MOBILE RADIO

MAINTENANCE MANUAL

FOR

GE—MARC V™ TONE BOARD 19D432014G1-G4

TABLE OF CONTENTS

DESCRIPTION

The tone board uses a frequency switchable selective amplifier (FSSA) and Versatone tone networks to provide tone signalling encode and decode functions. Up to 10 Versatones may be used to provide up to five group tones as well as Busy, Collect, Individual Decode, Acquisition and Individual Encode tones. In addition, the board contains a voice-reject filter, an alert tone generator and a busy tone notch filter. A block diagram of the tone board is shown in Figure 1.

CIRCUIT ANALYSIS

FREQUENCY SWITCHABLE SELECTIVE AMPLIFIER

Frequency Switchable Selective Amplifier (FSSA) is a highly stable, narrow bandpass filter for the 604 Hz to 3052 Hz frequency range. The selectivity of the filter is shifted across the bandpass frequency range by switching Tone Networks in the filter circuit (See Figure 1).

The gain of the FSSA is a function of the tone frequency. The Tone Frequency is determined by the Tone Network (Versatone) connected in the FSSA circuit. When the Versatone is in the circuit, the maximum gain occurs at the Versatone frequency.

VERSATONE NETWORKS

Versatone Networks FL1 through FL10 are parallel connected, precision resistor networks with associated switching transistors. A typical Versatone Network is shown in Figure 2. Pins 4 and 5 of the network are connected to ground, and pins 1, 2, 6 and 7 are connected to the FSSA.

When a positive voltage is applied to Pin 3, Q1 conducts. This disables Amplifier Q2 and feedback resistors R1, R2 and R3, effectively removing the network from the FSSA circuit.

Applying a ground to Pin 3 turns off Q1, switching Q2 and the precision resistors into the FSSA circuit.

Versatone selection is controlled by the logic board. U3 on the tone board consists of buffer-inverters. A high on the input (J1-1 through J1-5) results in a low applied to Pin 3 of Versatones FL1 through FL5. The low output of U3-C also enables the selection of the Group/Individual Tone 1.

U4 and U5 are NAND gates that provide additional select lines for Acquisition tone and one through five group/individual tones.

Selection of the Versatones is sequential, and only one Versatone is selected at a time.

VOICE REJECT FILTER

The voice reject filter consists of AR2 and associated circuitry. Sections B and A are two high pass filters in series. Section D and associated circuitry forms a notch filter that is centered at approximately 2.5 kHz. The filter removes the voice components from the signal to prevent voice blocking of the busy tone.

