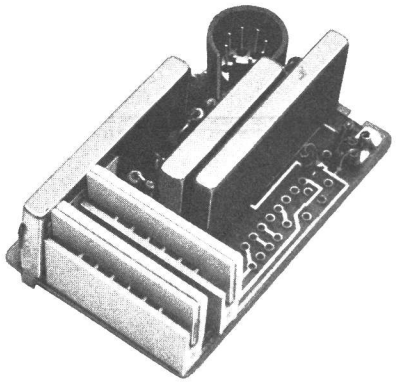
MOBILE RADIO

MASTR® Personal Series

PROGRESS LINE

PE MODELS

(TYPE 99 DECODER MODEL 4EJ21A10)



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)
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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ILLUSTRATIONS

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

Type 99 Decoder Model 4EJ21A10 is an individual call, two sequential tone decoder operating on Type 99 tone frequencies of 288.5 Hz to 1433.4 Hz. The Decoder assembly consists of discreet 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 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 remains 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 bandpass filter for the 288.5 Hz to 1433.4 Hz frequency range. The selectivity of the filter is shifted across the bandpass frequency range by switching Versatone Networks in the filter circuit. See Figure 1.

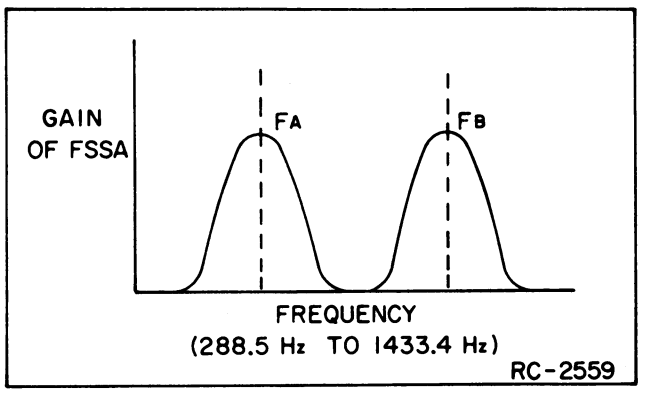


Figure 1 - Gain VS Frequency

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 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 disabling amplifier Q2 and feedback resistors R1, R2 and R3, effectively removing the network from the FSSA circuit.

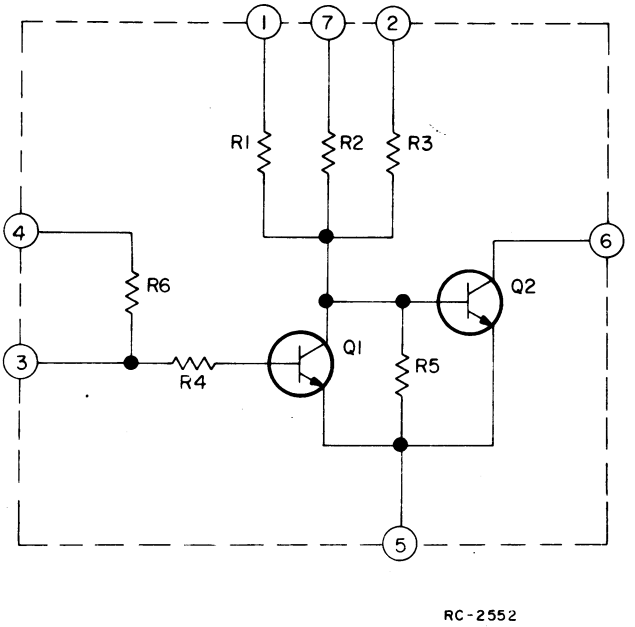


Figure 2 - Typical Versatone Network

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.

Initially Network FL1401 (Tone A) is in the FSSA circuit. When Tone A is applied to the input of FSSA it will appear at A1403-1 at a higher signal level than other signals. A1403-1 is connected to Threshold Detector Module A1401-1

