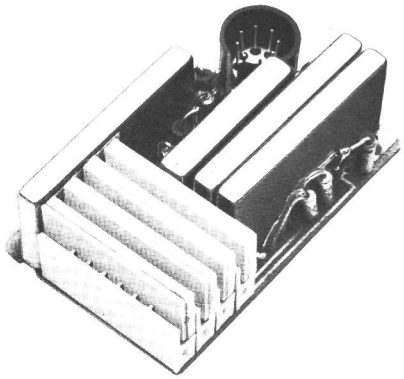
MOBILE RADIO

MASTR®

TYPE 99 DECODER MODEL 4EJ21A11
FOR
PE MODELS
AND
Porta-Mobile II™



EJ-21-A

SPECIFICATIONS *

Tone Frequencies	288.5 Hz to 1433.4 Hz
Frequency Stability	±0.4%
Current Drain	
Standby	4.41 Milliamperes
Decoded	5.61 Milliamperes
During Alarm	8.02 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 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 4EJ21A11 is an individual and group call, two squential tone decoder operating on Type 99 tone frequencies of 288.5 Hz to 1433.4 Hz. The Decoder assembly consists of discrete components and eight Thick Film Integrated Circuit Modules, consisting of Threshold Detector A1401, Control Module A1402 Frequency Switchable Selective Amplifier (FSSA) A1403, 4-Tone Search Module A1404, and four plug-in Versatone Networks FL1401 through FL1404.

Calls will not be heard from the receiver until the proper sequential tones have been applied to the Decoder. Initially, the Decoder is searching between two first tones (A1 and A2). Either of the first tones causes the Decoder to switch and search between second tones B1 and B2, after the first tone ends. An alert tone will sound when a 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, Control, and 4-Tone Search Modules are provided in Figures 2, 3, 4, and 5. 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).

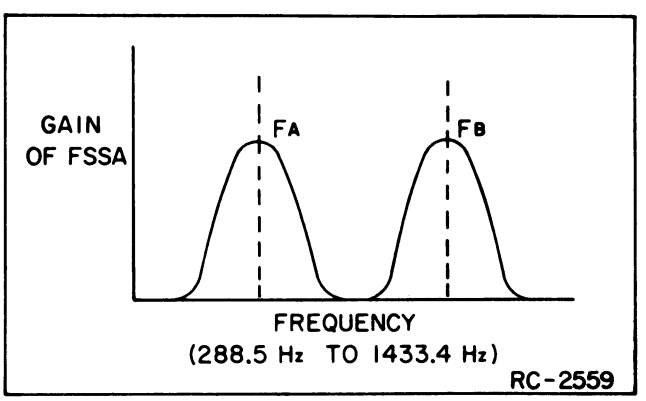


Figure 1 - GAIN VS FREQUENCY

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 through FL1404 are parallel connected, precision resistors. A typical Versatone network is shown in Figure 2. Pin 5 of the network is connected to ground. When a positive signal from 4-Tone Search Module A1404 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.

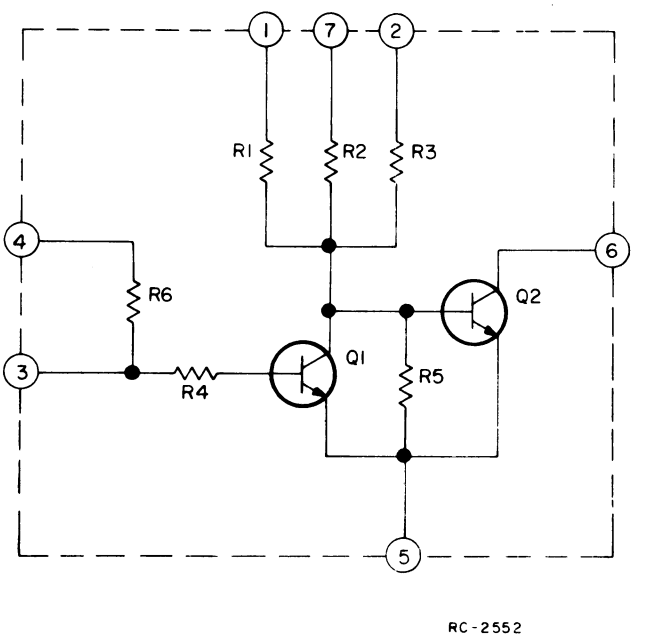


Figure 2 - Typical Versatone Network

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 A1403-12 on the FSSA. A typical Threshold Detector Circuit is shown in Figure 3.

