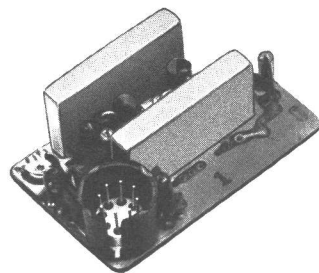


MASTR[®] *Personal Series*

PROGRESS LINE

PE MODELS

(CHANNEL GUARD ENCODER/DECODER MODELS 4EK17A10-13)



SPECIFICATIONS *

Tone Frequencies	71.9 Hz to 203.5 Hz
Frequency Stability	$\pm 0.3\%$
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.

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— WARNING —

No one should be permitted to handle any portion of the equipment that is supplied with voltage or RF power; 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 Models 4EK17A10-13 are continuous-tone encoders and decoders operating on tone frequencies between 71.9 Hz and 203.5 Hz. Both the encoder and decoder operate on the same frequency.

The differences between Channel Guard models is the application and interfacing between the circuit boards and the Personal PE System Board. Application of the different Channel Guard models are shown in the following chart.

Model	Application
4EK17A10	Encode/Decode only
4EK17A11	Encode/Decode with Tone Control
4EK17A12	Encode/Decode with Tone Control and Search Lock Monitor
4EK17A13	Encode/Decode with Type 99 Tone

The Encoder/Decoder consists of a printed wire board with three integrated circuit modules. The integrated circuit modules include Input Filter A601, Limiter and Switch A602, and Selective Amplifier A603. Typical diagrams of the Input Filter and Switch Circuits are shown in Figures 1 and 2. Also, where applicable, the Channel Guard Circuit uses a Tone Control Board.

The Channel Guard circuit is controlled by CG ON-OFF switch S2 and multi-frequency switch S1 on the control unit. Placing S2 in the OFF position disables the decoder circuits to permit monitoring all calls on the selected channel. Placing S2 in the ON position enables the Encoder/Decoder. Multi-frequency switch S1 selects the channel that will have Channel Guard, and also enables the Tone Control board circuitry.

CIRCUIT ANALYSIS

TONE CONTROL BOARD

The Tone Control board consists of diodes CR1 through CR7, and a three-transistor switching circuit. Placing multi-frequency switch S1 on a frequency with

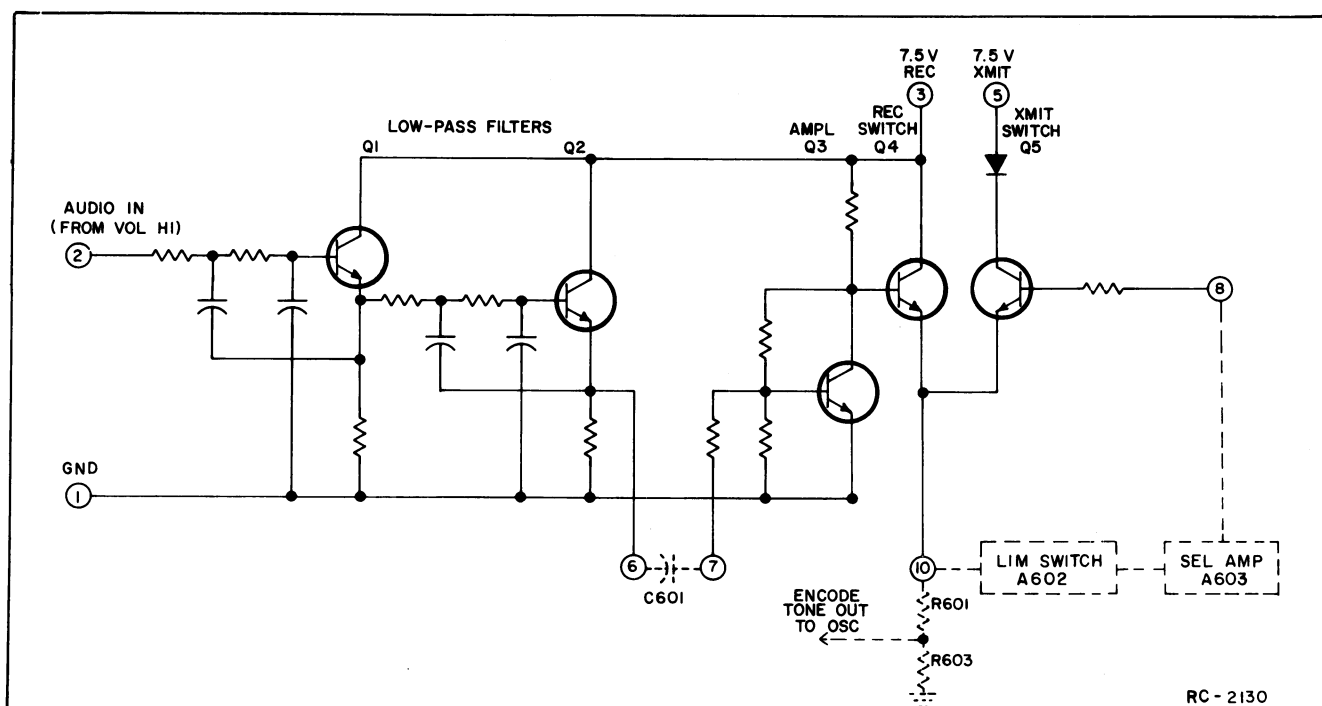


Figure 1 - Input Filter Circuit

Channel Guard applies 5.4 Volts to the Tone Control board. For example, placing A1 on the channel 1 frequency forward biases CRL and applies supply voltage to pin 5 of the Limiter-Switch Module, and the Selective Amplifier. In addition, the 5.4 Volts are applied to the base of Q1, turning it on. Turning on Q1 turns on Q2 which turns off Q3. Turning off Q3 removes the 7.5 Volts applied to the receiver Audio PA module so that the radio operates in the Channel Guard mode.