GENERAL ELECTRIC

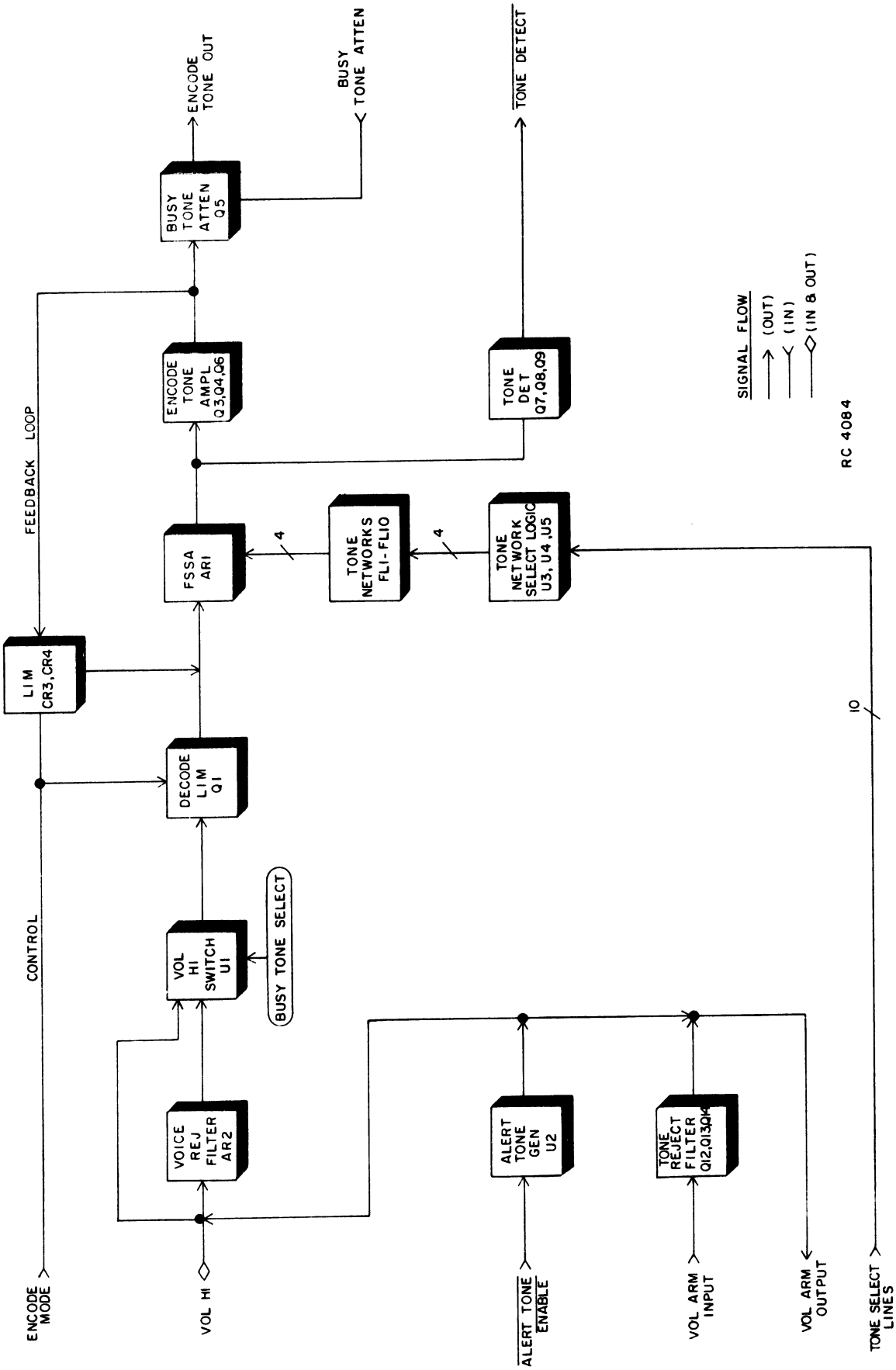


Figure 1 - Block Diagram

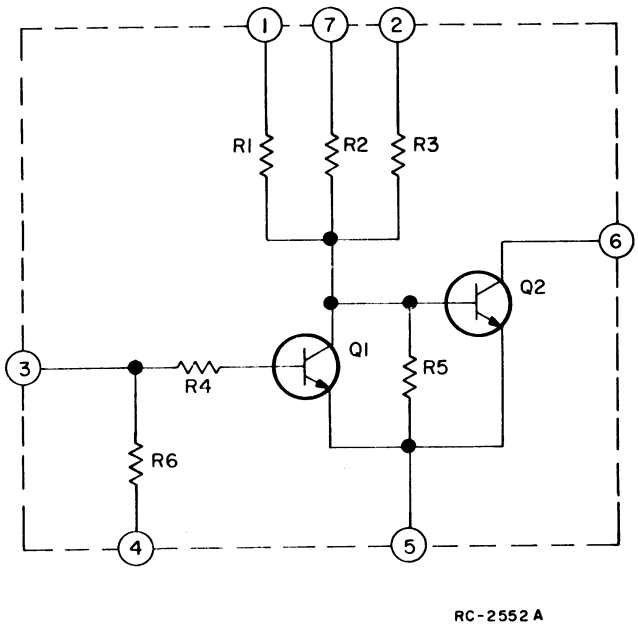


Figure 2 - Typical Versatone Network

U1 is a four-section bilateral switch. Sections B, C and D of the switch are connected so that when sections B and C are on (Busy Tone Sel lead high), section D is off and when sections B and C are off (Busy Tone Sel lead low), section D is on.

Whenever section C is on, audio and tone from J2-1 (VOL HI) is coupled through the filter to the decoder limiter stage. When section D is on (B and C off), the signal from VOL HI is coupled directly to the limiter.

DECODE

The output of U1 is applied to the base of decode limiter Q1 through a de-emphasis network consisting of R18 and C12. The network provides 6 dB per octave roll-off.

Diode CR2 connected from the emitter to base of Q2 prevents the amplitude of the square wave output from exceeding approximately 1.5 volts, providing a constant level to FSSA AR1.

The tone output of the FSSA is applied to the base of amplifier Q7 in the threshold detector circuit. The amplified output is applied to Q9 where the positive-going pulses cause Q9 to conduct. The negative half cycles in the output of Q9 turns Q8 on. When Q8 is turned on, Q9 conducts harder. This sequence continues until Q9 is saturated and it's collector is near ground potential (Tone Detect low at J1-6).

When the Busy Tone Sel lead goes high, switch U1-A turns on, connecting C85 in parallel with C47. When connected in parallel, both capacitors are discharged when Q7 conducts. The capacitors are used to keep Q7 on whenever the tone input is interrupted by voice signals (at approximately 3 kHz).

Encode tone amplifiers Q3, Q4 and Q5 are also on during the decode mode and the tone output is applied to the transmitter. However, the transmitter is off during the decode mode and no tone is transmitted.

ENCODE

When encoding, the Encode mode lead goes high, applying +10 volts to J2-3. The +10 volts forward biases diode CR1 and causes Q1 to saturate. When saturated, Q1 cannot pass decode tones and is effectively turned off while encoding.

The +10 volts applied to J2-3 also forward biases encode limiters CR3 and CR4, connecting the tone output of FSSA (AR1) through amplifiers Q3 and Q4 and through CR3 and CR5 back to the input. This causes the FSSA to oscillate at the frequency of the selected Versatone. This encode frequency is coupled through emitter-follower Q6 and applied to the transmitter audio processor.

Applying 10 volts causes a voltage spike to be coupled through C13 to the base of Q2. The resulting pulse at the emitter of Q2 is applied to the FSSA (AR1) to help decrease the starting time of the oscillation.

In the Ready mode, J1-7 goes high, turning on Busy Tone attenuator Q5. Turning on Q5 provides a 1000 ohms impedance to ground (R36) in conjunction with divider resistor R34. The circuit provides approximately 12 dB of busy tone attenuation.

NOTE

The Attenuated Busy Tone is set for 1.0 kHz deviation in the transmitter. Refer to the Transmitter Alignment Procedure for complete instructions.

TONE REJECT FILTER

The tone reject filter is used to remove the repeater busy tone from the speaker audio.

Audio and tone from Volume arm are applied to the filter through J1-11. Q12, Q13 and Q14 provide amplification and isolation. The filter is a single stage bridged-T filter providing approximately 30 dB of busy tone attenuation. The filtered audio at J1-12 is coupled to Volume arm (Reject Filter output) on the system board through the system harness and then to the audio PA stage.

NOTE

R66 in the Tone Reject Filter is selected at the factory to produce the maximum notch at the busy tone frequency. It is recommended that the notch be located at the high frequency side.

ALERT TONE GENERATOR

The Alert Tone Generator operates in three different modes: call or connect, no connect, and carrier control timer (CCT).

For an incoming call or channel acquisition, a series of four interrupted tone bursts or "beeps" is heard in the speaker.

When searching for a channel (wait mode) and all channels are busy, a continuous one second tone is heard in the speaker. After all channels have been searched and the tone is heard, the radio then reverts from the wait mode to the idle mode.

