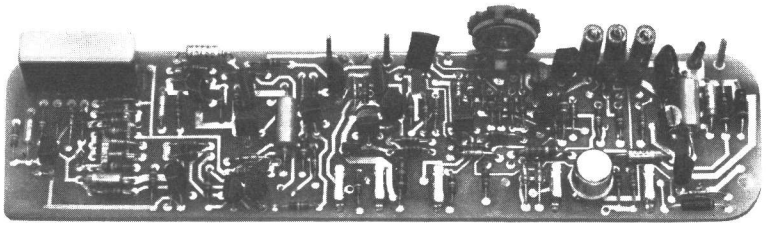
MOBILE RADIO

MAINTENANCE MANUAL

TYPE 90 TONE ENCODER/DECODER, ENCODER AND DECODER 19A129567G13-15

Maintenance Manual LBI-4968 A
DATAFILE FOLDER - DF - 5046



TYPE 90 TONE ENCODERS AND DECODERS 19A129567G13-15

SPECIFICATIONS *

Controls	Tone Level Adjust Tone/On Option/On
Input Voltage	13.8 VDC
Current Drain	40 milliamperes maximum
Encode Tone Amplitude	150 millivolts minimum @600 ohms
Tone Frequencies	1000 to 3000 Hz
Frequency Stability	±0.2%
Automatic Tone Burst Duration	1 second ±40%
Pushbutton Tone Burst Duration	Manually Controlled
Encode Start Time	Less than 200 milliseconds
Decode Input Signal	Less than 40 millivolts
Temperature Range	-40°C to +70°C (-40°F to +158°F)

*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

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.

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns. KEEP AWAY FROM THESE CIRCUITS WHEN THE TRANSMITTER IS ENERGIZED!

DESCRIPTION

General Electric Type 90 Pulse Tone Encoder and Decoder assemblies operate on standard Type 90 tone frequencies between 1000 and 3000 Hz. Operating frequencies for Type 90 tone are listed on the parts list.

The Type 90 Tone Assemblies include Encode/Decode, Encode only, Decode only and may also include such options as pushbutton tone, external alarm, automatic tone burst or a combination of these.

Figure 1 shows the various components used with each option. The Type 90 component board plugs into designated pins on the control unit printed wire board (PWB) 19D416737G3 or 19D423588G5.

OPERATION

Monitor Reset

The monitor/reset switch located on the handset holder or microphone hookswitch controls the decoder operation. When in the monitor (up) position, the receiver reverts to noise squelch operation and responds to all calls transmitted on the operating frequency. When in the reset (down) position the receiver responds only to those calls that are tone coded with the proper Type 90 tones and, if used, the proper Channel Guard frequency.

The monitor/reset switch and hookswitch are connected in parallel so that when the microphone or handset is removed the receiver reverts to noise squelch operation. Replacing the microphone or handset automatically resets the Type 90 decode circuits and turns off the call indicator.

Tone-On Switch

Operation of the pushbutton tone function is controlled by a momentary switch on the control unit. The TONE-ON switch on the control unit must be held in the ON position to transmit a continuous tone and released for normal operation of the encoder/decoder. (The monitor/reset switch on the microphone or handset holder must be in the "up" position to monitor the channel and in the down position for normal decoder operation.)

Option Switch

The external alarm (when provided) is controlled by a two position OPTION-ON switch on the control unit.

When a properly tone coded call is received and the OPTION switch is in the ON position, the external horn or light will operate. When in the "off" position, the external circuit is inactive.

Call Indicator

The decode call indicator is independent of the OPTION-ON switch and will light each time a call is received. The indicator is located in the front indicator slot of the control unit housing.

Automatic Tone Burst

The automatic tone burst feature, as supplied from the factory is wired to provide a tone burst at the beginning of each transmission. It can be internally modified with a jumper to transmit a tone burst each time the push-to-talk switch is operated.

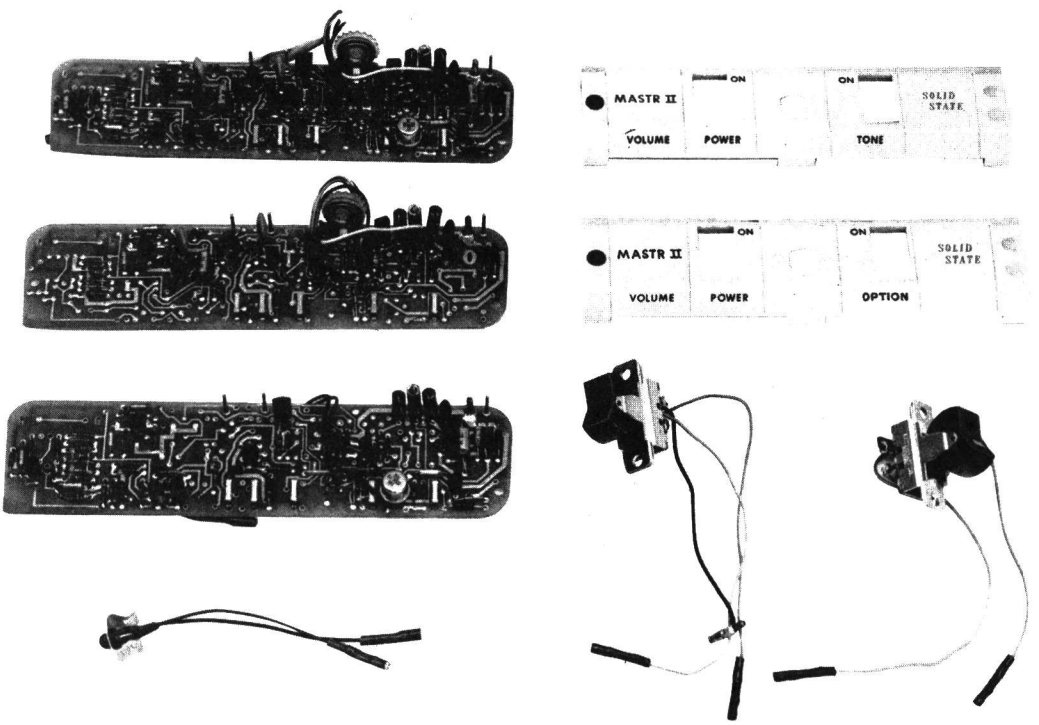


Figure 1 - Option Kit Components

CIRCUIT ANALYSIS

References to symbol numbers mentioned in the following text are found on the Schematic Diagrams, Outline Diagram and Parts List. Figures 2, 3 and 4 are block diagrams of the Type 90 Encode/Decode, Decode and Encode circuits.