Switching S1 to a non-Channel Guard position removes the 5.4 Volts to the Tone Control Board. This allows Q3 to conduct, applying 7.5 Volts to the squelch switching transistor on Audio PA module so that the receiver operates on noise squelch.

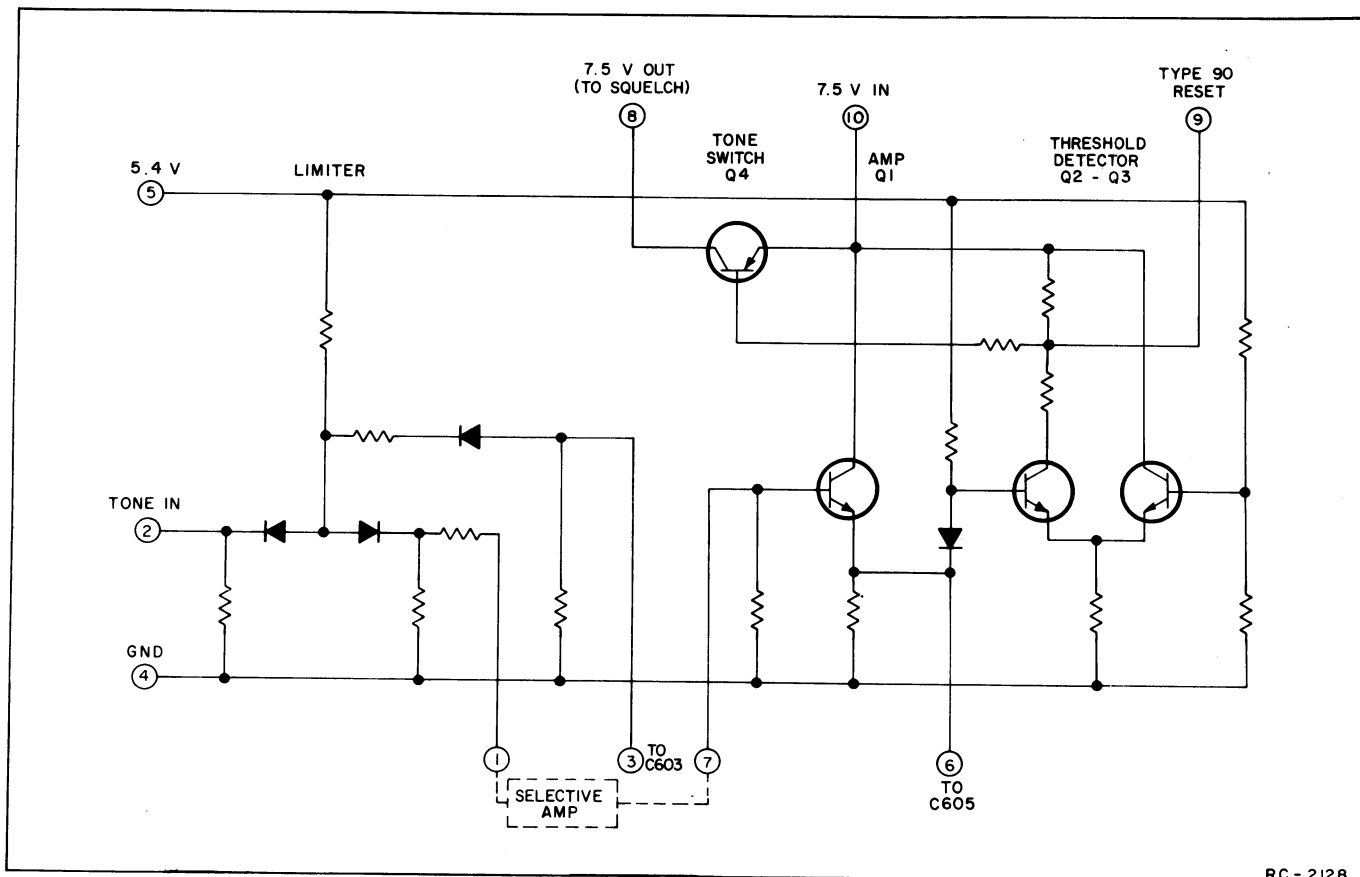
Whenever Channel Guard is not desired on a particular frequency, the lead to the Tone Control board can be removed from the appropriate frequency selector jack on the Systems Board (J25 through J31) and taped back, or the associated diode on the Tone Control board can be removed.

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.

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 HI) 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.



RC-2128

Figure 2 - Limiter-Switch Circuit

Any tone present in the signal applied to A602 is limited by the limiter diodes 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 over-rides 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 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.

