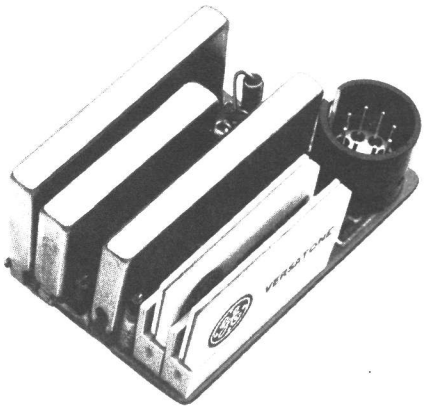
MOBILE RADIO

MASTR® Personal Series

PROGRESS LINE

PE MODELS

(TYPE 99 DECODER MODEL 4EJ20A10 & 11)



SPECIFICATIONS *

Tone Frequencies	288.5 Hz to 1433.4 Hz
Frequency Stability	±0.4%
Current Drain	
Standby	3.26 Milliamperes
Decoded	4.41 Milliamperes
During Alarm	6.89 Milliamperes
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Normal 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.

EJ-20-A

GENERAL ELECTRIC

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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

Type 99 Decoder Model 4EJ20A10 and 4EJ20A11 an individual call, two sequential tone decoders operating on Type 99 tone frequencies of 288.5 Hz to 1433.4 Hz. The Decoder assembly consists of discrete components and five thick Film Integrated Circuit Modules consisting of Threshold Detector A1401, Control Module A1402, Frequency Switchable Selective Amplifier (FSSA) A1403, and two plug-in Versatone Networks FL1401 a and FL1402.

Calls will not be heard from the receiver until the proper sequential tones have been applied to the Decoder. The first tone causes the Decoder to switch to accept the second tone after the first tone ends. An alert tone will sound when the second tone is recognized by the Decoder and will continue to sound as long as the second tone is transmitted. Receiver audio is muted during the alert tone. After the alert tone, the receiver audio circuit opens, and will remain open to receive calls until the Decoder is manually reset by tone option switch S704.

Typical diagrams of the Versatone Network, Threshold Detector, and Control Modules are provided in Figures 2, 3, and 4. 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 (FSSA) A1403 is a highly stable active band-pass filter for the 288.5 Hz to 1433.4 Hz frequency range. The selectivity of the filter is shifted across the band pass frequency range by switching Versatone Networks in the filter circuit (see Figure 1).

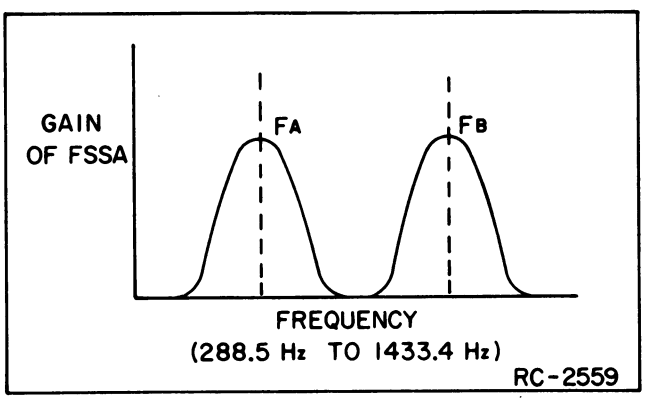


Figure 1 - Gain vs Frequency

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 Net-Work B is in the circuit, the maximum gain occurs at FB.

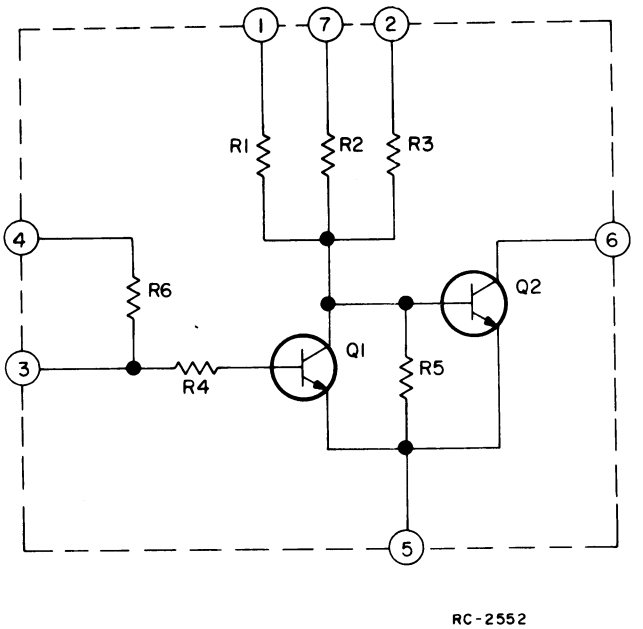


Figure 2
Typical Versatone Network

Tone Networks

Versatone Networks FL1401 and FL1402 are parallel connected, precision resistor networks with associated switching transistors. A typical Versatone Network is shown in Figure 2. Pin 5 of the network is connected to ground. When a positive signal from Control Module A1402 is applied to Pin 3, Q1 will conduct. This disables Amplifier Q2 and feedback resistors R1, R2 and R3, effectively removing the network from the FSSA circuit.

Limiter and FSSA

Receiver audio is applied to Pin 7 of Threshold Detector Module A1401 through associated coupling and attenuation networks providing the proper signal level to Limiter Q4. Refer to the Troubleshooting Procedure for a functional diagram. Limiter Q4 sets the input level to the FSSA at 42 millivolts Peak-to-Peak. The output of the Limiter is taken from A1401-5 and connected to FSSA, A1403-12. A typical Threshold Detector Circuit is shown in Figure 3.

