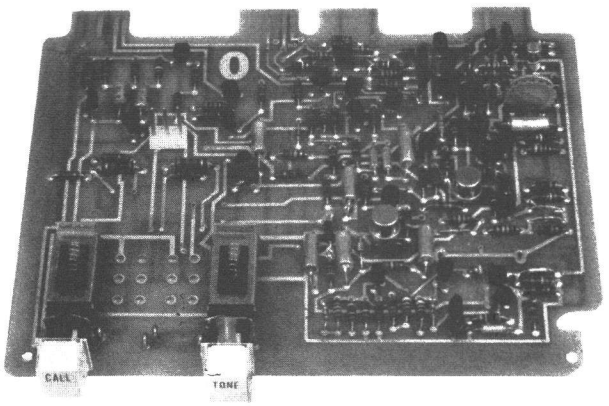
MOBILE RADIO

MAINTENANCE MANUAL

TYPE 90 TONE ENCODER/DECODER, ENCODER AND DECODER 19D417858G1-3 (OPTIONS 9409)



SPECIFICATIONS *

Controls	
Deviation Adjust	3 kHz Deviation
Tone	Manual Tone Burst
Call	Call Indicator/Reset
Horn	Option Alarm
Light	Option Alarm
Input Voltage	13.8 VDC
Current Drain	180 milliamperes maximum
Encode Tone Amplitude	150 millivolts minimum @ 600 ohms
Tone Frequencies	1000 to 3000 Hz
Frequency Stability	±0.3%
Automatic Tone Burst	1 second ±40%
Encode Start Time	Less than 200 milliseconds
Decode Input Signal	Less than 40 millivolts
Timed Decode Output	Approximately 2 seconds
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.

TYPE 90 TONE ENCODERS AND DECODERS 19D417858G1-3

GENERAL ELECTRIC

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ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage. Prior to connect any external [illegible] while the unit is supplied with power. KEEP AWAY FROM LIVE [illegible]

[illegible] Before [illegible] Power Supply [illegible] Parts, KEEP AWAY [illegible] CHECK [illegible]

DESCRIPTION

The General Electric Type 90 Pulse Tone Encoder/Decoder assemblies 19D417858 G1-3 are used in the C-800 and C-900 Series Control Units. These assemblies utilize standard Type 90 tone frequencies between 1000 and 3000 Hz to indicate receipt of a tone coded message. When a message is received the CALL indicator will flash on and off and the external alarm(s) (option 9409) will operate.

Type 90 Tone modules are provided in three groups, all using the same printed wire board. Group 1 provides both the encode and decode functions, group 2 provides the decode function only and group 2 the encode function only.

The decoder prevents the receiver from receiving calls that are not tone coded with the proper Type 90 tone frequency. Two decoder controlled outputs (transistors switched to ground) are provided to operate the optional external alarm relays - one timed, the other latched. Normally, the timed output is used to sound the horn while the latched output is used to operate the light alarm circuit. Both external alarm relays are limited to 15 Amperes maximum.

The encoder provides tone modulation to the transmitter. An automatic tone burst is transmitted once at the beginning of each call or can be transmitted manually via the TONE switch. In addition, the tone automatic burst feature can be bypassed via a strapping arrangement to allow the tone burst to be transmitted each time the PTT switch is operated.

All pushbutton light switches use light-emitting diodes for reliability, long life and low power consumption. The external alarm switches (HORN and LIGHT) are backlighted at a low level and glow at maximum brightness when selected.

OPERATION

TONE SWITCH

Operation of the manual tone function is controlled by the momentary TONE switch. The TONE switch must be held in to transmit a continuous tone and released for normal operation of the encoder/decoder. (The monitor/reset switch on the microphone or handset holder when supplied, must be in the "up" position to monitor the channel and in the "down" position for normal decoder operation.) The TONE light switch also doubles as a power indicator with the LED continually monitoring the A+ input. The TONE indicator glows at maximum brightness.

CALL SWITCH

The CALL indicator is normally off and will flash on and off when a call is received. Momentarily pressing the CALL light in resets the light and the decoder in preparation for the next call.

