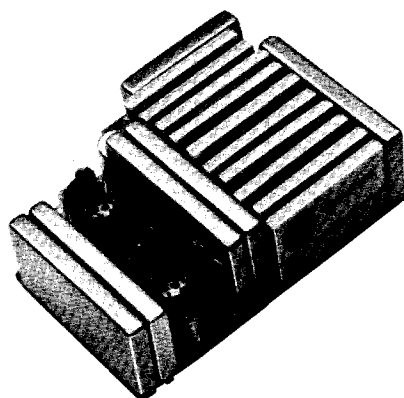


MASTR *Personal Series*

PROGRESS LINE

PE MODELS

MULTI-TONE CHANNEL GUARD ENCODER/DECODER 19D417823G1



SPECIFICATIONS *

Tone Frequencies	71.9 Hz to 203.5 Hz
Frequency Stability	±0.4%
Current Drain	
Standby	10.8 Milliamperes
Decode	11.1 Milliamperes
Encode	11.1 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.

TABLE OF CONTENTS

SPECIFICATIONS	Cover
DESCRIPTION	1
CIRCUIT ANALYSIS	1
FSSA	1
Tone Networks	1
Encode	2
Decode	3
OUTLINE DIAGRAM	6
SCHEMATIC DIAGRAM	7
PARTS LIST AND PRODUCTION CHANGES	8
TROUBLESHOOTING PROCEDURES	
Encode	9
Decode	10

ILLUSTRATIONS

Figure 1 - Gain vs Frequency	1
Figure 2 - Typical Versatone Network	2
Figure 3 - Typical Network Input Phase Inverter Circuit	2
Figure 4 - Typical Phase Inverting Amplifier Circuit	2
Figure 5 - Typical Encode Limiter Circuit	2
Figure 6 - Typical Low Pass Filter	3
Figure 7 - Typical Decode Limiter Circuit	3
Figure 8 - Typical Decode Amplifier and Threshold Detector Circuit	4

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

Multi-Tone Channel Guard 19D417823G1 is a continuous tone encoder/decoder for operation on tone frequencies in the 71.9 Hz to 203.5 Hz range. The encoder and the decoder operate on the same one to five tone frequencies, but can be modified, by adding the proper strapping on the printed wire board, to operate on one to five tone encode only, or one to five tone encode and one to five tone decode. The Multi-Tone Encoder/Decoder assembly consists of discrete components and a possible sixteen thick film Integrated Circuit Modules. The Integrated Circuit Modules consist of Decode Module A601, Encode Module A602, Frequency Switchable Selective Amplifiers (FSSA) A603 and A604, Phase Inverter Modules A605 and A606, and ten plug in Versatone Networks FL601 through FL610.

The Channel Guard is controlled by a switch on the control unit labeled CG "ON" - "OFF" or a six position Multi-Tone Selector switch with the first position labeled "MON" and the RF Channel Select Switch. The switch labeled CG "ON" - "OFF" is used with one to five tone encode/decode with both the encoder and decoder using the same Versatone networks or different Versatone networks. Placing the switch in the "OFF" position disables the decoder so that all calls will be monitored by the receiver. Channel Guard encode and decode tone frequencies are determined by the RF Channel Select switch. The six position Multi-Tone Select switch is used with one to five tone encode/decode with the encoder and decoder using different Versatone networks. Placing the Multi-Tone Select switch in the "MON" position disables the decoder so that all calls will be monitored by the receiver. The other five positions of the tone select switch determine encode tone frequencies. The decode tone frequencies are controlled by the RF Channel Select switch.

For one to five tone encode only operation, the RF Channel Select switch determines the Channel Guard tone frequency. No receiver monitor switch is provided.

For a functional diagram of the Multi-Tone Channel Guard Encoder/Decoder refer to the troubleshoot procedures.

Typical diagrams of the Versatone Network, Network Input Phase Inverter, Phase Inverting Amplifier, Encode Limiter, Low Pass Filter, Decode Limiter, Amplifier and Threshold detector are provided in Figures 2 through 8. References to symbol numbers mentioned in the following text are found on the Schematic Diagram, Outline Diagram, and Parts List.

CIRCUIT ANALYSIS

Frequency Switchable Selective Amplifier

Frequency Switchable Selective Amplifiers (FSSA) A603 and A604 are highly stable active bandpass filters for the 71.9 Hz to 203.5 Hz frequency range. The selectivity of the filters is shifted across the bandpass frequency range by switching Versatone Networks in the filter circuit (see Figure 1).

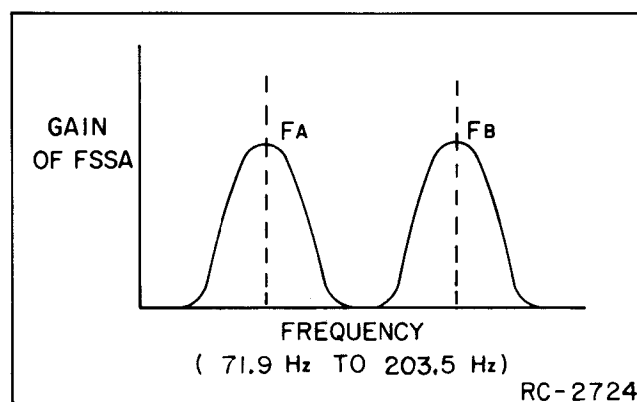


Figure 1 - Gain vs Frequency

In Figure 1, the gain of the FSSA is shown as a function of the tone frequency. The Tone Frequency is determined by the Tone Network connected in the FSSA circuit. When Tone Network A is in the circuit, the maximum gain occurs at FA. When Tone Network B is in the circuit, the maximum gain occurs at FB.

Tone Networks

Versatone Networks FL601 through FL610 are parallel connected, precision resistor networks with associated switching transistors. A typical Versatone Network is shown in Figure 2. Pin 4 of the network is connected to +7.5 VDC and Pin 5 of the network is connected to ground. When Pin 3 is grounded, Q1 will turn "OFF". This enables Amplifier Q2 and feedback resistors R1, R2 and R3, effectively connecting the network to the FSSA circuit.