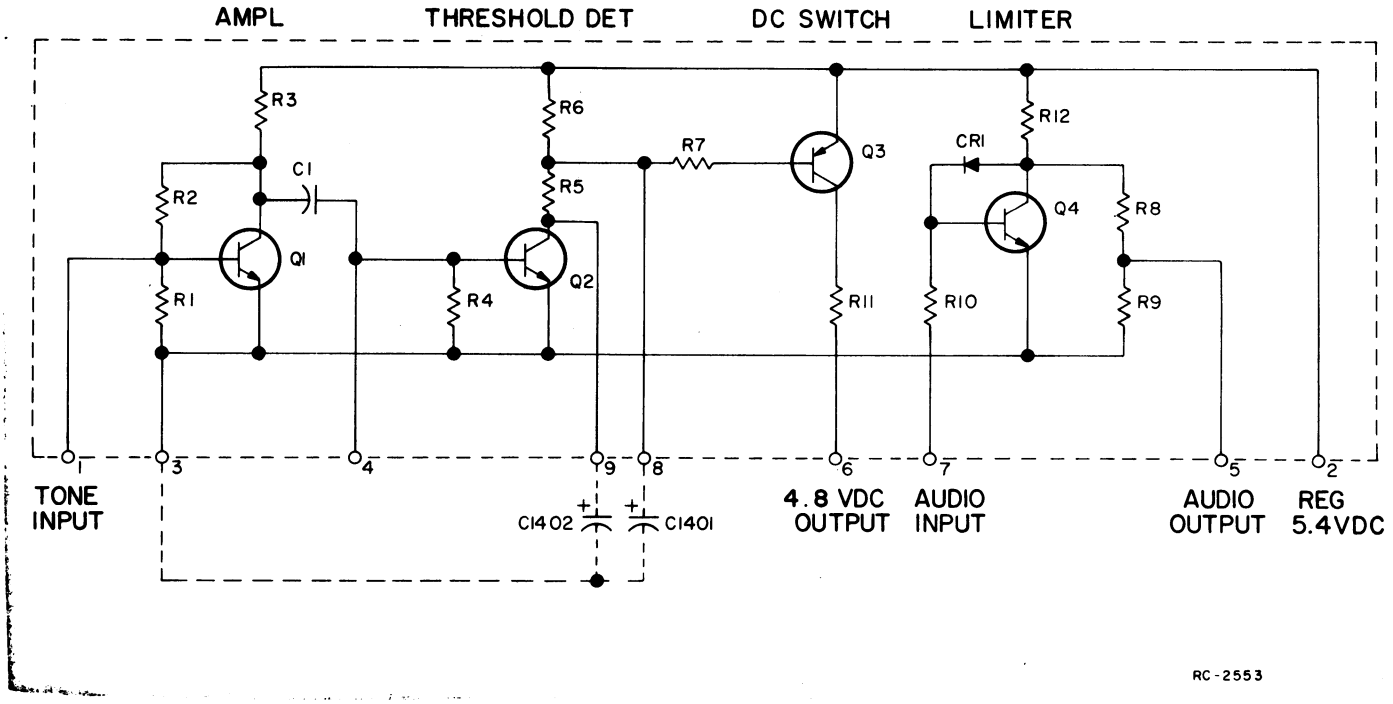


Figure 3 - Typical Threshold Detector Circuit

Initially, Network FL1401 (Tone A) is in the FSSA circuit. When Tone A is applied to the input of the FSSA it will appear at the output of the FSSA, (A1403-1) at a higher signal level than other signals. The FSSA output is coupled through C1403 and R1403 to threshold Detector Module A1401-1.

Threshold Detector

Amplifier A1401-Q1 amplifies the tone before it is coupled to the base of Threshold Detector Q2. If the tone is the correct one, the signal amplitude will be sufficient for Q2 to conduct. Q2 conducting causes DC switch Q3 to conduct, applying 4.8 Volts DC to A1401-6. A1401-6 is connected to Control Module A1402-2.

Control Module

The 4.8 Volts DC applied to A1402-2, causes Fast Clamp transistor Q2 to clamp DC Amplifier Q3 Off and allow Timing Capacitor C1406 to charge. A typical Control Circuit is shown in Figure 4. When 4.8 Volts is removed from the Pin 2, Q2 turns Off. C1406, in a charged state, causes DC Amplifier Q3 to conduct. Q3 conducting, switches Versatone Network FL1402 (Tone B) into the Versatone Network FL1401(Tone A) out of the FSSA Circuit. "A" Tone Hold transistor Q4 also turns "B" Time Hold transistor Q1 On. Turning Q1 On holds Fast Clamp transistor Q2 Off.

If Tone "B" is not received within 700 MS, timing capacitor C1406 will discharge and automatically reset the circuit to receive Tone A.

If Tone "B" is received, 2.4 Volts DC is applied to the base of Decode Gate Q5. With the emitter of Q5 held low by Q3, the 2.4 Volts causes Q5 to conduct. Q5 conducting causes Audio Mute Transistor Q8 to conduct, turning On Alarm Oscillator Q9 and muting the receiver audio so only the Alarm Tone is heard while Tone B is transmitted.

Q5 conducting also causes Audio Latch Transistors Q6 and Q7 to conduct, activating Audio Switch Q10. Q10 turns On the audio amplifier in the receiver.

The receiver audio will remain On until Audio Latch Transistors Q6 and Q7 are reset by tone option switch S704.

VARIABLE AND FIXED ALARM

The Alarm Tone is shipped from the factory wired so that it is adjustable with the receiver volume control. A fixed alarm, independent of the volume control, can be obtained by removing the jumper between H2 and H3 and adding a jumper between H2 and H1 (see Note 1 on the Schematic Diagram).