TYPE 90 ENCODE/DECODE

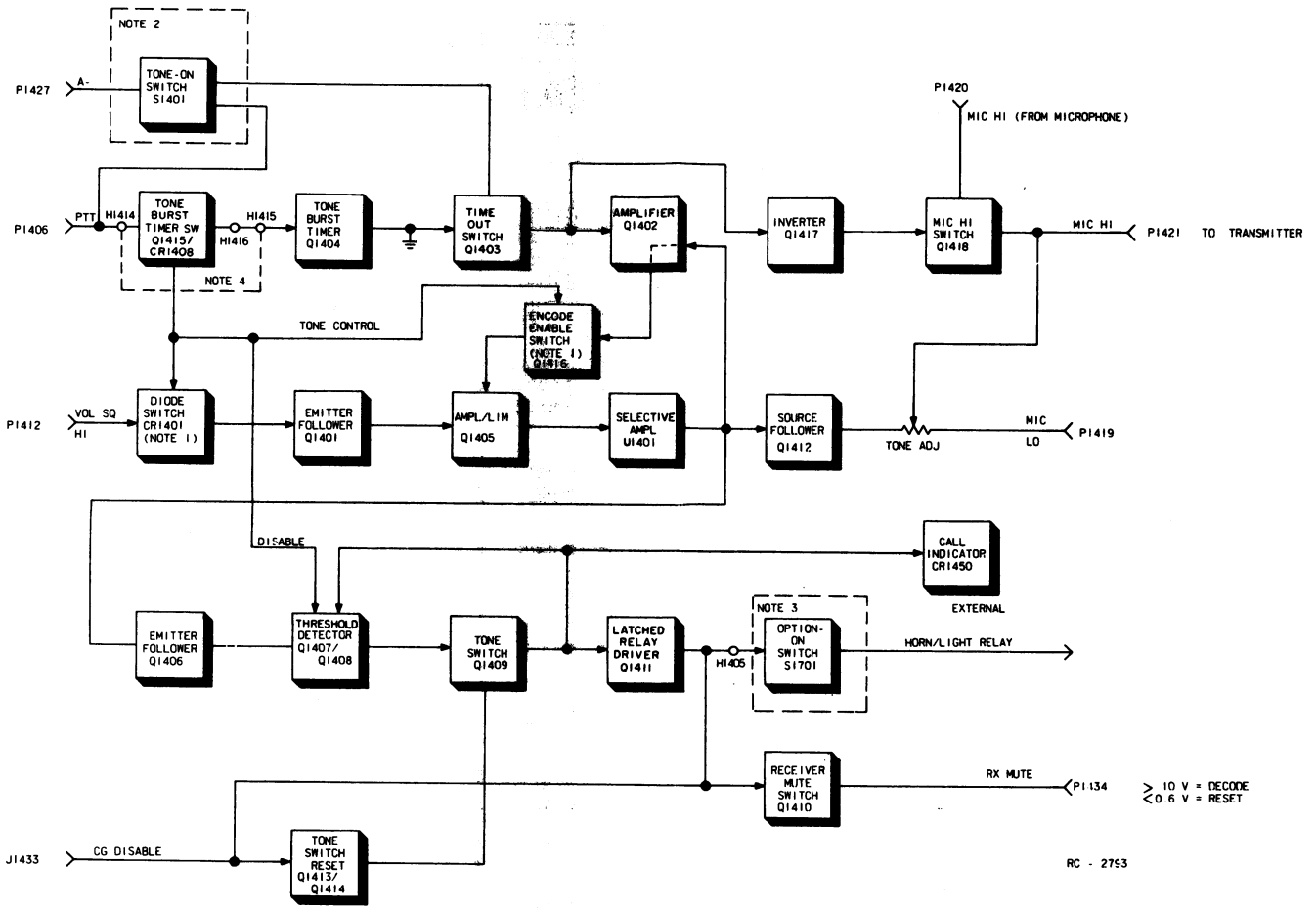
MONITOR

Placing the monitor/reset switch in the monitor (up) position applies A- via the CG disable lead to the base of receiver mute transistor Q1410 through J1433 and zener diode VR1403 and to timer reset switch Q1413. Receiver mute transistor Q1410 turns off, allowing the receiver to operate on noise squelch. Timer reset switch Q1413 also is turned off and provides +12 V to timer reset diode CR1408 and tone burst timer switch Q1404. Q1404 turns on and discharges timing capacitor C1405.

Placing the monitor/reset switch in the "down" position removes A- from the base of receiver mute switch Q1410, allowing it to turn on and mute the receiver. Note: This switch is the same as used with Channel Guard and, if Channel Guard is present, these functions operate in parallel.

ENCODE

Removing the microphone/handset from the hookswitch applies A- from the Channel Guard disable input J1433 to the base of timer reset switch Q1413, turning it off (refer to Figure 2). The collector of Q1413 goes positive and provides 13.8 V from P1407 through R1450, R1445 and R1413 to the base of tone burst timer Q1404. Q1404 turns on and discharges timing capacitor C1405 to reset the timer. C1405 will remain discharged until the transmitter is keyed.



NOTES
1. GROUP 1 ENCODE/DECODE ONLY.
2. PRESENT WHEN MANUAL TONE BURST IS REQUIRED.
3. USED WHEN EXTERNAL ALARM IS PRESENT.
4. ENCODE WITHOUT AUTOMATIC TONE BURST.

Figure 2 - Type 90 Tone Encode/Decode Block Diagram

Keying the transmitter applies A- to the base of tone burst switch Q1415, turning it off. This causes the collector voltage of Q1415 to increase and fire SCR CR1408. CR1408 applies A- to the base of tone burst timer Q1404, turning it off and actuating the timer.

Since the SCR will remain on until reset by placing the microphone/handset on-hook, only a single tone burst is transmitted for each transmission.

NOTE

A DA jumper wire is connected between H1415 and H1416 to provide automatic tone burst on first transmission only. This DA jumper wire may be removed and connected between H1415 and H1414 to provide a tone burst each time the transmitter is keyed rather than one tone burst for each transmission. With option 1016, which is equipped with a manual pushbutton, both DA jumpers can be removed to provide manual pushbutton control only.

In addition, the tone burst switch reverse biases diode switch CR1401 to eliminate interference from the audio input and turns off encode enable switch Q1416. This removes 5.4 V from the base of Q1402 and allows tone feedback amplifier Q1402 to be turned on. The tone burst switch also applies A+ through R1443, CR1406 and R1434 to the base of threshold reference transistor Q1408. This causes Q1408 to conduct harder, thereby increasing the operating level of the threshold detector. The threshold detector then does not respond to the encode tone when the transmitter is keyed and the receiver will not be unmuted.

The duration of the tone burst is determined by the RC time constant of R1412 and C1405. While C1405 is charging, timer output switch Q1403 is turned off, allowing tone feedback amplifier Q1402 to conduct and complete the tone feedback path for the selective amplifier. The tone feedback path is completed through R1409, feedback amplifier Q1402, tone amplifier Q1405 and limiter CR1403 and CR1404. With the feedback path completed the selective amplifier oscillates at the encode tone frequency.

Tone from the selective amplifier is applied to the gate of source follower Q1412. The output of the source follower is provided to the transmitter via tone adjust potentiometer R1440 and Mic Hi plug P1421. R1440 is set for 3 kHz deviation at the transmitter. At this time Mic Hi switch Q1418 is turned off by inverter Q1417. Since timer output switch Q1403 is also turned off at this time, the base of inverter Q1417 is positive, turning it on. Q1417 then applies A- to Mic Hi switch Q1418 turning it off and opening the microphone circuit.

After approximately one second C1405 charges up and turns on timer output switch Q1403. Q1403 applies A- to the emitter of tone feedback amplifier Q1402, turning it off and interrupting the tone feedback path. This causes the selective amplifier to stop oscillating. At the same time, Q1403 also applies A- to the base of inverter Q1417, turning it off. The collector of Q1417 then goes positive and turns on Mic Hi switch Q1418 to close the circuit to the microphone via P1420 and P1421.

Tone-On

In addition to generating a tone burst when the transmitter is keyed, a continuous tone can be generated by holding the TONE-ON switch in the ON position. The tone is generated in the same manner described above except the tone burst time is bypassed. A-, in addition to being applied to tone burst switch Q1415 as before, is applied directly to timing capacitor C1405 and the base of timer output switch Q1403. This keeps timing capacitor C1405 discharged and turns Q1403 off. With Q1403 turned off the tone feedback path is completed through tone feedback amplifier Q1402 and the selective amplifier oscillates as before.

Tone-Off

Releasing the TONE-ON switch removes A- from tone burst switch Q1415 and allows it to turn on. Q1415 applies A- to the base of encode enable switch Q1416 causing it to turn on and apply +5.4 V to the base of tone feedback amplifier Q1402. Q1402 stops conducting to interrupt the tone feedback path and stop oscillations from the selective amplifier.

DECODE

When the TONE switch is in the "off" position, tone burst timer switch Q1415 is held on by the push-to-talk lead. A- from tone burst timer switch Q1415 holds encode enable switch Q1416 on which prevents the selective amplifier from oscillating.

Diode switch CR1401 is forward biased to allow monitoring the volume/squelch high output.

Audio from the volume/squelch high output is coupled to tone amplifier Q1405 through emitter follower Q1401. The audio is amplified and then limited by limiter diodes CR1403 and CR1404. The limited audio is applied to the input of selective amplifier U1401. If the tone component of the audio is the same frequency as the selective amplifier, the tone frequency will be amplified to a level sufficient to operate the threshold detector and applied to peak detector Q1406.

The positive half cycles of the emitter follower output reverse bias diode CR1405, allowing the base of threshold detector Q1407

to rise. Q1407 turns on and turns on tone switch Q1409. Q1409 applies 8.2 V to call indicator LED CR1450, latched relay driver Q1411 and through R1423 to diode CR1405. Diode CR1405 is reverse biased, causing the base voltage of Q1407 to remain high and keep Q1407 on. This holds the base of tone switch Q1409 low, holding it on and latching the relay driver and option indicator on.

Latched relay driver Q1411 provides A- to receiver mute switch Q1410 through zener diode VR1403. This turns the receiver mute switch off and unmutes the receiver. The voltage at P1434 should be approximately 10 V in the unmuted condition.

Tone Switch Reset

Placing the microphone/handset on-hook removes A- from the base of timer reset switch Q1413, allowing it to turn on. When Q1413 turns on its collector goes to A- and a negative going transistion is coupled to the base of tone reset switch Q1414. Q1414 momentarily turns on and applies a positive pulse to the base of tone switch Q1409, turn- it off. Turning Q1409 off interrupts the latching circuit to the call indicator CR1450 and latched relay driver Q1411.

