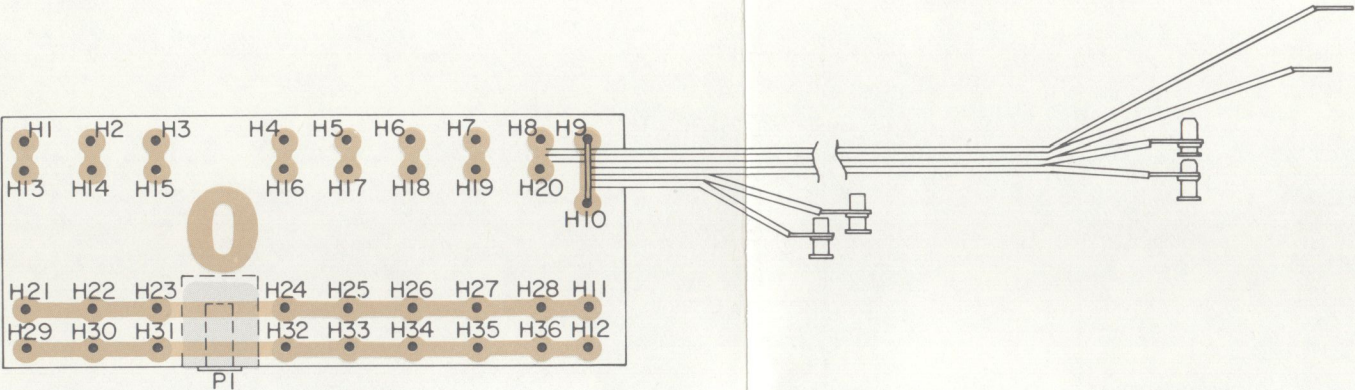


(19C317931, Rev. 6)  
(19B219044, Sh. 1, Rev. 1)  
(19B219044, Sh. 2, Rev. 1)



(19C317931, Rev. 6)  
(19B219044, Sh. 2, Rev. 1)


TONE BOARD



(19B219810, Rev. 0)  
(19B219488, Sh. 1, Rev. 0)  
(19B219488, Sh. 2, Rev. 0)

| TRANSMITTER CHANNEL |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|---------------------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| CR1                 |   | CR2       |   | CR3       |   | CR4       |   | CR5       |   | CR6       |   | CR7       |   | CR8       |   |
| F1<br>H13           |   | F2<br>H14 |   | F3<br>H15 |   | F4<br>H16 |   | F5<br>H17 |   | F6<br>H18 |   | F7<br>H19 |   | F8<br>H20 |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|                     |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
| A                   | B | A         | B | A         | B | A         | B | A         | B | A         | B | A,        | B | A         | B |
| TONE CHANNEL        |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |

USE THE ABOVE CHART FOR ASSEMBLING DIODES IN THE TWO TONE SELECTOR BOARD 19B219505G1.

SAMPLE: IF TONE B IS TO BE USED ON F3, THEN FIND F3 ON CHART. GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODE IN COLUMN B GIVES THE HOLE NUMBER AND DIRECTION THE DIODE SHOULD BE ASSEMBLED. DIODE IN SAMPLE IS CONNECTED FROM H15 TO H31 H15  H31

OUTLINE DIAGRAM  
CHANNEL GUARD ENCODER  
MODELS 4EH21A12&13



| SYMBOL | GE PART NO. | DESCRIPTION  |
|--------|-------------|--|
|        |             | TONE BOARD<br>19B219505G1  |
|        |             | ----- PLUGS -----  |
| P1     | 19A115834P4 | Contact, electrical: sim to Amp 2-332070-9.                                    |
|        |             | ----- MISCELLANEOUS -----  |
|        | 19B216316P1 | Insulator. (Used with J601).   |
|        | 5494922P1   | Diode, silicon; sim to Hughes 1N456. (Located on Channel Guard Encoder board). |
|        | 19A115834P4 | Contact, electrical: sim to Amp 2-332070-9. (Quantity 4- Hung in wiring).      |

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.