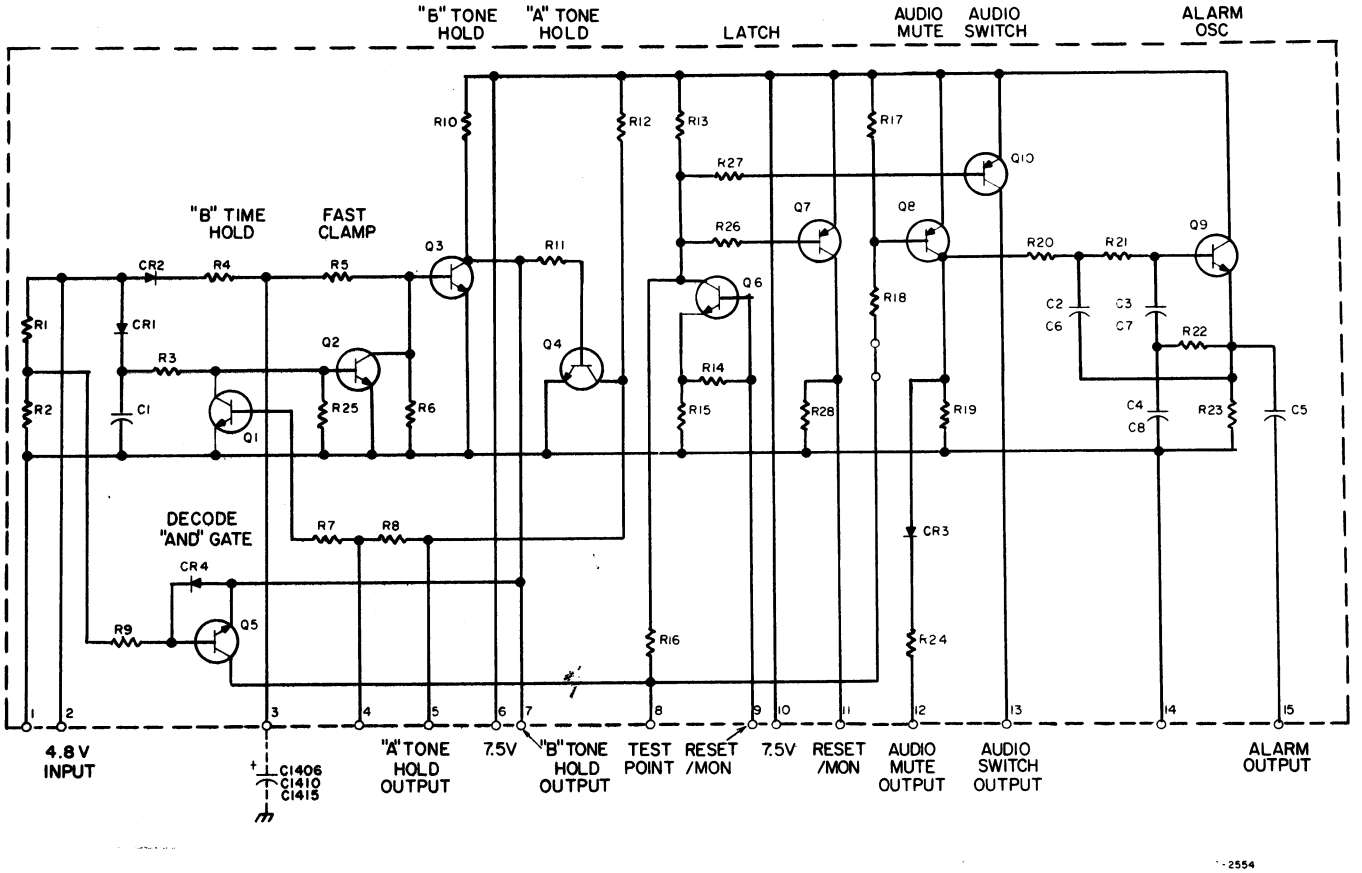


Figure 4 - Typical Control Circuit

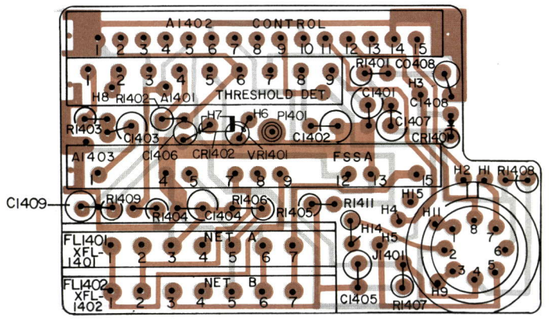
Tone Control Board

Tone Control Board 19B219507G1 is used with eight-frequency PE radios and consists of diodes CR1 through CR7, and a three-transistor switching circuit.

Placing multi-frequency switch S1 on a channel with Type 99 tone applies 5.4 Volts to the Tone Control Board. For example, placing S1 on the channel 1 frequency forward biases CR1 applying 5.4 Volts 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 decode mode.

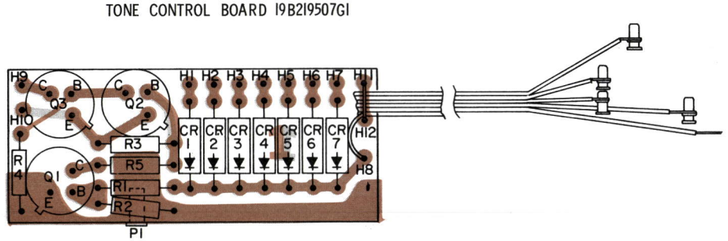
Switching S1 to a channel without tone removes the 5.4 Volts to the Tone Control Board. This allows Q3 to conduct, applying 7.5 Volts to the squelch switching transistor on the Audio PA module so that the receiver operates on noise squelch.

Whenever tone 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.