CHANNEL GUARD TONE FREQUENCIES

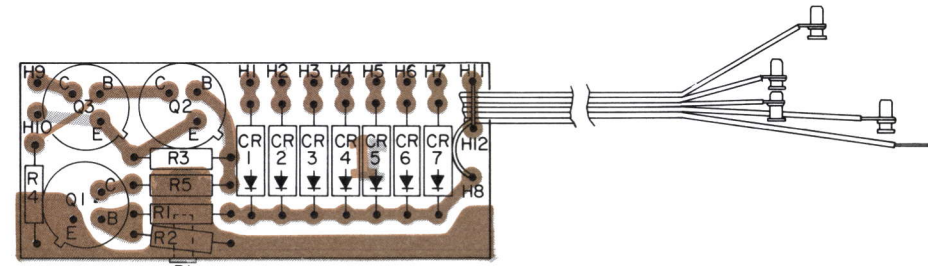
71.9 Hz
77.0
82.5
88.5
94.8
100.0
103.5
107.2
110.9
114.8
118.8
123.0
127.3
131.8
136.5
141.3
146.2
151.4
156.7
162.2
167.9
173.8
179.9
186.2
192.8
203.5

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 4EK17A11	REV LETTER 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.

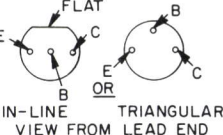
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS; CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS; INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR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

* APPLIES TO HIGH BAND (132-174 MHz) AND 450 (406-470 MHz) & (470-512 MHz)
** USED IN LOW BAND (30-50 MHz)



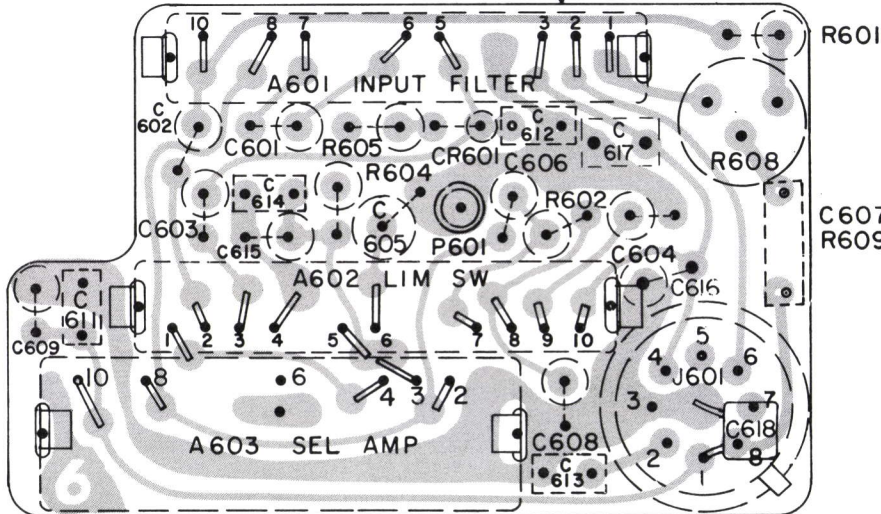
(19B219807, Rev. 0)
(19B219490, Sh. 1, Rev. 1)
(19B219490, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR Q1-Q3



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

SOLDER SIDE



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

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 - 4EK17A10

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.

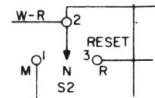
REV. D - To improve operation of Channel Guard. Added R607.

REV. A - 4EK17A11

To improve RF Filtering. Added C614.

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

REV. C - To change switch orientation. Changed W-Ga wire from terminal 3 to terminal 1 and Ga wire from terminal 1 to terminal 3.

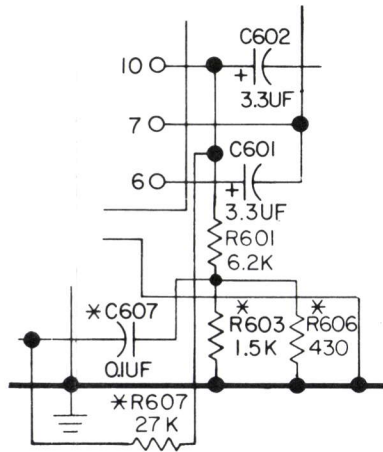


REV. D - To improve RF Filtering. Added C617.

REV. E - 4EK17A10, 11

REV. A - 4EK17A12, 13

To provide level control for Channel Guard. Deleted R603, R606 and R607. Changed R601 and added R608. Schematic Diagram was:



REV. F - 4EK17A10, 11

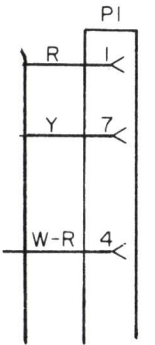
REV. B - 4EK17A12, 13

To improve Channel Guard operation. Added R609.

REV. G - 4EK17A10, 11

REV. C - 4EK17A12, 13

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

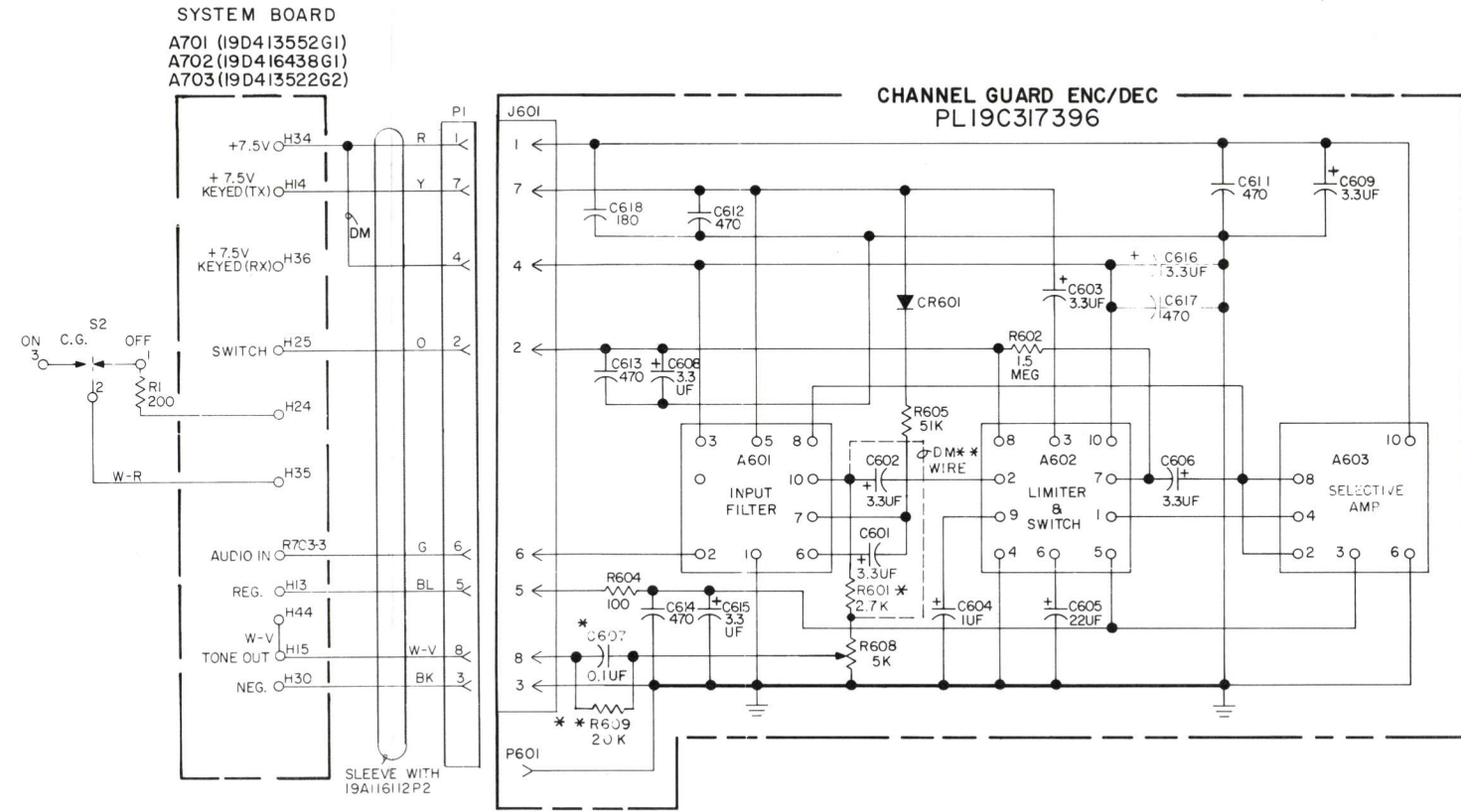


PARTS LIST

LBI4371F CHANNEL GUARD ENCODER/DECODER		
4EK17A10 STANDARD		
4EK17A11 TONE CONTROL		
4EK17A12 TONE CONTROL WITH SLM OR T99		
4EK17A13 T99		
SYMBOL	GE PART NO.	DESCRIPTION
----- PLUGS -----		
P601	19A115834P4	Contact, electrical: sim to Amp 2-332070-9.
----- RESISTORS -----		
R601*	3R152P272J	Composition: 2.7K ohms $\pm 5\%$, 1/2 w. In 4EK17A10, All of REV D and earlier: In 4EK17A12, A13 earlier than REV A: Composition: 6.2K ohms $\pm 5\%$, 1/2 w.
R602	3R152P622J	Composition: 1.5 megohm $\pm 10\%$, 1/4 w.
R603*	3R152P152J	Composition: 1.5K ohms $\pm 5\%$, 1/4 w. Deleted in 4EK17A10, A11 by REV E, 4EK17A12, A13 by REV A.
R604	3R152P101K	Composition: 100 ohms $\pm 10\%$, 1/4 w.
R605	3R152P513J	Composition: 51K ohms $\pm 5\%$, 1/4 w.
R606*	3R152P431J	Composition: 430 ohms $\pm 5\%$, 1/4 w. Deleted in 4EK17A10, A11 by REV E, 4EK17A12, A13 by REV A.
R607*	3R151P273J	Composition: 27K ohms $\pm 5\%$, 1/8 w. Added by REV D. Deleted in 4EK17A10, A11 by REV E, 4EK17A12, A13 by REV A.
R608*	19A116412P3	Variable, cermet: 5K ohms $\pm 10\%$, 1/2 w; sim to Helipot Model 62 ZF. Added to 4EK17A10, A11 by REV E, 4EK17A12, A13 by REV A.
TONE CONTROL BOARD 19B219507G1		
----- DIODES AND RECTIFIERS -----		
CR1 thru CR7	5494922P1	Silicon; sim to Hughes 1N456.
----- PLUGS -----		
P1	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
----- TRANSISTORS -----		
Q1	19A129184P1	Silicon, NPN.
Q2 and Q3	19A129187P1	Silicon, PNP.
----- RESISTORS -----		
R1	3R151P473K	Composition: 47K ohms $\pm 10\%$, 1/8 w.
R2	3R151P104K	Composition: 0.10 megohm $\pm 10\%$, 1/8 w.
R3 and R4	3R151P473K	Composition: 47K ohms $\pm 10\%$, 1/8 w.
R5	3R151P104K	Composition: 0.10 megohm $\pm 10\%$, 1/8 w.
----- MISCELLANEOUS -----		
19C320721P1		Boot, moisture seal. (Used with S2).
19B216928G1		Decorative cap. (Used with S2).
19B216316P1		Insulator. (Used with J601).
4035306P11		Insulator. (Used with Q1-Q3 on Tone Control Board).
4035306P2		Washer. (Used with S2).
----- CAPACITORS -----		
C601	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C602	5491674P28	Tantalum: 1.0 μ f $\pm 20\%$, 25 VDCW; sim to Sprague Type 162D.
C603	5491674P35	Tantalum: 22 μ f $\pm 20\%$, 4 VDCW; sim to Sprague Type 162D.
C604	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C605	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C606	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C607	19A116192P14	Ceramic: 0.1 μ f $\pm 20\%$, 50 VDCW, temp range -55 to 85°C; sim to Erie USCC CW20C104-M2.
C608 and C609	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C611 thru C614	19A116192P2	Ceramic: 470 pf $\pm 20\%$, 50 VDCW; sim to Erie 8111-050-W5R.
C615	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D.
C616*	5491674P36	Tantalum: 3.3 μ f $\pm 20\%$, 10 VDCW; sim to Sprague Type 162D. Added by REV A.
C617*	19A116192P2	Ceramic: 470 pf $\pm 20\%$, 50 VDCW; sim to Erie 8111-050-W5R. Added by REV A.
C618*	19A116114P10073	Ceramic: 180 pf $\pm 10\%$, 100 VDCW; temp coef -3300 PPM. Added by REV B.
----- DIODES AND RECTIFIERS -----		
CR601	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
----- JACKS AND RECEPTACLES -----		
J601	19A116122P1	Terminal, feed-thru: sim to Warren Co 1-B-2994-4.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC DIAGRAM