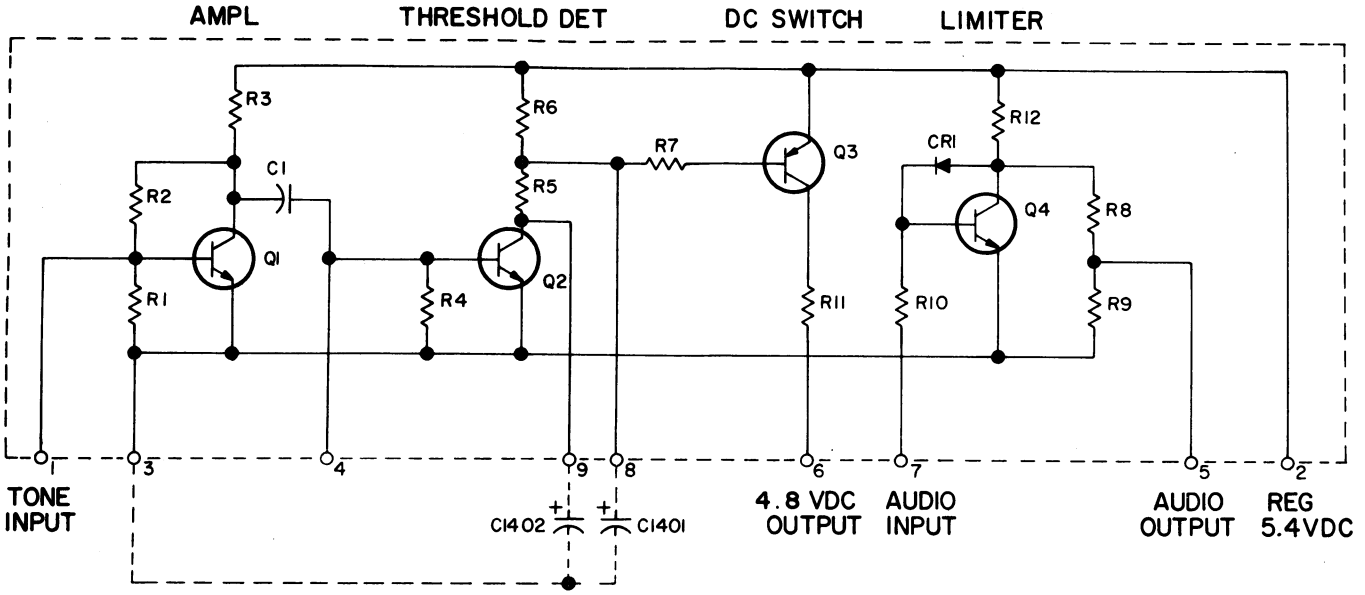


Figure 3 - Typical Threshold Detector Circuit

Initially, the 4-Tone Search Module A1404 is searching between first tone networks, A1401 (Tone A1) and A1402 (Tone A2). When either of the correct first tones 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 and 4-Tone Search Module A1404-5.

4-Tone Search Module

The 4-Tone Search Module, A1404, alternately switches Versatone Networks, FL1401 and FL1402 or FL1403 and FL1404, into the FSSA circuit. Inputs from the Control Module A1402 to A1404-10 and 14 determine if the networks are an "A" or a "B" tone. Clock circuit A1404-Q1 and Q3, selects the individual tone network.

The resistor "AND" gates on the 4-Tone Search Module need two logical zeros ("0") on their inputs to produce a logical "0" on their outputs. Any other inputs produce a logical "1" on the outputs.

Before a tone is received, a logical "0" is on A1404-10 and a logical "1" is on A1404-14. With this condition, the clock is switching between "A" tone networks FL1401 and FL1402..

When a tone is received, 4.8 volts DC is applied to A1404-5, causing Clock Clamp transistor Q2 to conduct. Q2 conducting stops clock circuit Q1 and Q3 from switching, and clamps it off as long as the tone is present.

After the first tone ends, the Control Module A1402 applies a logical "1" to A1404-10 and a logical "0" to A1404-14. The Clock starts and the 4-Tone Search Module alternately switches "B" Tone Networks FL1403 and FL1404 into the FSSA circuit.

A1404-Q4 is a Fast Clock Clamp circuit, controlled by Threshold Detector module A1401. When a tone is present, Q4 conducts, instantly stopping the clock. This insures the control module has time to react.