Voltage Regulator

The voltage regulator consists of zener diodes and associated components that provide a regulated output of 8.2 V and 5.4 V. Zener diode VR1401 provides 8.2 V to latched relay driver Q1411, tone switch Q1409 and threshold detector Q1407 and Q1408. Zener diode VR1402 provides bias voltage to threshold detector Q1407 and Q1408 and operating voltage to all other circuits.

TYPE 90 DECODER

Audio from the volume squelch high circuit is coupled to tone amplifier Q1405 through emitter follower Q1401 (refer to Figure 3). The audio is amplified and then limited by CR1403 and CR1404. The limited audio is applied to selective amplifier U1401. If the tone component of the audio matches the frequency of the selective amplifier, the tone frequency will be amplified to a level sufficient to operate the threshold detector and is applied to peak detector Q1406. Q1406 turns on and provides collector voltage to tone switch Q1409.

The positive half cycles of the emitter follower output reverse bias diode CR1405 in the base circuit of threshold detector Q1407. Q1407 turns on and pulls the base of tone switch Q1409 low, turning it on. Q1409 provides 8.2 V to call indicator LED CR1450, latched relay driver Q1411 and through R1423 to diode CR1405. The 8.2 V reverse biases diode CR1405, causing the base voltage of threshold detector Q1407 to remain high and hold Q1407 on. This holds the base of tone switch Q1409 low keeping it on and latching relay driver Q1411 and call indicator CR1450 on.

Latched relay driver Q1411 provides A- to the base of receiver mute switch Q1410 through zener diode VR1403. Q1410 turns off, removing A- from P1434 and unmuting the receiver. The voltage at P1434 should be approximately 10 V in the unmuted condition.

Tone Switch Reset

Placing the microphone/handset on-hook removes A- from the base of timer reset

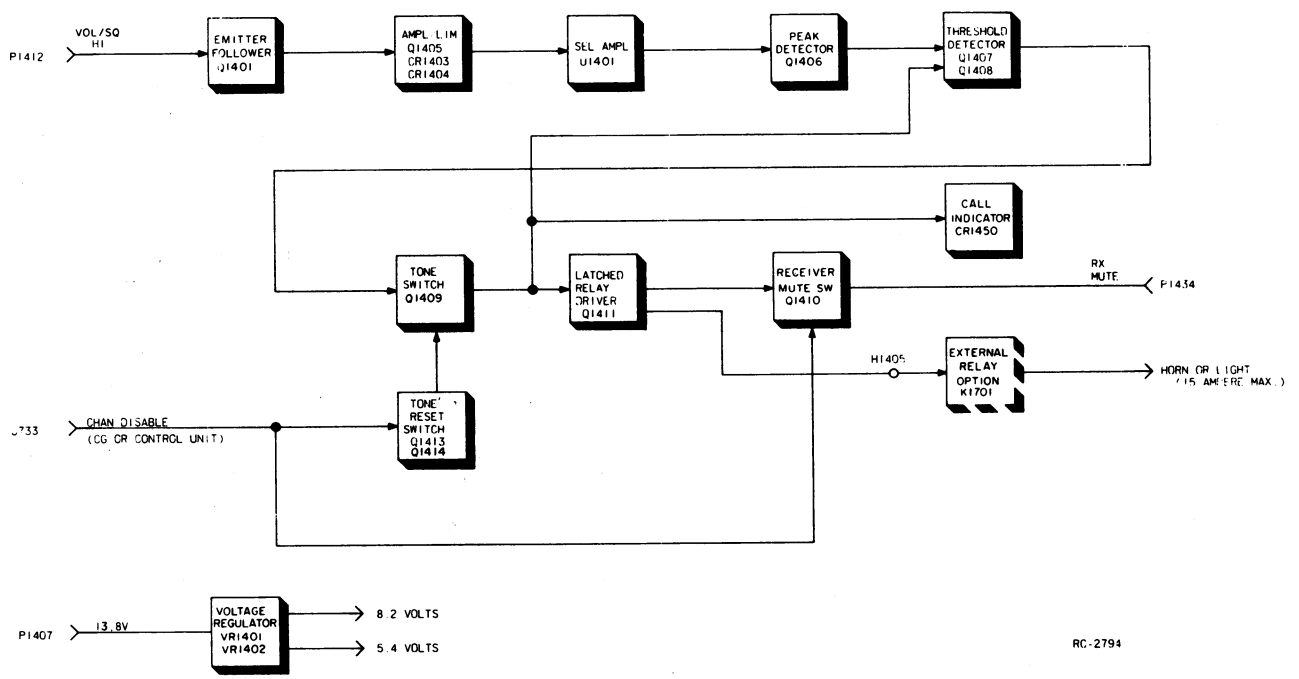


Figure 3 - Type 90 Tone Decoder Block Diagram

switch Q1413. Q1413 turns on, generating a negative transistion that is applied to the base of tone reset switch Q1414. Q1414 momentarily turns on and applies a positive pulse to the base of tone switch Q1409. Q1409 turns off and interrupts the latching circuit to call indicator CR1450 and latched relay driver Q1411.

Voltage Regulator

The voltage regulator consists of two zener diodes (VR1401, VR1402) and associated components. Zener diode VR1401 provides 8.2 V to latched relay driver Q1411, tone switch Q1409, call indicator CR1450 (through Q1409) and threshold detector Q1407 and Q1408. Zener diode VR1402 provides 5.4 V to all remaining circuits.

External Alarm (Options 1017 and 1019)

Latched relay driver Q1411 supplies A- through H1405, S1701, J714 and J701-19 to operate the external relay when a correct tone is decoded. Maximum current through Q1411 is approximately 200 milliamperes.

The external relay is used when the current rating of the external alarm (horn, light, etc.) exceeds the current rating of Q1411. A normally open set of contacts, rated at 15 amperes maximum at 12 Volts DC, is provided to operate the external alarm. A diode is connected across the relay coil to suppress voltage spikes produced across the relay when it operates. The relay is connected from battery (+) through fuse F1 to pin 3 of the relay. Pin 4 of the relay is connected to pin 19 of vehicle systems plug P701 on the rear of the control unit.

TYPE 90 ENCODE

Removing the microphone/handset from the hookswitch applies A- from Channel Guard disable input J1433 to the base of timer reset switch Q1413, turning it off (refer to Figure 4). The collector of Q1413 goes positive and provides 13.8 V from P1407 through R1450, R1445 and R1413 to the base of tone burst timer Q1404. Q1404 turns on and discharges timing capacitor C1405. It remains discharged until the transmitter is keyed.

Keying the transmitter applies A- to the base of tone burst switch Q1415, turning it off. This causes the collector voltage of Q1415 to increase and fire SCR CR1408. CR1408 applies A- to the base of tone burst timer Q1404, turning it off and actuating the timer.

Since the SCR will remain on until reset by replacing the microphone/handset on-hook, only a single tone burst is transmitted for each transmission.

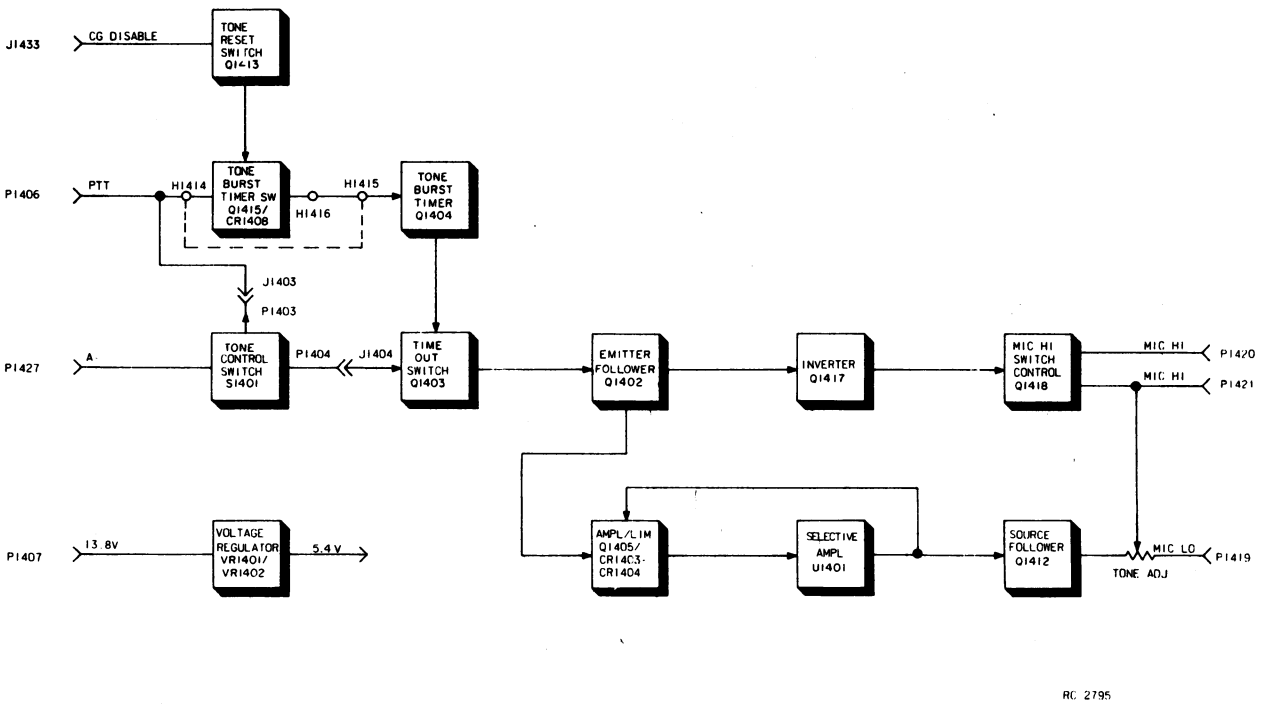


Figure 4 - Type 90 Tone Encoder Block Diagram

NOTE

When automatic tone burst is required on the first transmission only a DA jumper wire is connected between H1415 and H1416. This DA jumper wire may be removed and connected between H1414 and H1415 to provide a tone burst each time the transmitter is keyed rather than a single burst for each transmission. With option 1020, which is equipped with a manual pushbutton both DA jumpers are removed to provide manual pushbutton control only.

The duration of the tone burst is determined by the RC time constant of R1412 and C1405. While C1405 is charging, timer output switch Q1403 is turned off, allowing tone feedback amplifier Q1402 to conduct and complete the tone feedback path for the selective amplifier. The tone feedback path is completed through R1409, feedback amplifier Q1402, tone amplifier Q1405 and limiter CR1403 and CR1404. With the feedback path completed the selective amplifier oscillates at the encode tone frequency.

Tone from the selective amplifier is applied to the gate of source follower Q1412 through R1410. The output of the source follower is provided to the transmitter via tone adjust potentiometer R1440 and Mic Hi plug P1421. R1440 is set for 3 kHz deviation at the transmitter.

At this time, Mic High switch Q1418 is turned off by inverter Q1417. Also since timer output switch Q1403 is turned off at this time, the base of inverter Q1417 is positive, turning it on. Q1417 then applies A- to Mic High switch Q1418 turning it off and opening the microphone circuit.

After approximately one second C1405 charges up and turns on timer output switch Q1403. Q1403 applies A- to the emitter of tone feedback amplifier Q1402 turning it off and interrupting the tone feedback path. This causes the selective amplifier to stop oscillating. At the same time, Q1403 also applies A- to the base of inverter Q1417, turning it off. The collector of Q1417 then goes positive and turns on Mic High switch Q1418 to close the circuit to the microphone via P1420 and P1421.

Tone-On

In addition to generating a tone burst when the transmitter is keyed, a continuous tone is generated when the TONE-ON switch, S1401, is held in the ON position. The tone is generated in the same manner described above except the tone burst timer is bypassed. A-, in addition to being applied to tone burst timer switch Q1415 as before, is applied directly to timing capacitor C1405 and the base of timer output switch Q1403. This keeps timing capacitor C1405 discharged and turns Q1403 off. With Q1403 turned off, the tone feedback path is completed through tone feedback amplifier Q1402 and the selective amplifier oscillates continuously.

Tone-Off

Releasing the TONE-ON switch removes A- from the base of timer output switch Q1403. Timing capacitor C1405 charges up and turns on Q1403 which turns off tone feedback amplifier Q1402. Q1402 stops conducting. This interrupts the tone feedback path to the selective amplifier and stops it from oscillating.

Voltage Regulator

The voltage regulator consists of two zener diodes (VR1401 and VR1402) and associated components. 13.8 V is applied to the 8.2 V zener diode VR1401 via P1407, R1450 and R1451. Zener diode VR1401 provides 8.2 V to the 5.4 V regulator VR1402. Operating voltage for tone burst timer Q1415 and timer reset switch Q1413 is taken from the 13.8 V line through R1450. Zener diode VR1402 provides 5.4 V to all other circuits.

FIELD INSTALLATION

The following instructions install the Type 90 Encoder/Decoder options in a multi-frequency control unit that is not equipped with an exclusive option such as the Internal/External Speaker, Squelch Operated Relay, Public Address Option, Type 99 Tone, or Priority Search Lock Monitor.

TONE OPTION KIT

Installation of the Type 90 Option board requires a wire run at point "E" on PWB 19D416737G3 be cut on when PWB 19D423-588G5 is used, the DA jumper wire between H59 and H60 must be cut.

NOTE

When PWB 19D416737G3 is used, the PWB must be removed from the control unit in order to cut the wire run at point "E". Refer to Control Unit manual for removal procedures.

PROCEDURE

1. Cut the wire run or DA jumper wire at point "E". Refer to the Control Unit Maintenance Manual for the location of the specified points.
2. Re-install the board assembly in the control unit, but do not replace the top cover at this time.
3. Refer to the Outline Diagram and check that the correct jumpers are in place on the tone board for the desired mode of operation.
4. Position the Type 90 component board assembly in the guide slots located inside the sides of the control unit housing. Gently insert the board

assembly into the control unit, making sure that the connectors on the board assembly mate correctly with the square pins of the control unit printed wire board.

5. Mount the option switch (S1701, S1401) in the space provided in the control unit.

NOTE

The option-on external alarm switch S1701 (19A129831G1) is used with external alarms. The tone-on encode switch S1401 (19A130361G1) is used in applications requiring manual control of the tone burst.

Position the switch as shown on the Outline Diagram. Secure the switch to the control mounting bracket with the 4-40 x 1/4 inch Phillips head POZ-IDRIV® tap screw provided. Secure the other end of the switch to the control unit housing with the 4-40 x 1/4 inch Phillips head tap screw provided.

6. Position the LED (CR1450) in the front indicator slot of the control unit housing and secure in place with the spring clip provided.

7. Make LED and switch connections as indicated on the outline diagram.

NOTE

Omit Step 8 when option 1018, Decode only, is used. Since an external alarm is not provided, the nameplate is not changed.

8. Remove the existing nameplate from the control unit top cover and install new nameplate (NP270753P8-P12) as follows:

   a. Viewing the control unit from the front, note that there are only three of the plastic nameplate tabs which lock in place. These are the top left hand tab, the top right hand tab and the bottom center tab. The remaining tabs function only as guide tabs.

   b. Release the locking action of the tabs, starting with the top right hand tab, then the top left hand tab. Apply pressure with fingers or use a small flat blade screwdriver to release tabs. Push released tabs up through slots to prevent relocking of tabs.

   c. Release the locking action of the bottom center tab and pry the nameplate loose from the top cover. The old nameplate is not used.

   d. Install the new nameplate. NP270753P8 is used in external alarm applications. NP270753P12 is used in manual tone control applications.

8. Replace the top cover on the control unit and secure in position with the two screws previously removed.

EXTERNAL RELAY KIT

Refer to Outline Diagram and Systems Board manual to locate and identify connecting points.

1. Install relay in desired location using self tapping screws.

2. Connect yellow lead from lug 4 of relay to vehicle systems plug P701-19 located on rear of control unit. Insert the contact on lead, flat side down, in hole 19 until it locks.

3. Cut red fused lead so that fuse assembly is close to voltage source. Attach the solderless terminal to the end of red fused lead to be connected to relay. Using 8-32 x 5/16 hardware connect the terminal to lug 3 of the relay.

4. Connect the other end of fused lead to voltage source.

5. Connect external alarm (horn, light, etc.) to lugs 1 and 2 of relay.

MAINTENANCE

Troubleshooting the Type 90 component board in the control unit is facilitated using extender board 19C320588. The extender board provides feed throughs for all connections to the control unit printed wire board.

A chart containing typical voltage readings for each transistor for the reset, decode and encode modes and a table of Quick Checks containing fault symptoms and associated troubleshooting procedure is provided to assist in isolating defective components.

REMOVING INTEGRATED CIRCUITS

Removing integrated circuits IC's (and all other soldered in components) can be easily accomplished by using a de-soldering tool such as a Solda-PULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

An alternate method is to use a special soldering tip that heats all the pins simultaneously.

ADJUSTMENTS

The encode tone amplitude is adjustable from ground to approximately 200 millivolts. Normally, the tone amplitude is adjusted to provide 3 kHz deviation at the transmitter.

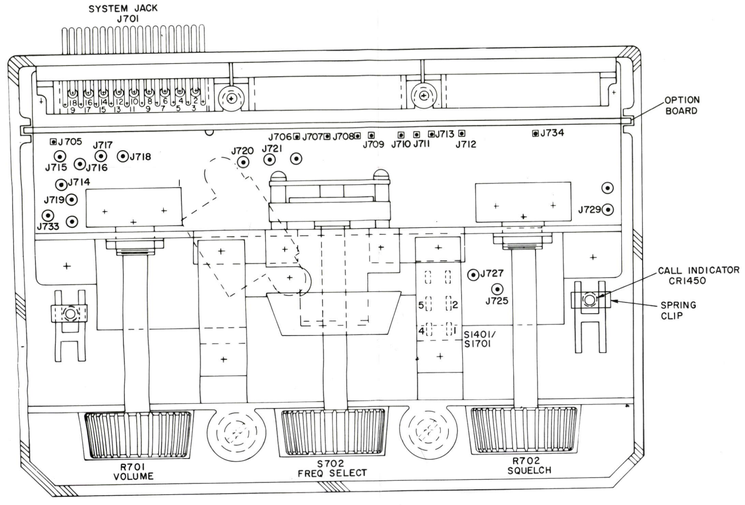
QUICK CHECKS

STEP	SYMPTOM	PROCEDURE
1.	Will Not Decode	1. Check that input tone is same as that of SELECTIVE amp. 2. Check regulated supply voltage. 3. Inject proper tone frequency into Q1401 and trace signal with a scope through Q1401, Q1405, and Selective amplifier.
2.	Call Light Will Not Reset	1. Check that hookswitch is working. 2. Check to see that there is a short pulse at the collector of Q1414 when the hookswitch is operated. 3. Check Q1409 and Q1407 and Q1416.
3.	Call Light Comes On During Transmit	1. Check CR1406.
4.	Receiver Will Not Unmute But Call Light Comes On	1. Check Q1410, Q1411, CR1407 and VR1403.
5.	No Tone During Transmit	1. Check Q1416, Q1415, Q1404, Q1403 and CR1408. 2. If step one is normal; inject a signal on the selective amplifier frequency at the collector of Q1402 and trace signal through Q1402, Q1405, CR1403, CR1404, and selective amplifier U1401.
6.	Automatic Tone Burst Will Not Reset	1. Check CR1408, Q1413 and Q1415.
7.	Continuous Tone is Heard While Transmitting	1. Check CR1401
8.	No Voice Modulation From Microphone	1. Check Q1418, Q1417 and Q1402.

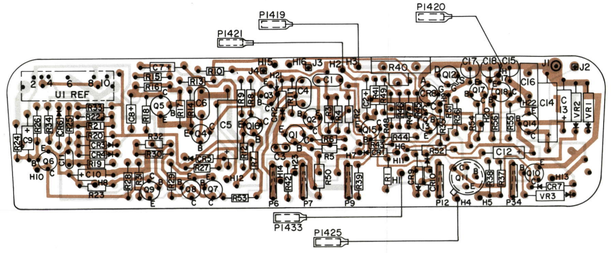
VOLTAGE READINGS

TRANSISTOR	RESET			DECODED			ENCODE		
	Emitter	Base	Collector	Emitter	Base	Collector	Emitter	Base	Collector
Q1401	1.5	2.0	5.4	1.5	2.0	5.3			
Q1402	5.4	5.4	1.5	1.5	5.4	5.4			
Q1403	0.5	0	5.4	0.5	0	5.3			
Q1404	0	0.6	0	0	0.6	0			
Q1405	0	0.6	3.4	0	0.6	3.4			
Q1406	0.2	0.6	8.3	0.8	0.6	8.2			
Q1407	0.4	0.6	8.2	0.5	1.0	0.5			
Q1408	0.4	1.0	8.3	0.5	1.0	8.2			
Q1409	8.3	8.2	0.2	8.2	7.5	6.8			
Q1410	0	0	0	0	0	13.8			
Q1411	0	0.2	11.0	0	0.7	0	(During Reset)		
Q1413	0	0.4	12.4	0	0.4	12.4	0	0.7	0
Q1414	12.8	12.8	8.2	12.8	12.8	7.0	12.7	12.7	7.
							(Encode)		
Q1415	0	0.6	0	0	0.6	0	0	0	10.3
Q1416	5.4	4.7	5.4	5.4	4.7	5.4	5.4	10.3	3.4
Q1417	0	5.4	0	0	1.5	12.8			
Q1418									
	Source	Gate	Drain	Source	Gate	Drain			
Q1412	3.7	2.1	5.4	3.7	2.1	5.4			

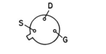
CONTROL UNIT TOP VIEW



TYPE 90 TONE OPTION BOARD

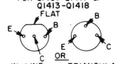


LEAD IDENTIFICATION FOR Q1412



VIEW FROM LEAD END

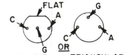
LEAD IDENTIFICATION FOR Q1401-Q1411 & Q1413-Q1418



IN-LINE OR TRIANGULAR VIEW FROM LEAD END

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

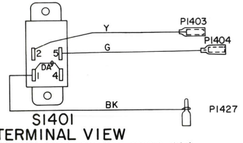
LEAD IDENTIFICATION FOR CR1408



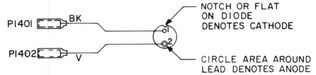
IN-LINE OR TRIANGULAR VIEW FROM LEAD END

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

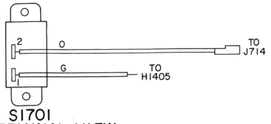
LEAD FORMING FOR C1415, C1417 & C1418



S1401 TERMINAL VIEW
(USED WITH OPTIONS 1016, 1020 & 1021)

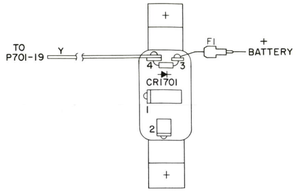


LED CONNECTIONS FOR CALL INDICATOR CR1450

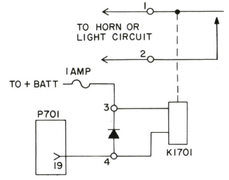


S1701 TERMINAL VIEW
(USED WITH OPTIONS 1017 & 1019)

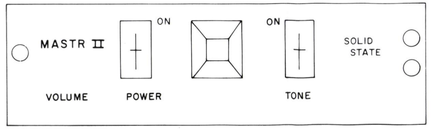
EXTERNAL RELAY KIT



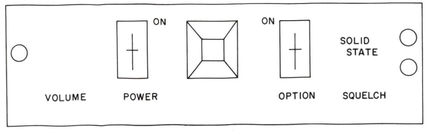
TERMINAL VIEW K1701



NOTES:
1. REFER TO CONTROL UNIT MANUAL AND CUT PRINTED WIRE RUN "E" ON CONTROL UNIT PWB FOR OPTION 1016, 1017, 1020 & 1021 ONLY.
2. ALL ELECTRICAL COMPONENTS ON OPTION BOARD ARE 1400 SERIES. FOR EXAMPLE, C1 WILL BE C1401, H1 WILL BE H1401, R50 WILL BE R1450, ETC.



NAMEPLATE
(USED WITH OPTIONS 1016, 1020, 1021)



NAMEPLATE
(USED WITH OPTIONS 1017 & 1019)

OPTION 1016

CONNECTIONS FOR ENCODE/DECODE FUNCTIONS WITH PUSHBUTTON ENCODER		
FROM	TO	WIRE
P1425	J725	BK
P1433	J733	V
CR1450-1	J1401	BK
CR1450-2	J1402	V
P1419	J719	BL
P1420	J720	W
P1421	J721	O
P1427	J727	BK
P1403	J1403	Y
P1404	J1404	G

S1401

OPTION 1017

CONNECTIONS FOR ENCODE/DECODE FUNCTION WITH EXTERNAL DECODER ALARM		
FROM	TO	WIRE
P1425	J725	BK
P1433	J733	V
CR1450-1	J1401	BK
CR1450-2	J1402	V
P1419	J719	BL
P1420	J720	W
P1421	J721	O
S1701-1	H1405	G
S1701-2	J714	O

OPTION 1018

CONNECTIONS FOR DECODE FUNCTION ONLY WITHOUT EXTERNAL DECODER ALARM		
FROM	TO	WIRE
P1425	J725	BK
P1433	J733	V
CR1450-1	J1401	BK
CR1450-2	J1402	V