The input to Pin 3 of a Versatone Network is through Network Input Phase Inverter Module A505 or A506. A typical Network Input Phase Inverter Circuit is shown in Figure 3.

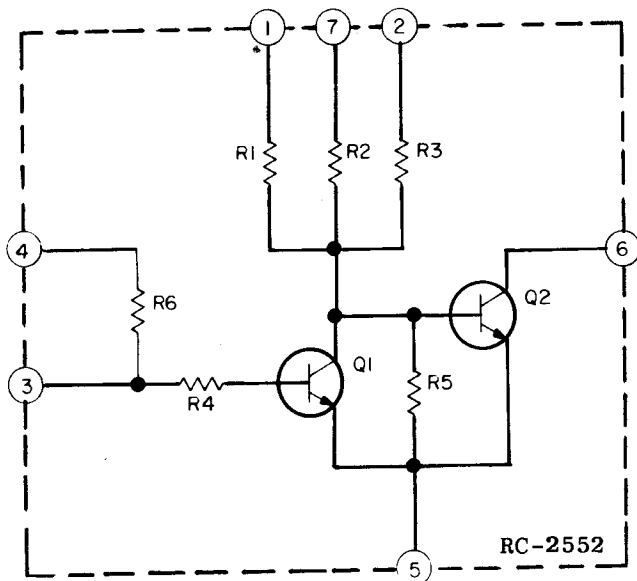


Figure 2 - Typical Versatone Network

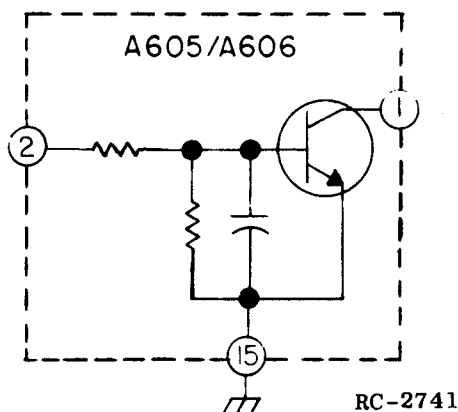


Figure 3 - Typical Network Input Phase Inverter Circuit

Pin 1 of A605/A606 is normally positive. Placing a positive voltage on Pin 2 of A605/A606 causes the voltage on Pin 1 to drop from +1.5 VDC to less than +0.3 VDC. This drop is sufficient to connect the Versatone Network into the FSSA circuit.

Encode

The Channel Guard encode tone is generated by coupling the output of FSSA band-pass filter A604 back to its input through a phase inverting amplifier circuit and a limiter circuit. The output of the FSSA is coupled from A604-1 to the input of the phase inverting amplifier at A602-9. A typical phase inverting amplifier circuit is shown in Figure 4.

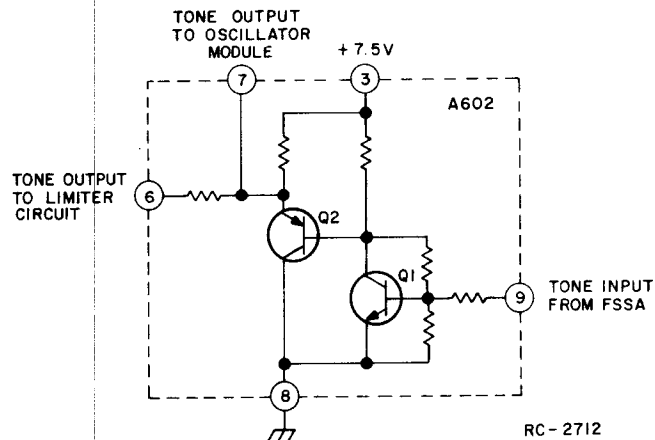


Figure 4 - Typical Phase Inverting Amplifier

Amplifier Q1 provides 180° phase shift of the tone frequency at the output of emitter follower Q2. The output of the phase inverting amplifier circuit is coupled from A602-6 to the input of the limiter circuit at A602-5. A typical limiter circuit is shown in Figure 5.

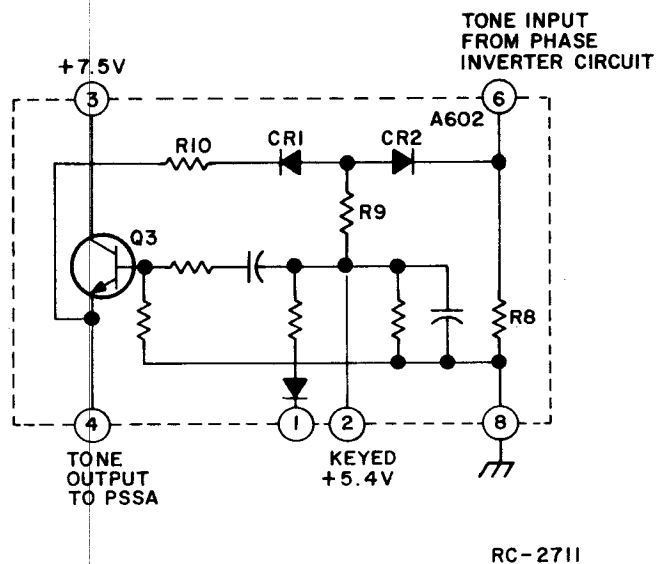


Figure 5 - Typical Encode Limiter Circuit

Limiting network CR1, CR2, R8, R9 and R10 sets the tone output coupled from A602-4 to the input of the FSSA (A604-12) at 53 milli-volts peak to peak.

The limiter circuit is also used as an encode switch. Keying the transmitter applies +5.4 Volts to A602-2. This forward biases Limiter diodes CR1 and CR2 and momen-

tarly turns Q3 on. Forward biasing CR1 and CR2 allows the circuit to oscillate. Momentarily turning Q3 on starts the circuit oscillating. The tone frequency is determined by the tone network connected in the FSSA circuit.

The tone output of the encoder circuit is taken from A602-7 and coupled through modulation adjustment R601 to the transmitter oscillator modules.