When the transmitter is keyed continuously for two minutes and 45 seconds, a series of "beeps" will be heard for 15 seconds before the transmitter is disabled. Transmitter shut-down can be prevented at any time during the three minute cycle by releasing and re-keying the microphone button.

The alert tone generator consists of switch Q10, timer U2 and associated circuitry. Switching a low on J1-10 turns Q10 off. This allows the collector lead to rise to 10 volts which turns on U2. The 800 to 1000 Hz output of U2 can be switched on and off as required.

The alert tone output is coupled to VOL HI through resistive network R55 and R56. It is also coupled through resistive network R56 and R57 to VOL ARM to permit the alert tone to be heard at the speaker with the Volume control turned down.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

The following procedure permits checking all functions of the tone board while in the radio by using Test Set TL59. Refer to the Maintenance Manual for the TL59 for complete operating instructions.

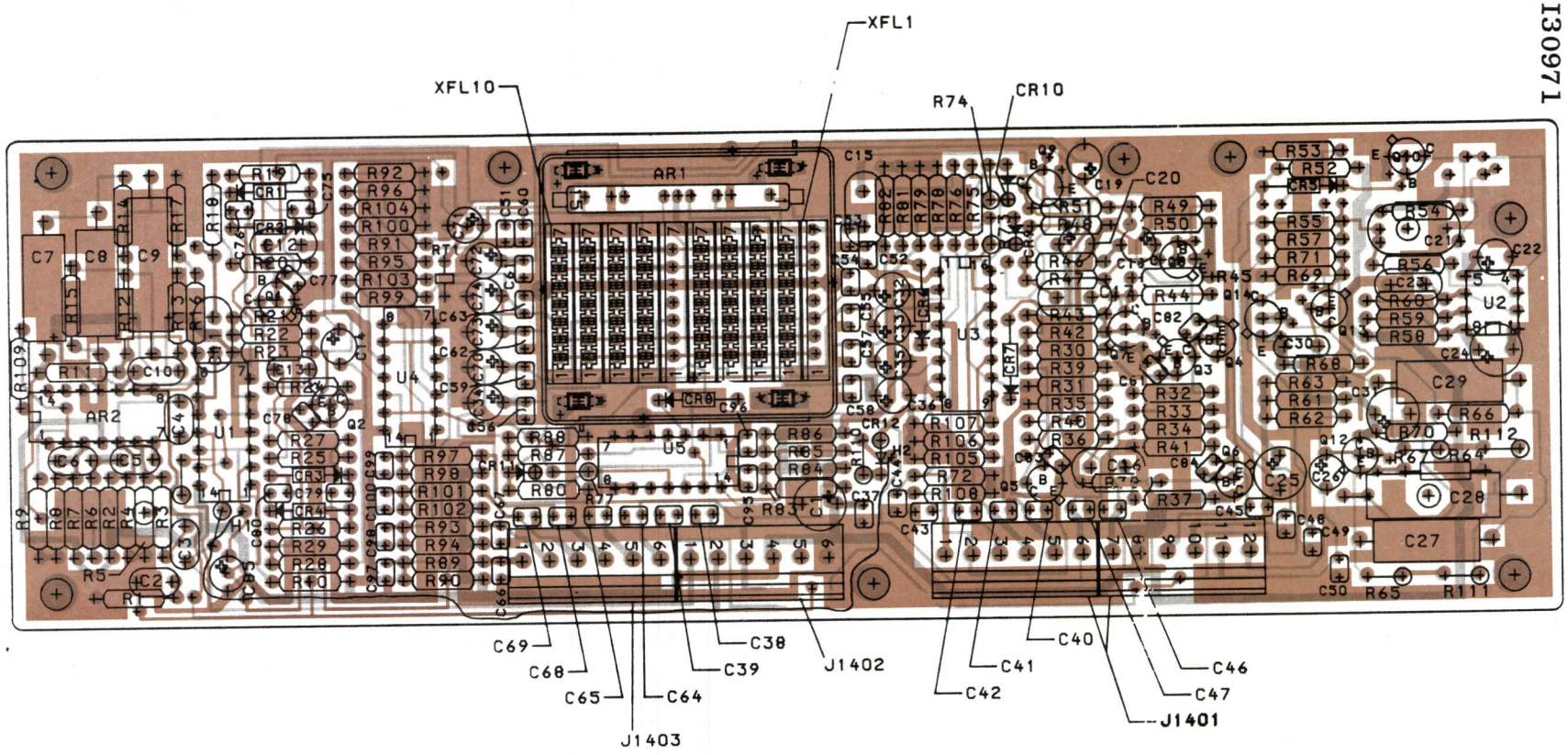
EQUIPMENT REQUIRED

1. Test Set TL59
2. Frequency Counter
3. Tone Burst Generator
4. RF Signal Generator

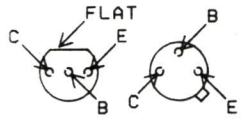
TO CHECK	TEST SET SWITCH	PROCEDURE
Versatones, FSSA, Tone Detect and Tone Ampl	S2 on ENCODE and TONE switch S4	Switch through each tone position. The TONE LED should light for each Versatone on the tone board. NOTE 1. The ALERT tone is not a Versatone. 2. ATTN and BUSY use the same Versatone. Approx. 750 millivolts RMS of tone should be present at J1-9 for each Versatone (at the tone frequency stamped on the Versatone ±1%). NOTE ATTN tone is approx. 12 dB below the BUSY tone level.