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 4EK17A10	REV LETTER G

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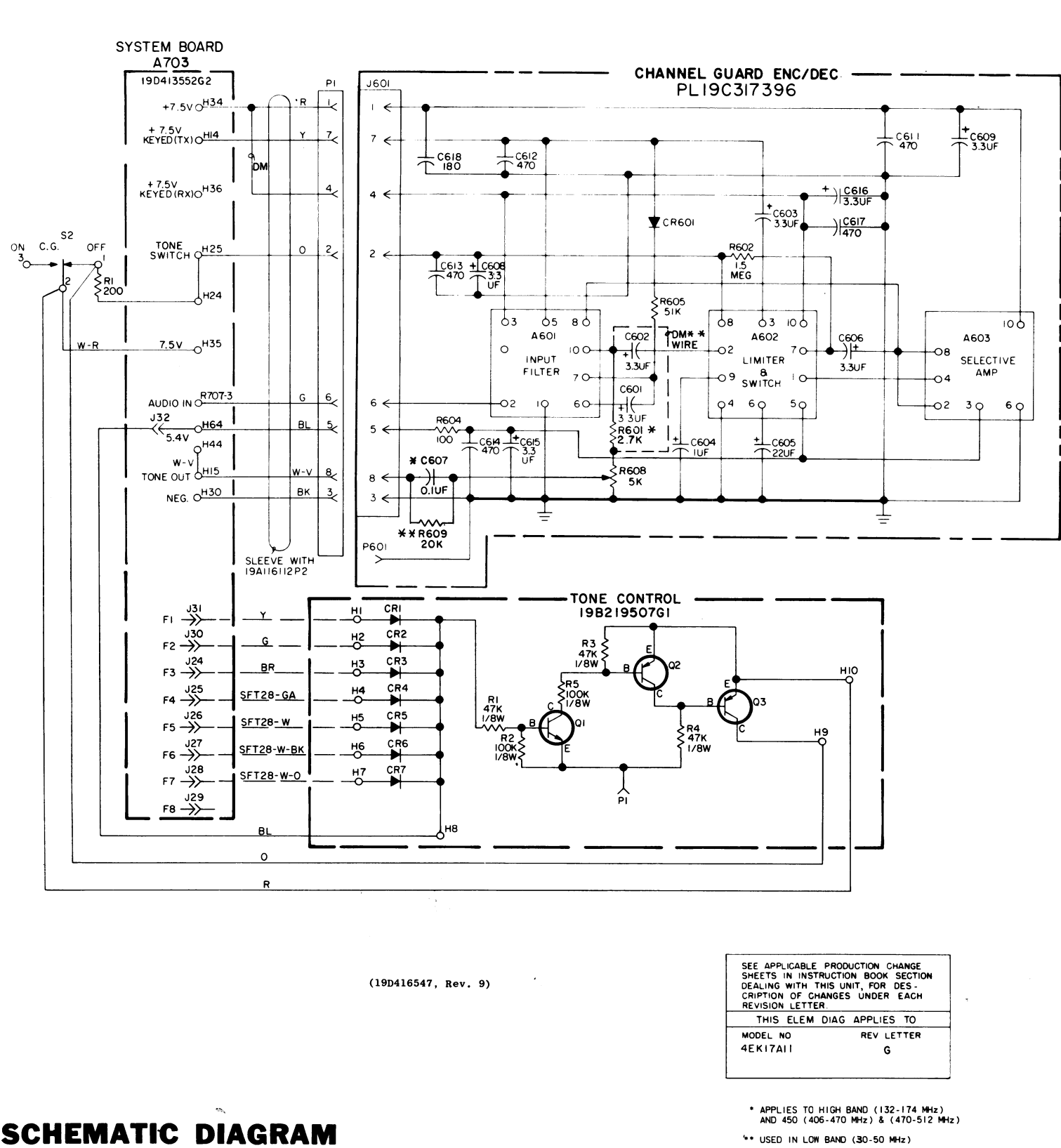
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS; CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS; INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR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