HORN AND LITE SWITCHES (Optional)

The external alarms are selected by the HORN and LIGHT switches (push-push) to alert the operator to an incoming call.

When properly tone coded message is received and the horn alarm is selected, the horn will sound for approximately two seconds. If the LITE alarm is selected, the light alarm will remain on continuously until reset. Both alarms, if present, may be selected simultaneously.

MONITOR RESET (With Optional Hookswitch)

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. This is the proper position for normal operation.

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.

CIRCUIT ANALYSIS

References to symbol numbers mentioned in the following text are found on the Schematic Diagrams, Outline Diagram and Parts List. Figures 1, 2, and 3 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 P1405B-7 and zener diode VR1403 and to timer reset switch Q1413. Receiver mute transistor Q1410 turns off,

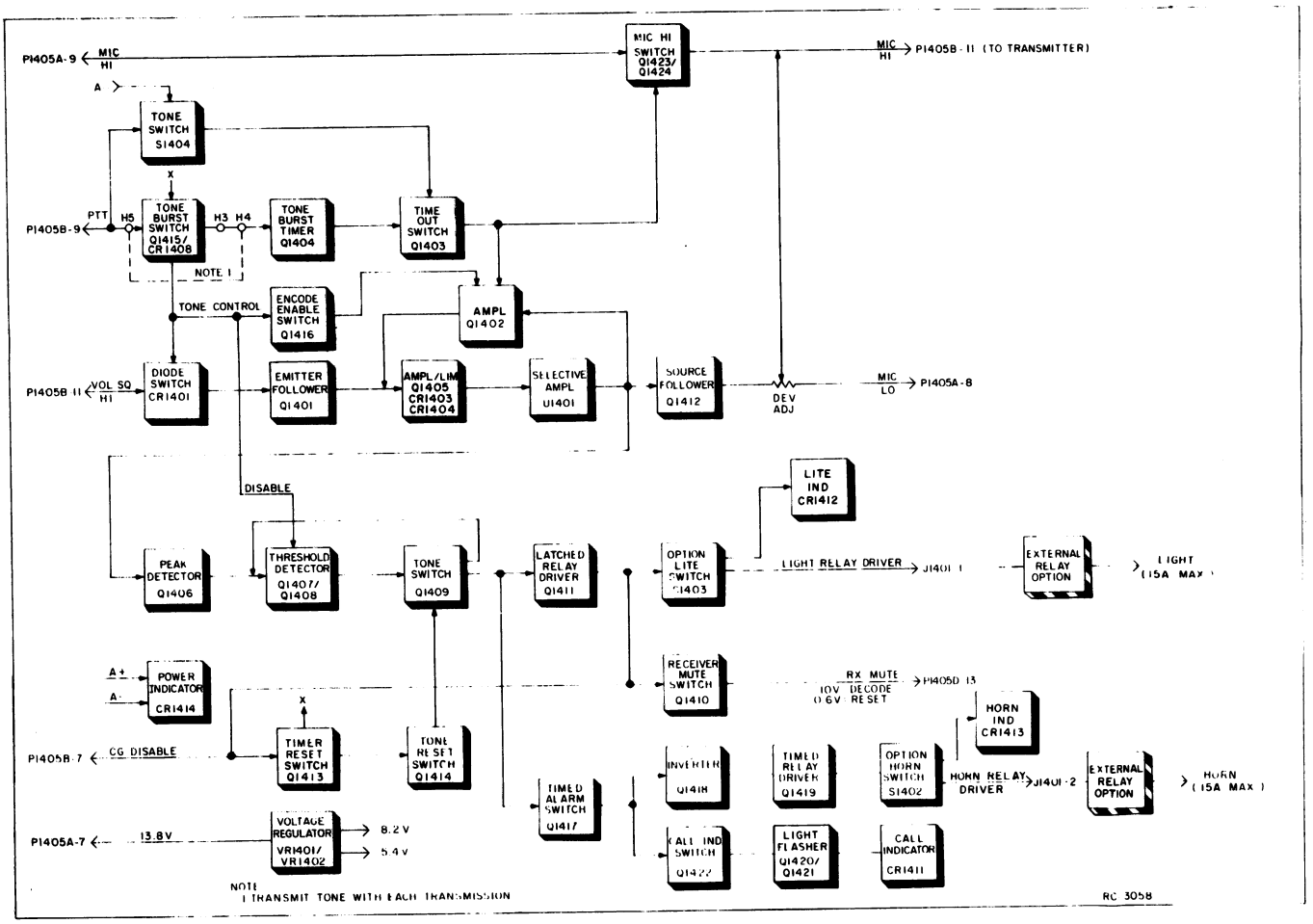


Figure 1 - Type 90 Tone Encode/Decode Block Diagram

allowing the receiver to operate on noise squelch. Timer reset switch Q1413 also turns off allowing +12 V to be applied to timer reset diode CR1408 and tone burst timer switch Q1404. Q1404 turns on and discharges timing capacitor C1405. CR1408 is re-armed in preparation for the next tone burst transmission.

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 CG disable input P1405B-7 to the base of timer reset switch Q1413, turning it off (refer to Figure 2).

The collector of Q1413 goes positive and provides +12 V from P1405A-7 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.

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 H3 and H4 to provide automatic tone burst on the first transmission only. This DA jumper wire may be removed and connected between H4 and H5 to provide a tone burst each time the transmitter is keyed. Both DA jumpers can be removed to provide only manual push-button tone control using the tone switch.

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 R1450, 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. This threshold detector then does not respond to the encode tone when the transmitter is keyed and the receiver will remain muted.

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

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 deviation adjust potentiometer R1440 and Mic Hi lead P1405B-11. R1440 is set for 3 kHz deviation at the transmitter. At this time Mic Hi switch Q1424 is turned off by inverter Q1423. Since time out switch Q1403 is also turned off at this time, the base of inverter Q1423 is positive, turning it on. Q1423 then applies A- to Mic Hi switch Q1424 turning it off and opening the microphone circuit.