ALERT TONE	S4 on ALERT	With the ALERT tone selected, a tone should be heard in the speaker with the VOLUME control at minimum. The tone should get louder as the VOLUME control is turned clockwise.
Decode Threshold	S2 on DECODE	Apply an RF signal with 0.5 kHz deviation of busy tone at 20 dB above equivalent 12 dB SINAD level. The "TONE" LED should light. Check "COLLECT", "GROUP(S)", "IND" tone(s), and ACQ tone frequencies at J1-9.
Voice Reject Filter	S2 on DECODE	Apply BUSY tone to J2-1 just above decode threshold (approx. 100 millivolts). Swap the BUSY tone Versatone (Position 1) with the lowest frequency Versatone on the tone board. Readjust the input frequency to the lowest frequency Versatone. The TONE LED should NOT light. Next, select the position on S4 where the BUSY Versatone is presently located. Readjust the input tone to the BUSY Versatone frequency. The TONE LED should light. Be sure to return the two Versatones to their proper positions.
Busy tone Reject filter		Apply an on-frequency signal with 1 kHz tone at 3 kHz deviation to radio antenna jack. Set up the VOLUME control for normal listening level on the speaker. Adjust the tone input to the BUSY tone frequency. The tone level at the speaker should drop approx. 30 dB at Busy frequency (just audible at Busy frequency. NOTE A sharp notch should be noted at the Busy frequency.

OUTLINE DIAGRAM

TONE BOARD 19D432014G1-G4



LEAD IDENTIFICATION
FOR Q1-Q10, Q12-Q14



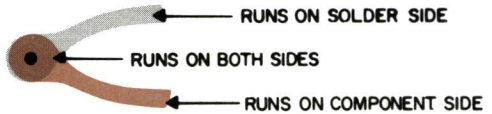
OR

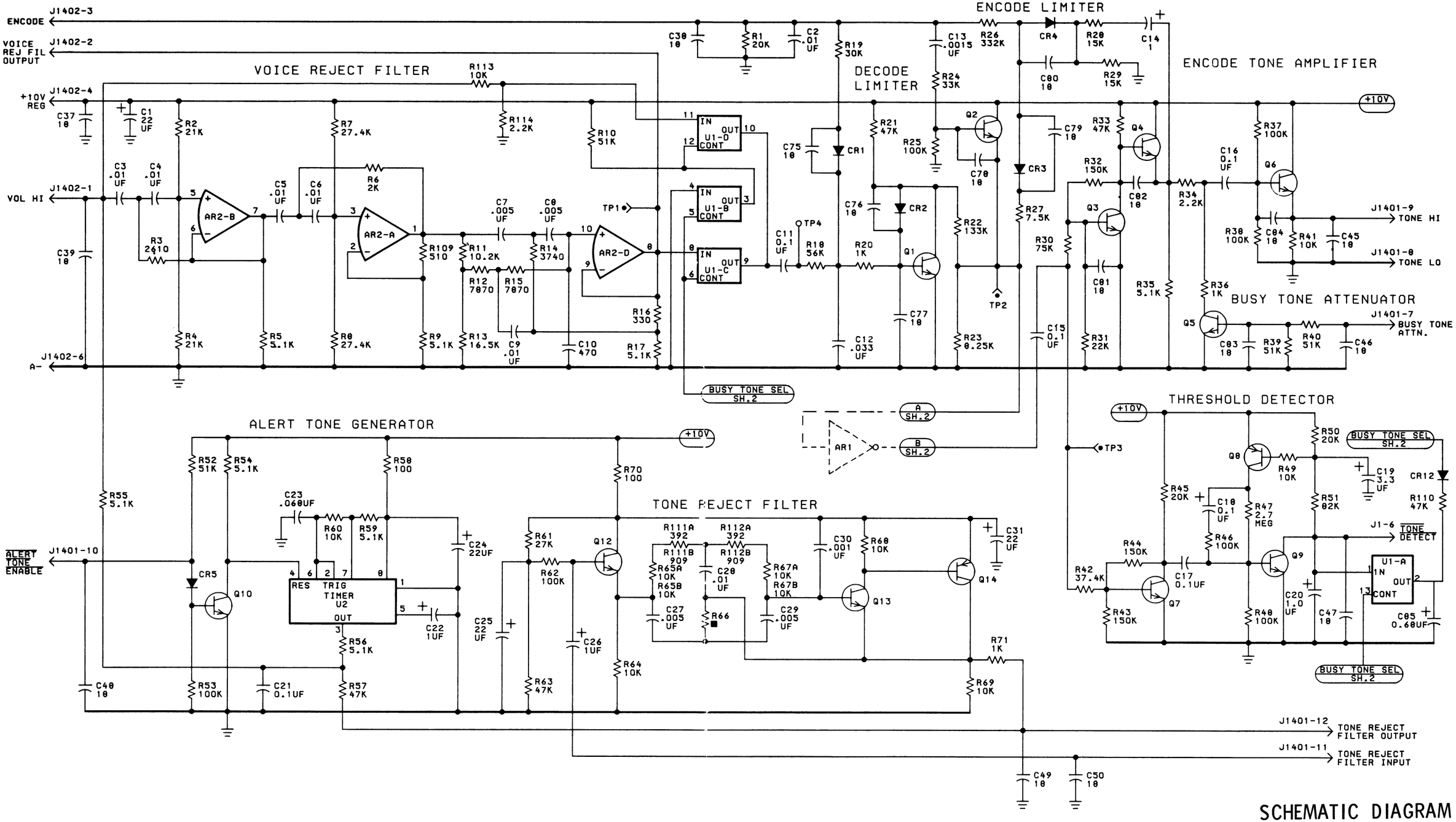
IN-LINE TRIANGULAR

TOP VIEW

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

(19D432016, Rev. 8) *
(19A144101, Sh. 1, Rev. 2)
(19A144101, Sh. 2, Rev. 2)



