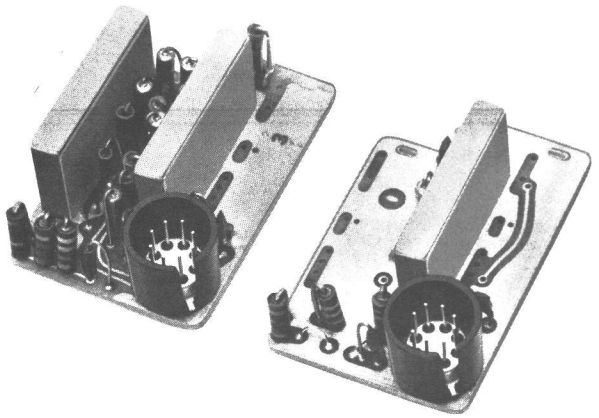
MOBILE RADIO

MASTR® Personal Series
PROGRESS LINE

PE MODEL CHANNEL GUARD
(ENCODER/DECODER MODEL 4EK17A10 AND ENCODER MODELS 4EH21A10 & 11)



SPECIFICATIONS *

Tone Frequencies	71.9 Hz to 203.5 Hz
Frequency Stability	±0.3 %
Transmit Drain	3.6 Milliamperes
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Nominal Input Voltage Requirements	+7.5 VDC

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

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

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

DESCRIPTION

CHANNEL GUARD ENCODER/DECODER

Encoder/Decoder Model 4EK17A10 is a continuous-tone encoder and decoder for operation on tone frequencies in the 71.9 to 203.5 Hz range. Both the encoder and decoder operate on the same frequency. The assembly consists of three Integrated Circuit modules that includes Input Filter A601, Limiter & Switch A602, and Selective Amplifier A603. Typical diagrams of the Input Filter and Limiter Switch circuits are shown in Figures 1 and 2.

The Channel Guard circuit is controlled by an ON-OFF switch on the control unit. Placing the switch in the OFF position disables the decoder circuits to permit monitoring all calls on the channel. Placing the switch in the ON position enables the Decoder.

CIRCUIT ANALYSIS

ENCODE

Keying the transmitter applies 7.5 Volts to Pin 5 of the Input Filter module, turning on encode switch Q5. This allows tone from Selective Amplifier A603 to be coupled through Q5 and applied to the transmitter oscillator module. In two-frequency radios, both RF channels are modulated by the Channel Guard tone.

DECODE

Releasing the PTT switch removes the 7.5 Volts at Pin 5 and applies 7.5 Volts to Pin 3, turning on decode switch Q4. At the same time the signal from R707-3 (Volume H) is coupled to Pin 2 of Input Filter A601, where it is applied to a two-stage, active low-pass filter (Q1 and Q2) for attenuating frequencies over 205 Hz. The output of A601 at Pin 10 is applied to Pin 2 of Limiter-Switch A602. When no tone is present in the signal, the random noise output of the filter will not operate the decoder circuitry.

Any tone present in the signal applied to A602 is limited by diodes CR1 and CR2, and the output applied through Pin 1 to the Selective Amplifier module. If the incoming tone is of the proper frequency, the output of the Selective Amplifier will be just sufficient to operate the detector circuit (Q1 thru Q3).

The positive half cycles of the Selective Amplifier output turns on Q1, which overrides the diode and turns on Q2. Turning on Q2 causes its collector to drop to ground potential, turning on the PNP tone switch Q4. When conducting, the 7.5 Volts