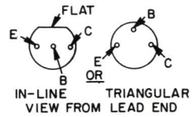
(19B226528, Rev. 3)
(19C320569, Sh. 2, Rev. 1)
(19C320569, Sh. 3, Rev. 1)

TONE CONTROL BOARD I9B219507G1

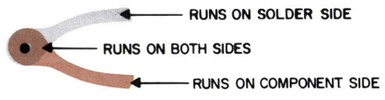


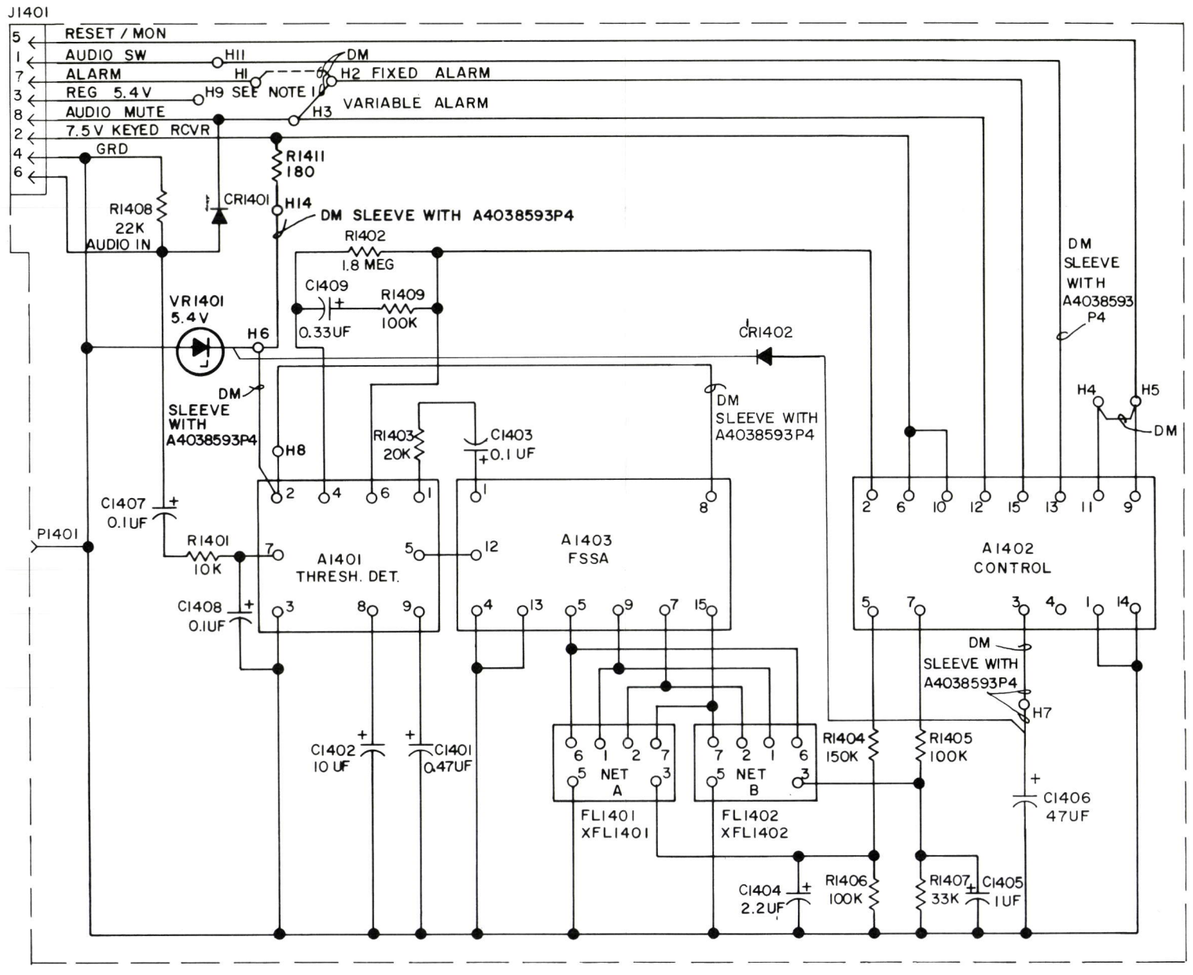
(19B219807, Rev. 0)
(19B219490, Sh. 1, Rev. 1)
(19B219490, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR Q1-Q3



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





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 PICOFARADS (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.

NOTE:
1. FOR FIXED ALARM, REMOVE JUMPER FROM H2 TO H3 AND ADD JUMPER FROM H2 TO H1

(19C327761 Rev. 1)

SCHEMATIC & OUTLINE DIAGRAM

TYPE 99 DECODER MODEL 4EJ20A10

Issue 5

PARTS LIST

LBI4670B

TYPE 99 DECODER
MODEL 4EJ20A10
MODEL 4EJ20A11

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219973G1	Plug: 8 contacts.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P152K	Composition: 1.5K ohms ±10%, 1/8 w.
R2	3R151P103K	Composition: 10K ohms ±10%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19A116648P5	Toggle: SPDT, 5 amps at 28 VDC or 115 VAC; sim to C and K Components 7107SDG.
		COMPONENT BOARD 19C320570G1
A1401	19C320539G1	Threshold Detector Module.
A1402	19D417098G1	Control Module.
A1403	19D417092G1	Frequency Switchable Selective Amplifier Module.
		- - - - - - - - - - - CAPACITORS - - - - - - - - -
C1401	5491674P27	Tantalum: 0.47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1402	5491674P2	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1403	5491674P43	Tantalum: 0.1 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1404	5491674P44	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C1405	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C1406	5491674P45	Tantalum: 4.7 µf ±10%, 6 VDCW; sim to Sprague Type 162D.
C1407 and C1408	5491674P43	Tantalum: 0.1 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1409	5491674P46	Tantalum: 0.33 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR1401	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR1402*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV B.
		- - - - - - - - - TONE NETWORKS - - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
FL1401 and FL1402	19C320291G2	Hybrid. 517.5-997.5 Hz. Hybrid. 288.5-1433.4 Hz.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1401	19A116122P1	Terminal, feed-thru: sim to Warren 1-B-2994-4.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1401	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R1401	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
R1402	3R151P185K	Composition: 1.8 megohm ±10%, 1/8 w.
R1403	3R151P203J	Composition: 20K ohms ±5%, 1/8 w.
R1404	3R151P154K	Composition: 150K ohms ±10%, 1/8 w.
R1405 and R1406	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R1407	3R151P333K	Composition: 33K ohms ±10%, 1/8 w.
R1408	3R151P223K	Composition: 22K ohms ±10%, 1/8 w.
R1409	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R1411*	3R151P181J	Composition: 180 ohms ±5%, 1/8 w. Added by REV A.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - -
VR1401*	4036887P5	Zener: 500 mW, 5.4 v. nominal.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL1401 and XFL1402		Includes:
	19D416714P1	Shell.
	19B219681P1	Contact, electrical.
		TONE CONTROL BOARD 19B219507G1
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR7	5494922P1	Silicon; sim to Type 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 ±10%, 1/8 w.
R2	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R3 and R4	3R151P473K	Composition: 47K ohms ±10%, 1/8 w.
R5	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - -
	19A129811P1	Insulator. (Located under A1401).
	19A216316P1	Insulator. (Used with J1401).
	19B216926P8	Decorative cap. (Used with S2).
	19C320721P1	Seal, weatherproof. (Used with S2).
	NP243580-L	Nameplate. (PE)
	NP279905	Nameplate. (MVP)
	4035306P11	Washer, fiber. (Used with Q1-Q3 on Tone Control Board).
	19A115834P4	Contact, electrical. (Terminates Tone Control Board cable).
	19B219531G1	Cable: wire size No. 30 AWG, 6 conductors; approx 9-1/2 inches long. (Used with Tone Control Board).
		INTRINSICALLY SAFE KIT 19A130602G1, G2
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C1701*	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D. Added by REV B.
C1702*	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D. Added by REV C.
C1703*	19A116192P14	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2. Added by REV C.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1701*	3R152P471J	Composition: 470 ohms ±5%, 1/4 w. Added by REV A.
R1702*	3R152P270J	Composition: 27 ohms ±5%, 1/4 w. Added by REV B.
R1703*	3R152P150K	Composition: 15 ohms ±10%, 1/4 w. Added by REV C.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

GE TYPE 99 TONE FREQUENCIES

TONE GROUD "A"		TONE GROUP "B"		TONE GROUP "C"	
TONE DESIGNATOR	TONE FREQUENCY	TONE DESIGNATOR	TONE FREQUENCY	TONE DESIGNATOR	TONE FREQUENCY
A0	682.5 Hz	B0	652.5 Hz	C0	667.5 Hz
A1	592.5 Hz	B1	607.5 Hz	C1	712.5 Hz
A2	757.5 Hz	B2	787.5 Hz	C2	772.5 Hz
A3	802.5 Hz	B3	832.5 Hz	C3	817.5 Hz
A4	847.5 Hz	B4	877.5 Hz	C4	862.5 Hz
A5	892.5 Hz	B5	922.5 Hz	C5	907.5 Hz
A6	937.5 Hz	B6	967.5 Hz	C6	952.5 Hz
A7	547.5 Hz	B7	517.5 Hz	C7	532.5 Hz
A8	727.5 Hz	B8	562.5 Hz	C8	577.5 Hz
A9	637.5 Hz	B9	697.5 Hz	C9	622.5 Hz
DIAGONAL TONE (D) IS 742.5 Hz FOR ALL GROUPS.					

OTHER TYPE 99 TONE FREQUENCIES AVAILABLE

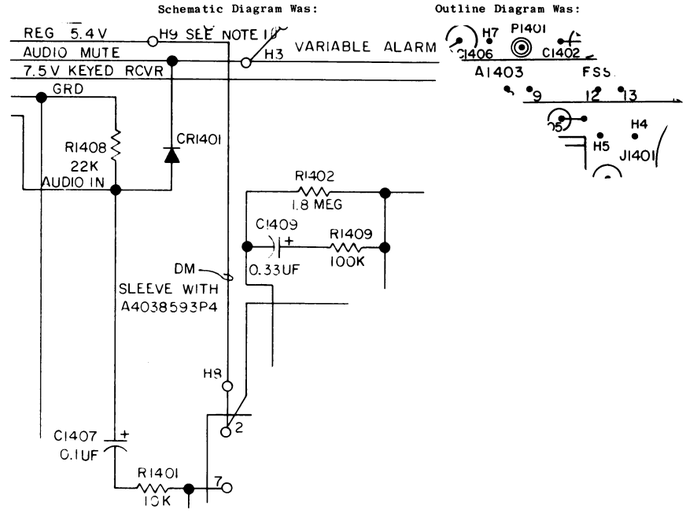
288.5	378.6	496.8	651.9	855.5	1122.5
296.5	389.0	510.5	669.9	879.0	1153.4
304.7	399.8	524.6	688.3	903.2	1185.2
313.0	410.8	569.0	707.3	928.1	1217.8
321.7	422.1	653.9	726.8	953.7	1251.4
330.5	433.7	569.1	746.8	979.9	1285.8
339.6	445.7	584.8	767.4	1006.9	1321.2
349.0	457.9	600.9	788.5	1034.7	1357.6
358.6	470.5	617.4	810.2	1063.2	1395.0
368.5	483.5	634.5	832.5	1092.4	1433.4

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 - 4EJ20A10 & 11

To improve operation, Added R1411 and VR1401.

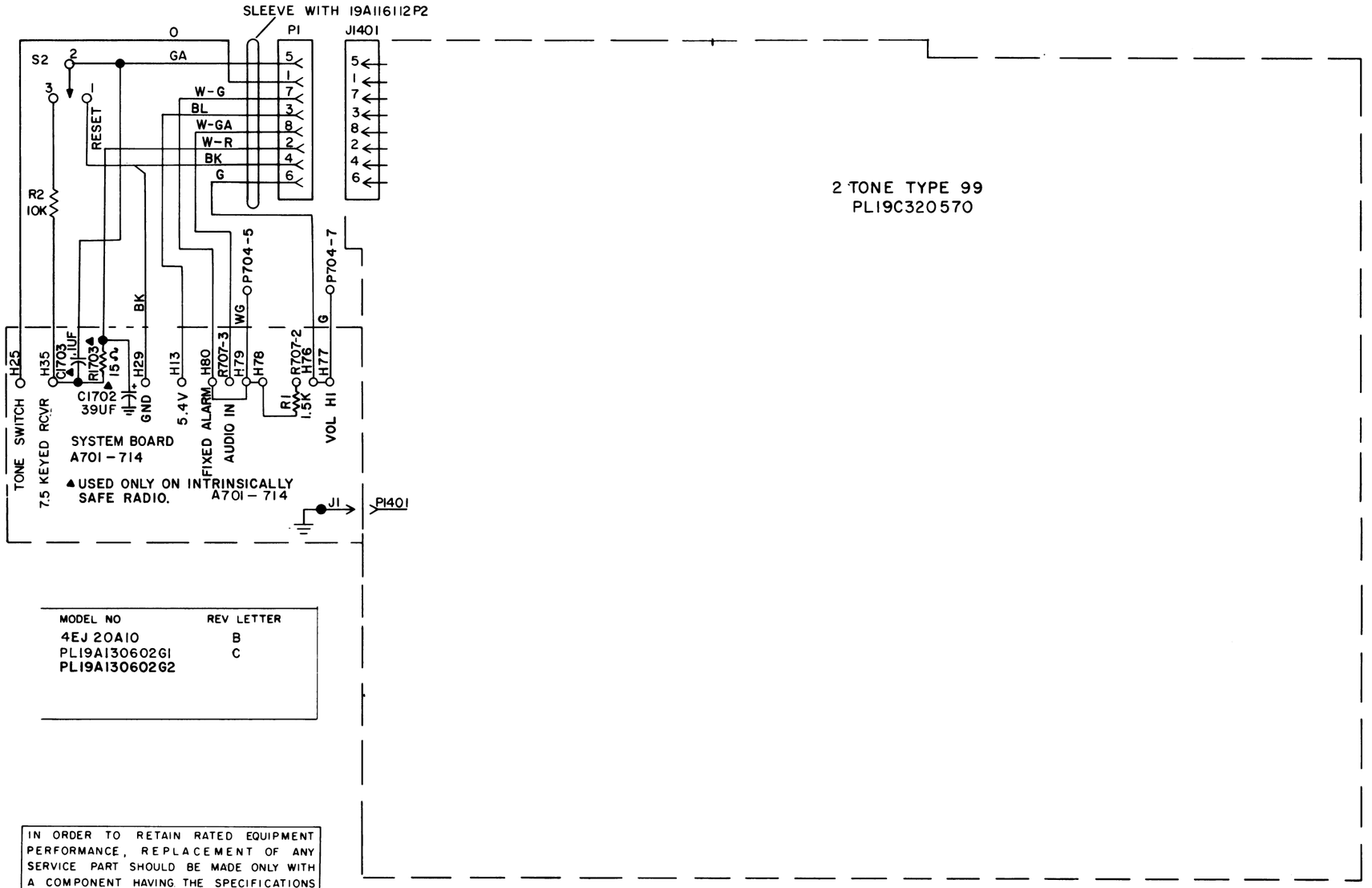


REV. B - To prevent alert tone from sounding under certain squelch and PTT operating conditions.
Added CR 1402.

REV. A - Instrinsically Safe Mod. Kit 19A130602G1
To improve safe conditions.
Added 1701.

REV. B - To improve Channel Guard operation with intrinsically safe radios.
Added C1701 and R1702.

REV. C - To improve alarm tone.
Added R1703, C1702 and C1703.



MODEL NO	REV LETTER
4EJ20A10	B
PL19A130602G1	C
PL19A130602G2	

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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 PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

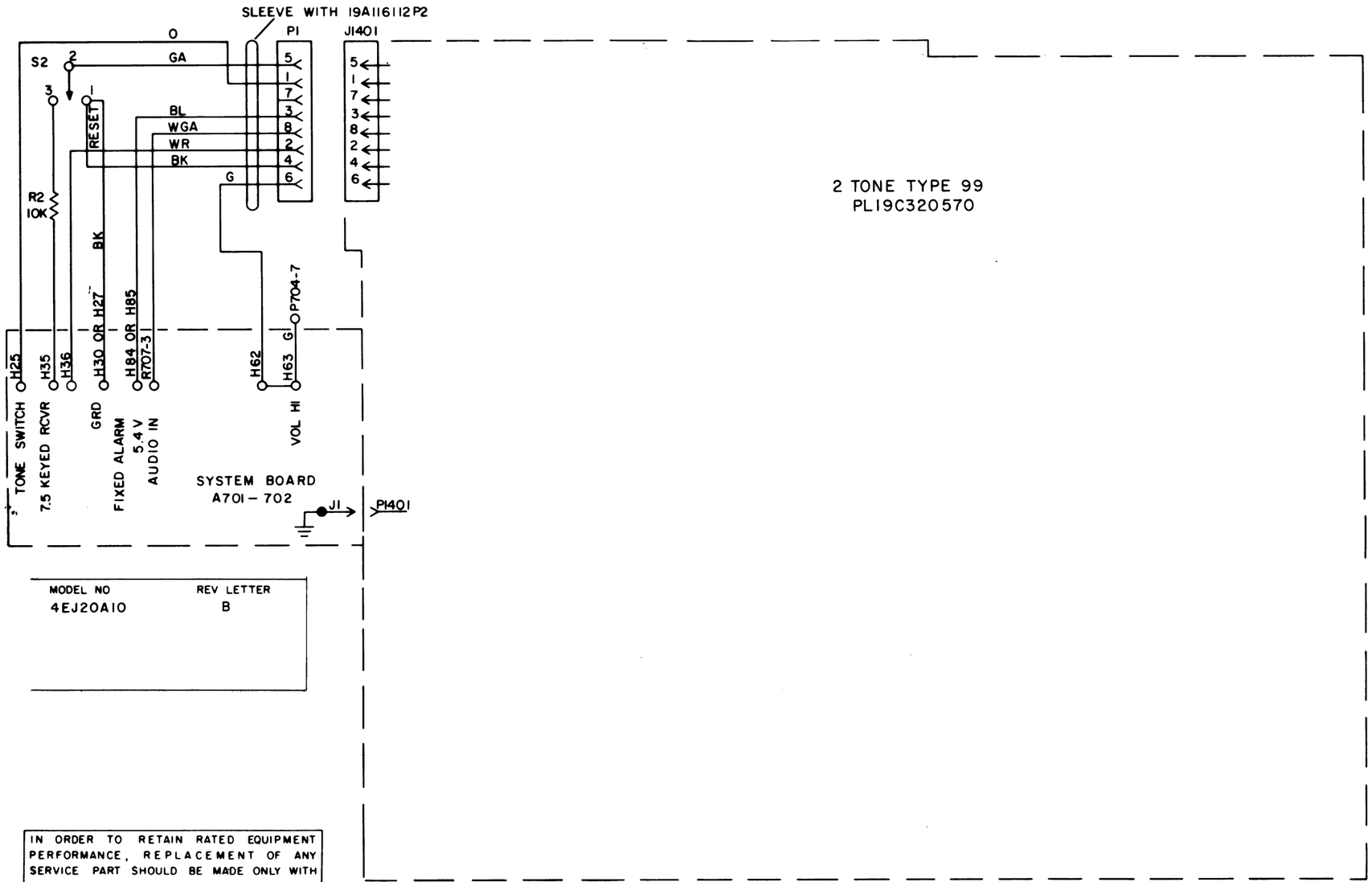
NOTES:

1. FOR FIXED ALARM, REMOVE JUMPER FROM H2 TO H3 AND ADD JUMPER FROM H2 TO H1.
2. ALL WIRES ARE SFT28 UNLESS OTHERWISE SPECIFIED.

(19C320568, Rev. 8)

INTERCONNECTION DIAGRAM

TYPE 99 DECODER MODEL 4EJ20A10 PERSONAL PE



MODEL NO	REV LETTER
4EJ20A10	B

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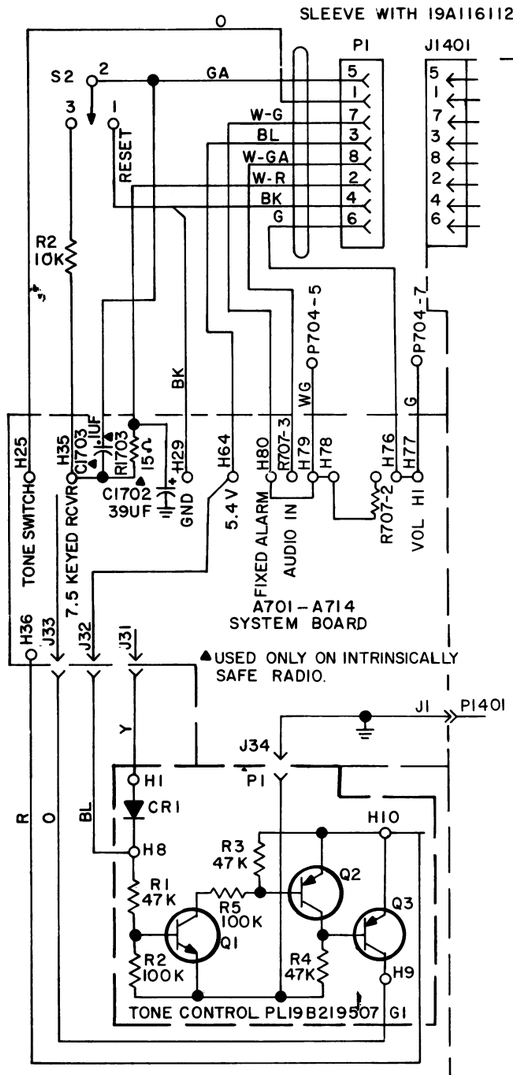
NOTES:
1. ALL WIRES ARE SFT28 UNLESS OTHERWISE SPECIFIED.

(19C327556, Rev.5)

INTERCONNECTION DIAGRAM

TYPE 99 DECODER MODEL 4EJ20A10 MVP PERSONAL



2 TONE TYPE 99
PL19C320570

NOTE:
1. ALL WIRES ARE SFT28 UNLESS OTHERWISE NOTED.