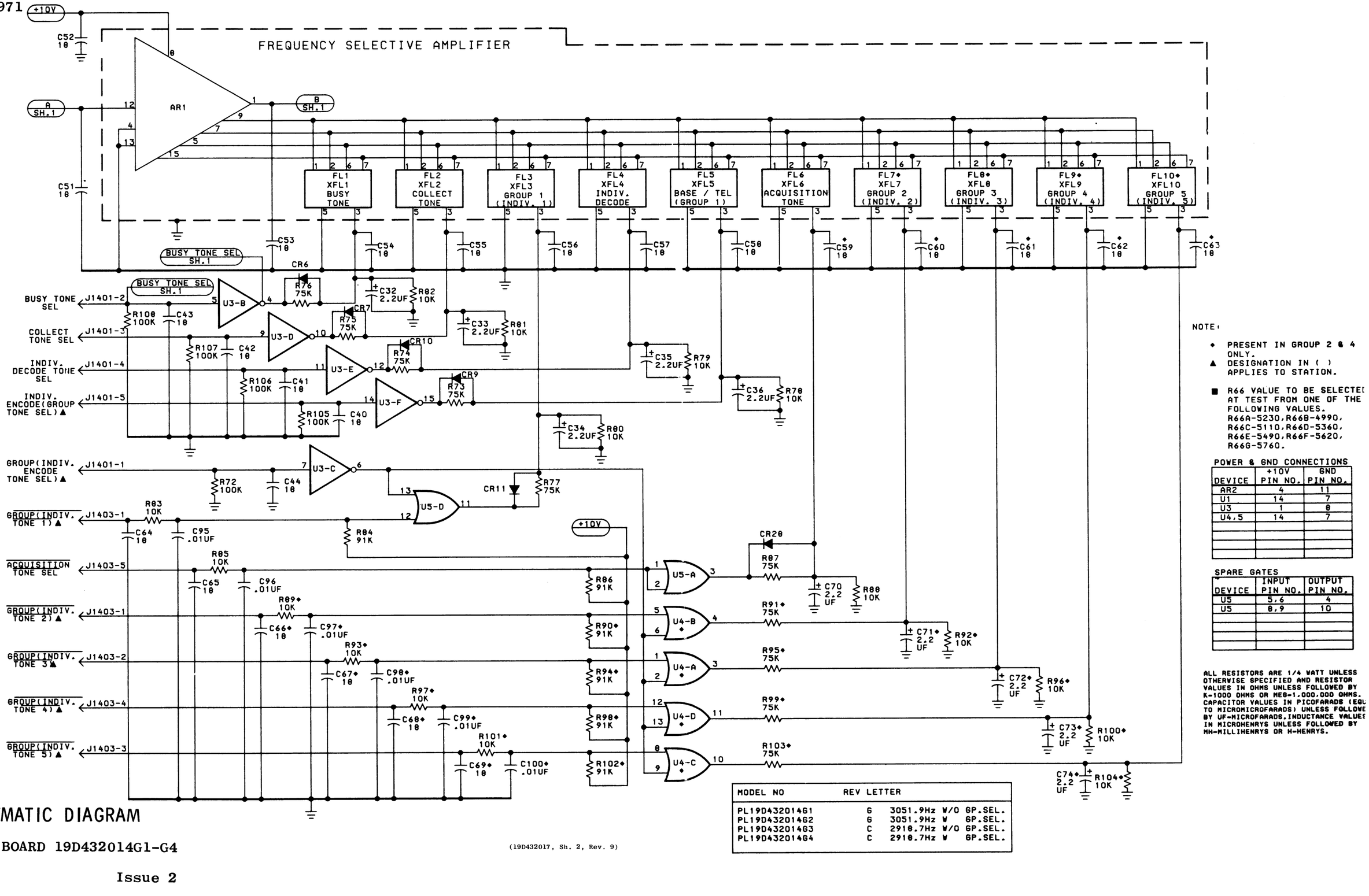


(19D432017, Sh. 1, Rev. 9)

SCHEMATIC DIAGRAM

TONE BOARD 19D432014G1-G4

Issue 2



NOTE:

◆ PRESENT IN GROUP 2 & 4 ONLY.
▲ DESIGNATION IN ( ) APPLIES TO STATION.

■ R66 VALUE TO BE SELECTED AT TEST FROM ONE OF THE FOLLOWING VALUES. R66A-5230, R66B-4990, R66C-5110, R66D-5360, R66E-5490, R66F-5620, R66G-5760.

POWER & GND CONNECTIONS

DEVICE	+10V PIN NO.	GND PIN NO.
AR2	4	11
U1	14	7
U3	1	8
U4,5	14	7

SPARE GATES

DEVICE	INPUT PIN NO.	OUTPUT PIN NO.
U5	5,6	4
U5	8,9	10

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 (EQU TO MICROMICROFARADS) UNLESS FOLLOWE BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

MODEL NO	REV LETTER	
PL19D43201461	G	3051.9Hz W/O GP.SEL.
PL19D43201462	G	3051.9Hz W GP.SEL.
PL19D43201463	C	2918.7Hz W/O GP.SEL.
PL19D43201464	C	2918.7Hz W GP.SEL.