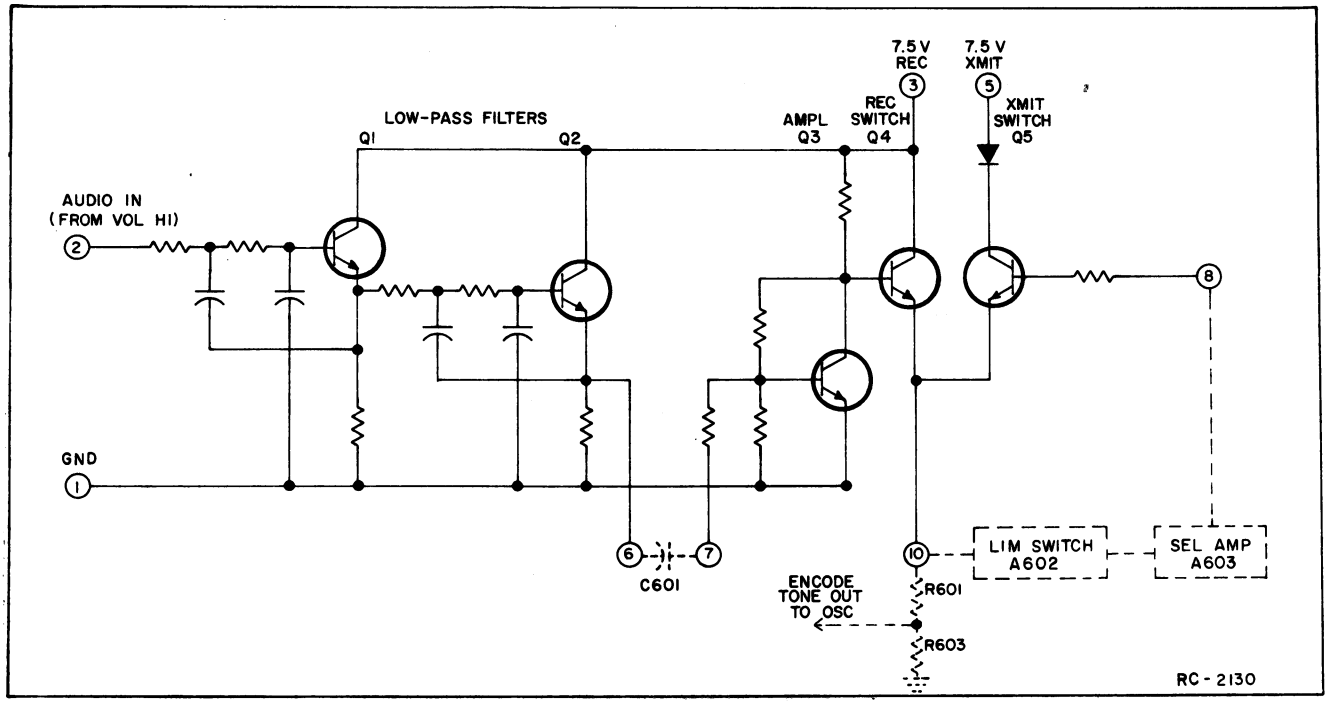


Figure 1 - Input Filter Circuit

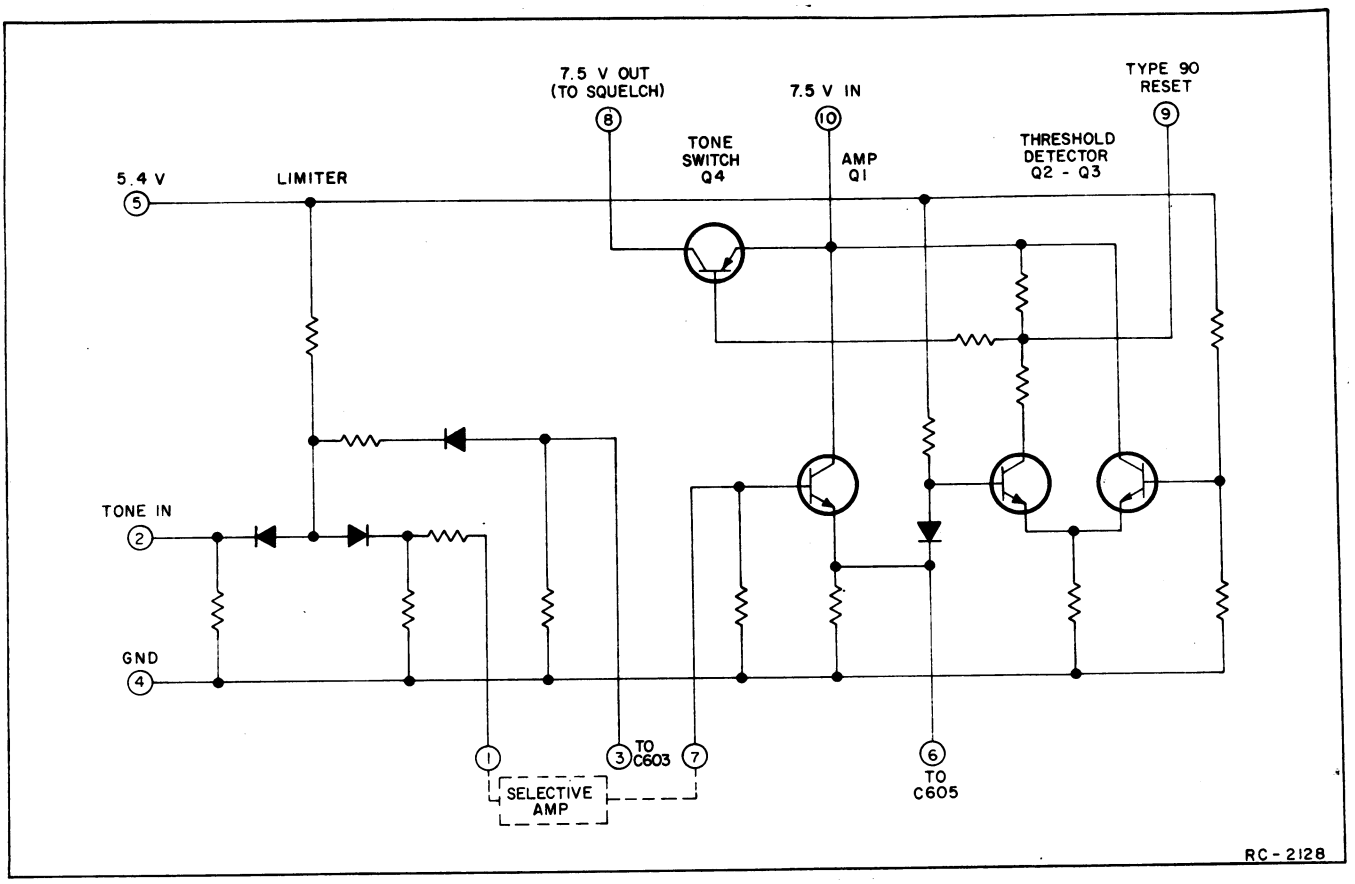


Figure 2 - Limiter Switch Circuit

at the collector of Q4 is applied to the squelch switching transistor on the Audio PA module. The receiver now operates on noise squelch, permitting the call to be monitored.

DESCRIPTION

CHANNEL GUARD ENCODER

Encoder Models 4EH21A10 (one-tone) and 4EH21A11 (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 Encoder is controlled by a three position switch on the control unit. Placing the switch in the OFF position disables the Encoder so that no tone is applied to the transmitter oscillator module.

CIRCUIT ANALYSIS

Placing the switch in the Tone A or Tone B position applies 5.4 Volts to the Limiter-Switch module and one of the Selective Amplifier modules; causing the modules to oscillate on the encode frequency. 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.

CHANNEL GUARD TONE FREQUENCIES

71.9 Hz
77.0
82.5
88.5
94.8
100.0
103.5
107.2
110.9
114.8
118.8
123.0
127.3
131.8
136.5
141.3
146.2
151.4
156.7
162.2
167.9
173.8
179.9
186.2
192.8
203.5