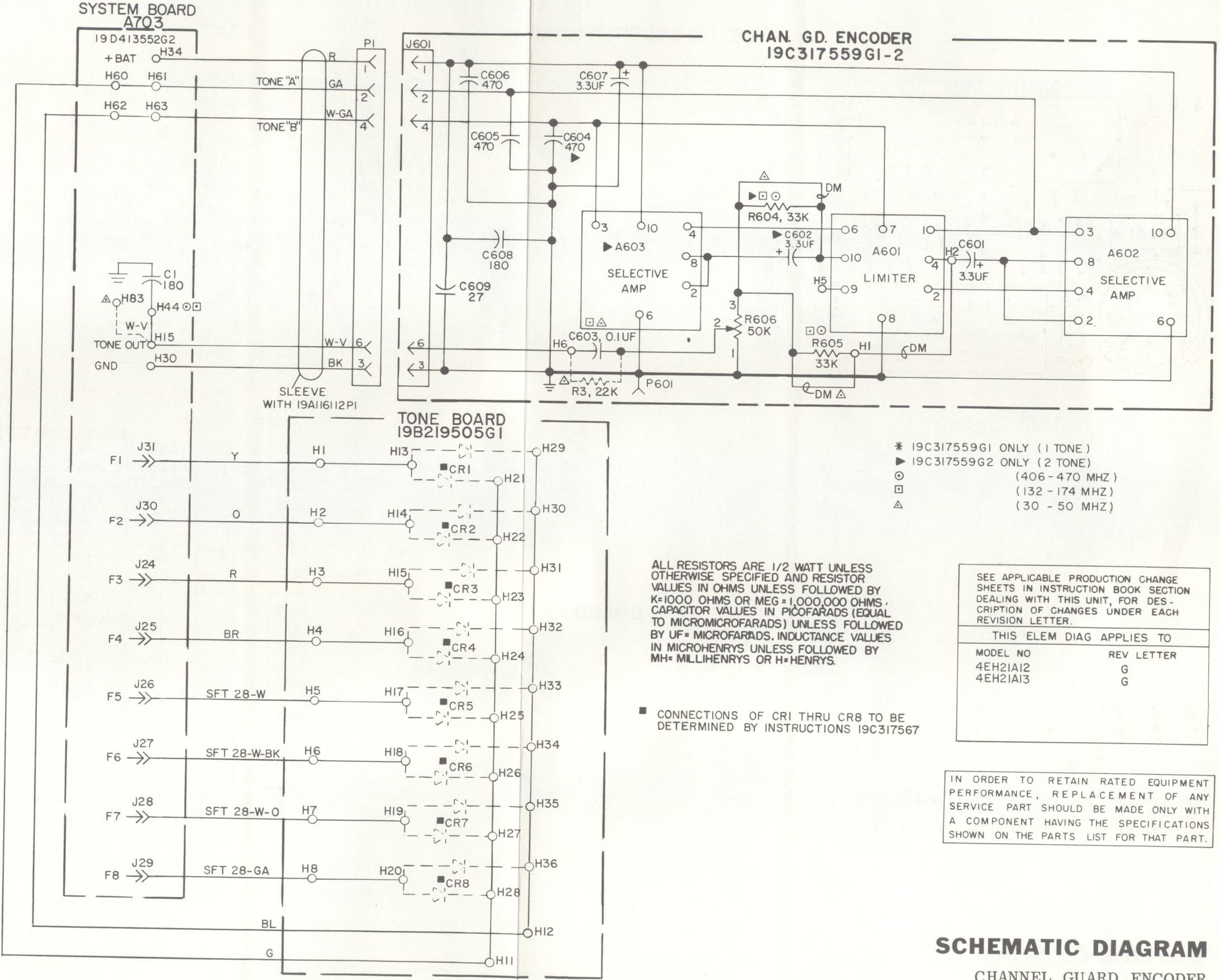
- REV. A - To improve RF Filtering. Added C608.
- REV. B - To improve RF Filtering. Added C1.
- REV. C - To make Channel Guard Encode compatible with PE Low Band. Added holes H5 and H6. Added jumper between H5 and H6.
- REV. D - To make Channel Guard Encode compatible with PE Low Band. Added R1 and R2.
- REV. E - To improve RF filtering. Added C609.
- REV. F - To increase Channel Guard tone deviation. Changed R601.
- REV. G - To increase tone modulation and improve operation. Deleted R601, R602 and R603. Added R604, R605 and R606.