(19D432017, Sh. 2, Rev. 9)

SCHEMATIC DIAGRAM

TONE BOARD 19D432014G1-G4

PARTS LIST

TONE BOARD
19D432014G1 w/O SELECTABLE, 3051.9 BUSY TONE REV G
19D432014G2 W SELECTABLE, 3051.9 BUSY TONE REV G
19D432014G3 W/O SELECTABLE, 2918.7 BUSY TONE REV C
19D432014G4 W SELECTABLE, 2918.7 BUSY TONE REV C
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
AR1	19D417092G2	Selective Amplifier.
AR2	19A134511P1	Integrated Circuit, Linear.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A701534P8	Tantalum: 22 µf ±20%, 16 vdcw.
C2	19A700234P7	Polyester: 0.01 µf ±20%, 50 VDCW.
C3 thru C6	19A143477P14	Polyester: 0.01 µf ±5%, 50 VDCW.
C7 and C8	19C307114P5001G	Polystyrene: 5K pf ±2%, 100 VDCW, temp coef -120±30 PPM/°C.
C9	19C307114P1002G	Polystyrene: 0.010 µf ±2%, 100 VDCW, temp coef -120±30 PPM/°C.
C10	19A116655P14	Ceramic: 470 pf ±10%, 1000 VDCW; sim to Radio Materials Type JF DISCAPS.
C11	19A1143477P26	Polyester: 0.1 µf ±20%, 50 VDCW.
C12	19A700234P10	Polyester: 0.033 µf ±20%, 50 VDCW.
C13	19A700234P2	Polyester: 0.0015 µf ±20%, 50 VDCW.
C14	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C15 thru C17	19A143477P26	Polyester: 0.1 µf ±20%, 50 VDCW.
C18	19A701534P1	Tantalum: 0.1 µf ±20%, 35 VDCW.
C19	19A143486P7	Tantalum: 3.3 µf ±20%, 15 VDCW.
C20	19A134202P112	Tantalum: .47 µf ±10%, 35 VDCW.
C21	19A143477P26	Polyester: 0.1 µf ±20%, 50 VDCW.
C22	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C23	19A143477P24	Tantalum: 22 µf ±10%, 15 VDCW.
C24 and C25	19A701534P8	Tantalum: 22 µf ±20%, 16 vdcw.
C26	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C27	19C307114P5001G	Polystyrene: 5K pf ±2%, 100 VDCW, temp coef -120±30 PPM/°C.
C28	19C307114P1002G	Polystyrene: 0.010 µf ±2%, 100 VDCW, temp coef -120±30 PPM/°C.
C29	19C307114P5001G	Polystyrene: 5K pf ±2%, 100 VDCW, temp coef. -120±30 PPM/°C.
C30	19A700233P7	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C31	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C32 thru C36	19A143486P112	Tantalum: 2.2 µf ±10%, 20 VDCW.
C37 thru C69	19A700219P38	Ceramic: 18 pf ±5%, 100 VDCW.
C70 thru C74	19A143486P112	Tantalum: 2.2 µf ±10%, 20 VDCW.
C75 thru C84	19A700219P38	Ceramic: 18 pf ±5%, 100 VDCW.
C85*	19A143486P118	Tantalum: 0.68 µf ±10%, 35 VDCW.
		Earlier than REV A:
	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW.
C95 thru C100	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR2*	19A115775P1	Silicon, fast recovery, 225 mA, 50 PIV.
		Earlier than REV A:
	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR3 and CR4	19A115775P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR5	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR6* thru CR8*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added to G1 & G2 by REV A.
CR9 thru CR12	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - VERSATONES - - - - - - - - - -
		NOTE: When reordering FL1 and FL6 give GE Part part Number and specify the exact frequency on component.
FL1A	19C320291G6	Busy Tone Network. (3051.8).
FL1B	19C320291G8	Busy Tone Network. (2918.7).
FL6	19C320291G7	Acquisition Tone Network.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1401	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061. (Quantity 2).
J1402 and J1403	19A116659P50	Connector, printed wiring: 6 contacts; sim to Molex 09-65-1061.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1*	19A116774P1	Silicon, NPN; sim to Type 2N5210.
		Earlier than REV A:
	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q2 thru Q7	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q8	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q9 thru Q13	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q14	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A143400P52	Deposited carbon: 20K ohms ±5%, 1/4 w.
R2	19C314256P22102	Metal film: 21K ohms ±1%, 1/4 w.
R3	19A701250P241	Metal film: 2.6K ohms ±1%, 250 VDCW, 1/4 w.
R4	19C314256P22102	Metal film: 21K ohms ±1%, 1/4 w.
R5	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R6	19A701250P230	Metal film: 2K ohms ±1%, 250 VDCW, 1/4 w.
R7 and R8	19C314256P22742	Metal film: 27.4K ohms ±1%, 1/4 w.
R9	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R10	19A143400P57	Deposited carbon: 51K ohms ±5%, 1/4 w.
R11	19C314256P21022	Metal film: 10.2K ohms ±1%, 1/4 w.
R12	19A701250P187	Metal film: 7.87K ohms ±1%, 250 VDCW, 1/4 w.
R13	19C314256P21652	Metal film: 16.5K ohms ±1%, 1/4 w.
R14	19A701250P256	Metal film: 3.74K ohms ±1%, 250 VDCW, 1/4 w.
R15	19A701250P287	Metal film: 7.87K ohms ±1%, 250 VDCW, 1/4 w.
R16	19A700019P31	Deposited carbon: 330 ohms ±5%, 0.25 w.
R17	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R18	19A700019P58	Deposited carbon: 56K ohms ±5%, 0.25 w.
R19	19A143400P54	Deposited carbon: 30K ohms ±5%, 1/4 w.
R20	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R21*	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
		In REV A:
	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
		Earlier than REV A:
	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R22*	19C314256P21333	Metal film: 133K ohms ±1%, 1/4 w.
		In REV B:
	19C314256P21213	Metal film: 121K ohms ±1%, 1/4 w.
		In REV A & earlier:
	19C314256P21503	Metal film: 150K ohms ±1%, 1/4 w.
R23	19A701250P289	Metal film: 8.25K ohms ±1%, 250 VDCW. 1/4 w.
R24	19A700019P55	Deposited carbon: 33K ohms ±5%, 0.25 w.
R25	19A700019P61	Deposited carbon: 0.1 megohm ±5%, 0.25 w.
R26	19C314256P23323	Metal film: 332K ohms ±1%, 1/4 w.
R27	19A701250P285	Metal film: 7.5K ohms ±1%, 250 VDCW, 1/4 w.
R28 and R29	19C314256P21502	Metal film: 15K ohms ±1%, 1/4 w.
R30	19C314256P27502	Metal film: 75K ohms ±1%, 1/4 w.
R31	19A700019P53	Deposited carbon: 22K ohms ±5%, 0.25 w.
R32	19C314256P21503	Metal film: 150K ohms ±1%, 1/4 w.
R33	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
R34*	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 0.25 w.
		In REV A & earlier:
	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R35	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R36	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R37 and R38	19A700019P61	Deposited carbon: 0.1 megohms ±5%, 0.25 w.
R39 and R40	19A143400P57	Deposited carbon: 51K ohms ±5%, 1/4 w.
R41	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R42	19C314256P23742	Metal film: 37.4K ohms ±1%, 1/4 w.
R43	19A700019P63	Deposited carbon: 0.15 megohms ±5%, 0.25 w.
R44	19C314256P21503	Metal film: 150K ohms ±1%, 1/4 w.
R45	19A143400P52	Deposited carbon: 20K ohms ±5%, 1/4.
R46*	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
		Earlier than REV A:
	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R47	3R152P275J	Composition: 2.7 megohms ±5%, 1/4 w.
R48*	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
		Earlier than REV A:
	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R49*	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
		Earlier than REV A:
	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R50*	19C314256P22002	Metal film: 20K ohms ±1%, 1/4 w.
		Earlier than REV A:
	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
R51*	19C314256P28252	Metal film: 82.5K ohms ±1%, 1/4 w.
		Earlier than REV A:
	3R152P823J	Composition: 82K ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R52	19A143400P57	Deposited carbon: 51K ohms ±5%, 1/4 w.
R53	19A700019P61	Deposited carbon: 0.1 megohms ±5%, 0.25 w.
R54 thru R56	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R57	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
R58	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
R59	19A143400P45	Deposited carbon: 5.1K ohms ±5%, 1/4 w.
R60	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R61	19A700019P54	Deposited carbon: 27K ohms ±5%, 0.25 w.
R62	19A700019P61	Deposited carbon: 0.1 megohms ±5%, 0.25 w.
R63	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
R64	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R65A and R65B	19A701250P301	Metal film: 10 K ohms ±1%, 250 VDCW, 1/4 w. (3051.9 Hz).
R66A*	19A701250P270	Metal film: 5.23K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66B*	19A701250P268	Metal film: 4.99K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66C*	19A701250P269	Metal film: 5.11K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66D*	19A701250P271	Metal film: 5.36K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66E*	19A701250P272	Metal film: 5.49K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66F*	19A701250P273	Metal film: 5.62K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R66G*	19A701250P274	Metal film: 5.76K ohms ±1%, 250 VDCW, 1/4 w. Added by REV A.
R67A and R67B	19A701250P301	Metal film: 10K ohms ±1%, 250 VDCW, 1/4 w.
R68 and R69	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R70	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
R71	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R72	19A700019P61	Deposited carbon: 0.1 megohms ±5%, 0.25 w.
R73	3R152P753J	Composition: 75K ohms ±5%, 1/4 w.
R74 thru R77	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R78 thru R83	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R84	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R85	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R86	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R87	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R88 and R89	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R90	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R91	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R92 and R93	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R94	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R95	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R96 and R97	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R98	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R99	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R100 and R101	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.