DF-5044

PARTS LIST

LBI-4247D

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A10

SYMBOL	GE PART NO.	DESCRIPTION
		COMPONENT BOARD 19C317396G1
A601	19C317009G2	Input Filter.
A602	19C317014G2	Limiter and Switch.
		NOTE: When reordering A603 give GE Part Number and specify exact frequency needed.
A603	19D413245G3	Selective Amplifier. 71.9-203.5 Hz freq range.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 thru C603	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C605	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C606	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C607	19A116307P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104K.
C608 and C609	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611 thru C614	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C615	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C616*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D. Added by REV A.
C617*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R. Added by REV A.
C618*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV B.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR601	19A115250P1	Silicon.
		- - - - - - - 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*	3R152P272J	Composition: 2700 ohms ±5%, 1/2 w. In REV D and earlier:
	3R152P622J	Composition: 6200 ohms ±5%, 1/2 w.
R602	3R152P155K	Composition: 1.5 megohm ±10%, 1/4 w.
R603*	3R152P152J	Composition: 1500 ohms ±5%, 1/4 w. Deleted by REV E.
R604	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R605	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R606*	3R152P431J	Composition: 430 ohms ±5%, 1/4 w. Deleted by REV E.
R607*	3R151P273J	Composition: 27,000 ohms ±5%, 1/8 w. Added by REV D. Deleted by REV E.
R608*	19A116412P3	Variable, cermet: 5000 ohms ±10%, 1/2 w; sim to Beilpot Model 62 PF. Added by REV E.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B216958G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R609*	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w. Added by REV F.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
		SWITCH ASSEMBLY 19A127833G1
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19A116648P6	Toggle: SPDT; sim to C and K Components 7101SD6.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	5490135P3	Boot, moisture seal. (Used with S2).
	19B216926P1	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	403530P2	Washer. (Used with S2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

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

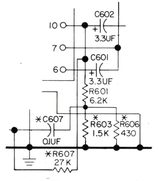
REV. A - To prevent RF interference from the transmitter. Added C616 and C617.

REV. B - To improve RF filtering of +7.5 Volt line. Added C618.

REV. C - To improve switch. Changed S2 and added washer.

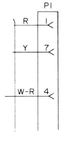
REV. D - To improve operation of Channel Guard. Added R607.

REV. E - To provide level control for Channel Guard. Deleted R603, R606 and R607. Changed R608 and added R608. Schematic Diagram was:



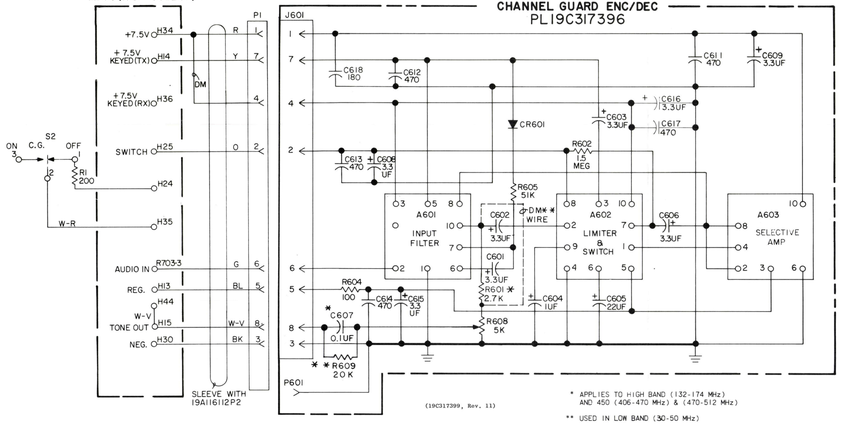
REV. F - To improve Channel Guard operation. Added R609.

REV. G - To improve Channel Guard operation. Changed connections to P1 Schematic Diagram was:



SYSTEM BOARD
A701 (19D413552G1)
A702 (19D416438G1)
A703 (19D413522G2)

SCHEMATIC DIAGRAM



(19C317399, Rev. 11)

* APPLIES TO HIGH BAND (132-174 MHz) AND 450 (406-470 MHz) & (470-512 MHz)

** USED IN LOW BAND (30-50 MHz)

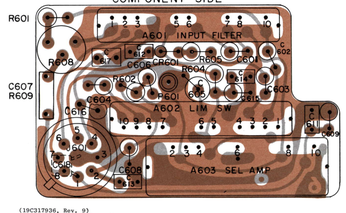
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR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

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

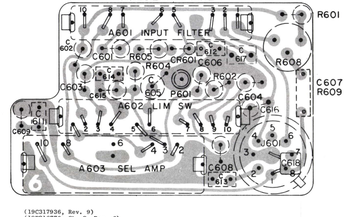
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EK17A10	G

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.