* APPLIES TO HIGH BAND (132-174 MHz) AND 450 (406-470 MHz) & (470-512 MHz)
** USED IN LOW BAND (30-50 MHz)

(19C317399, Rev. 11)

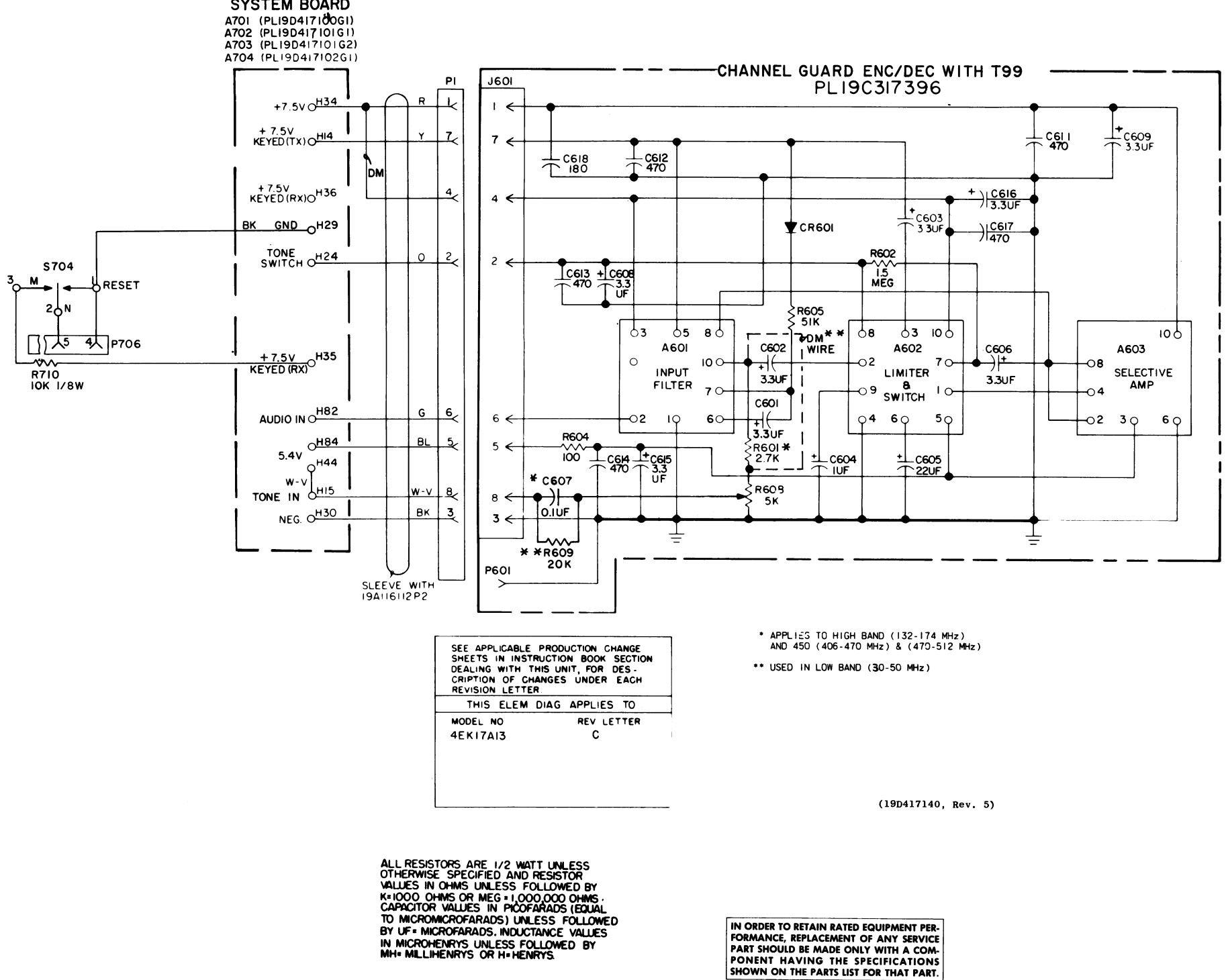
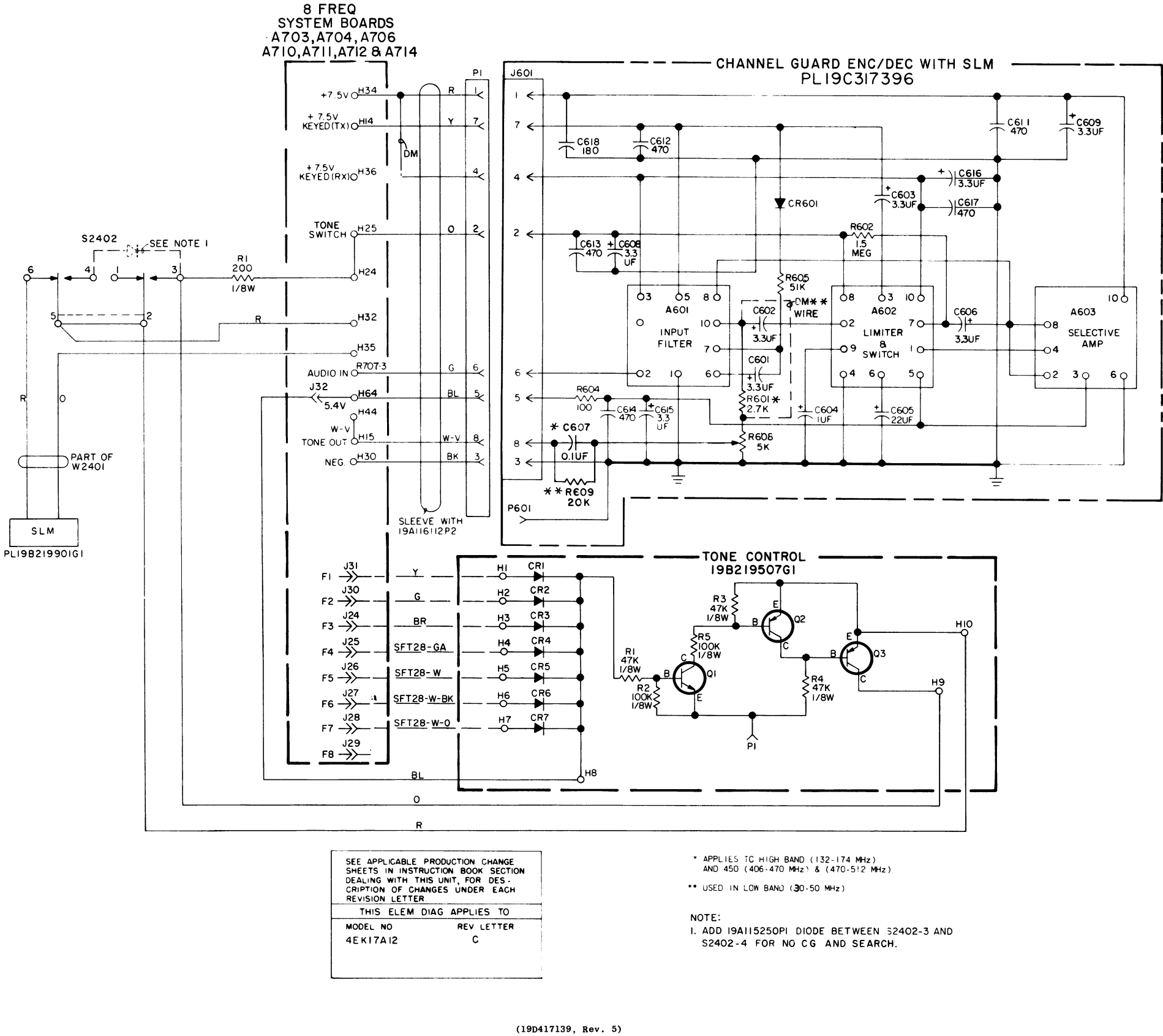
SCHEMATIC & OUTLINE DIAGRAM

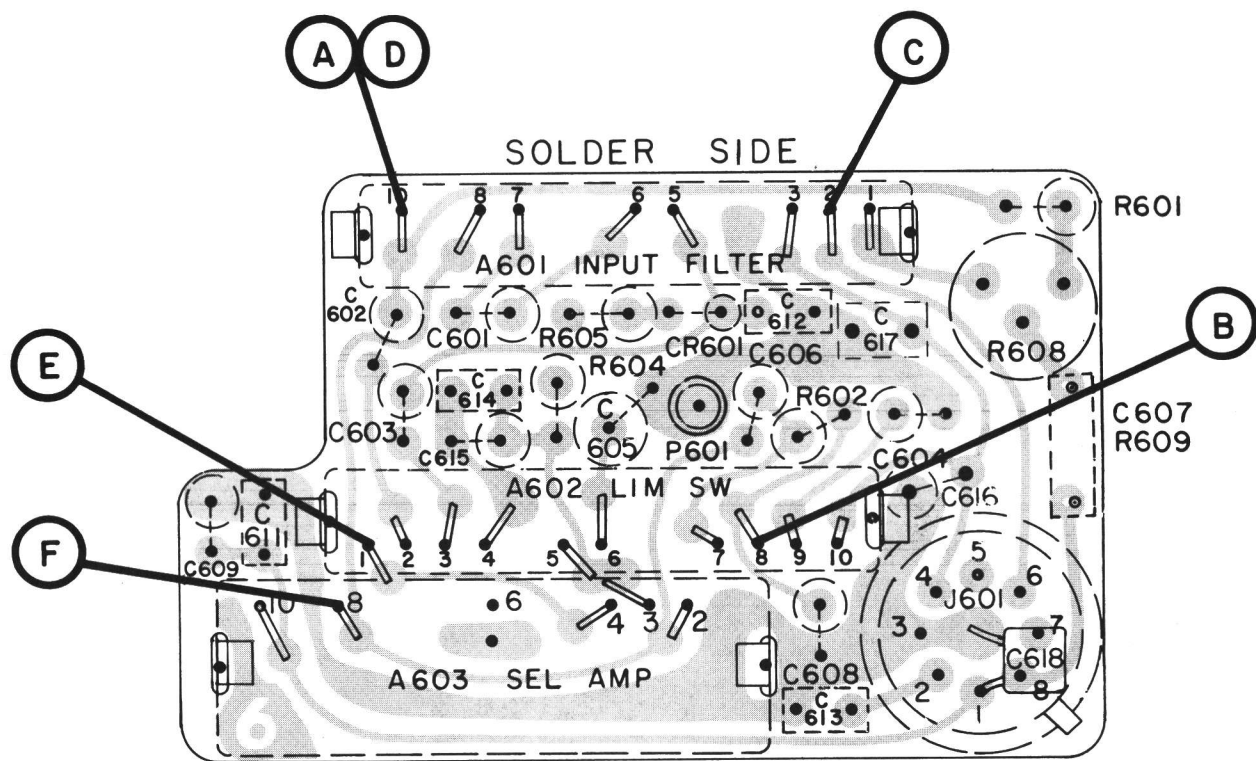
CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A11