PARTS LIST

LBI-4374C  
CHANNEL GUARD ENCODER  
MODEL 4EH21A12 1 TONE  
MODEL 4EH21A13 2 TONE

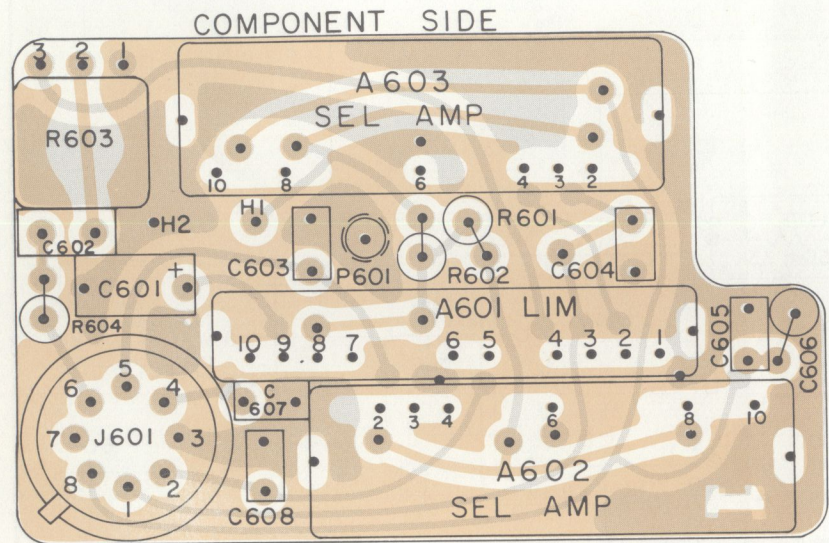
| SYMBOL          | GE PART NO.     | DESCRIPTION  |
|-----------------|-----------------|--|
|                 |                 | ----- CAPACITORS -----   |
| C1*             | 19A116114P10073 | Ceramic: 180 pf $\pm 10\%$ , 100 VDCW; temp coef -3300 PPM. Added by REV B.                |
|                 |                 | ----- PLUGS -----  |
| P1              | 19B219050G1     | Socket, crystal: 8 contacts.   |
|                 |                 | ----- RESISTORS -----  |
| R1* and R2*     | 3R152P333J      | Composition: 33,000 ohms $\pm 5\%$ , 1/4 w. Added by REV D. Deleted by REV G.              |
| R3*             | 3R152P223J      | Composition: 22,000 ohms $\pm 5\%$ , 1/4 w. Added by REV G.                                |
|                 |                 | CHANNEL GUARD ENCODER BOARD<br>19C317559G1 1 TONE<br>19C317559G2 2 TONE                    |
| A601            | 19C317033G2     | Limiter.   |
| A602 and A603   | 19D413245G3     | Selective Amplifier. 71.9-203.5 Hz freq range.   |
|                 |                 | ----- CAPACITORS -----   |
| C601 and C602   | 5491674P36      | Tantalum: 3.3 $\mu$ f $\pm 20\%$ , 10 VDCW; sim to Sprague Type 162D.                      |
| C603            | 19A116192P14    | Ceramic: .1 $\mu$ f $\pm 20\%$ , 50 VDCW; sim to Erie USCC CW20C104-M2.                    |
| C604 thru C606  | 19A116192P2     | Ceramic: 470 pf $\pm 20\%$ , 50 VDCW; sim to Erie 8111-050-W5R.                            |
| C607            | 5491674P36      | Tantalum: 3.3 $\mu$ f $\pm 20\%$ , 10 VDCW; sim to Sprague Type 162D.                      |
| C608*           | 19A116114P10073 | Ceramic: 180 pf $\pm 10\%$ , 100 VDCW; temp coef -3300 PPM. Added by REV A.                |
| C609*           | 19A116114P43    | Ceramic: 27 pf $\pm 10\%$ , 100 VDCW; temp coef 0 PPM. Added by REV E.                     |
|                 |                 | ----- JACKS AND RECEPTACLES -----  |
| J601            | 19A116122P1     | Terminal, feed-thru; sim to Warren Co 1-B-2994-4.  |
|                 |                 | ----- PLUGS -----  |
| P601            | 19A115834P4     | Contact, electrical: sim to Amp 2-332070-9.  |
|                 |                 | ----- RESISTORS -----  |
| R601*           | 3R152P622J      | Composition: 6200 ohms $\pm 5\%$ , 1/4 w. Deleted by REV G.<br>In REV E and earlier:       |
|                 | 3R152P333J      | Composition: 33,000 ohms $\pm 5\%$ , 1/4 w.  |
| R602*           | 3R152P133J      | Composition: 13,000 ohms $\pm 5\%$ , 1/4 w. Deleted by REV G.                              |
| R603*           | 3R152P622J      | Composition: 6200 ohms $\pm 5\%$ , 1/4 w. Deleted by REV G.                                |
| R604* and R605* | 3R152P333J      | Composition: 33,000 ohms $\pm 5\%$ , 1/4 w. Added by REV G.                                |
| R606*           | 19A116412P9     | Variable, cermet: 500 ohms $\pm 10\%$ , 0.5 w; sim to Helipot Model 62 PR. Added by REV G. |