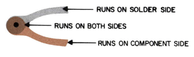
OUTLINE DIAGRAM



(19C317936, Rev. 9)
(19B216776, Sh. 1, Rev. 6)
(19B216776, Sh. 2, Rev. 6)



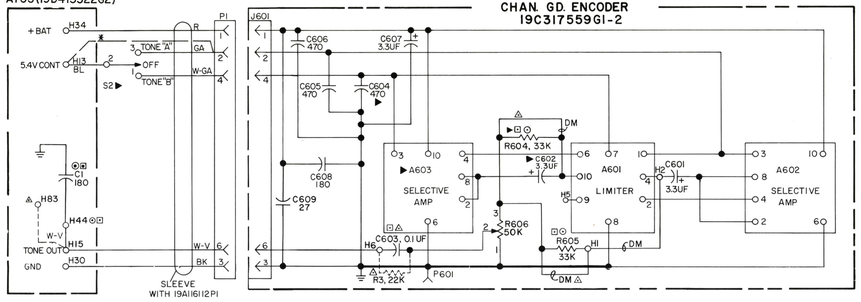
(19C317936, Rev. 9)
(19B216776, Sh. 2, Rev. 6)



SCHEMATIC & OUTLINE DIAGRAM

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A10

SYSTEM BOARD
A701 (19D413552G1)
A702 (19D416438G1)
A703 (19D413522G2)



(19C317558, Rev. 10)

✱ 19C317559G1 ONLY (1 TONE)
▶ 19C317559G2 ONLY (2 TONE)
⊙ (406 - 512 MHZ.) ONLY
⊡ (132 - 174 MHZ.) ONLY
△ (30 - 50 MHZ.) ONLY

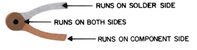
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS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

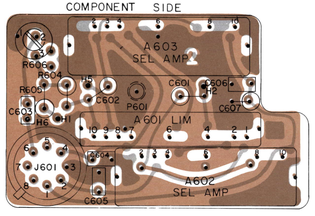
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EH21A10	G
4EH21A11	J

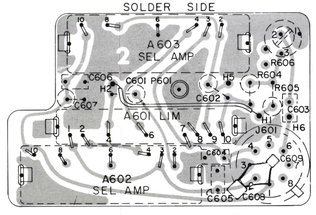
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

OUTLINE DIAGRAM





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



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

SCHEMATIC & OUTLINE DIAGRAM
CHANNEL GUARD ENCODER
MODELS 4EH21A10 & 11

PARTS LIST

LBI-4248D
CHANNEL GUARD ENCODER
MODEL 4EH21A10 1 TONE
MODEL 4EH21A11 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added to 4EH21A10 by REV C. Added to 4EH21A11 by REV D.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219050G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1* and R2*	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w. Added to 4EH21A10 by REV D. Added to 4EH21A11 by REV E. Deleted in 4EH21A10 by REV G. Deleted in 4EH21A11 by REV J.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19B219053G1	Toggle: SPDT; sim to C and K Components 7103SDG.
A601	19C317033G2	Limiter. 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.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 and C602	5491674P36	Tantalum: 3.3 uf ±20%, 10 VDCW; sim to Sprague Type 162D.
C603	19A116207P3	Ceramic: 0.1 uf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA75C104K.
C604 thru C606	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 811-050-X5R.
C607	5491674P36	Tantalum: 3.3 uf ±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 to 4EH21A10 by REV E. Added to 4EH21A11 by REV G.
		- - - - - - - 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*	3R152P623J	Composition: 6200 ohms ±5%, 1/4 w. Deleted in 4EH21A10 by REV G, 4EH21A11 by REV J. In 4EH21A10 of REV E and earlier: In 4EH21A11 of REV G and earlier:
	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R602*	3R152P133J	Composition: 13,000 ohms ±5%, 1/4 w. Deleted in 4EH21A10 by REV G. Deleted in 4EH21A11 by REV J.
R603*	3R152P623J	Composition: 6200 ohms ±5%, 1/4 w. Deleted in 4EH21A10 by REV G. Deleted in 4EH21A11 by REV J.
R604*	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w. Added to 4EH21A10 by REV G. Added to 4EH21A11 by REV J.
R605*	3R152P533J	Composition: 53,000 ohms ±5%, 1/4 w. Added to 4EH21A10 by REV G. Added to 4EH21A11 by REV J.
R606*	19A116412P9	Variable, cermet: 500 ohms ±10%, 1/2 w; sim to Bourns Model 62 PF. Added to 4EH21A10 by REV G. Added to 4EH21A11 by REV J.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B216926P2	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	19C320721P1	Seal. (Used with S2).
	549013SP3	Boot, moisture seal. (Used with S2).
	4035306P2	Washer.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits will be 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 - Models 4EH21A10,11
To improve RF filtering. Added C608.