SYMBOL	GE PART NO.	DESCRIPTION
R102	19A143400P60	Deposited carbon: 91K ohms ±5%, 1/4 w.
R103	19A143400P59	Deposited carbon: 75K ohms ±5%, 1/4 w.
R104	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R105 thru R108	19A700019P61	Deposited carbon: 0.1 megohms ±5%, 0.25 w.
R109	19A143400P33	Deposited carbon: 510 ohms ±5%, 1/4 w.
R110	19A700019P57	Deposited carbon: 47K ohms ±5%, 250 VDCW, 1/4 w.
R111A	19A701250P158	Metal film: 392 ohms ±1%, 250 VDCW, 1/4 w.
R111B	19A701250P193	Metal film: 909 ohms ±1%, 250 VDCW, 1/4 w.
R112A	19A701250P158	Metal film: 392 ohms ±1%, 250 VDCW, 1/4 w.
R112B	19A701250P193	Metal film: 909 ohms ±1%, 250 VDCW, 1/4 w.
R113	19A700019P49	Deposited carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R114	19A700106P71	Deposited carbon: 0.68 MEGohm ±5%, 250 VDCW, 1/4 w.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1*	19C300048P16	Disc: 400K ohms ±20%; sim to NL Ind. RODAN1DE - 404MEC. Added by REV A.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP1 thru TP4	19B211379P1	Spring (Test Point).
		- - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	19A134097P52	Digital, Quad Bilateral Switch(Improved CD4016AE): Identification No. 4066.
U2	19A116968P1	Linear, timer: Dual In-Line 8 Pin Mini Dip Package; sim to Signetics SA555N.
U3	19A134097P341	Digital, Hex Buffer/Converter (Inverting: Identification No. 4049 UB.
U4 and U5	19A134097P55	Digital, Quad (2) Input Or Gate: Identification No. 4071.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL1 thru XFL10	19C320299G1	Connector. Includes:
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).
		ASSOCIATED PARTS
		- - - - - - - - - - VERSATONES - - - - - - - - - -
		NOTE: When reordering FL2-FL5 and FL7-FL10 give GE Part Number & specify the exact frequency on component.
FL2 thru FL5	19C320291G5	Tone Network. (604.2 - 3051.9 Hz).
FL7 thru FL10	19C320291G5	Tone Network. (604.2 - 3051.9 Hz).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B233343G1	Shield. (Located around the Versatones).
	19A142654G1	Cover.
	19A142730G1	Shield. (Located under the Versatones).
	19A116428P4	Contact, electrical. (Located at the Versatones).