\*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

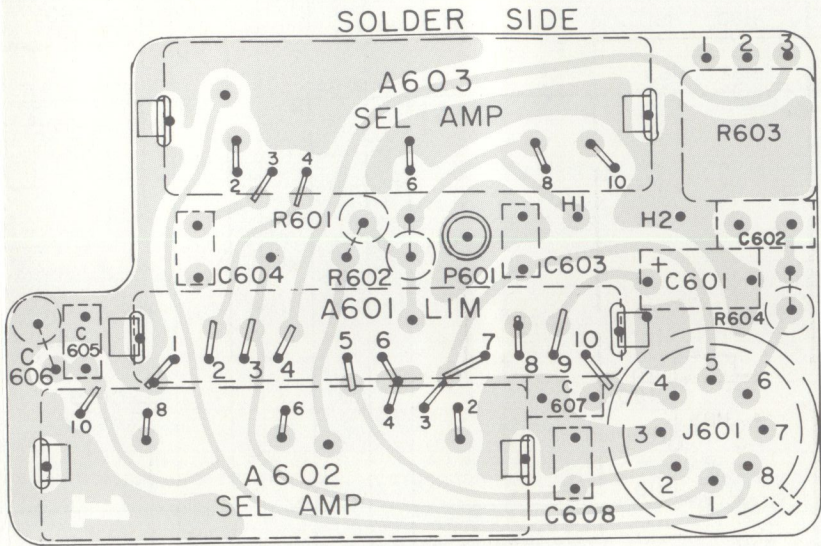




TYPE 90 ENCODER BOARD

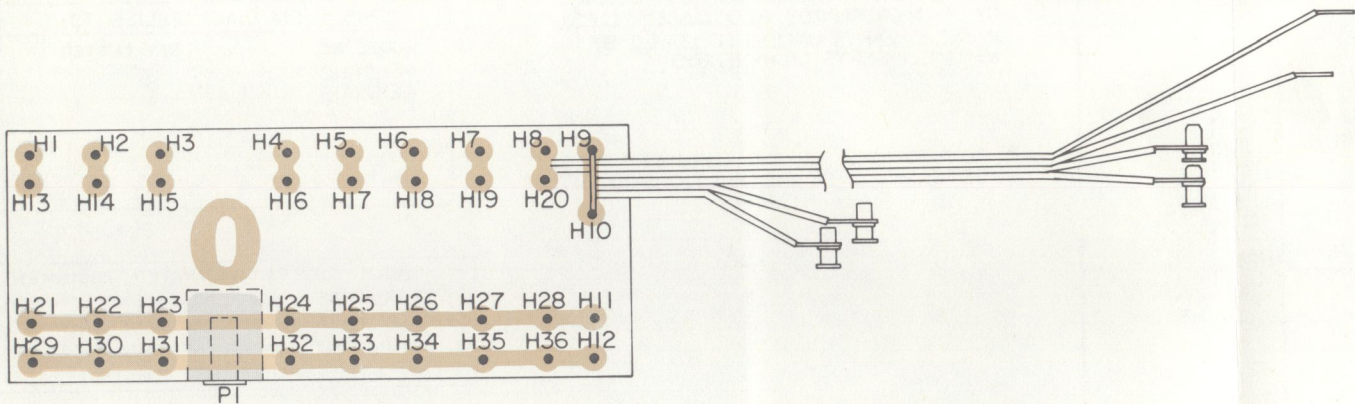


(19C317933, Rev. 0)  
(19B219043, Sh. 1, Rev. 1)  
(19B219043, Sh. 2, Rev. 1)



(19C317933, Rev. 0)  
(19B219043, Sh. 2, Rev. 1)

TONE BOARD



(19B219810, Rev. 0)  
(19B219488, Sh. 1, Rev. 0)  
(19B219488, Sh. 2, Rev. 0)

OUTLINE DIAGRAM

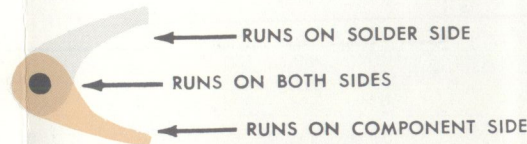
TYPE 90 ENCODER  
MODELS 4EH20A12&13

| TRANSMITTER CHANNEL |           |           |           |           |           |           |           |     |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|
| CR1                 | CR2       | CR3       | CR4       | CR5       | CR6       | CR7       | CR8       |     |
| F1<br>H13           | F2<br>H14 | F3<br>H15 | F4<br>H16 | F5<br>H17 | F6<br>H18 | F7<br>H19 | F8<br>H20 |     |
| H21                 |           |           |           |           |           |           |           | H29 |
| H22                 |           |           |           |           |           |           |           | H30 |
| H23                 |           |           |           |           |           |           |           | H31 |
| H24                 |           |           |           |           |           |           |           | H32 |
| H25                 |           |           |           |           |           |           |           | H33 |
| H26                 |           |           |           |           |           |           |           | H34 |
| H27                 |           |           |           |           |           |           |           | H35 |
| H28                 |           |           |           |           |           |           |           | H36 |
| A                   | B         | A         | B         | A         | B         | A         | B         |     |
| TONE CHANNEL        |           |           |           |           |           |           |           |     |