OPTION 1019

CONNECTIONS FOR DECODE FUNCTION ONLY WITH EXTERNAL DECODER ALARM		
FROM	TO	WIRE
P1425	J725	BK
P1433	J733	V
CR1450-1	J1401	BK
CR1450-2	J1402	V
S1701-1	H1405	G
S1701-2	J714	O

OPTION 1020

CONNECTIONS FOR PUSHBUTTON ENCODE ONLY		
FROM	TO	WIRE
P1403	J1403	Y
P1404	J1404	G
P1427	J727	BK
P1419	J719	BL
P1420	J720	W
P1421	J721	O
H1415	H1416	REMOVE DA JUMPER
P1433	J733	V

S1401

OPTION 1021

CONNECTION FOR ENCODE FUNCTION WITH AUTOMATIC TONE BURST		
FROM	TO	WIRE
P1403	J1403	Y
P1404	J1404	G
P1427	J727	BK
P1419	J719	BL
P1420	J720	W
P1421	J721	O
P1433	J733	V

S1401

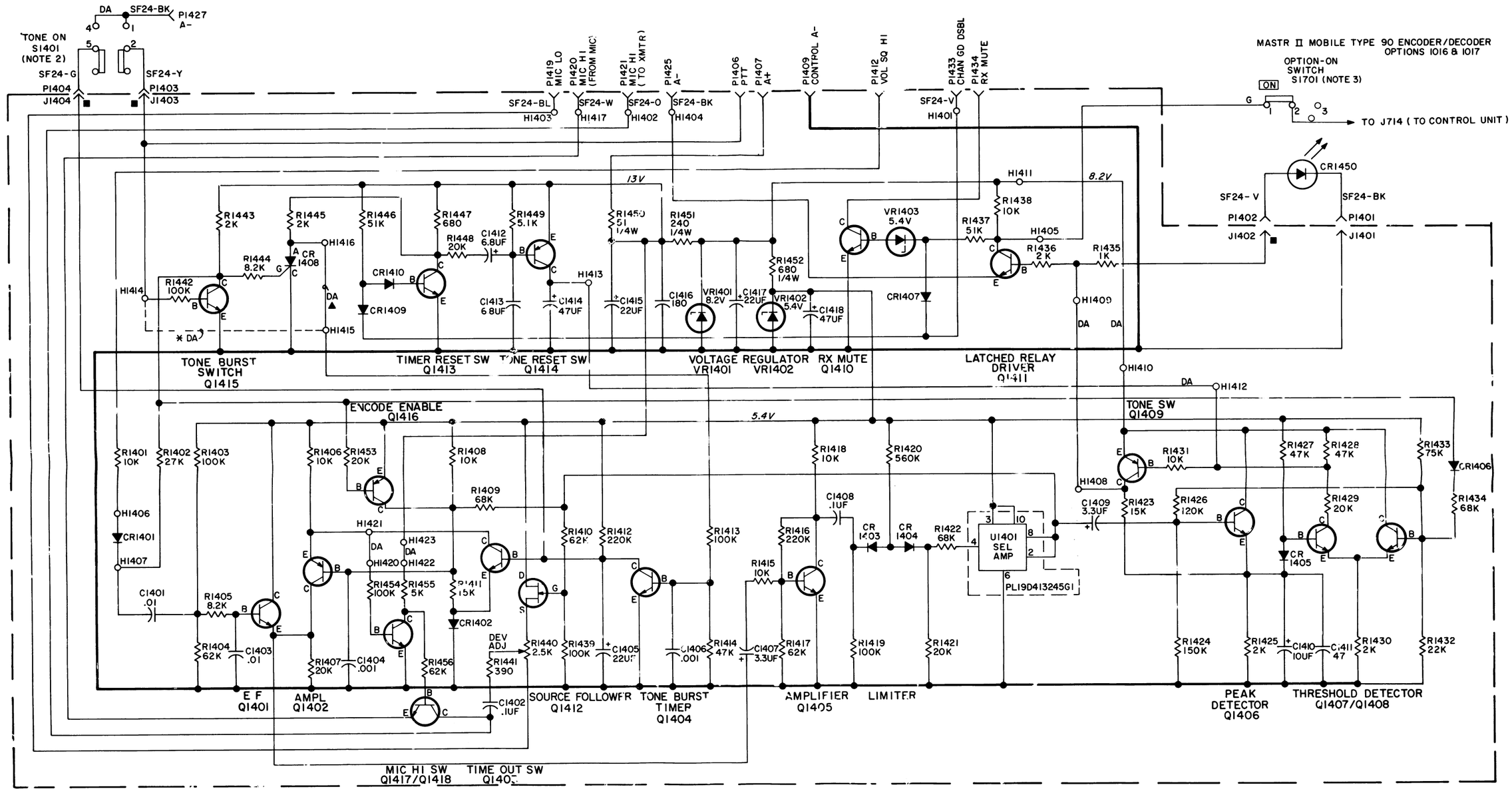
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19R622203, Rev. 1)
(19C321140, Sh. 2, Rev. 1)
(19C321140, Sh. 3, Rev. 1)

OUTLINE DIAGRAM

TYPE 90 TONE ENCODER & DECODER

10 Issue 2



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		
DESCRIPTION	MODEL NO	REV LETTER
ENCODER/DECODER	PLI9C321221G1	

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.

(19D417757, Rev. 6)

■ INDICATES SQUARE POSTS

▲ JUMPER HI415-HI416 TO PROVIDE AUTOMATIC TONE BURST ON FIRST TRANSMISSION ONLY.

✱ JUMPER HI415-HI414 TO PROVIDE TONE BURST ON EACH TRANSMISSION.

NOTE 1: REMOVE BOTH JUMPERS, HI415-HI416 AND HI415-HI414, FOR PUSHBUTTON CONTROL OF TONE ONLY.

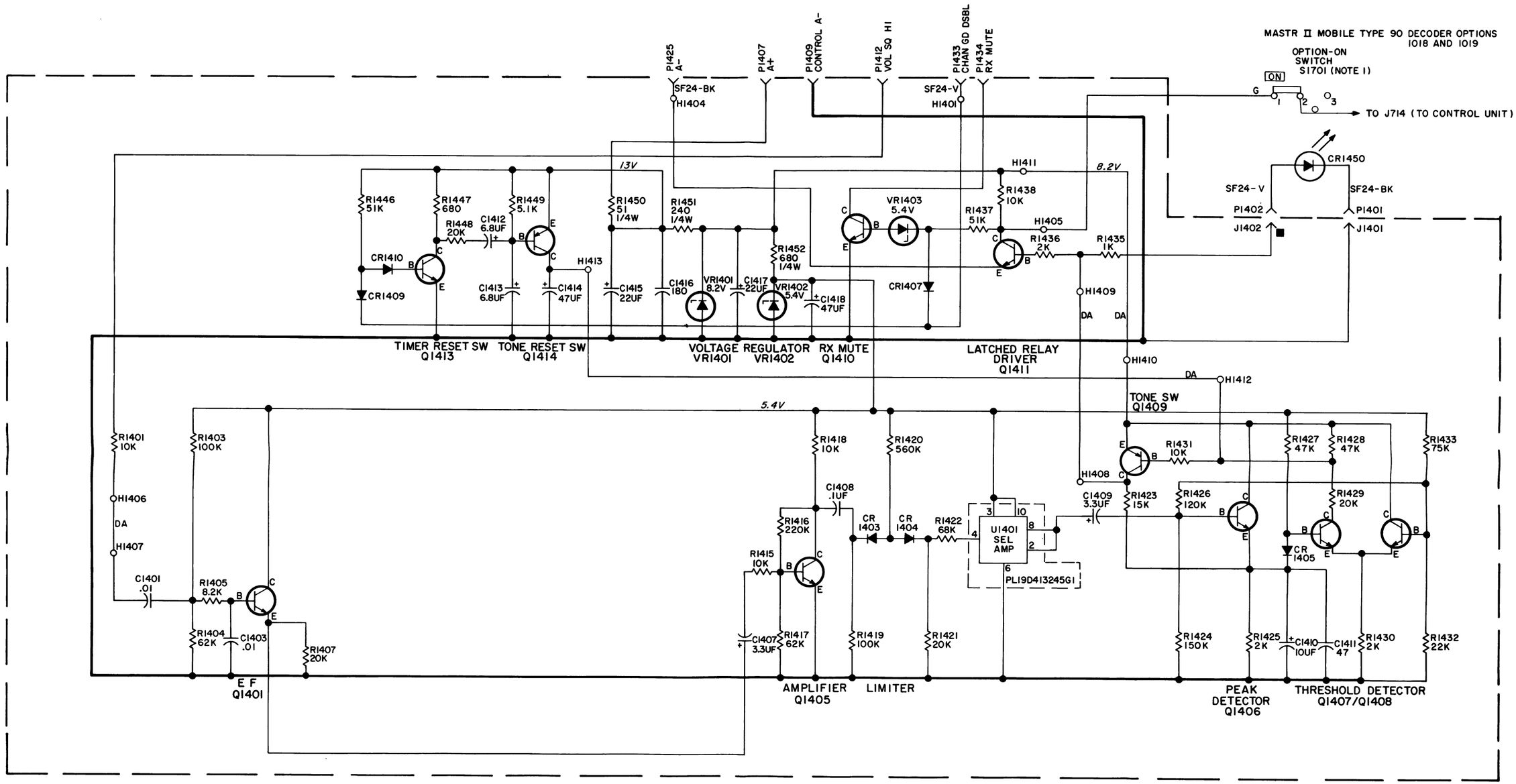
NOTE 2: PRESENT WITH OPTION 1016 ONLY.

NOTE 3: USED WITH EXTERNAL ALARM OPTIONS 1017 ONLY.

SCHEMATIC DIAGRAM

TYPE 90 TONE ENCODER/DECODER

Issue 2



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		
DESCRIPTION	MODEL NO	REV LETTER
DECODER	PLI9C321221G2	

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.

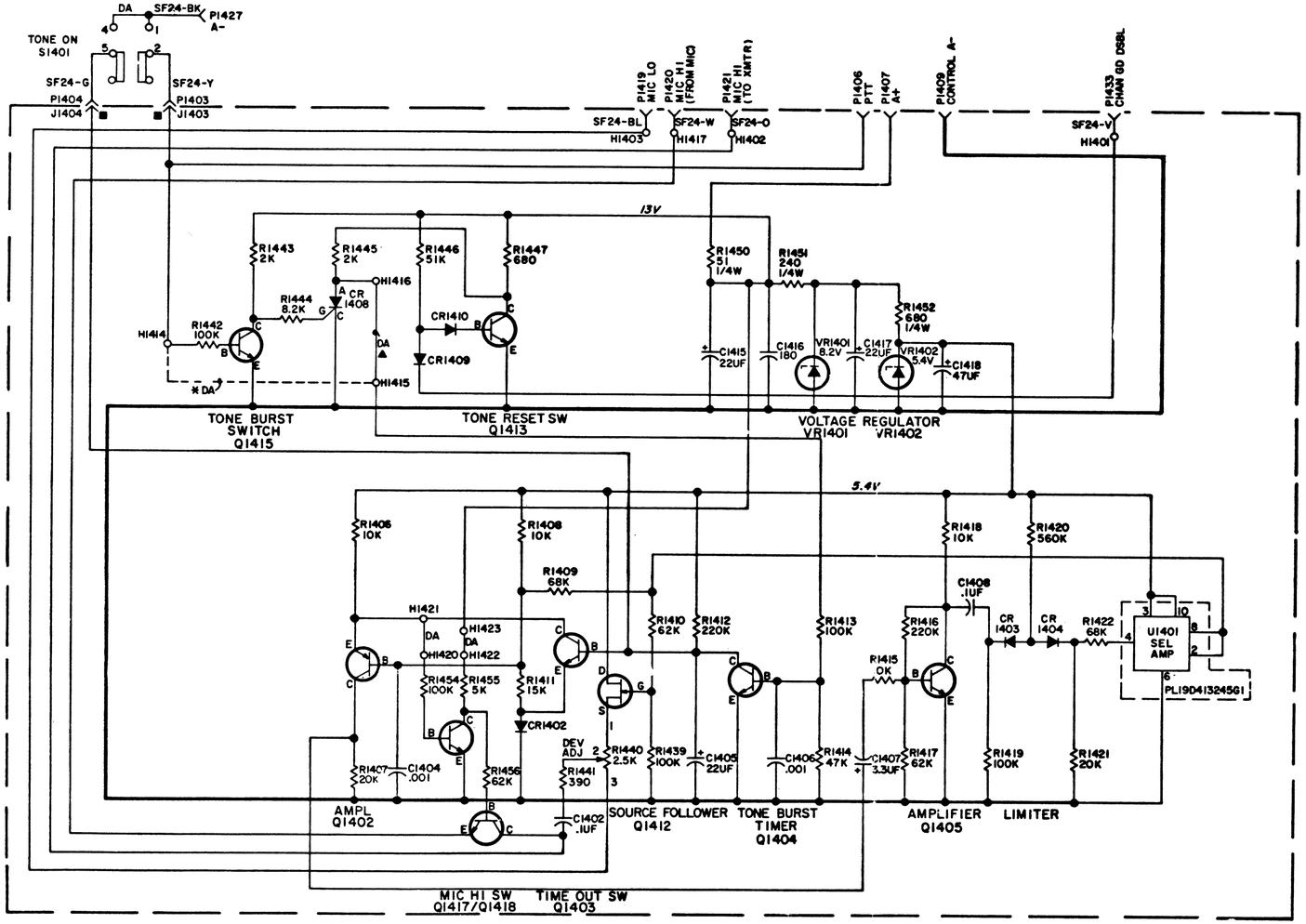
■ INDICATES SQUARE POSTS

NOTES:
1. USED WITH OPTION 1019 EXTERNAL ALARM.

SCHEMATIC DIAGRAM

TYPE 90 TONE DECODER

(19D417973, Rev. 5)



■INDICATES SQUARE POSTS

▲JUMPER H1415-H1416 TO PROVIDE AUTOMATIC TONE BURST ON FIRST TRANSMISSION ONLY.

*JUMPER H1415-H1414 TO PROVIDE TONE BURST ON EACH TRANSMISSION.

NOTE 1: REMOVE BOTH JUMPERS, H1415-H1416 AND H1415-H1414, FOR ONLY PUSHBUTTON CONTROL OF TONE. (OPTION 1020)

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		
DESCRIPTION	MODEL NO	REV LETTER
ENCODER	PLI9C321221G3	

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.

(19D417972, Rev. 3)