A typical 4-Tone Search Circuit is shown in Figure 4.

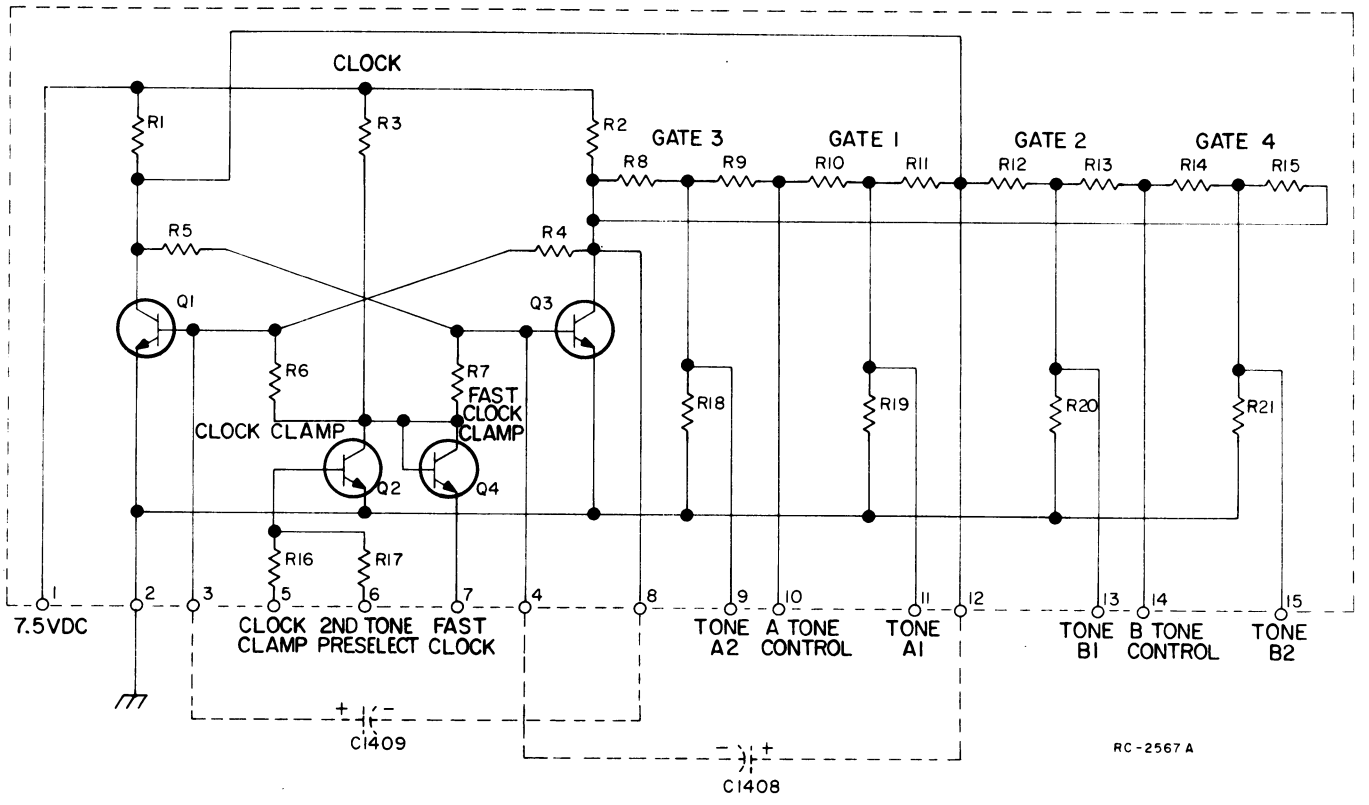


Figure 4 - Typical 4-Tone Search Circuit

Control Module

The 4.8 Volts DC from the Threshold Detector applied to A1402-2, causes Fast Clamp transistor Q2 to clamp DC Amplifier Q3 Off, allowing Timing Capacitor C1410 to charge. A typical Control Circuit is shown in Figure 5. When the tone ends, 4.8 Volts is removed from Pin 2, turning Q2 Off. C1410, in a charged state, causes DC Amplifier Q3 to conduct. Q3 conducting causes the 4-Tone Search Module A1404 to search between Versatone Networks FL1403 (Tone B1) and FL1404 (Tone B2). Q3 also turns "A" Tone Hold transistor Q4 Off causing A1404 to stop searching between Tone A1 and Tone A2. Q4 also turns "B"-Time Hold transistor Q1 On. Turning Q1 On holds Fast Clamp Transistor Q2 Off.