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 - 19D432014G1 & G2

To improve operation. Changed CR2, C85, R21, R46, R48, R49, R50, R51 and Q1. Added RT1, R66A-R66E, CR6, CR7 and CR8.

REV. B - 19D432014G1 & G2

To improve operation of tone detect circuit at 60°C. Changed R21, R22 and R34.

REV. C - 19D432014G1 & G2

To improve operation of tone detect circuit. Changed R22.

REV. D - 19D432014G1 & G2

To prevent false tone detection. Added CR9, CR10. CR11 and R110.

REV. E - 19D432014G1 & G2

REV. A - 19D432014G3 & G4

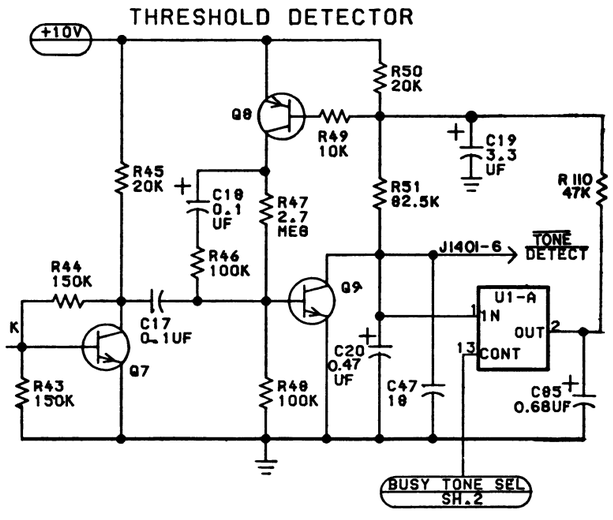
To increase Acquisition Tone dropout delay to 30 milliseconds. Changed C20.

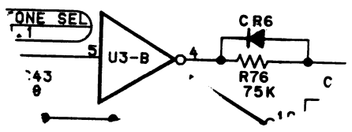
REV. F - 19D432014G1 & G2

REV. B - 19D432014G3 & G4

To increase busy tone dropout delay by switching R110 out of the circuit. Added CR12 and moved R110 from +10 Volts to output of U3-B through CR12.

OLD SCHEMATIC WAS:





REV. G - 19D432014G1 & G2

REV. C - 19D432014G3 & G4

To assure that the tone reject filter provides the proper attenuation. Changed R65A, R65B, R67A and R67B. Also added R111A, R111B, R112A and R112B. Components were: R67A - 19C314256P21052, Metal film: 10.5K ohms ±1%, 1/4 W. (3051.9 Hz). R67B - 19C314256P21102, Metal film: 11K ohms ±1%, 1/4 W. (2918.7 Hz). R65A - 19C314256P21052, Metal film: 10.5K ohms ±1%, 1/4 W. (3051.9 Hz). R65B - 19C314256P21102, Metal film: 11K ohms ±1%, 1/4 W. (2918.7 Hz).

REV. H - 19D432014G1 & G2

REV. D - 19D432014G3 & G4

To reduce the chance of falsing in the GE-MARC V system. Changed C20 and added R113 and R114. C20 was: 19A116080P12 - Polyester: 0.0015 µF ±20%, 50 VDCW.

ADDENDUM #1 TO LBI30971A

This addendum provides corrections to the Production Change section.

PRODUCTION CHANGES

REV. E - 19D432014G1 & G2

REV. A - 19D432014G3 & G4

To increase Acquisition Tone dropout delay to 30 milliseconds. Changed C20 from 0.47 to 1.0 µf (19A134202P14).

REV. F - 19D432014G1 & G2

REV. B - 19D432014G3 & G4

To assure that the tone reject filter provides the proper attenuation. Changed R65A, R65B, R67A and R67B. Also added R111A, R111B, R112A and R112B. Components were: R67A - 19C314256P21052, Metal film: 10.5K ohms ±1%, 1/4 W. (3051.9 Hz). R67B - 19C314256P21102, Metal film: 11K ohms ±1%, 1/4 W. (2918.7 Hz). R65A - 19C314256P21052, Metal film: 10.5K ohms ±1%, 1/4 W. (3051.9 Hz). R65B - 19C314256P21102, Metal film: 11K ohms ±1%, 1/4 W. (2918.7 Hz).

REV. G - 19D432014G1 & G2

REV. C - 19D432014G3 & G4

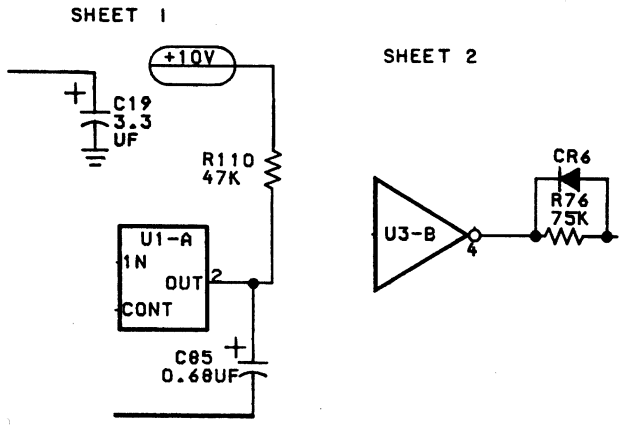
To reduce the chance of falsing in the GE-MARC V system. Changed C20 and added R113 and R114. C20 was: 19A134202P14 - tantalum, 1.0 µf ±20%, 50 VDCW. C20 was changed to 7015534P3, tantalum, 0.47 µf ±10%, 35 VDCW.

REV. H - 19D432014G1 & G2

REV. D - 19D432014G3 & G4

To increase busy tone dropout delay by switching R110 out of the circuit. Added CR12 and moved R110 from +10 Volts to output of U3-B through CR12.

OLD SCHEMATIC WAS:



NEW SCHEMATIC IS: