MOBILE RADIO

MAINTENANCE MANUAL

FOR

CHANNEL GUARD ENCODER AND TYPE 90 ENCODER

(OPTIONS 4463 AND 4464)

CONTENTS

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 assemblied 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.

GENERAL ELECTRIC

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 ±3 KHz deviation.

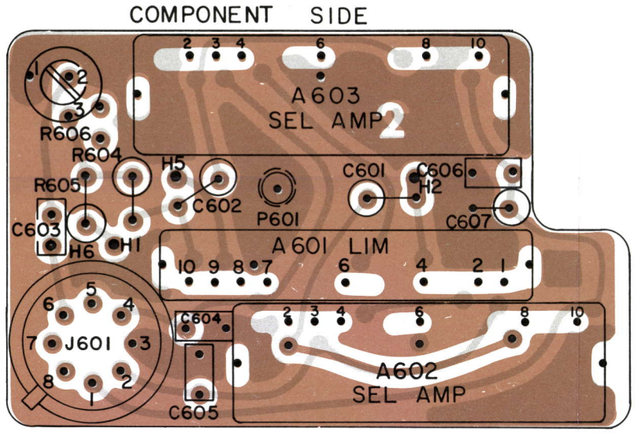
The Type 90 Encoder is controlled by the location of diodes on Tone Board 19B219505G1. The placement of a diode on the Tone Board enables the frequency selector switch to apply +5.4 Volts to the Limiter-Switch module and one of the Selective Amplifier modules, causing the module to oscillate on encode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

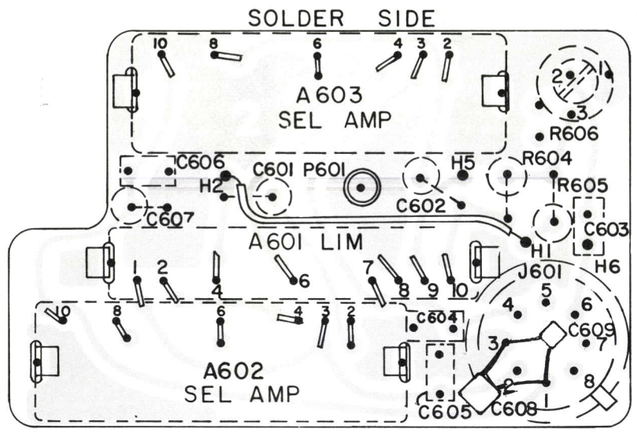
GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

CHANNEL GUARD BOARD



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



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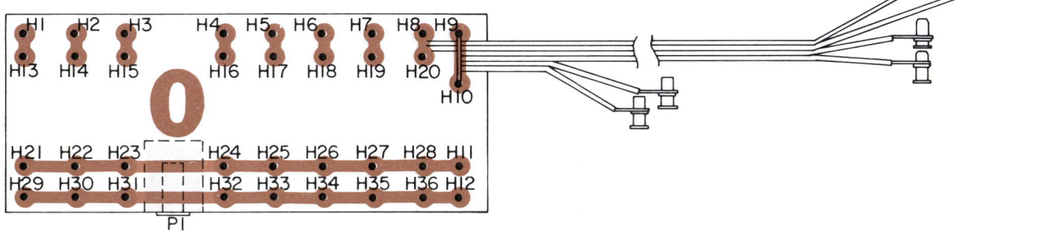
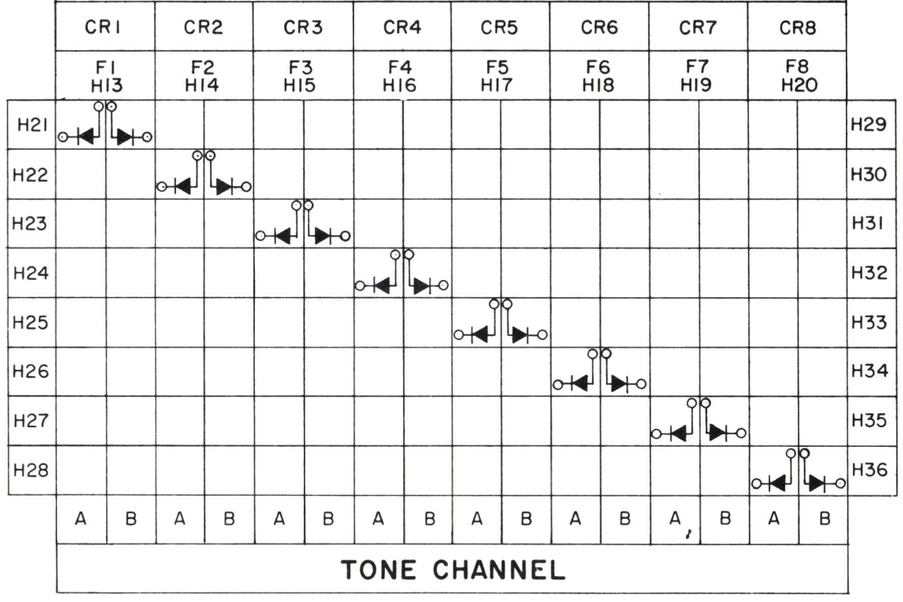
(19B219044, Sh. 2, Rev. 2)

TONE BOARD



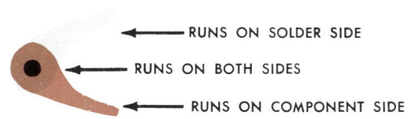
(19B219810, Rev. 0)
(19B219488, Sh. 1, Rev. 0)
(19B219488, Sh. 2, Rev. 0)



(19C317567, 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 H15 ⟶ H31



OUTLINE DIAGRAM

CHANNEL GUARD ENCODER
MODELS 4EH21A12&13

PARTS LIST

LBI4374D

CHANNEL GUARD ENCODER
MODEL 4EH21A12 1 TONE
MODEL 4EH21A13 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV B.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219050G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1* and R2*	3R152P333J	Composition: 33K ohms ±5%, 1/4 w. Added by REV D. Deleted by REV G.
R3*	3R152P223J	Composition: 22K ohms ±5%, 1/4 w. Added by REV G.
		CHANNEL GUARD ENCODER BOARD 19C317559G1 1 TONE 19C317559G2 2 TONE
A601	19C317033G2	Limiter.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 and C602	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C603	19A116192P14	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
C604 thru C606	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C607	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C608*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV A.
C609*	19A116114P43	Ceramic: 27 pf ±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: 6.2K ohms ±5%, 1/4 w. Deleted by REV G.
		In REV E & earlier:
	3R152P333J	Composition: 33K ohms ±5%, 1/4 w.
R602*	3R152P133J	Composition: 13K ohms ±5%, 1/4 w. Deleted by REV G.
R603*	3R152P622J	Composition: 6.2K ohms ±5%, 1/4 w. Deleted by REV G.
R604* and R605*	3R152P333J	Composition: 33K ohms ±5%, 1/4 w. Added by REV G.
R606*	19A116412P9	Variable, cermet: 500 ohms ±10%, 0.5 w; sim to Helipot Model 62 PR. Added by REV G.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		TONE BOARD 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).
	4037914P2	Pad.
		ASSOCIATED ASSEMBLIES
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
A602 and A603	19D413245G3	Selective Amplifier. 71.9-203.5 Hz freq range.

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.

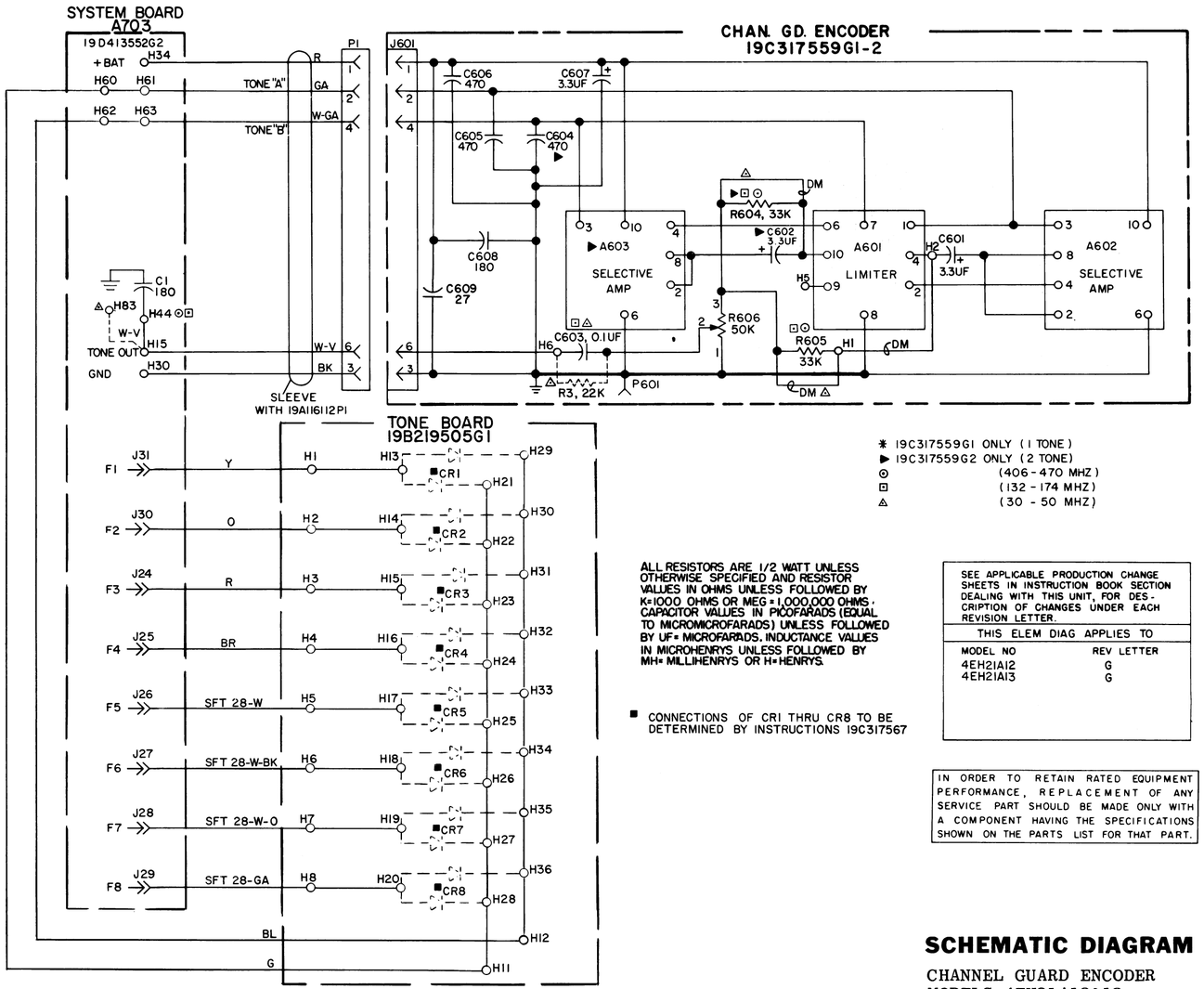
REV. C - To make Channel Guard Encode compatible with PE Low Band. Added holes H5 and H6. Added jumper between H5 and H6.

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.



(19D416551, Rev. 8)

✱ 19C317559G1 ONLY (1 TONE)
▶ 19C317559G2 ONLY (2 TONE)
⊙ (406 - 470 MHZ)
⊡ (132 - 174 MHZ)
△ (30 - 50 MHZ)

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.

■ CONNECTIONS OF CR1 THRU CR8 TO BE DETERMINED BY INSTRUCTIONS 19C317567

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

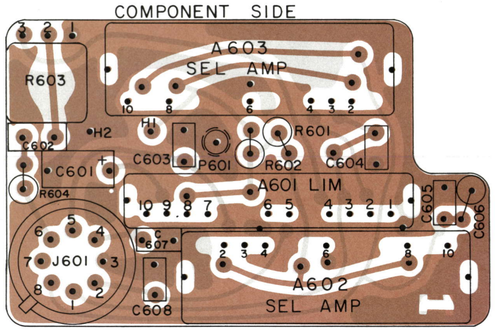
MODEL NO	REV LETTER
4EH21A12	G
4EH21A13	G

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.

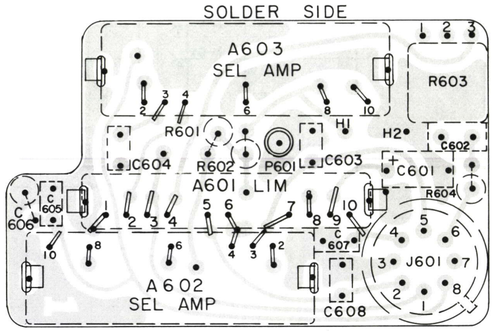
SCHEMATIC DIAGRAM

CHANNEL GUARD ENCODER
MODELS 4EH21A12&13

TYPE 90 ENCODER BOARD

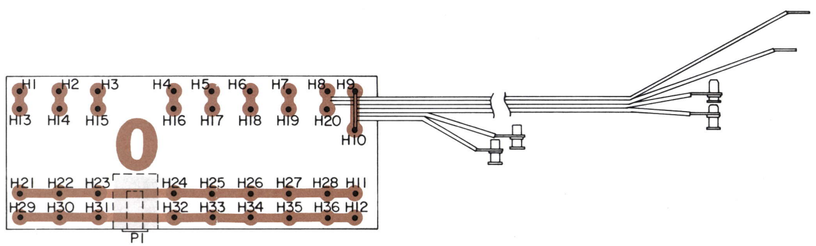


(19C317933, Rev. 0)
(19B219043, Sh. 1, Rev. 1)
(19B219043, Sh. 2, Rev. 1)



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

TONE BOARD



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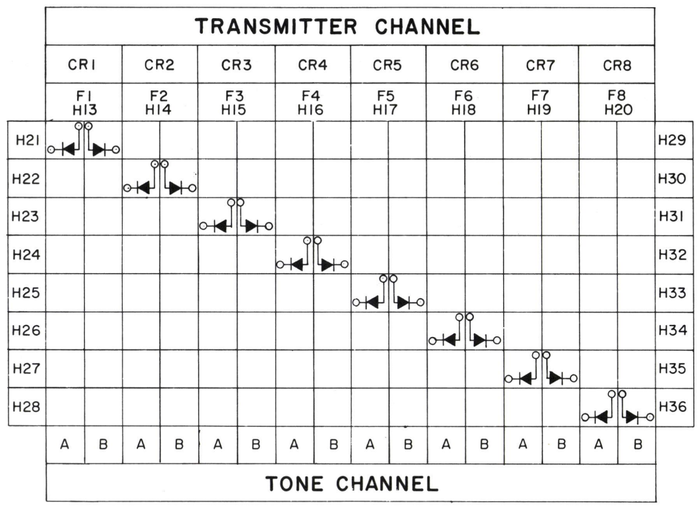
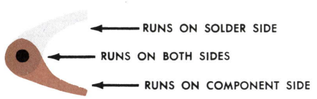


(19C317569, Sh. 3, Rev. 1)

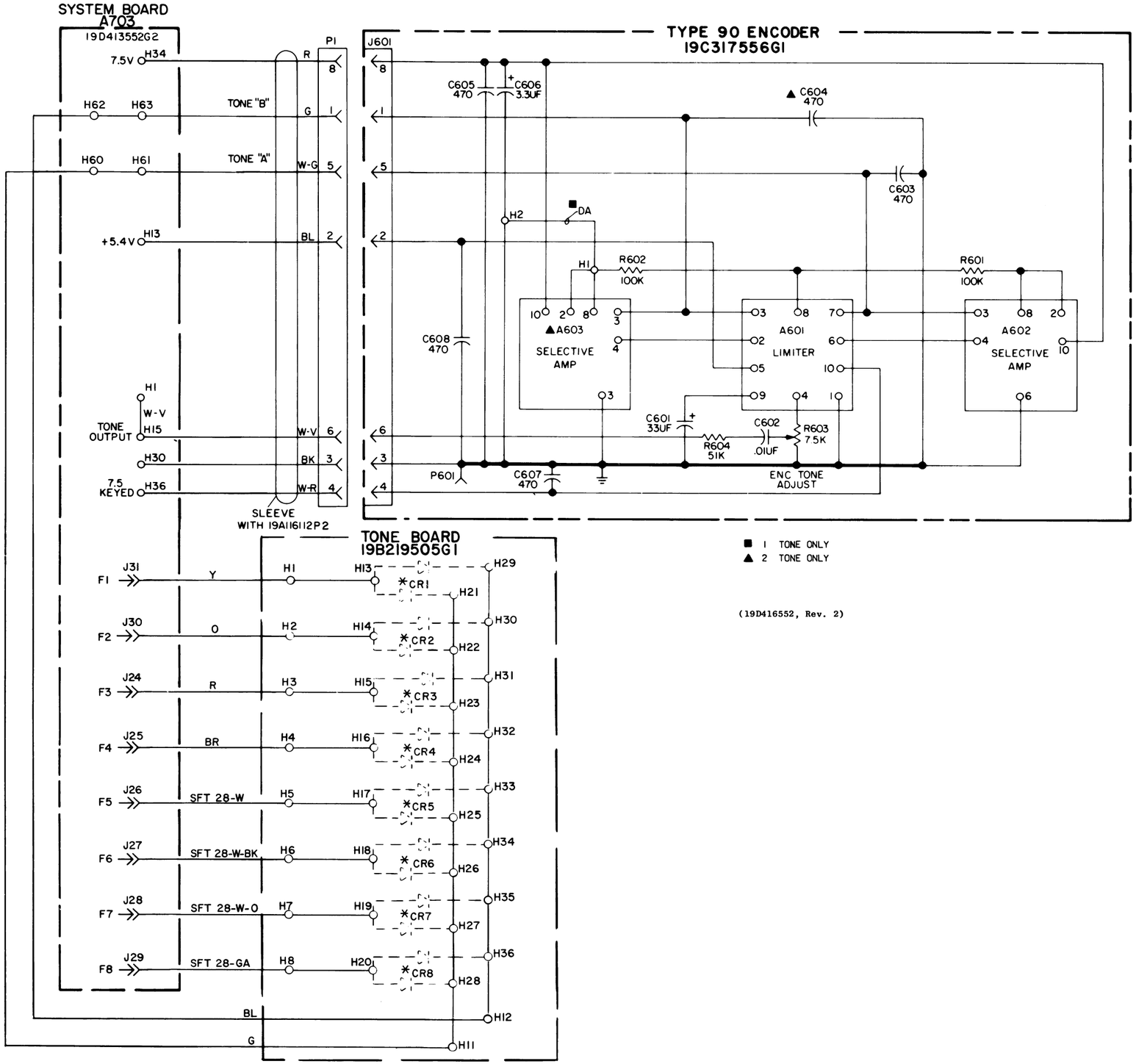
USE THE ABOVE CHART FOR ASSEMBLING DIODES IN THE TWO TONE SELECTOR BOARD 19B219505G1.

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 H15 ○—▷|—○ H31



OUTLINE DIAGRAM

TYPE 90 ENCODER
MODELS 4EH20A12&13



■ 1 TONE ONLY
▲ 2 TONE ONLY

(19D416552, Rev. 2)

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 PICOFARADS (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 19C317567

SCHEMATIC DIAGRAM

TYPE 90 ENCODER
MODELS 4EH20A12&13

PARTS LIST

LBI4373B

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

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C604	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19B219051G1	Socket, crystal: 8 contacts.
		TYPE 90 ENCODER BOARD 19C317556G1 1 TONE
A601	19C317037G2	Limiter.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	19C307102P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Component Inc S336R.
C602	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
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 and C608	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R-471M.
		- - - - - - - - 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 and R602	3R152P104K	Composition: 100K ohms ±10%, 1/4 w.
R603	19A116093P1	Variable, carbon film: 7.5K ohms ±20%, 0.20 w; sim to Centralab Series 3 Type 620-1.
R604	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
		TONE BOARD 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 Tone Board).
		ASSOCIATED ASSEMBLIES
		NOTE: When reordering A602 & A603 give GE Part Number and specify exact frequency needed.
A602 and A603	19D413245G4	Selective Amplifier. 1050-3000 Hz.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

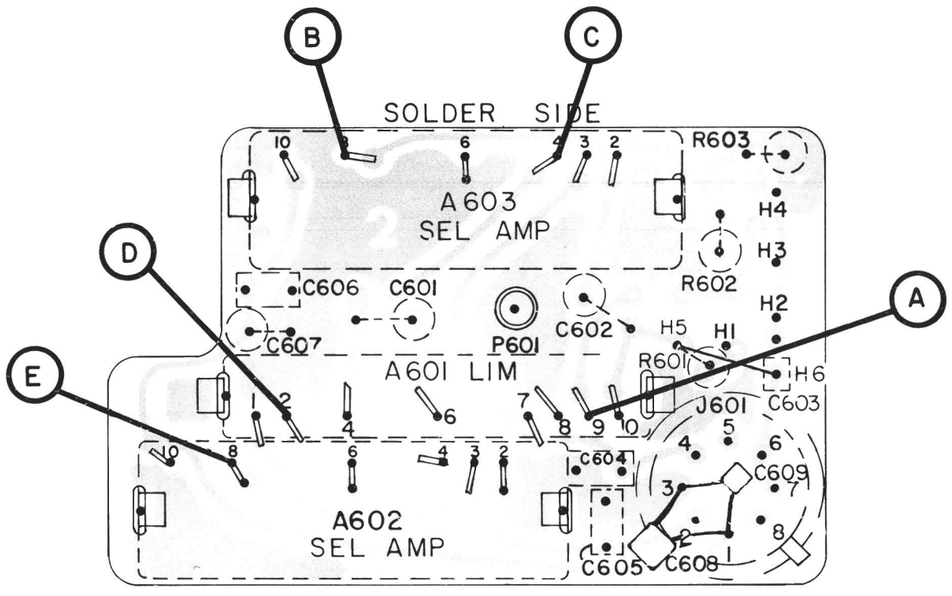
TROUBLESHOOTING

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

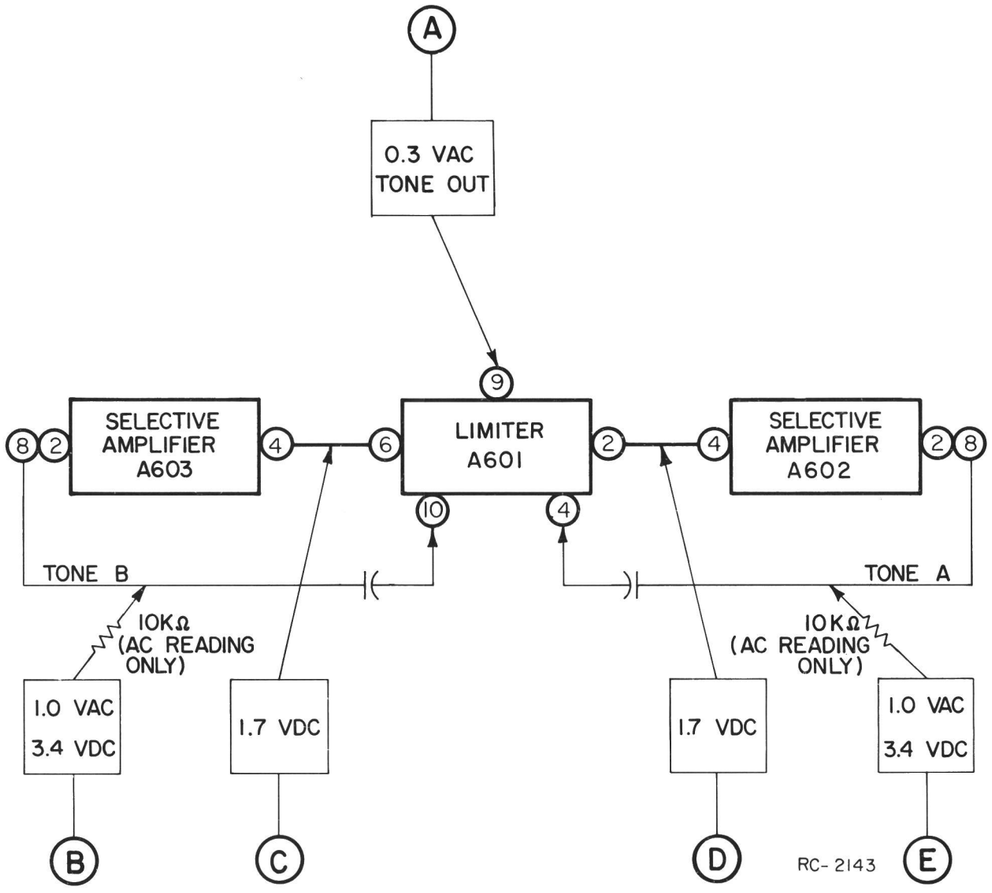
1. Place Channel Guard switch S2 in the tone "A" or "B" position and check for 0.3 volts AC at position (A) .
2. If reading is correct, check the transmitter oscillator module.
3. If reading is not correct, check readings at (B) through (E) .