REV. B - Model 4EH21A11
To improve switch.
Changed S2 and added washer.

REV. B - Model 4EH21A10
REV. C - Model 4EH21A11
To make Channel Guard Encoder compatible with Low Band PE.
Added jumper between R5 and H6.

REV. C - Model 4EH21A10
Rev. D - Model 4EH21A11
To prevent RF from shifting CG modulation.
Added C1.

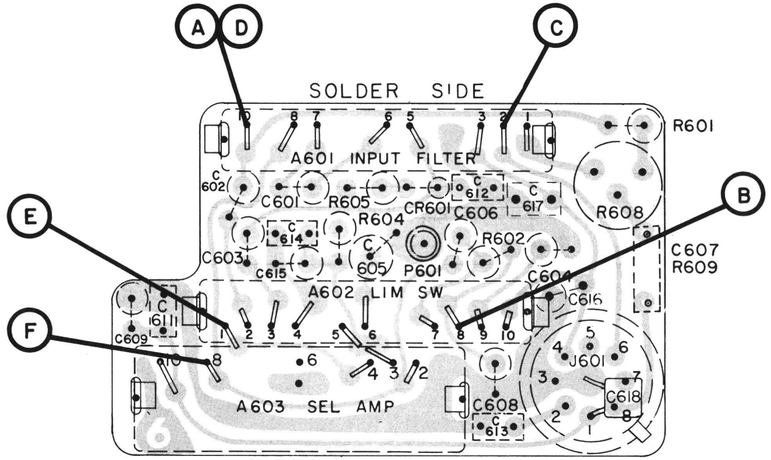
REV. D - Model 4EH21A10
REV. E - Model 4EH21A11
To prevent RF from shifting CG modulation.
Added R1 and R2. Deleted jumper between R5 and H6.

REV. F - Model 4EH21A11
To change switch orientation.
Rotated S2 180°.

REV. E - Model 4EH21A10
REV. G - Model 4EH21A11
To prevent RF feedback.
Added C609.

REV. F - Model 4EH21A10
REV. H - Model 4EH21A11
To increase CG tone deviation.
Changed R601

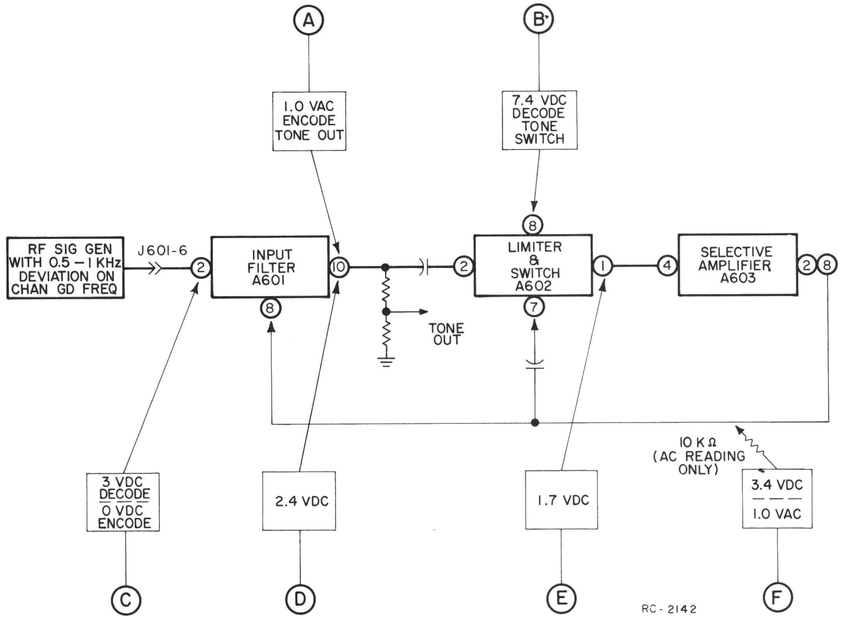
REV. G - Model 4EH21A10
REV. J - Model 4EH21A11
To increase CG tone modulation.
Deleted R1 and R2.
Added R3.