Decode

Audio, containing the correct tone frequency from R707-3 (Volume Hi), is coupled to Pin 1 of Decode Module A601. Pin 1 of A601 is the input of an active, three stage, low pass filter. The low pass filter attenuates frequencies over 205 Hz. A typical low pass filter is shown in Figure 6. The output of the low pass filter at A601-15 is applied to A601-14. A601-14 is the input of a limiter circuit, limiting the output of A601-13 to 55 millivolts peak to peak. A typical limiter circuit is shown in Figure 7. The output from the limiter is coupled to Pin 12 of FSSA A603. Since the tone is the proper frequency the FSSA will allow it to pass. The output of the FSSA is coupled from A603-1 to A601-3. A601-3 is the input to an amplifier circuit. The output of the amplifier at A601-4 is coupled to the input of a threshold detector at A601-6. A typi-

cal amplifier and threshold detector circuit is shown in Figure 8. When a tone is present Q6 will conduct causing Q7 to conduct and +7.5 VDC to be on the output of the threshold detector circuit (A601-10). The +7.5 Volts is applied to the Squelch switching transistor on the receiver Audio PA module. The receiver now operates on noise squelch, permitting the call to be monitored.

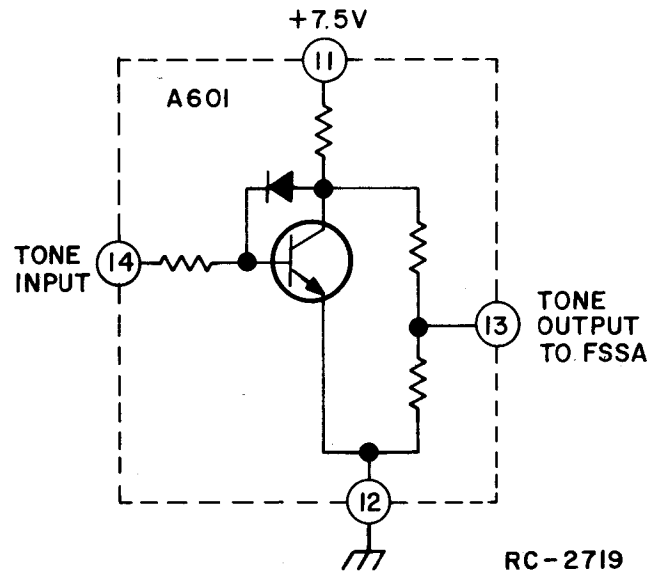


Figure 7 - Typical Decode Limiter Circuit

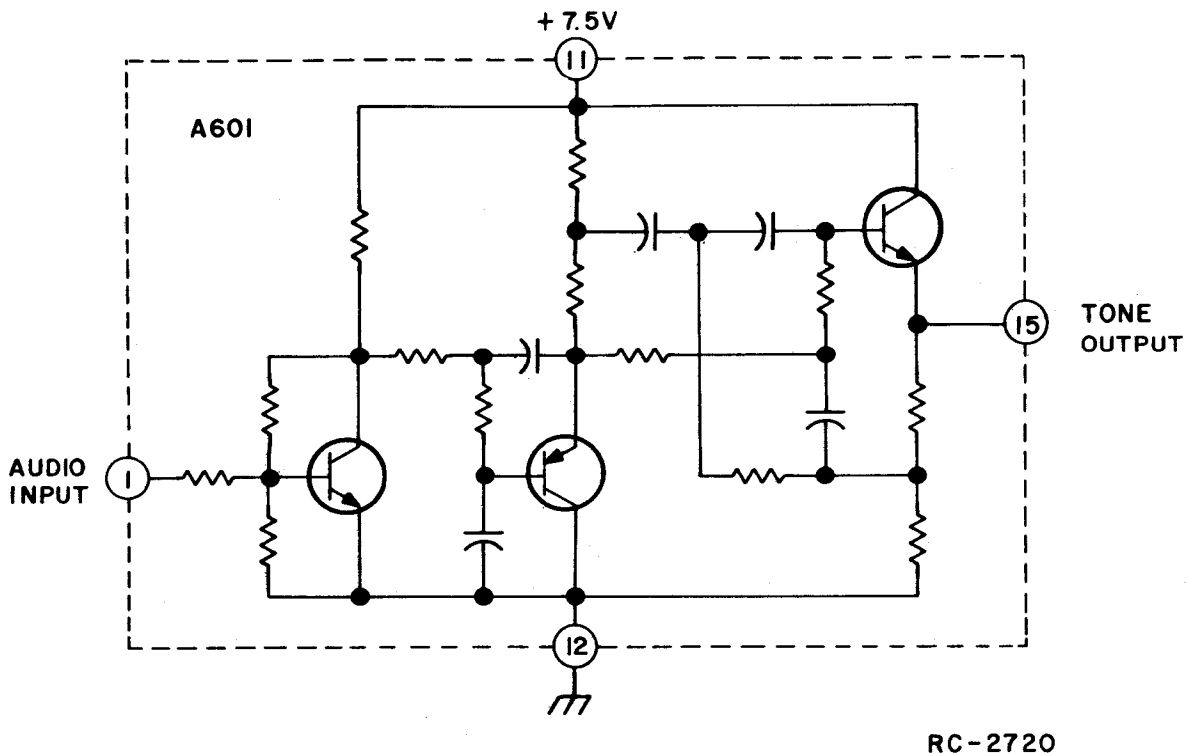


Figure 6 - Typical Low Pass Filter

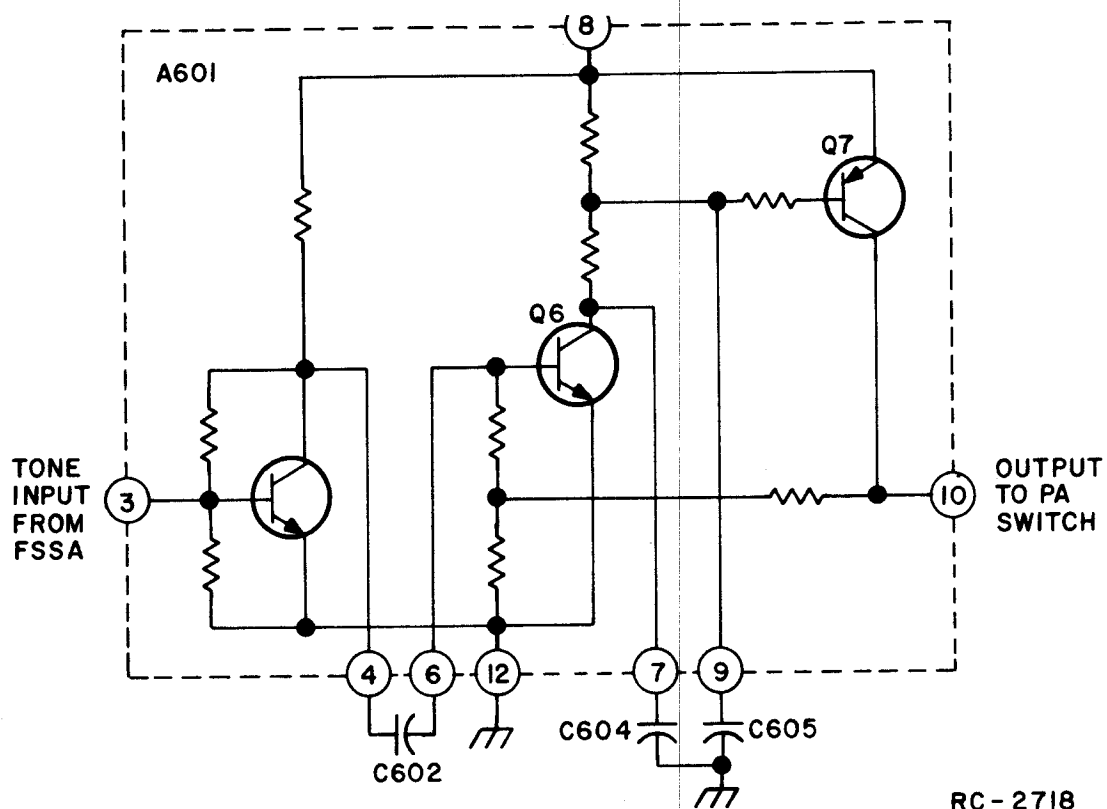
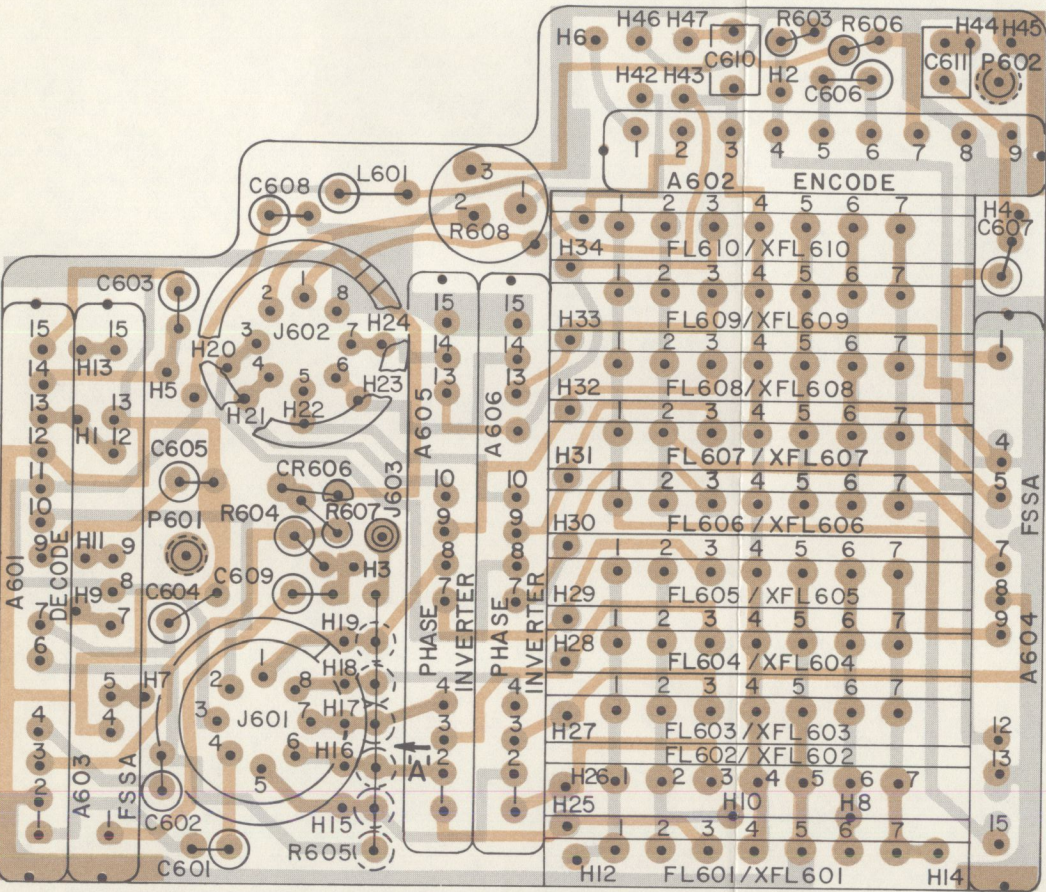