SCHEMATIC DIAGRAM

TYPE 90 TONE ENCODER

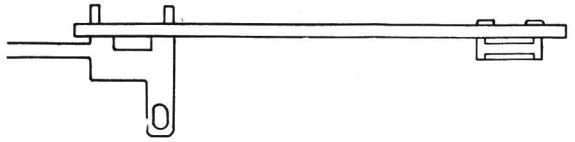
PARTS LIST

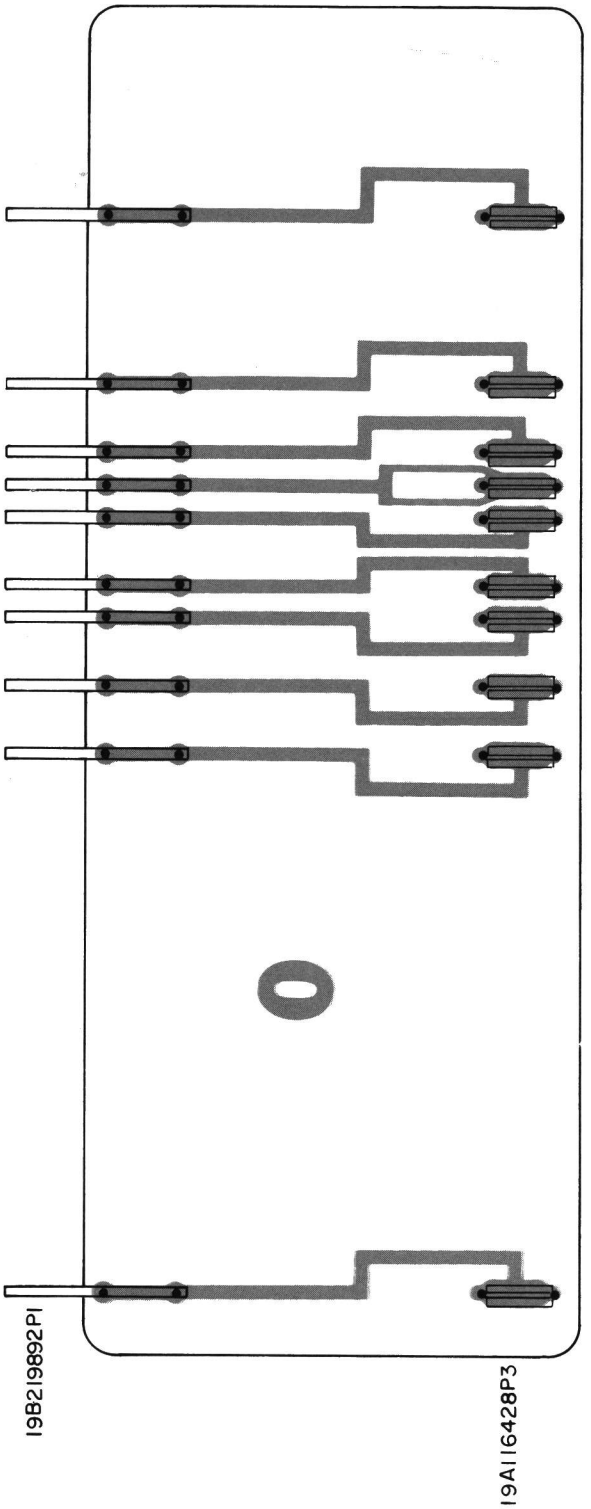
LBI-4969A

TYPE 90 ENCODER/DECODER
AND
ASSOCIATED KITS

SYMBOL	GE PART NO.	DESCRIPTION
		TYPE 90 ENCODER/DECODER 19A129567G13 ENCODER/DECODER 19A129567G14 DECODER 19A129567G15 ENCODER
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1450	19B219800G2	Diode, red light emitting.
		COMPONENT BOARD 19C321221G1 ENCODER/DECODER 19C321221G2 DECODER 19C321221G3 ENCODER
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C1401	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C1402	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1403	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C1404	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1405	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1406	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1407	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1408	5491674P43	Tantalum: 0.1 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C1409	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1410	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1411	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C1412 and C1413	5491674P39	Tantalum: 6.8 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C1414	19A134202P2	Tantalum: 47 µf ±20%, 6 VDCW.
C1415	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1416	7489162P33	Silver mica: 180 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C1417	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1418	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1401 thru CR1407	19A115250P1	Silicon.
CR1408	19A116642P1	Thyristor, silicon controlled: sim to Type 2N5064.
CR1409 and CR1410	19A115250P1	Silicon.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1401	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J1402 thru J1404	19A116779P1	Contact, electrical: sim to Molex 08-50-0404.
P1406 and P1407	19A116428P3	Contact, electrical: sim to AMP 85487-3 (Strip Form).
P1409	19A116428P3	Contact, electrical: sim to AMP 85487-3 (Strip Form).
P1412	19A116428P3	Contact, electrical: sim to AMP 85487-3 (Strip Form).
P1419 thru P1421	4029840P2	Contact, electrical: sim to Amp 42827-2.
P1425	4029840P2	Contact, electrical: sim to Amp 42827-2.
P1433	4029840P2	Contact, electrical: sim to Amp 42827-2.
R1434	19A116428P3	Contact, electrical: sim to AMP 85487-3 (Strip Form).
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1401	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1402	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1403 thru Q1408	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1409	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1410	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1411	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q1412	19A134137P1	N Type, field effect.
Q1413	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1414	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1415	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1416	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1417 and Q1418	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1401	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1402	3R151P273J	Composition: 27,000 ohms ±5%, 1/8 w.
R1403	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1404	3R151P623J	Composition: 62,000 ohms ±5%, 1/8 w.
R1405	3R151P822J	Composition: 8200 ohms ±5%, 1/8 w.
R1406	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1407	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w.
R1408	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1409	3R151P683J	Composition: 68,000 ohms ±5%, 1/8 w.
R1410	3R151P623J	Composition: 62,000 ohms ±5%, 1/8 w.
R1411	3R151P153J	Composition: 15,000 ohms ±5%, 1/8 w.
R1412	3R151P224J	Composition: 0.22 megohm ±5%, 1/8 w.
R1413	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1414	3R151P473J	Composition: 47,000 ohms ±5%, 1/8 w.
R1415	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1416	3R151P224J	Composition: 0.22 megohm ±5%, 1/8 w.
R1417	3R151P623J	Composition: 62,000 ohms ±5%, 1/8 w.
R1418	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1419	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1420	3R151P564J	Composition: 0.56 megohm ±5%, 1/8 w.
R1421	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w.
R1422	3R151P683J	Composition: 68,000 ohms ±5%, 1/8 w.
R1423	3R151P153J	Composition: 15,000 ohms ±5%, 1/8 w.
R1424	3R151P154J	Composition: 0.15 megohm ±5%, 1/8 w.
R1425	3R151P202J	Composition: 2000 ohms ±5%, 1/8 w.
R1426	3R151P124J	Composition: 0.12 megohm ±5%, 1/8 w.
R1427 and R1428	3R151P473J	Composition: 47,000 ohms ±5%, 1/8 w.
R1429	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w.
R1430	3R151P202J	Composition: 2000 ohms ±5%, 1/8 w.
R1431	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1432	3R151P223J	Composition: 22,000 ohms ±5%, 1/8 w.
R1433	3R151P753J	Composition: 75,000 ohms ±5%, 1/8 w.
R1434	3R151P683J	Composition: 68,000 ohms ±5%, 1/8 w.
R1435	3R151P102J	Composition: 1000 ohms ±5%, 1/8 w.
R1436	3R151P202J	Composition: 2000 ohms ±5%, 1/8 w.
R1437	3R151P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R1438	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R1439	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1440	19B209358P104	Variable, carbon film: approx 100 to 2500 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R1441	3R151P391J	Composition: 390 ohms ±5%, 1/8 w.
R1442	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1443	3R151P202J	Composition: 2000 ohms ±5%, 1/8 w.
R1444	3R151P822J	Composition: 8200 ohms ±5%, 1/8 w.
R1445	3R151P202J	Composition: 2000 ohms ±5%, 1/8 w.
R1446	3R151P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R1447	3R151P681J	Composition: 680 ohms ±5%, 1/8 w.
R1448	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w.
R1449	3R151P512J	Composition: 5100 ohms ±5%, 1/8 w.
R1450	3R152P510J	Composition: 51 ohms ±5%, 1/4 w.
R1451	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R1452	3R152P681J	Composition: 680 ohms ±5%, 1/4 w.
R1453	3R151P203J	Composition: 20,000 ohms ±5%, 1/8 w.
R1454	3R151P104J	Composition: 0.10 megohm ±5%, 1/8 w.
R1455	3R151P512J	Composition: 5100 ohms ±5%, 1/8 w.
R1456	3R151P623J	Composition: 62,000 ohms ±5%, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
		NOTE: When reordering give GE Part number and specify exact frequency needed.
U1401	19D413245G4	Selective Amplifier: 1050-3000 Hz.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1401	4036887P40	Silicon, Zener.
VR1402 and VR1403	4036887P5	Silicon, Zener.
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A116807P1	Clip, spring tension. (Used with CR1450).
	4036555P1	Insulator, washer: nylon. (Used with Q1411).
		ASSOCIATED KITS EXTERNAL RELAY KIT 19B226025G1 EXTERNAL RELAY MOD KIT 19A129567G11 TONE SWITCH KIT 19A129567G16
		EXTERNAL RELAY KIT 19B226025G1
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1701	4037822P2	Silicon.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1701	7486515P2	Enclosed armature: 12 VDC, nominal, 85 to 90 ohms coil resistance, 1 form A contact rated at 15 amps; sim to REM Co.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A129833P1	Support.
	19B226454G1	Fused lead.
	N130P1608C6	Tap screw: No. 10 x 1/4.
	N402P37C13	Flatwasher: No. 6.
		EXTERNAL RELAY MOD KIT 19A129567G11
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1701	19A116622P6	Push: SPDT, 3 amp at VAC or 0.5 amp VDC at 125 v; sim to Switchcraft 11K1041.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4029840P2	Contact, electrical: sim to Amp 42827-2. (Located on S1701-2 wire).
	NP270753P8	Nameplate, plastic.
	19B201074P204	Tap screw, Phillips POZIDRIV®: No. 4-40 x 1/4.
	N117P9004C6	Tap screw, phillips: No. 4-40 x 1/4.
		TONE SWITCH KIT 19A129567G16
		SWITCH ASSEMBLY 19A130361G1
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1403 and P1404	19A127042P2	Terminal, solderless: sim to Malco 12093-10.
P1427	4033348P1	Contact, electrical: sim to Bead Chain M125-34.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1401	19A116622P9	Push: DPST Spring return, normally open, 3 amp at VAC or 0.5 amp VDC at 125 v; sim to Switchcraft 11K1078.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B201074P204	Tap screw, Phillips POZIDRIV®: No. 4-40 x 1/4.
	N117P9004C6	Tap screw, phillips: No. 4-40 x 1/4.
	NP270753P12	Nameplate, plastic.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES





(19C321356, Rev. 0)
(19C321590, Sh. 2, Rev. 0)
(19C321590, Sh. 3, Rev. 0)

OUTLINE DIAGRAM

EXTENDER BOARD

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.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

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