(RC-2142)
(19C317936, Rev. 9)
(19B216776, Sh. 2, Rev. 6)

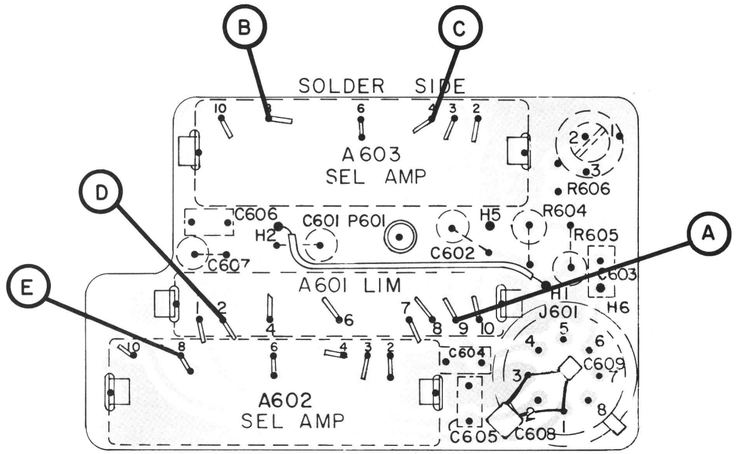
TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit won't decode	1. Place Channel Guard switch S2 in the OFF position and check for proper operation of the receiver. 2. If the receiver operates properly, apply the proper Channel Guard tone to the radio and check for 7.4-volts DC at Position (B) . Next, remove the tone and check for zero volts at (B) . 3. If readings are not correct, isolate the defective module by checking readings (C) through (F) . CAUTION Do not ground Pins 2 or 8 on Selective Amplifier A603, or Pin 8 on Input Filter A601. To do so will destroy the Selective Amplifier module.
Unit won't encode	1. Key the transmitter and check for 1-volt RMS at Position (A) . 2. If the reading is correct, check the transmitter oscillator module. 3. If the reading is not correct, isolate the defective module by checking readings (C) thru (F) .



TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A10



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

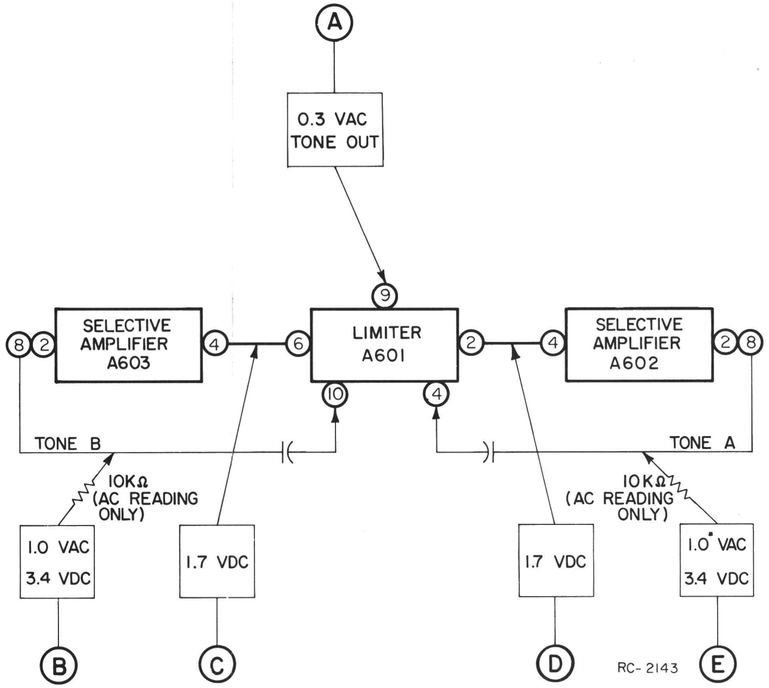
TROUBLESHOOTING

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

1. Place 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 4EH21A10 & 11