——CAUTION——

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



(RC-2143
(19C317931, Rev. 6)
(19B219044, Sh. 2, Rev. 2)



TROUBLESHOOTING

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

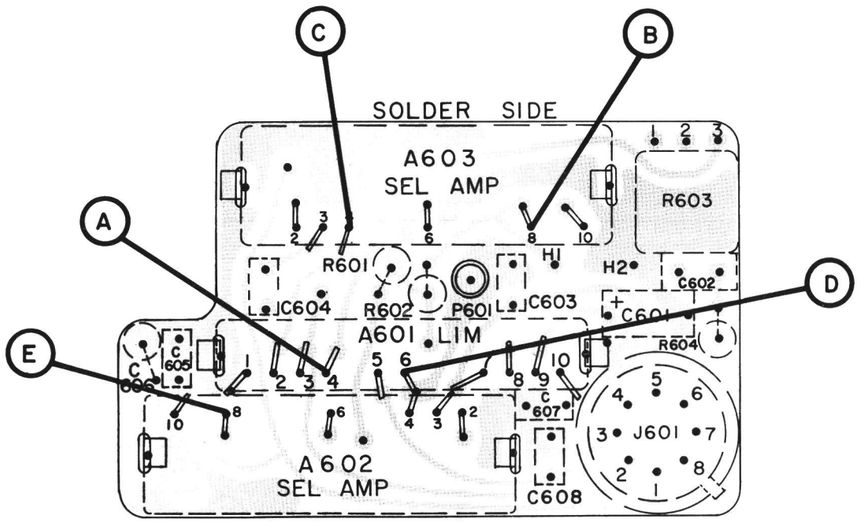
1. Place Type 90 switch S2 in the Tone "A" or "B" position and check for .06 volts RMS at position (A) . Next, key the transmitter and check for the reading at (A) to drop to zero in approximately one second (pulsed tone).

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.



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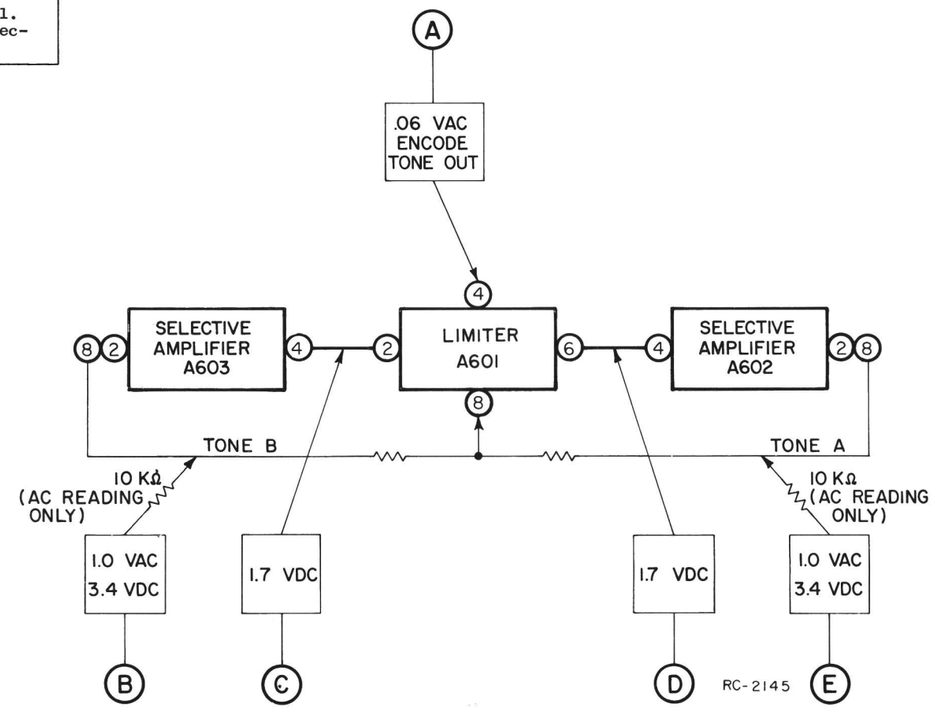

TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER
MODELS 4EH20A10, 11