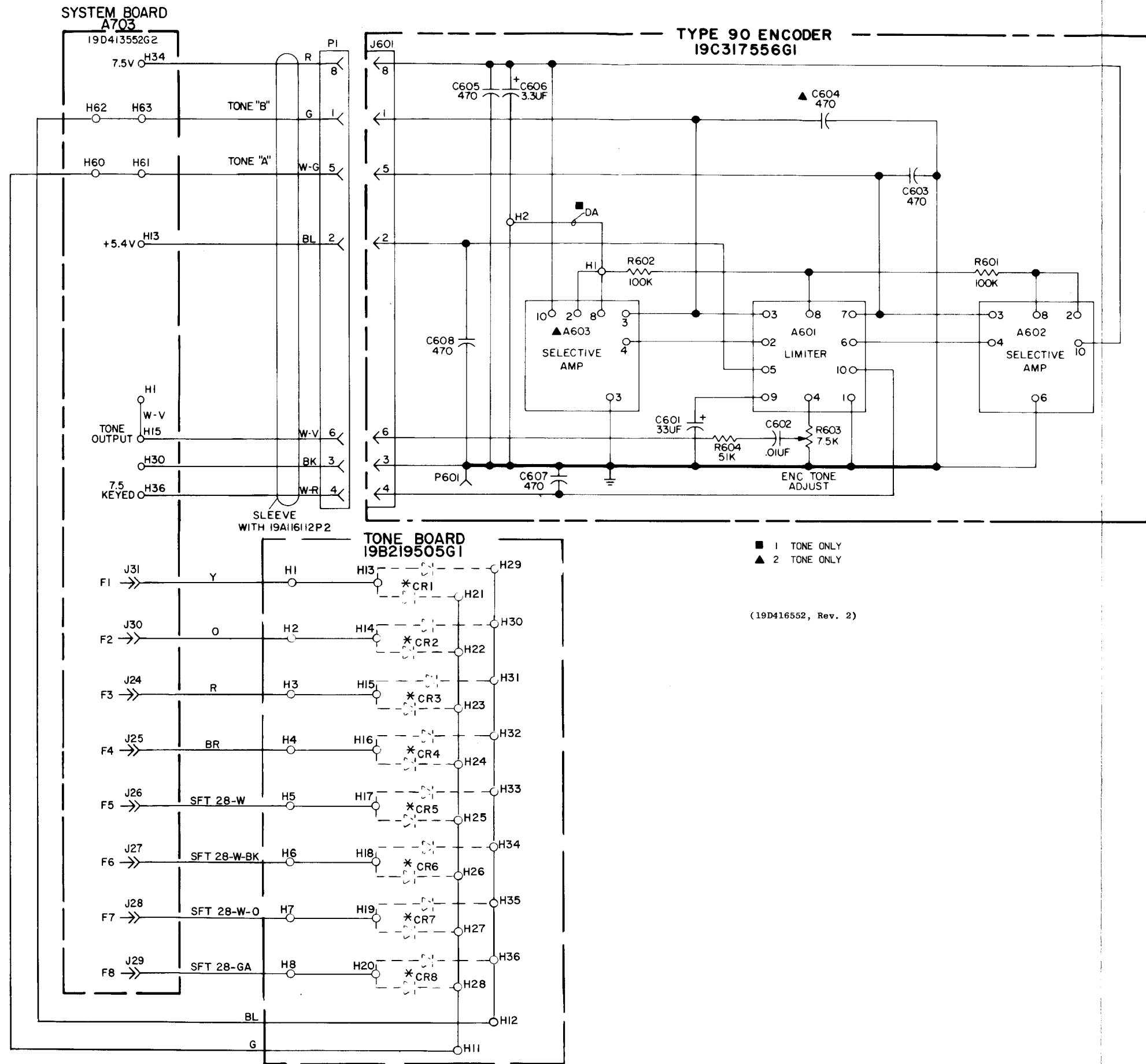
(19C317569, Sh. 3, Rev. 1)

USE THE ABOVE CHART FOR ASSEMBLING DIODES IN THE TWO TONE SELECTOR BOARD 19B219505G1.

SAMPLE: IF TONE B IS TO BE USED ON F3, THEN FIND F3 ON CHART. GO DOWN COLUMN UNTIL YOU FIND A DIODE. THE DIODE IN COLUMN B GIVES THE HOLE NUMBER AND DIRECTION THE DIODE SHOULD BE ASSEMBLED. DIODE IN SAMPLE IS CONNECTED FROM H15 TO H31







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 |
|----------|------------|
| 4EH20A12 |            |
| 4EH20A13 |            |