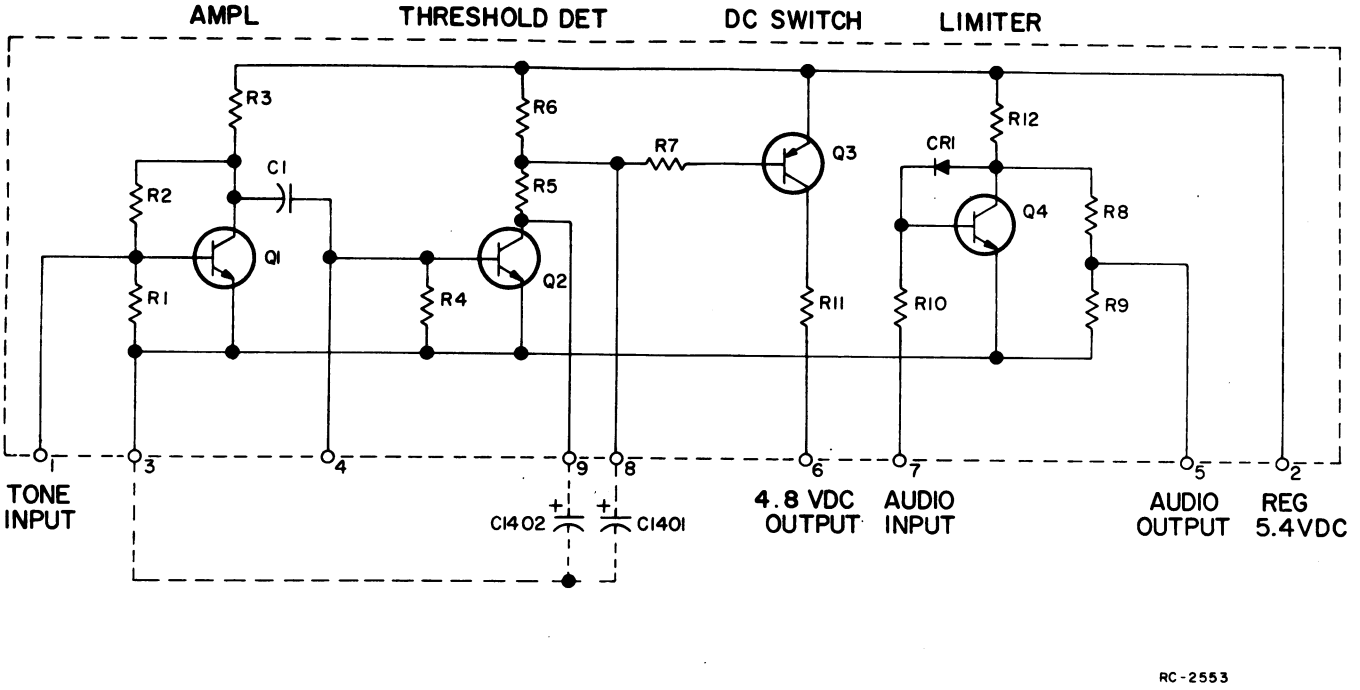


Figure 3 - Typical Threshold Detector Circuit

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 C1415 to charge. A typical Control Circuit is shown in Figure 4. When 4.8 Volts is removed from Pin 2, Q2 turns Off. C1415, in a charged state, causes DC Amplifier Q3 to conduct. Q3 conducting, switches Versatone Network FL1402 (Tone B) into the FSSA circuit and turns "A" Tone Hold Transistor Q4 Off. Q4 turning Off switches 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 C1415 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).

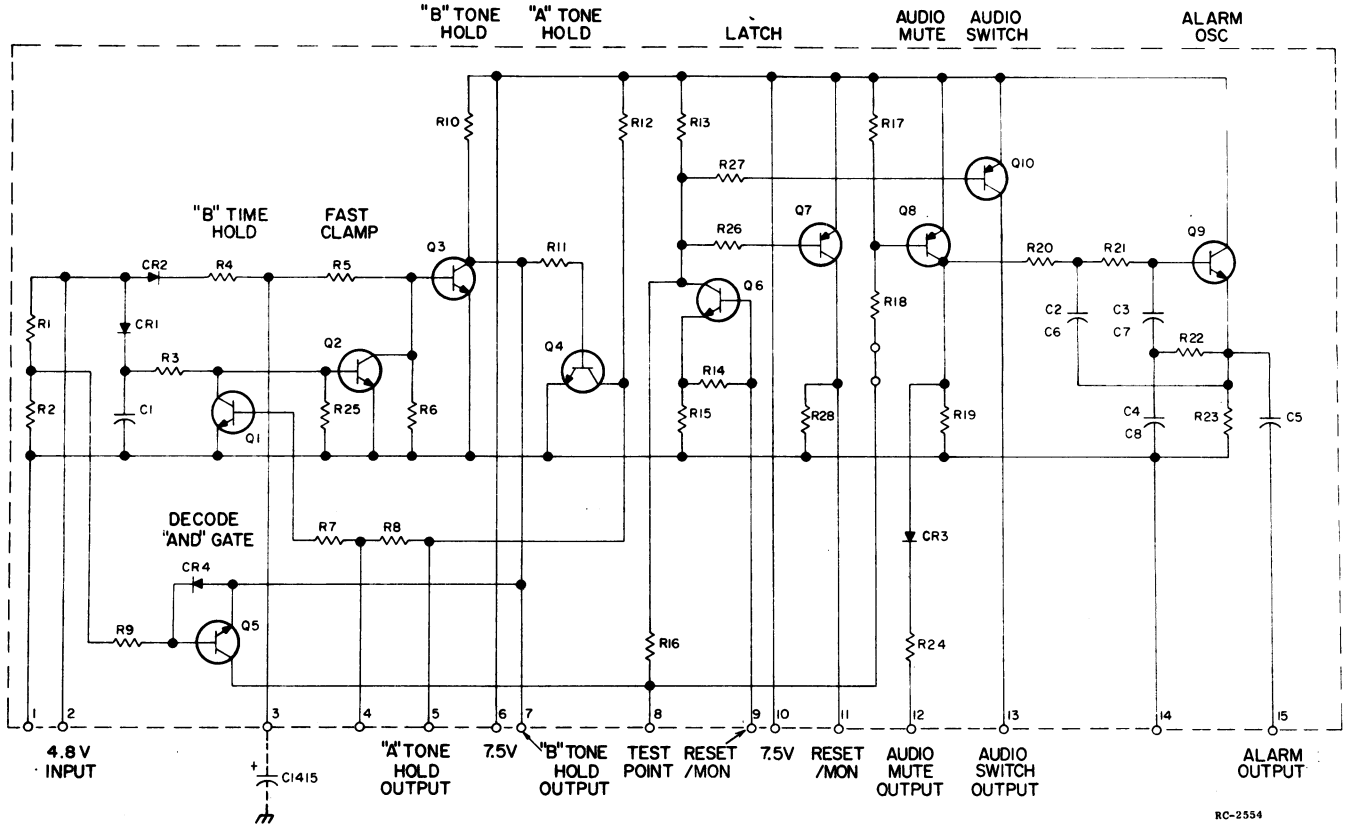
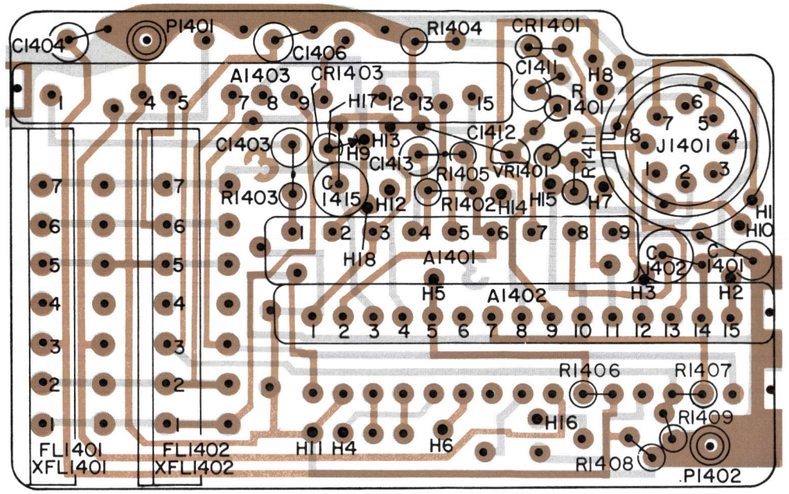
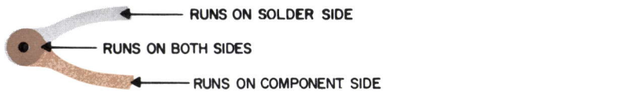
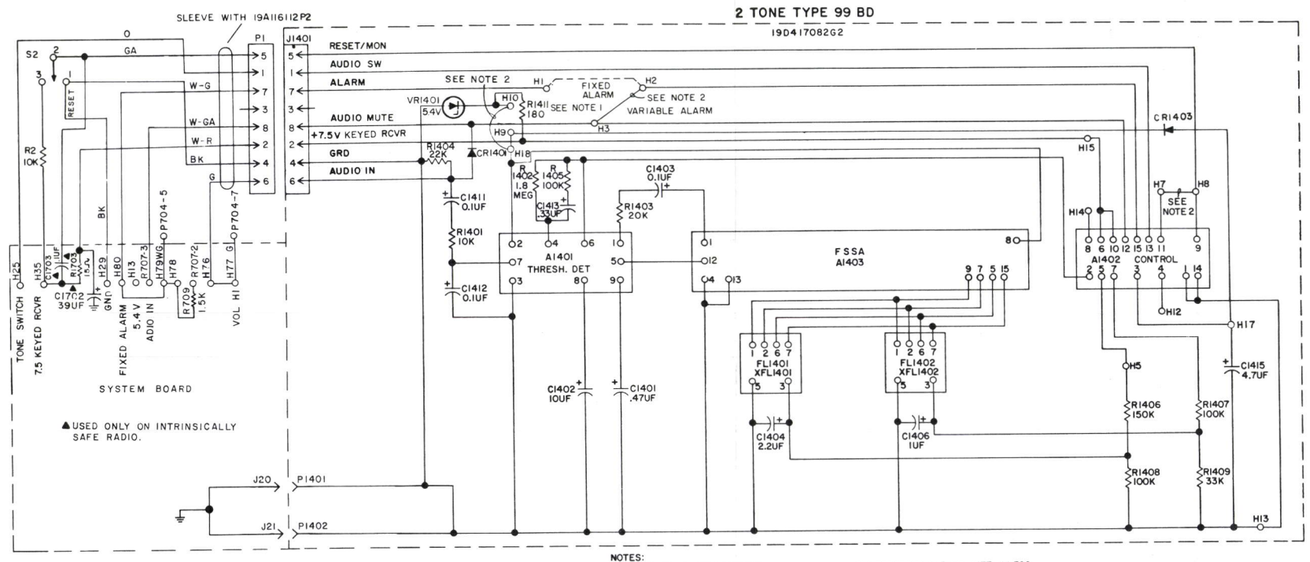


Figure 4 - Typical Control Circuit



(19C321198, Rev. 2)
(19D417081, Sh. 2, Rev. 3)
(19D417081, Sh. 3, Rev. 3)





NOTES:
1. FOR FIXED ALARM, REMOVE JUMPER FROM H2 TO H3 AND ADD JUMPER FROM H2 TO HI.
2. USE DM WIRE AND SLEEVE WITH A4038593P4.

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 1/8 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.

(19C320548, Rev. 7)

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
4EJ21A10	B
PLI9A130602G1	C

SCHEMATIC & OUTLINE DIAGRAM

TYPE 99 DECODER MODEL 4EJ21A10

Issue 3

PARTS LIST

LBI4668B

TYPE 99 DECODER
4EJ21A10

SYMBOL	GE PART NO.	DESCRIPTION
A1401	19C320539G1	Threshold Detector Limiter.
A1402	19D417098G1	Control.
A1403	19D417092G1	Selective Amplifier.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1401	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1402	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1403	5491674P43	Tantalum: 0.1 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C1404	5491674P47	Tantalum: 2.2 µf ±10%, 15 VDCW; sim to Sprague Type 162D.
C1406	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C1411 and C1412	5491674P43	Tantalum: 0.1 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C1413	5491674P46	Tantalum: 0.33 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1415	5491674P45	Tantalum: 4.7 µf ±10%, 6 VDCW; sim to Sprague Type 162D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1401	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR1403*	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	19C320291G2	Hybrid: 517.5-997.5 Hz.
FL1402	19C320291G3	Hybrid: 288.5-1433.4 Hz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1401	19A116122P1	Terminal, feed-thru: sim to Warren 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1401 and P1402	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	3R151P223K	Composition: 22K ohms ±10%, 1/8 w.
R1405	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R1406	3R151P154K	Composition: 150K ohms ±10%, 1/8 w.
R1407 and R1408	3R151P104K	Composition: 100K ohms ±10%, 1/8 w.
R1409	3R151P333K	Composition: 33K ohms ±10%, 1/8 w.
R1411*	3R151P181J	Composition: 180 ohms ±5%, 1/8 w. Added by REV A.
		- - - - - - - - VOLTAGE REGULATORS - - - - - -
VR1401*	4036887P5	Diode, Zener: 500 mW, 1.5 PIV. Added by REV A.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL1401 and XFL1402		Includes:
	19D416714P1	Socket.
	19B219681P1	Contact.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B216316P1	Insulator. (Used with J1401).
	19A129811P1	Insulator. (Located under A1401).

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 operation.
Added R1411 and VR1.

REV. B - To improve operation under PTT and Squelch conditions.
Added CR1403.

GE TYPE 99 TONE FREQUENCIES

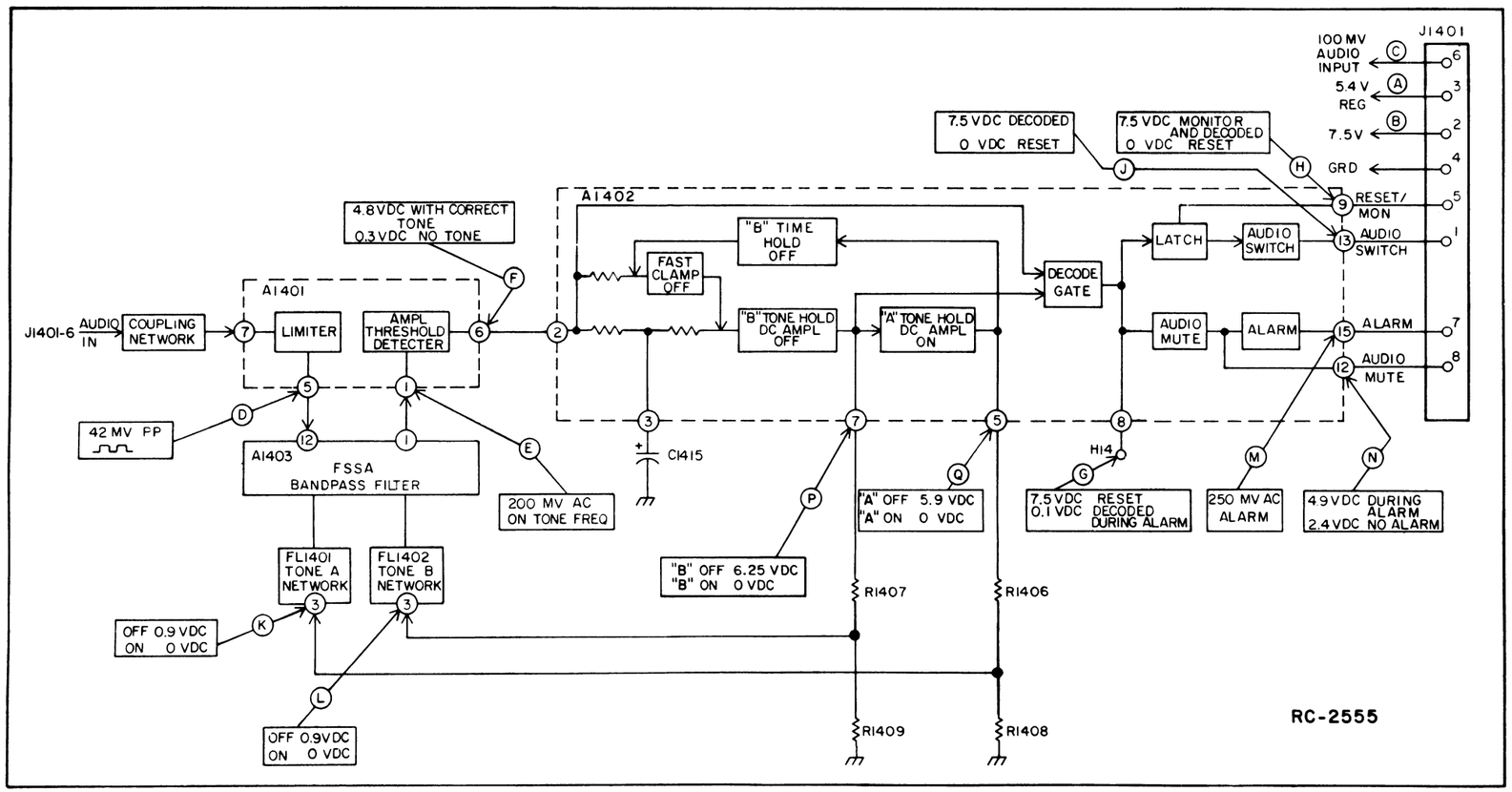
TONE GROUP "A"		TONE GROUP "B"		TONE GROUP "C"	
TONE DESIGNATOR	TONE FREQUENCY	TONE DESIGNATOR	TONE FREQUENCY	TONE DESIGNATOR	TONE FREQUENCY
A0	682.5 Hz	B0	652.5 Hz	C0	667.5 Hz
A1	592.5 Hz	B1	607.5 Hz	C1	712.5 Hz
A2	757.5 Hz	B2	787.5 Hz	C2	772.5 Hz
A3	802.5 Hz	B3	832.5 Hz	C3	817.5 Hz
A4	847.5 Hz	B4	877.5 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	289.0	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

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

TROUBLESHOOTING



SYMPTOM	STEP	TEST POINT	ACTION
Unit does not decode	1	(D)	Apply correct frequency TYPE 99 Tone to J1401-6 (C) at a level sufficient to cause limiting at (D) (approximately 100 mV).
Note 1	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. XLF1402 and replace FL1402 2. For approximately 4.5 VDC across C1415 during the first tone. If no voltage, replace C1415. If still no voltage, replace A1402. 3. For shorts of A1402. 4. R1406, R1407, R1408 and R1409. 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.