If Tone "B1" or Tone "B2" is not received within 1.5 seconds, timing capacitor C1410 will discharge and automatically reset the circuit to receive Tone "A1" or Tone "A2".

If Tone "B1" or Tone "B2" 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 "B1" or Tone "B2" 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.

When the second tone ends, the alarm will stop, the clock in the 4-Tone Search Module will start and the timing circuit in the Control Module will reset the Decoder to receive a first tone.

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).

PREDETERMINED SIGNALLING PATHS

The Decoder normally has four signal paths; Tone A1 and Tone B1, Tone A1 and Tone B2, Tone A2 and Tone B1 and Tone A2 and Tone B2. The number of signal paths can be limited to two predetermined signal paths, Tone A1 and Tone B1 and Tone A2 and Tone B2, by removing the jumper between H6 and H11, and adding a jumper between H6 and H5. This clamps the clock off for the second tone (see Note 2 on the Schematic Diagram).

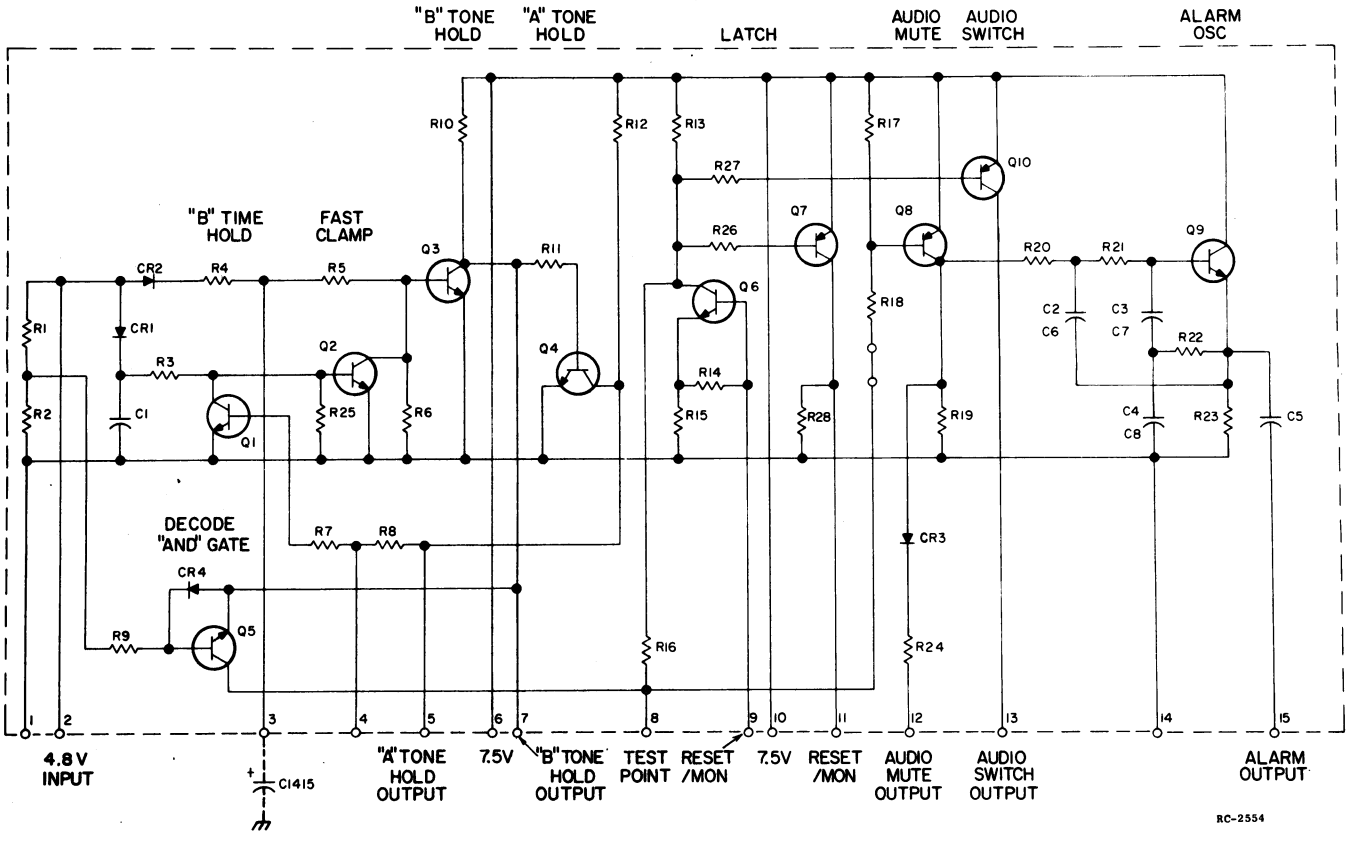
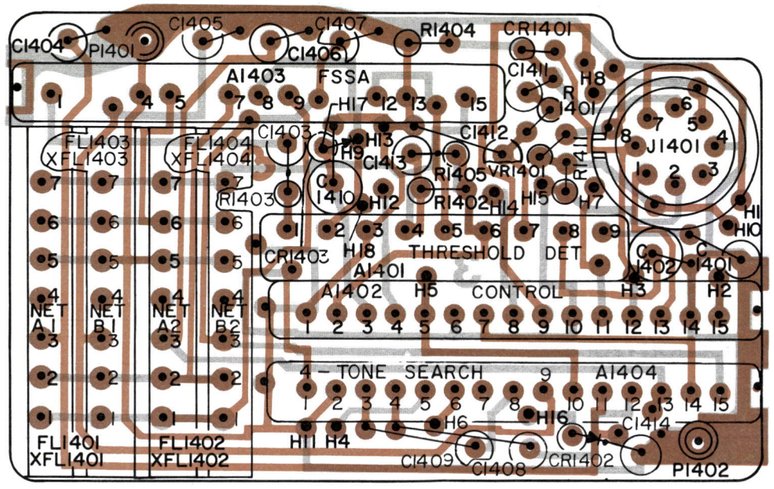
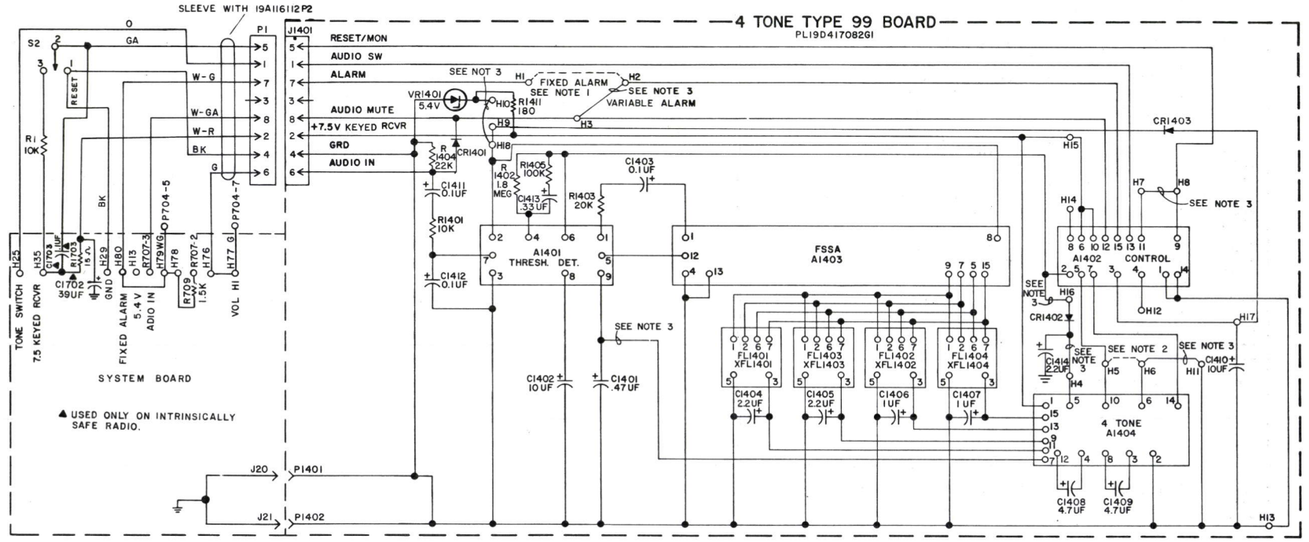


Figure 5 - Typical Control Circuit



(19C321227, 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 H1.
2. TO PRESELECT 2ND TONE, REMOVE JUMPER FROM H6 TO H11 AND ADD JUMPER FROM H6 TO H5.
3. USE DM WIRE AND SLEEVE WITH A4038593P4.

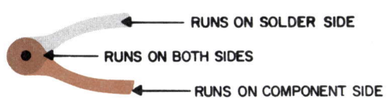
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

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.