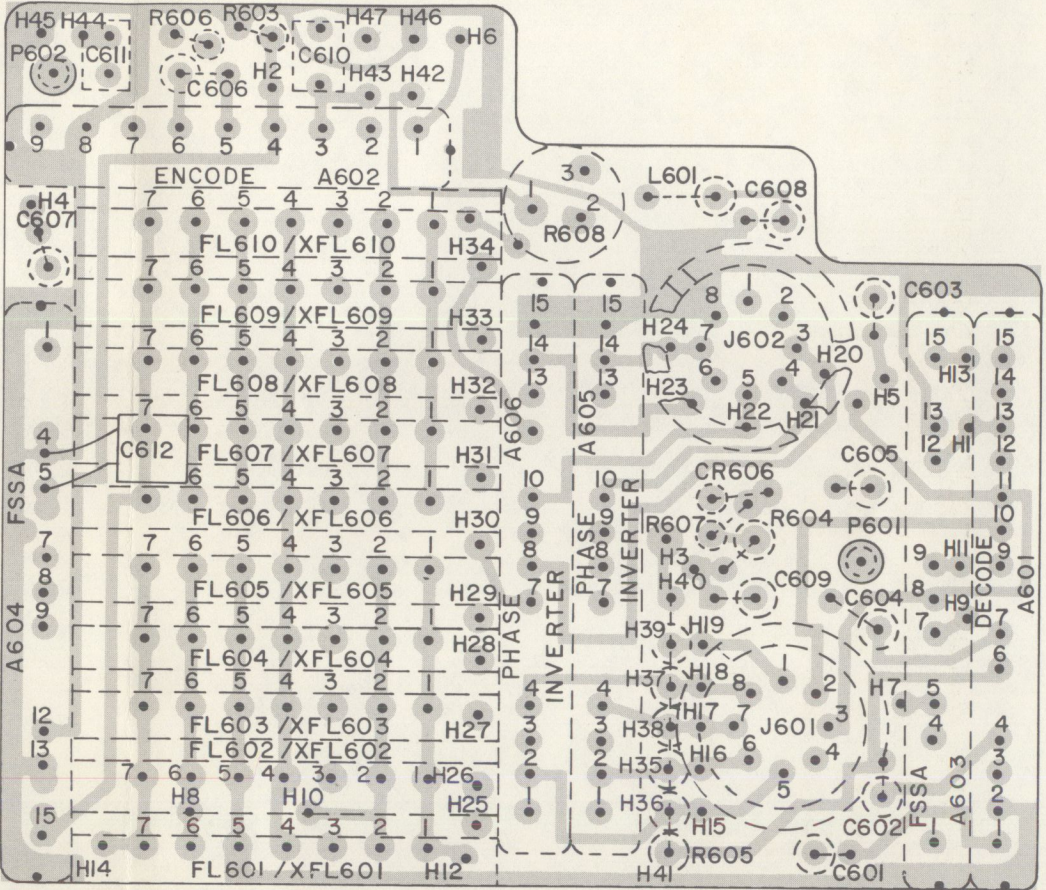
Figure 8 - Typical Amplifier & Threshold Detector Circuit

COMPONENT SIDE



(19D417826, Sh. 2, Rev. 0)
(19D417826, Sh. 3, Rev. 0)

SOLDER SIDE



(19D417826, Sh. 2, Rev. 0)

THESE INSTRUCTIONS COVER THE INSTALLATION OF THE AUTOMATIC MONITOR OPTION.

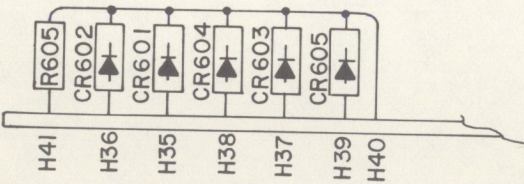
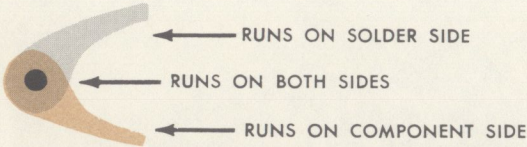
NOTES:

1. SOLDER ALL ELECTRICAL CONNECTIONS.
2. LEAD FORM ALL COMPONENTS AS BEST SUITED FOR THIS APPLICATION.

TO PROVIDE AUTOMATIC MONITOR ON ONE OR MORE RF CHANNELS, INSTALL R605 AND THE APPROPRIATE DIODE OR DIODES FROM THE TABLE BELOW.

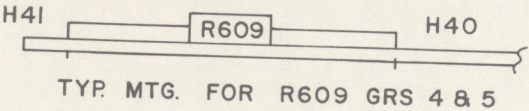
RF CHANNEL	DIODE
1	CR601
2	CR602
3	CR603
4	CR604
5	CR605

(19D423280, Rev. 1)



VIEW "A"

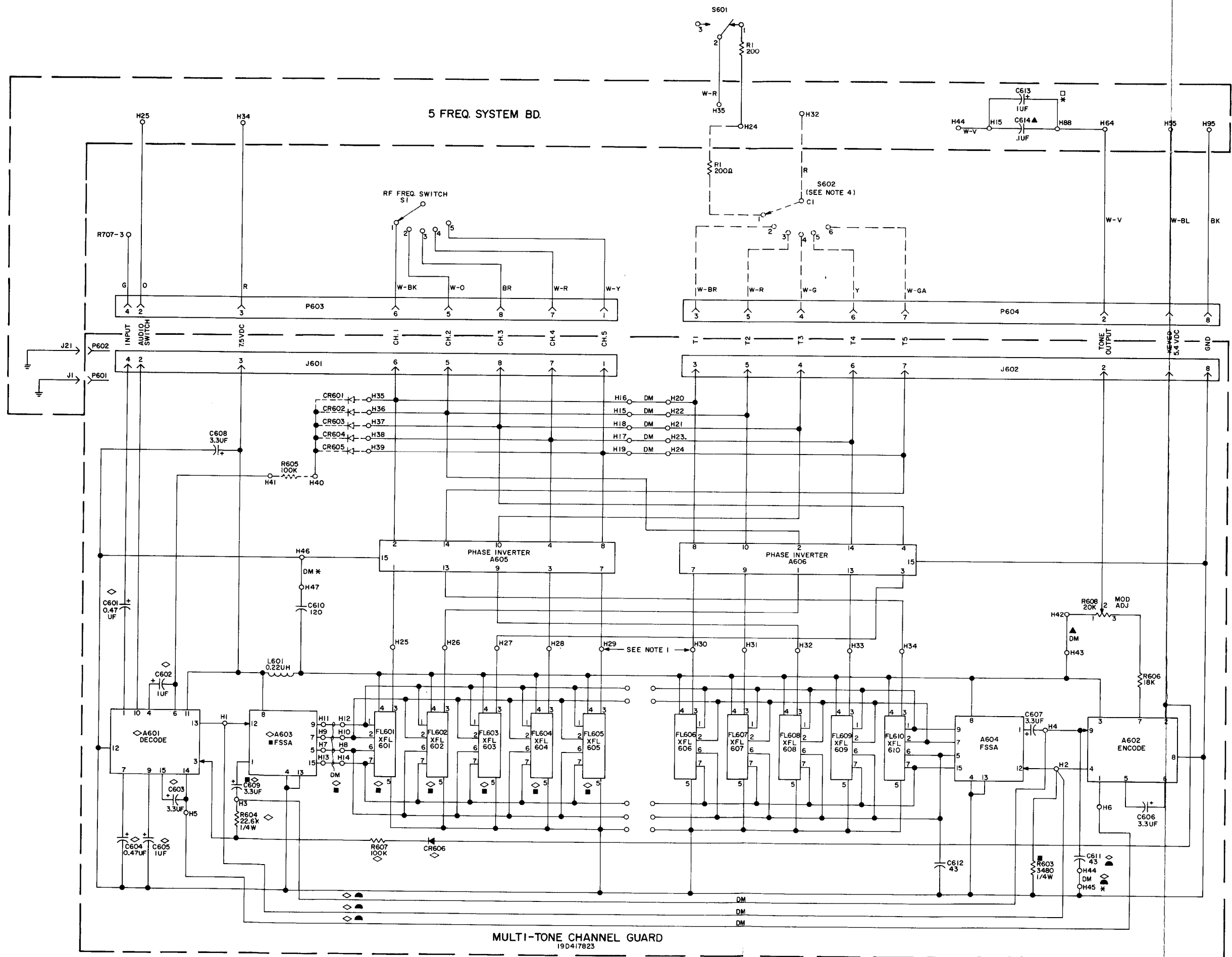
ROTATED 90° CLOCKWISE
TYP. MTG. FOR DIODES GRS 1-3



TYP. MTG. FOR R609 GRS 4 & 5

OUTLINE DIAGRAM

MULTI-TONE CHANNEL GUARD
ENCODER/DECODER 19D417823G1



NOTES:

1. TO CONNECT ONE VERSATONE FOR MULTI-CHANNEL USE, JUMPER THE APPROPRIATE SOCKETS TOGETHER USING HOLES 25 THROUGH 29 AND/OR HOLES 30 THROUGH 34. INSERT ONE VERSATONE IN ANY SOCKET OF A STRAPPED GROUP.
2. \diamond NOT PRESENT IN ENCODE ONLY (17 PARTS) (8 JUMPERS) (4 JUMPERS)
 \blacksquare NOT PRESENT IN ENCODE/DECODE SAME TONE (8 PARTS) (4 JUMPERS)
 \blacktriangle NOT PRESENT IN 5 TONE ENCODE, 5 TONE DECODE (1 PART) (4 JUMPERS)
 \blacktriangle NOT PRESENT IN LOW BAND (30-50 MHz) (1 PART) (1 JUMPER)
 \square NOT PRESENT IN HIGH BAND (132-174 MHz) (1 PART) (2 JUMPERS)
 \star NOT PRESENT IN 450 (406-512 MHz) (1 PART) (2 JUMPERS)
3. ALL JUMPERS DM WIRE & SLEEVED ALL OTHER WIRES ARE SFT 28 UNLESS OTHERWISE SPECIFIED.
4. S602 USED WITH 1 TO 5 TONE ENCODE - 1 TO 5 TONE DECODE, WITH S602 TO SELECT ENCODE TONE ONLY AND 1 POSITION USED FOR MONITOR.

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

ALL RESISTORS ARE 1/8 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.

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

MULTI-TONE CHANNEL GUARD
ENCODER/DECODER 19D417823G1-G3

PARTS LIST

LBI-4872
MULTI-TONE CHANNEL GUARD
19D417823G1 5 TONE ENCODE, 5 TONE DECODE
19D417823G2 5 TONE ENCODE, DECODE SAME TONE
19D417823G3 5 TONE ENCODE ONLY

SYMBOL	GE PART NO.	DESCRIPTION
A601	19D417763G1	Decoder.
A602	19C321133G1	Encoder.
A603 and A604	19D417833G1	Selective Amplifier.
A605 and A606	19D417850G1	Phase Inverter.
		----- CAPACITORS -----
C601	5491674P27	Tantalum: .47 μ f \pm 20%, 35 VDCW; sim to Sprague Type 162D.
C602	5491674P1	Tantalum: 1.0 μ f +40-20%, 10 VDCW; sim to Sprague Type 162D.
C603	5491674P36	Tantalum: 3.3 μ f \pm 20%, 10 VDCW; sim to Sprague Type 162D.
C604	5491674P27	Tantalum: .47 μ f \pm 20%, 35 VDCW; sim to Sprague Type 162D.
C605	5491674P1	Tantalum: 1.0 μ f +40-20%, 10 VDCW; sim to Sprague Type 162D.
C606 thru C609	5491674P36	Tantalum: 3.3 μ f \pm 20%, 10 VDCW; sim to Sprague Type 162D.
C610	19A116114P7068	Ceramic: 120 pf \pm 5%, 100 VDCW; temp coef -750 PPM.
C611 and C612	19A116114P7051	Ceramic: 43 pf \pm 5%, 100 VDCW; temp coef -750 PPM.
		----- DIODES AND RECTIFIERS -----
CR606	19A115250P1	Silicon.
		----- TONE NETWORKS -----
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
FL601 thru FL610	19C320291G1	Hybrid: 71.9-203.5 Hz.
		----- JACKS AND RECEPTACLES -----
J601 and J602	19A116122P1	Terminal, feed-thru: sim to Warren 1-B-2994-4.
		----- INDUCTORS -----
L601	19B209420P105	Coil, RF: 0.22 μ h \pm 10%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
		----- PLUGS -----
P601 and P602	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		----- RESISTORS -----
R603	19C314256P23481	Metal film: 3480 ohms \pm 1%, 1/4 w.
R604	19C314256P22262	Metal film: 22,600 ohms \pm 1%, 1/4 w.
R606	3R151P183J	Composition: 18,000 ohms \pm 5%, 1/8 w.
R607	3R151P104K	Composition: 100,000 ohms \pm 10%, 1/8 w.
R608	19A116412P6	Variable, cermet: 20,000 ohms \pm 10%, 1/2 w; sim to Helipot Model 62 PF.

SYMBOL	GE PART NO.	DESCRIPTION
XFL601 thru XFL610	19D416714P1 19B219681P1	----- SOCKETS ----- Socket. Includes: Shell. Contact.
	19B216316P1 19A130013P1	----- MISCELLANEOUS ----- Insulator. (Used with J601 and J602). Insulator. (Used with A605 and A606).
		AUTOMATIC MONITOR KIT 19A130414G1
CR601 thru CR605	19A115250P1	----- DIODES AND RECTIFIERS ----- Silicon.
R605	3R151P104K	----- RESISTORS ----- Composition: 0.10 megohm \pm 10%, 1/8 w.
		MULTI-TONE KIT 19A130295G1 ENC/DEC 1-5 TONE SAME TONE 19A130295G2 ENC 1 TO 5 TONE 19A130295G3 ENC/DEC 1 TO 5 TONE
C613	5491674P1	----- CAPACITORS ----- Tantalum: 1.0 μ f +40-20%, 10 VDCW; sim to Sprague Type 162D.
C614	19A116207P3	Ceramic: 0.1 Uf \pm 20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104M.
S601		----- SWITCHES ----- SWITCH ASSEMBLY 19A127833G1
R1	3R151P201J	----- RESISTORS ----- Composition: 200 ohms \pm 5%, 1/8 w.
	4036949P1	----- SWITCHES ----- Switch, toggle: SPDT, 100 μ a at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman T6-3.
S602		SWITCH ASSEMBLY 19B226542G1
R1	3R151P201J	----- RESISTORS ----- Composition: 200 ohms \pm 5%, 1/8 w.
S1	19A116195P4	----- SWITCHES ----- Rotary: 1 section, 1 pole, (adj 2-10 positions), non-shorting; sim to Grayhill Co. 50MY23155-1-8N.
W601	19B226541G1	----- CABLES ----- Cable: 11 conductors, approx 1 foot long.
W602	19B226541G2	Cable: 16 conductors, approx 1 foot long.
		----- MISCELLANEOUS ----- 19B216926P1 Decorative Cap. 19C320721P1 Seal. NP276589 Nameplate. 19A130289P2 Shield. 19C311888P2 Knob. N70P702C13 Set screw: No. 3-48 x 1/8. 19A127319P2 Nut. 19B216520P4 Washer.

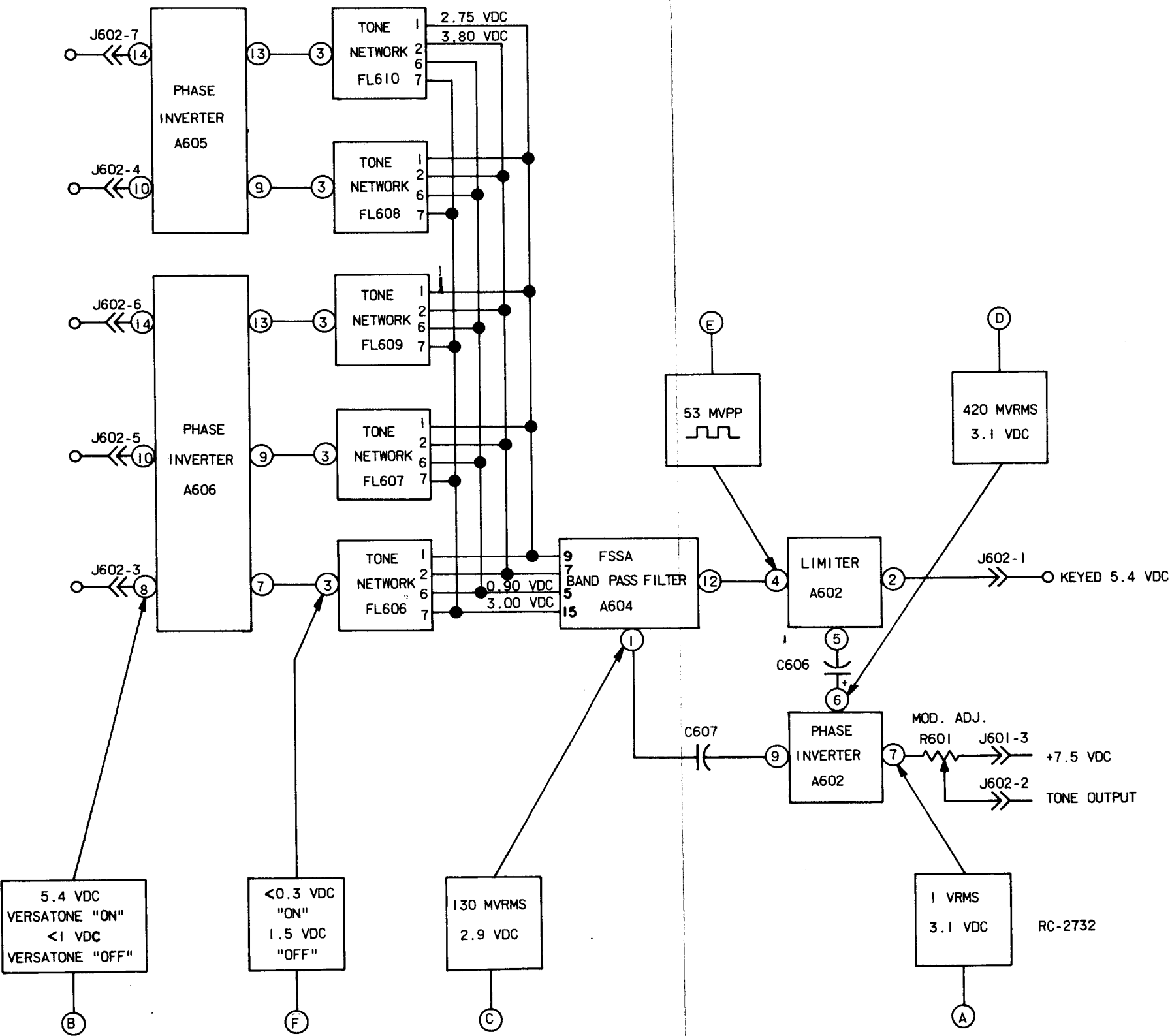
CHANNEL GUARD
TONE FREQUENCIES

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

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

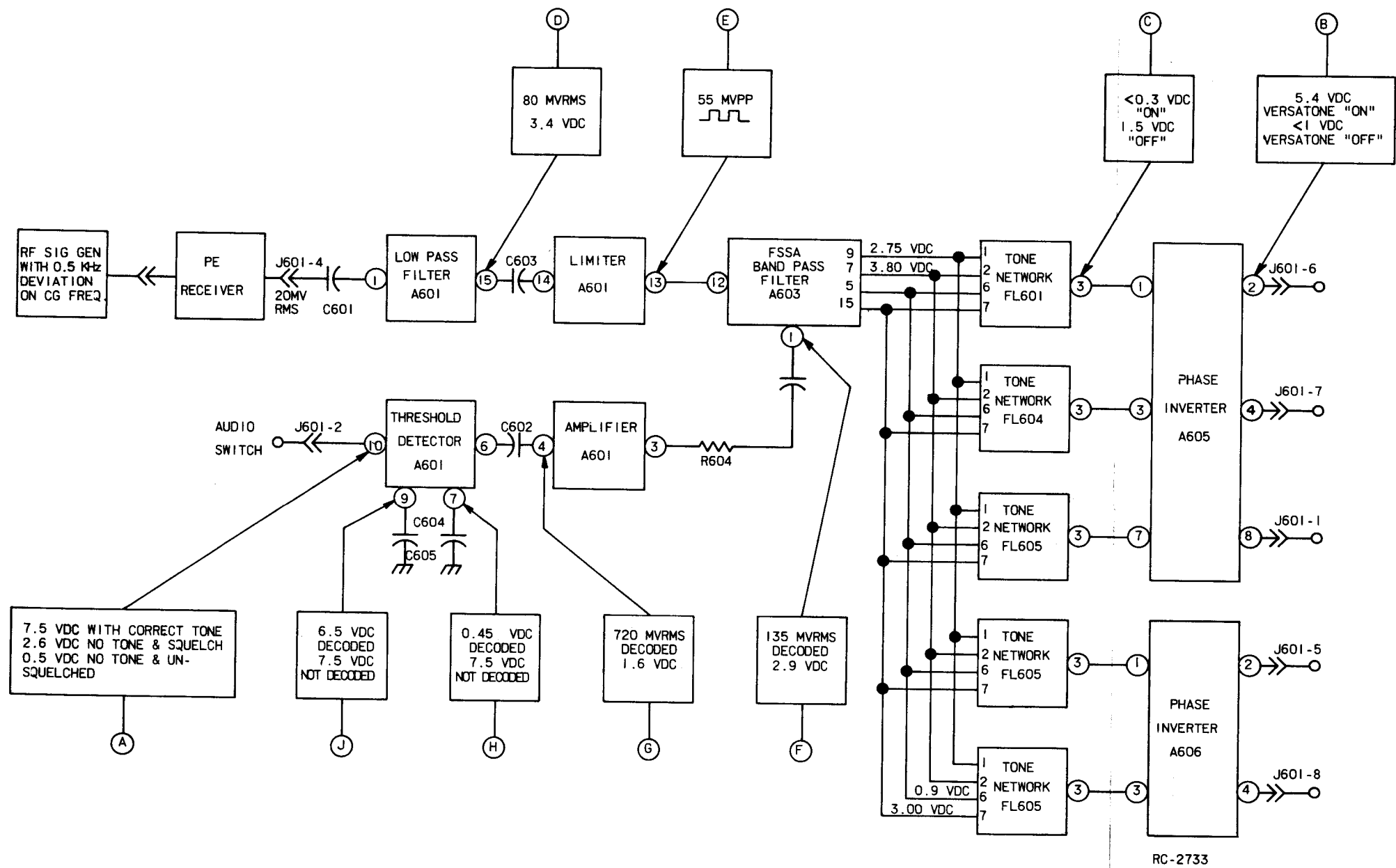
TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit will not encode	<ol style="list-style-type: none">1. Check for 1 VRMS and 3.1 Volts DC at (A) .2. If reading is correct, check MOD ADJ, R608, then check the transmitter oscillator module.3. If reading is not correct, check voltage readings on connections between tone networks FL607 through FL610 and A604.4. If readings between the tone networks and A604 are incorrect, insure good contact between the tone networks and network sockets.5. If readings are correct check readings at (B) through (F) .



TRUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODE



TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit will not decode	<ol style="list-style-type: none">1. Place Channel Guard switch S601 in the "OFF" position or S602 in the "MON" position and check for proper receiver operation.2. If the receiver operates properly, place S601 in the "ON" position or S602 in position "2" through "6". Apply the proper Channel Guard tone to the radio and check for 7.5 Volts DC at (A).3. If reading is not correct check voltage readings on connection between tone networks FL601, through FL605 and A603/A604.4. If the readings between the tone networks and A603/A604 are incorrect, insure good contact between the tone networks and the network sockets.5. If readings are correct, check readings at (B) through (J).

TROUBLESHOOTING PROCEDURE

CHANNEL GUARD DECODE

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

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.

MAINTENANCE MANUAL

LBI-4873

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL  ELECTRIC

PRINTED IN U.S.A.

DF-5044