SCHEMATIC DIAGRAM

CHANNEL GUARD ENCODE/DECODE
WITH TYPE 99 TONE
4EK17A11,12 & 13

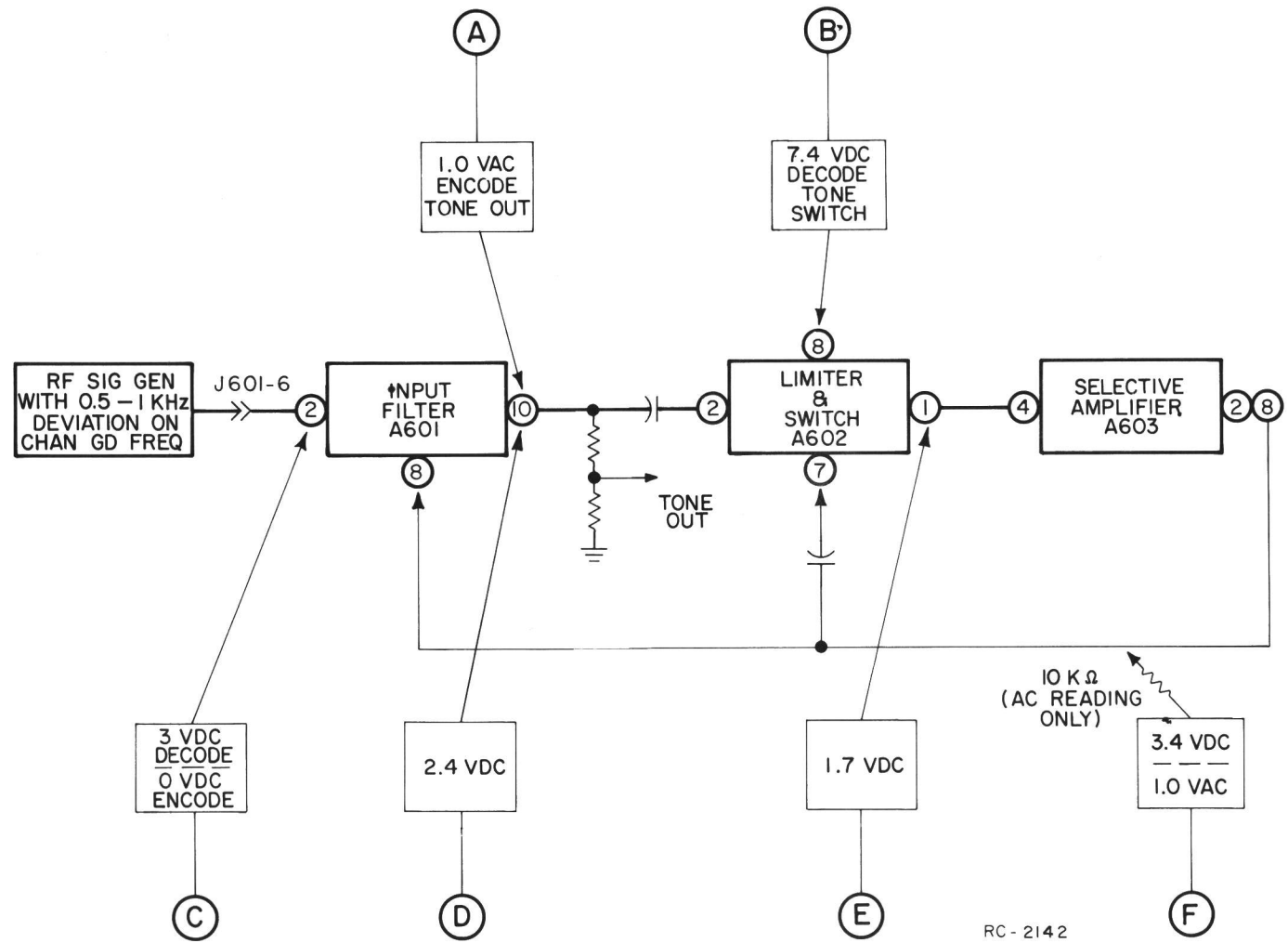




(RC-2142)
(19C317936, Rev. 9)
(19B216776, Sh. 2, Rev. 6)

TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit won't decode	<ol style="list-style-type: none">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). <div><p>CAUTION</p><p>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.</p></div>
Unit won't encode	<ol style="list-style-type: none">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).



RC - 2142

TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A10-13