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
4EJ21A11	B
PLI9A130602G1	C

(19C320547, Rev. 7)



PARTS LIST

LBI4669B

TYPE 99 DECODER
4EJ21A11

SYMBOL	GE PART NO.	DESCRIPTION
A1401	19C320539G1	Threshold Detector Limiter.
A1402	19D417098G1	Control.
A1403	19D417092G1	Selective Amplifier.
A1404	19D417132G1	4 Tone Search.
		- - - - - - - - - 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 and C1405	5491674P47	Tantalum: 2.2 µf ±10%, 15 VDCW; sim to Sprague Type 162D.
C1406 and C1407	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C1408 and C1409	5491674P45	Tantalum: 4.7 µf 10%, 6 VDCW; sim to Sprague Type 162D.
C1410	5491674P37	Tantalum: 10 µf ±20%, 10 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.
C1414	5491674P44	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1401 and CR1402	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 thru FL1404	19C320291G2 19C320291G3	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 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.
R1411*	3R151P181J	Composition: 180 ohms ±5%, 1/8 w. Added by REV A.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1401*	4036887P5	Diode, Zener: 500 mW, 5.4 v. nominal. Added by REV A.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL1401 thru XFL1404		Includes:
	19D416714P1	Socket.
	19B219681P1	Contact.
		- - - - - - - - - - MISCELLANEOUS - - - - - - -
	19B216316P1	Insulator. (Used with J1401).
	19A129811P1	Insulator. (Located under A1401).
		PE MODIFICATION KIT 19A130396G1
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19B219973G2	Plug: 8 pins.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P103K	Composition: 10K ohms ±10%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19A116648P5	Toggle: SPDT; sim to C and K Components 7107SDG.
		PMII MODIFICATION KIT 19A130971G1
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1401	19B226809G8	Toggle: SPDT; sim to C and K Components 7107SDG.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1401	19B226806G5	Cable: includes P1 19A127569G1.
		INTRINSICALLY SAFE KIT 19A130602G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1701	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1702	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1703	19A116192P14	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1701	3R152P471J	Composition: 470 ohms ±5%, 1/4 w.
R1702	3R152P270J	Composition: 27 ohms ±5%, 1/4 w.
R1703	3R152P150K	Composition: 15 ohms ±10%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

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

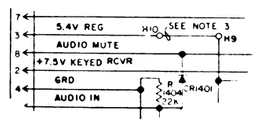
288.5	378.6	496.8	651.9	855.5	1122.5
296.5	289.0	510.5	669.9	879.0	1153.4
304.7	399.8	524.6	688.3	903.2	1185.2
313.0	410.8	569.0	707.3	928.1	1217.8
321.7	422.1	653.9	726.8	953.7	1251.4
330.5	433.7	569.1	746.8	979.9	1285.8
339.6	445.7	584.8	767.4	1006.9	1321.2
349.0	457.9	600.9	788.5	1034.7	1357.6
358.6	470.5	617.4	810.2	1063.2	1395.0
368.5	483.5	634.5	832.5	1092.4	1433.4

PRODUCTION CHANGES

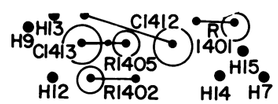
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To improve operation.
Added R1411 and VR1.

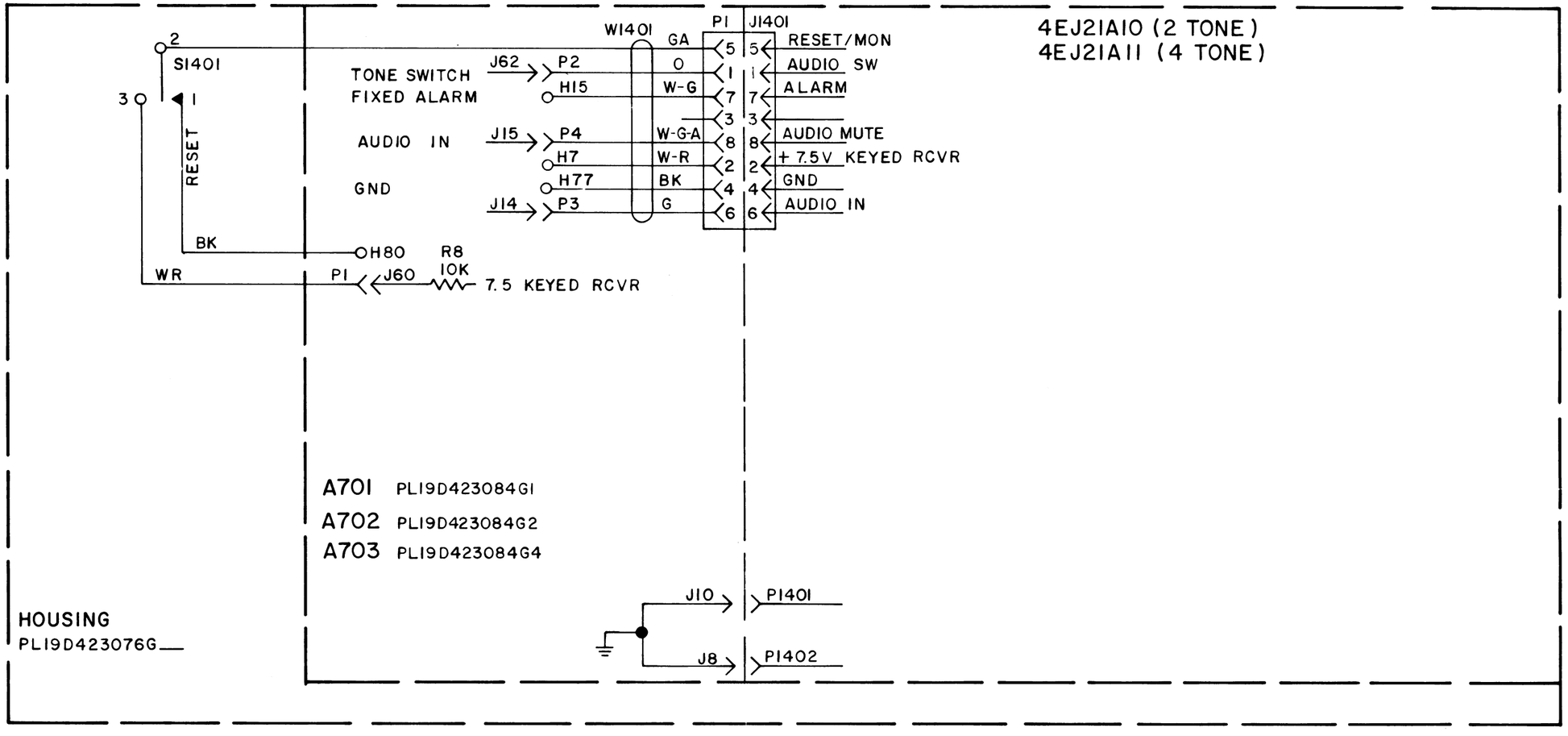
Schematic Diagram was:



Outline Diagram was:



REV. B - To prevent Type 99 alet tone from sounding under certain Squelch and PTT conditions.
Added CR 1403.



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(19C321583, Rev. 1)