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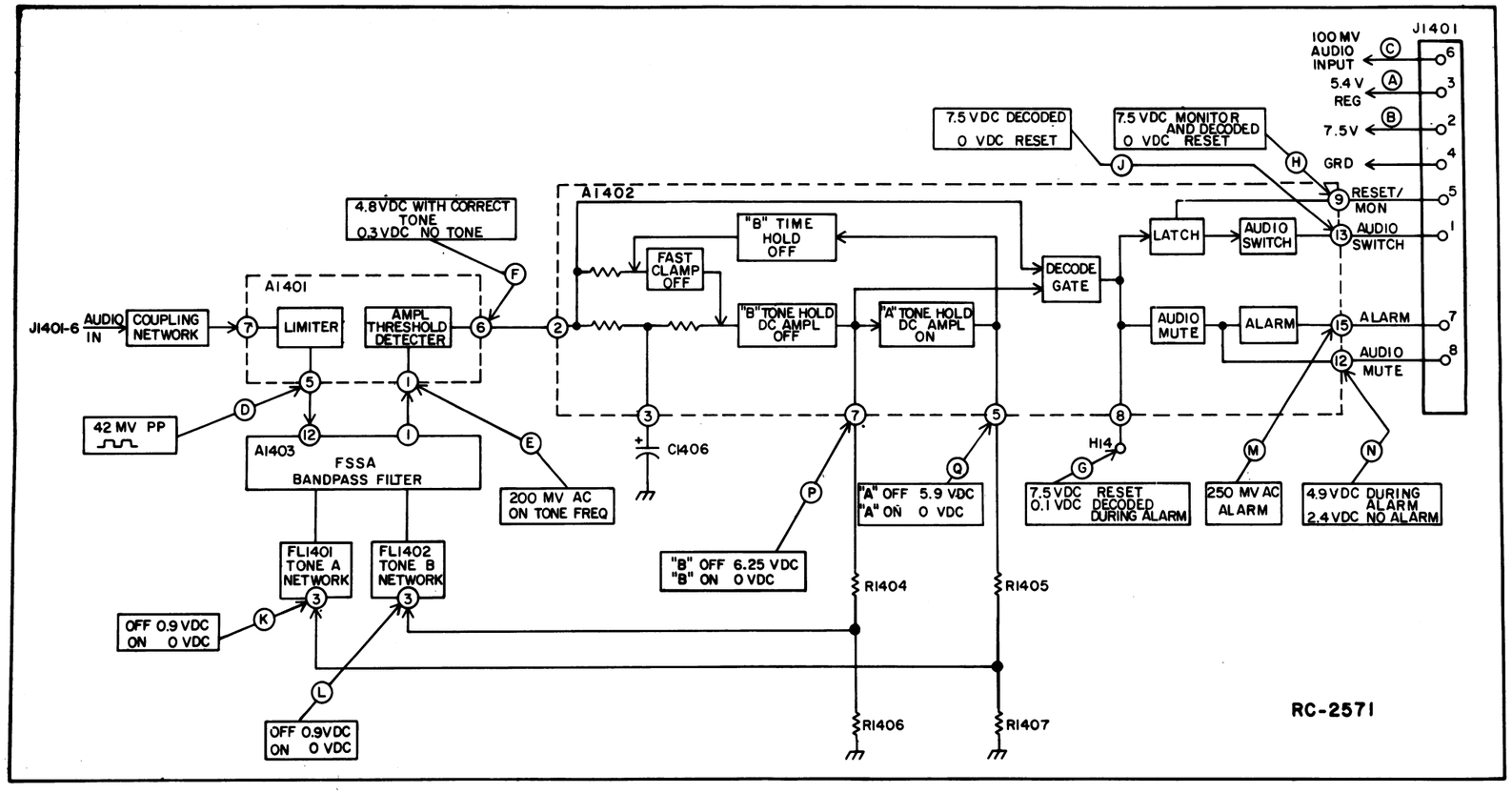
MODEL NO	REV LETTER
4EJ20A11	B
PL19A130602G1	C

INTERCONNECTION DIAGRAM

TYPE 99 DECODER MODEL 4EJ20A11
PERSONAL PE

(19C320678, Rev. 4)



TROUBLESHOOTING

SYMPTOM	STEP	TEST POINT	ACTION
Unit does not Decode (Note 1)	1	(D)	Apply correct frequency TYPE 99 Tone to J1401-6 (C) at a level sufficient to cause limiting at (D) (approximately 100 mV).
	2	(A)	Check for +5.4 VDC
	3	(B)	Check for +7.5 VDC
	4	(F)	Check for 4.8 VDC
	5	(E)	If (F) is incorrect, check for 200 mV AC.
	6	(K) (L)	If FSSA appears to be bad, before replacing check: 1. XFL1401 for proper contact. 2. Versatone Switching voltages at (K) (L). 3. Replace FL1401.
	7	(F)	If the switching voltages at (K) and (L) are incorrect, connect Pin 3 of XFL1401 to ground. Remove FL1402. Repeat Step 4.
	8	(K) (L)	If 4.8 VDC is present at (F) monitor the switching Voltages at (K) and (L) with no tone and a continuous first tone. Remove the input tone. (K) and (L) should reverse voltages for approximately 1/2 second. If this sequence is correct continue to step 9. If the switching voltage is incorrect check: 1. XFL1402 and replace FL1402 2. For approximately 4.5 VDC across C1406 during the first tone. If no voltage, replace C1406. If still no voltage, replace A1402. 3. For shorts on A1402. 4. R1404, R1405, R1406 and R1407. 5. Replace A1402.
	9	(G)	If the response at (F) is correct, a decode indication should be a near ground DC voltage at (G) during the second tone. If no decode, replace A1402.
	10	(J) (M) (N)	Check performance at (J) (M) and (N) . Replace A1402 if any test point fails to respond properly.

NOTE 1: The tone network can be checked by substitution of a known good network.

TROUBLESHOOTING PROCEDURE

TYPE 99 DECODER MODEL 4EJ20A10