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

\* CONNECTIONS OF CR1 THRU CR8 TO BE DETERMINED BY INSTRUCTIONS I9C317567

# **SCHEMATIC DIAGRAM**

TYPE 90 ENCODER  
MODELS 4EH20A12&13

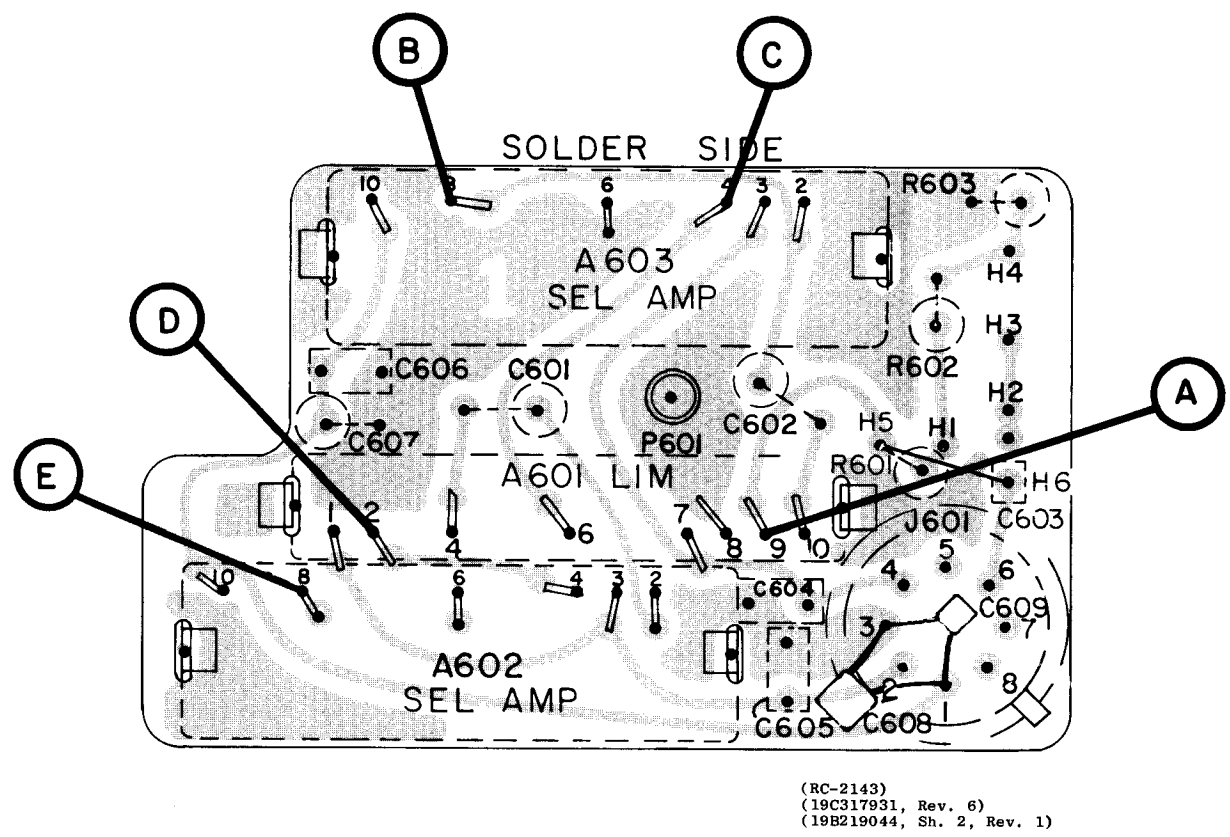
PARTS LIST

LBI-4373A

TYPE 90 ENCODER  
MODEL 4EH20A12 1 TONE  
MODEL 4EH20A13 2 TONE

| SYMBOL              | GE PART NO. | DESCRIPTION   |
|---------------------|-------------|---|
| C604                | 19A116192P2 | ----- CAPACITORS -----<br>Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.  |
|                     |             | ----- PLUGS -----<br>Socket, crystal: 8 contacts.   |
| P1                  | 19B219051G1 | TYPE 90 ENCODER BOARD<br>19C317556G1  |
| A601                | 19C317037G2 | Limiter.  |
| A602<br>and<br>A603 | 19D413245G4 | NOTE: When reordering A602 and A603 give GE Part Number and specify exact frequency needed.   |
|                     |             | Selective Amplifier. 1050-3000 Hz.  |
| C601                | 19C307102P4 | ----- CAPACITORS -----<br>Tantalum: 33 µf ±20%, 10 VDCW; sim to Component Inc S336R.  |
|                     |             | Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.   |
| C602                | 19A116192P1 | Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.  |
| C603                | 19A116192P2 | Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.  |
| C605                | 19A116192P2 | Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.  |
| C606                | 5491674P36  | Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.   |
| C607<br>and<br>C608 | 19A116192P2 | Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R-471M.   |
| J601                | 19A116122P1 | ----- JACKS AND RECEPTACLES -----<br>Terminal, feed-thru: sim to Warren Co 1-B-2994-4.  |
|                     |             | ----- PLUGS -----<br>Contact, electrical: sim to Amp 2-332070-9.  |
| P601                | 19A115834P4 | ----- RESISTORS -----<br>Composition: 0.10 megohm ±10%, 1/4 w.  |
| R601<br>and<br>R602 | 3R152P104K  | Variable, carbon film: 7500 ohms ±20%, 0.20 w; sim to Centralab Series 3 Type 620-1.  |
| R603                | 19A116093P1 | Composition: 51,000 ohms ±5%, 1/4 w.  |
| R604                | 3R152P513J  | TONE BOARD<br>19B219505G1   |
| P1                  | 19A115834P4 | ----- PLUGS -----<br>Contact, electrical: sim to AMP 2-332070-9.  |
|                     |             | ----- MISCELLANEOUS -----<br>Boot, moisture seal. (Used with S2).<br>Decorative cap. (Used with S2).<br>Insulator. (Used with J601).<br>Contact, electrical. (Used with Tone Board).<br>Diode, silicon; sim to Hughes 1N456. (Located on Tone Board). |

\*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

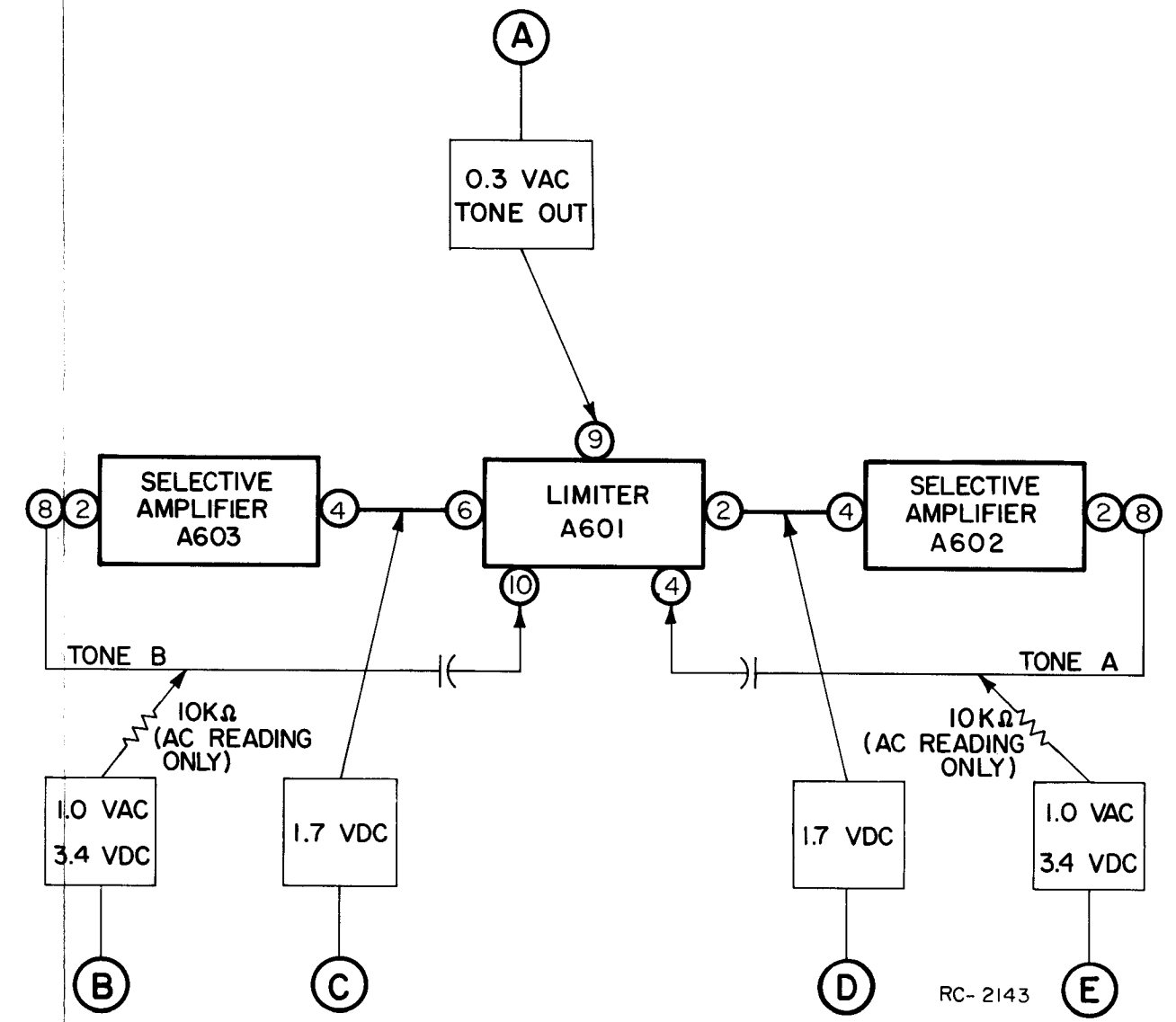


### TROUBLESHOOTING

ALWAYS CONNECT THE BOARD TO GROUND WHEN REMOVED FROM THE RADIO FOR TROUBLESHOOTING.

1. Place Channel Guard switch S2 in the tone "A" or "B" position and check for 0.3 volts AC at position **A**.
2. If reading is correct, check the transmitter oscillator module.
3. If reading is not correct, check readings at **B** through **E**.

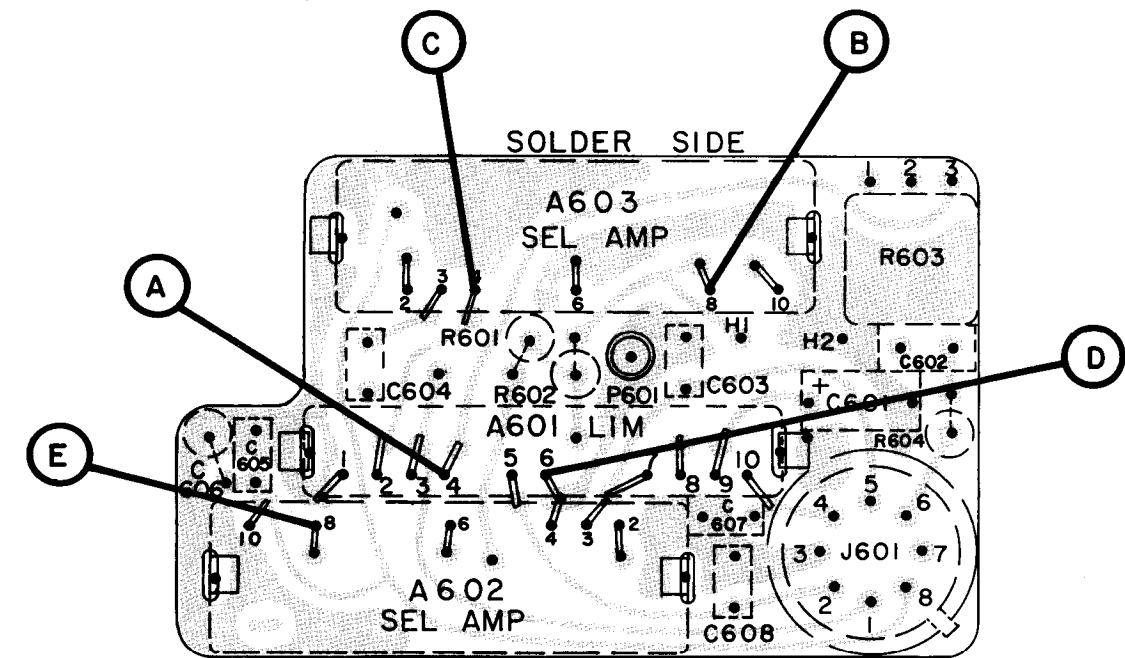
—CAUTION—  
Do not ground Pins 2 or 8 on the selective amplifier modules. To do so will destroy the selective amplifier.



### TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER  
MODELS 4EH21A12&13





(RC-2145)  
(19C317933, Rev. 0)  
(19B219043, Sh. 2, Rev. 0)

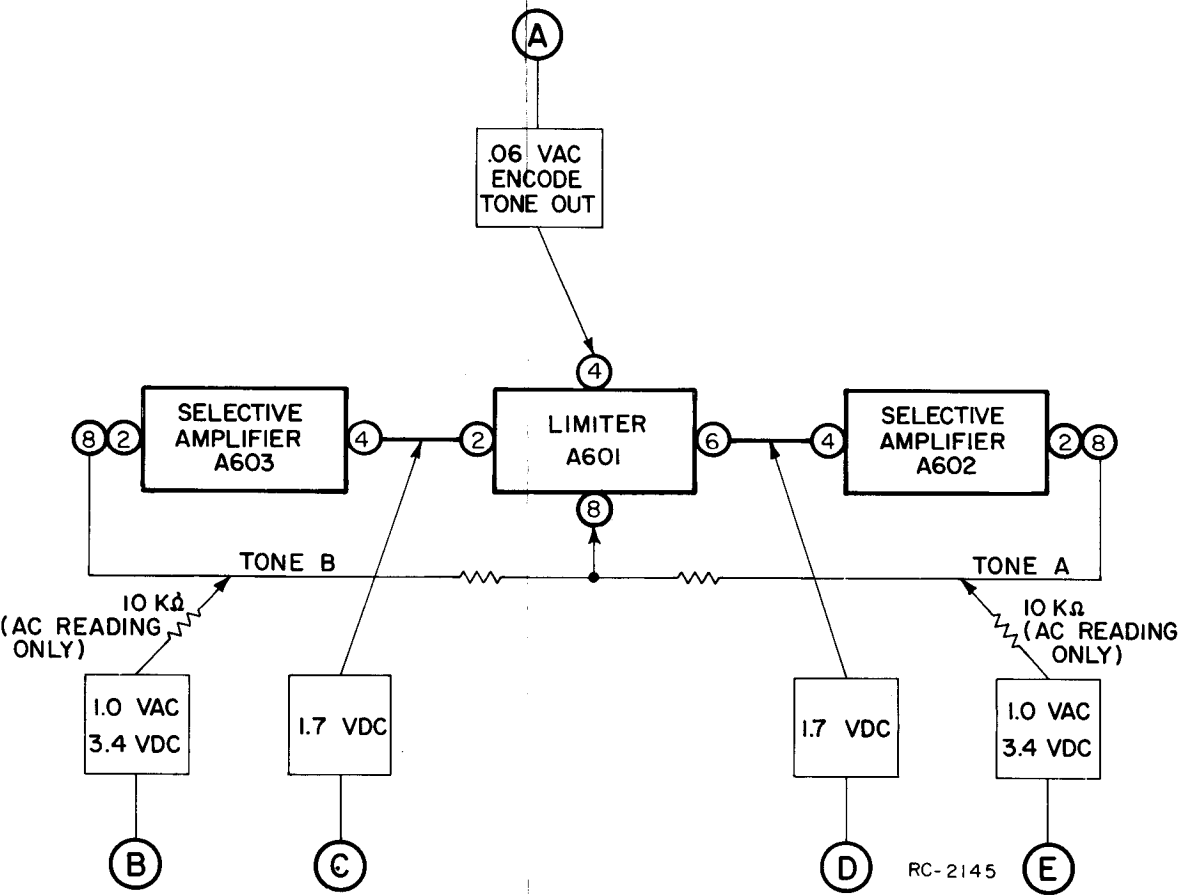
TROUBLESHOOTING

Always connect the board to ground when removed from the radio for troubleshooting.

1. Place Type 90 switch S2 in the Tone "A" or "B" position and check for .06 volts RMS at position A. Next, key the transmitter and check for the reading at A to drop to zero in approximately one second (pulsed tone).
2. If these readings are correct, then check the transmitter audio circuit and modulation setting.
3. If the readings are not correct, isolate the defective module by checking readings B through E.

- CAUTION -

Do not ground Pins 2 or 8 of Selective Amplifiers A602 and A603, or Pin 8 of limiter A601. To do so will destroy the Selective Amplifier.



TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER  
MODELS 4EH20A10, 11



## ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

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These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

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MOBILE RADIO DEPARTMENT  
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

**GENERAL**  **ELECTRIC**