INTERCONNECTION DIAGRAM

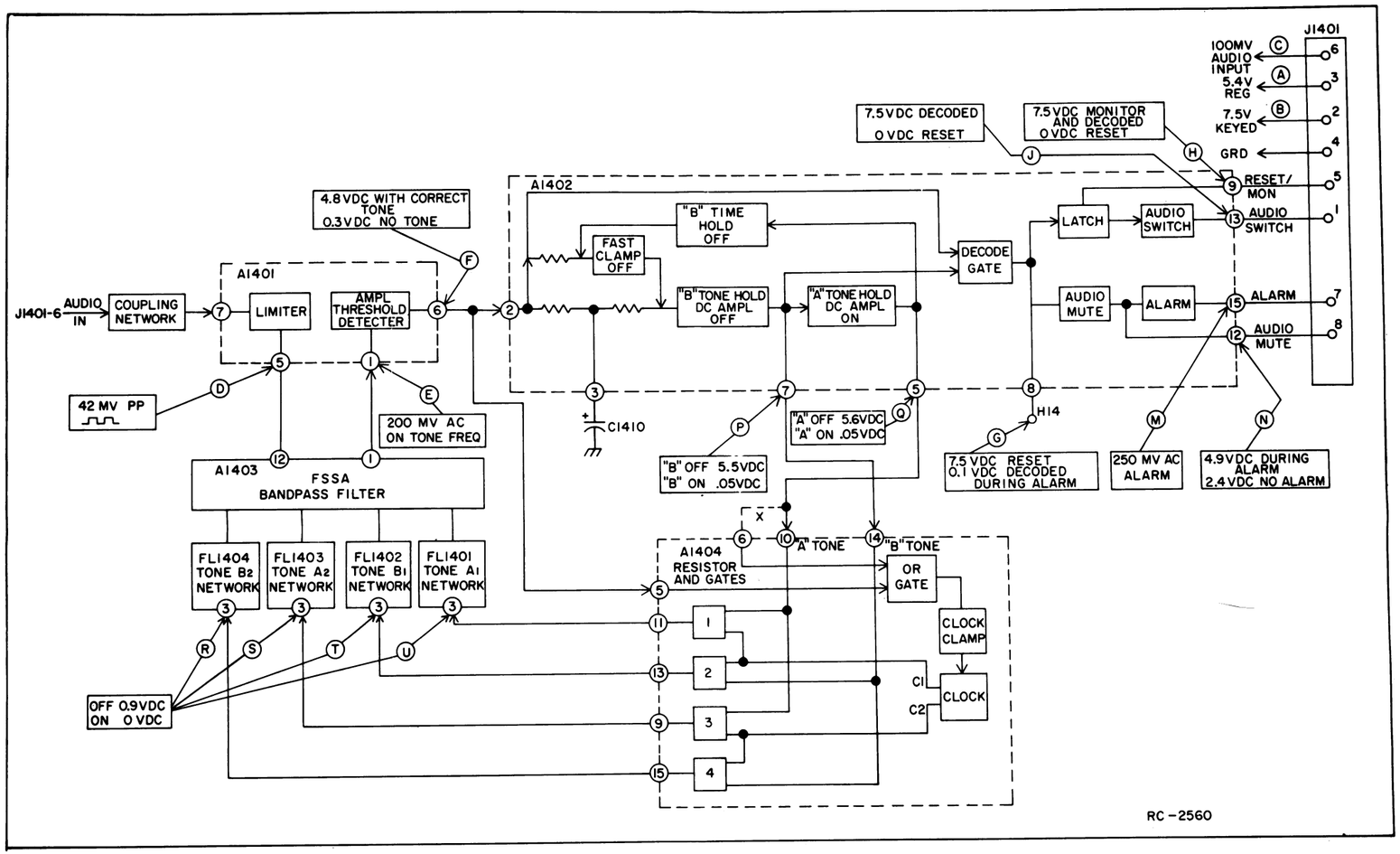
Porta•Mobile II - TYPE 99 TONE

Issue 1

TROUBLESHOOTING

SYMPTOM	STEP	TEST POINT	ACTION
Unit does not Decode (Note 1)	1		Connect A1404-4 to ground. This stops the clock so that the Decoder can be check as a two tone decoder. "A" Tone network FL1401 and "B" Tone network FL1402 are the switchable networks in the FSSA circuit.
	2	(D)	Apply correct frequency TYPE 99 Tone to J1401-6 (C) at a level sufficient to cause limiting at (D) (Approximately 100 mV).
	3	(A)	Check for +5.4 VDC
	4	(B)	Check for +7.5 VDC
	5	(F)	Check for 4.8 VDC
	6	(E)	If (F) is incorrect, check for 200 mV AC.
	7	(T) (U)	If FSSA appears to be bad, before replacing check: 1. XFL1401 for proper contact. 2. Versatone Switching Voltage at (T) and (U) 3. Replace FL1401
	8	(F)	If the switching voltages at (T) and (U) are incorrect, connect Pin 3 of XFL1401 to ground. Remove FL1402. Repeat Step 5.
	9	(T) (U)	If 4.8 VDC is present at (F) monitor the switching Voltages at (T) and (U) with no tone and a continuous first tone. Remove the input tone. (T) and (U) should reverse voltages for approximately 1.5 second. If this sequence is correct continue to step 10. If the switching voltage is incorrect check: 1. XFL1402 and replace FL1402 2. For approximately 4.5 VDC across C1410 during the first tone. If no voltage, replace C1410. If still no voltage, replace A1402. 3. For shorts on A1402. 4. Replace A1402.
	10	(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.
	11	(J) (M) (N)	Check performance at (J) (M) and (N). Replace A1402 if any test point fails to respond properly.
	12	(S) (U)	Remove ground connection from A1404-4. With no tone, monitor switching voltages at (S) and (U). If clock is not switching check: 1. Timing capacitors C1408 and C1409 2. Replace A1404

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



TROUBLESHOOTING PROCEDURE

TYPE 99 DECODER MODEL 4EJ21A11