After approximately one second C1405 charges up and turns on time out 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 Q1423, turning it off. The collector of Q1423 then goes positive and turns on Mic Hi switch Q1424 to close the circuit to the microphone via P1405A-7 and P1405B-11.

Tone-On

In addition to generating a tone burst when the transmitter is keyed, a continuous tone can be generated by holding the TONE switch in. The tone is generated in the same manner described above except that the tone burst timer is bypassed. A-, in addition to being applied to tone burst switch Q1415 and PTT lead (P1405B-9) as before, is applied directly to timing capacitor C1405 and the base of time out 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 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 turns off interrupting the tone feedback path and stopping the tone oscillations.

DECODE

When the TONE switch is in the "off" position, toneburst switch Q1415 is held on by the positive voltage on the PTT lead. A- from tone burst timer switch Q1415 holds encode enable switch Q1416 on to prevent 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 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 peak detector Q1406 and then applied to threshold detector Q1407.

The positive half cycles of the emitter follower output reverse biases diode CR1405, allowing the base of threshold detector Q1407 to rise. Q1407 conducts and turns on tone switch Q1409. Q1409 applies 8.2 V to the timed alarm switch Q1417, 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 hold Q1407 on. Q1407 holds the base of tone switch Q1409 low, latching Q1409 on. Q1409 holds latched relay driver Q1411 and timed alarm switch Q1417 on.

Latched relay driver Q1411 provides A- to receiver mute switch Q1410 through zener diode VR1403 and to the option light relay through S1403 and J1401-1. This turns the receiver mute switch off and unmutes the receiver. The voltage at P1405D-13 is approximately 10 V in the unmuted condition. The external alarm light is reset (turned off) by either replacing the microphone/handset on-hook or momentarily pressing the CALL pushbutton light switch.

Q1417 remains on until tone reset switch Q1409 is reset, it applies A- to

call indicator switch Q1422 and through an RC network to the base of timed inverter Q1418.

Timed inverter Q1418 is pulsed on initially when A- is coupled through R1456 and C1420 to its base. While Q1418 is turned on, A+ is applied through R1458 to the base of timed relay driver Q1419. Q1419 applies A- to the optional horn relay through S1402 and J1401-2. The horn will sound for approximately two seconds. As C1420 charges through R1457, R1456 and the collector/emitter junction of Q1417, the base of Q1418 rises. As the base voltage rises above the cut off point, Q1418 turns off and, in turn, turns Q1419 off. This de-energizes the external horn alarm relay and stops the horn from blowing.

Call indicator switch Q1422 turns on and applies A+ to the light flasher multivibrator Q1421 and Q1420. The multivibrator operates at a frequency of approximately 7 Hz, Q1420 alternately applies and removes A- from CALL indicator CR1411, causing it to flash on and off. A+ is supplied to the anode of CR1411 by call indicator switch Q1422.

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 transition 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, turning it off. Turning Q1409 off removes the positive latching voltage from CR1405 from timed alarm transistor switch Q1417 and latched relay driver Q1411, turning the external alarms off. In addition, Q1413 removes the anode voltage from CR1408, re-arming CR1408 and allowing it to be fired again after the anode voltage has been reapplied.

Voltage Regulator

The voltage regulator consists of zener diodes VR1401, VR1402 and associated components that provide a regulated output of 8.2 V and 5.4 V. Zener diode VR1401 provides 8.2 V to 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 Q1401-Q1405, Q1412, Q1416, Q1423 and U1401.

TYPE 90 DECODER AND TYPE 90 ENCODER

The Type 90 Decoder and Type 90 Encoder circuits are identical to like circuits on the Type 90 Encoder/Decoder described separately. The same printed wire board is used for each group; however, only those components required to perform the applicable function are included. All other components normally included on the encoder/decoder are deleted. Refer to Figures 2 and 3 for the decoder and encoder block diagrams and to the appropriate schematic to identify circuit functions.

EXTERNAL ALARMS

Two external alarm control circuits, horn and light, are available. Either one or both may be present. A latched relay driver, Q1411 is used to control the light alarm while a timed relay driver, Q1419, is used to sound the horn. Maximum allowable current through the driver transistors is 200 milliamperes.

Latched relay driver, Q1411 supplies A- through contacts 3 and 5 of S1403 and J1401-1 to the external light relay.

Timed relay driver, Q1419, supplies A- through contacts 3 and 5 of S1402 and J1401-2 to the external horn relay.

The external relay must be used when the current rating of the external alarm (horn, light, etc.) exceeds the current rating of the driver transistors, i.e. 200 milliamperes. 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.

FIELD INSTALLATION

The following instructions install the Type 90 Encoder/Decoder options in the C-800 and C-900 Series Control Units. Refer to the control unit maintenance manual for removal and replacement procedures for the control module and to locate jumper "E".

PROCEDURE

Control Module

1. Remove front panel of control unit.
2. Refer to control unit maintenance manual for control module removal procedures. Remove control module (lower deck).
3. When decode function is present on Type 90 component board, (19D417858G1, 2) cut or remove jumper "E" on control module.
4. Do not reinstall control module at this time.

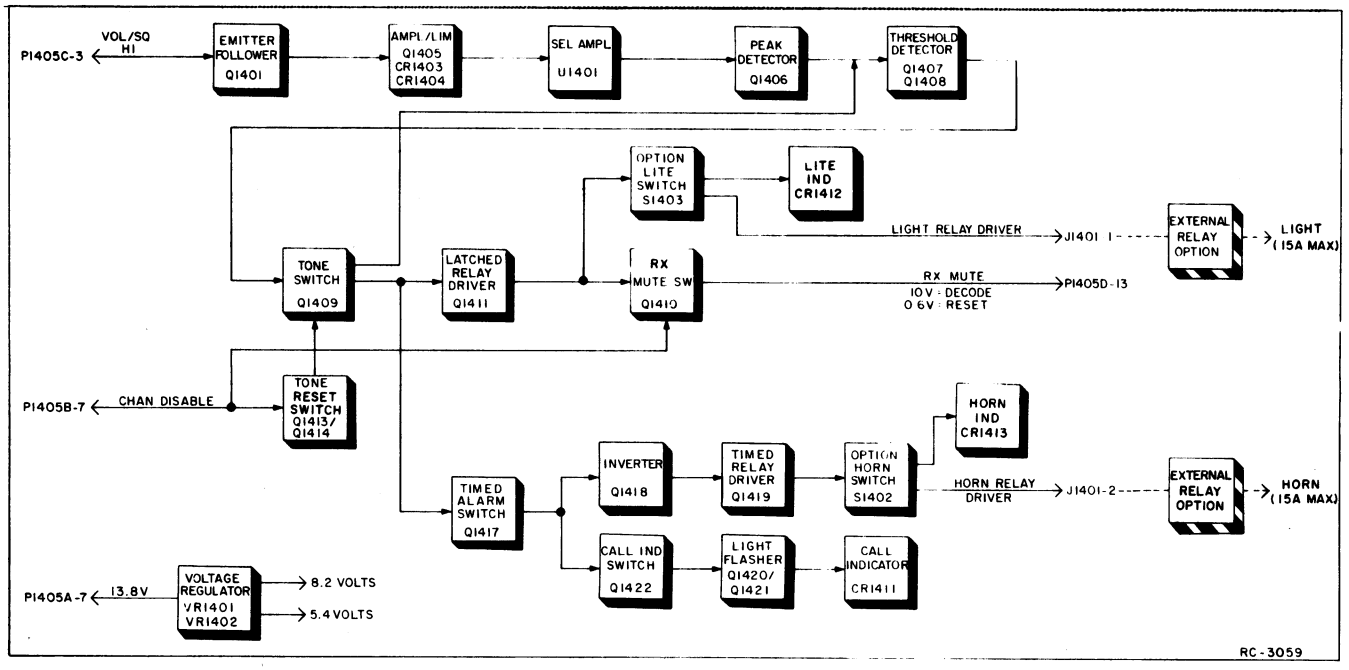


Figure 2 - Type 90 Tone Decoder Block Diagram

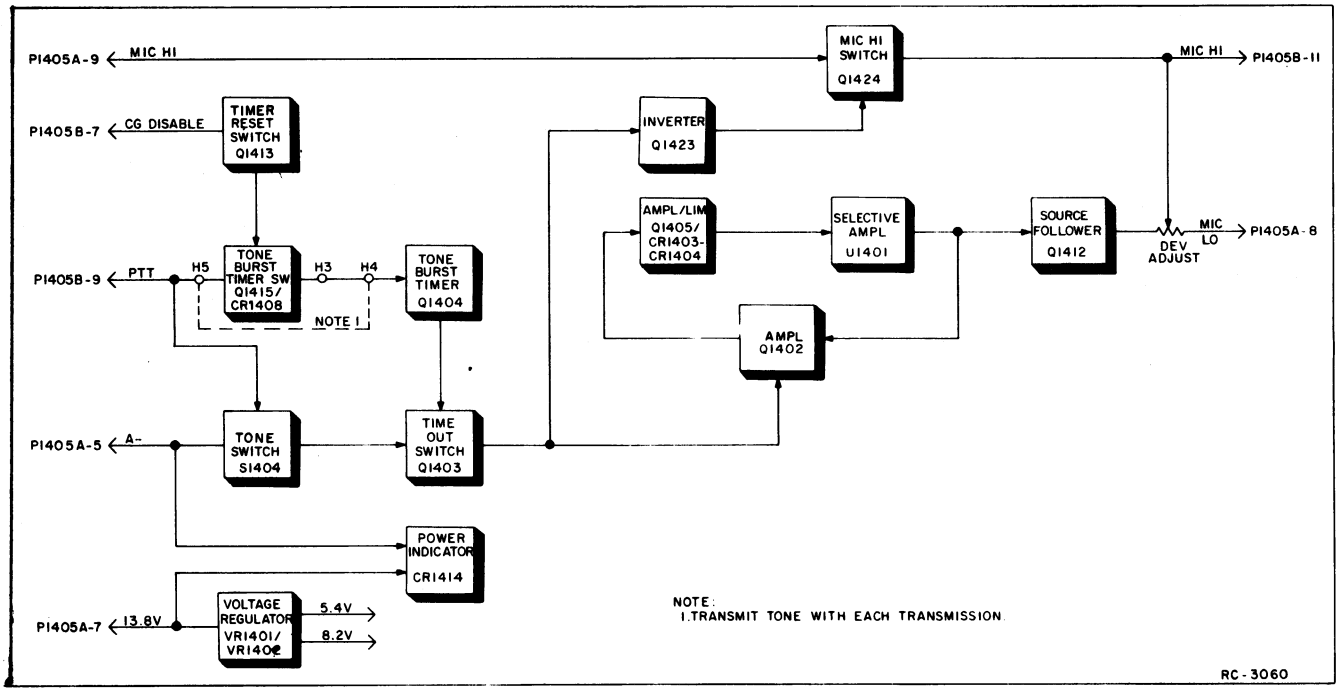


Figure 3 - Type 90 Tone Encoder Block Diagram

Type 90 Option Module

(Tone Burst Modification)

As shipped from the factory, the Type 90 module will provide an automatic tone burst only once at the beginning of each call. A strapping arrangement on the Type 90 component board allows it to be modified to provide a tone burst each time the PTT switch is operated. If this modification is desired, disconnect DA jumper H4-H3 and resolder between H4-H5.

Option Switch Installation

1. Unsolder and discard pin from hole reserved for LED contact (See Outline Diagram). Do not unsolder or damage LED contact. Hole thru LED contact must remain open.

2. Install and solder switch. Shoulder of switch terminal must be tight against board, .010 max. gap after solder.

3. Install and solder LED.

4. Insert red wire from cable 19B227438G1 into J760-1 and black wire into J760-2.

5. Remove second option module if present and necessary to gain access to install J760.

6. Install J760 by pressing connector into rear cover from inside control unit. Refer to control unit manual for location.

7. Install cable clip around 19B227438G1 and fasten clip to backplane board using an existing 6-32 screw.

8. Install Type 90 component board in appropriate option deck and plug short cable into J1401 on option board. Install control module and second option board if removed.

EXTERNAL RELAY KIT

Refer to Outline Diagram to locate and identify connecting points.

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

2. Crimp terminal 19B209260P12, provided, to red or black wire. Connect terminal to relay lug #4 using 8-32 x 5/16 screw.

3. Cut red fused lead so fuse assembly is close to voltage source. Attach the solderless terminal with the 0.197 inch hole to the end of the lead going to the relay. Using #8-32 x 5/16 LG hardware attach the terminal to lug 3 of the relay. Attach other end of fused lead to voltage source with appropriate hardware.

4. Connect horn or light circuit to lugs 1 and 2 of relay.

MAINTENANCE

Troubleshooting the Type 90 module in the control unit is facilitated by using option extender board 19D417773. The extender board provides feed throughs for all connections to the control unit backplane 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 procedures are provided to assist in isolating defective components.

REMOVING INTEGRATED CIRCUITS

Removing integrated circuit IC's 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

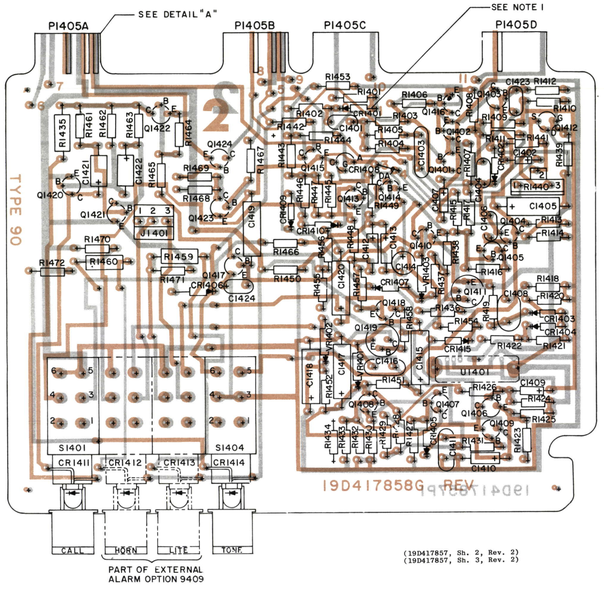
The encode tone amplitude is adjustable from zero to approximately 200 milli-volts. Normally, the tone amplitude is adjusted to provide 3 kHz deviation at the transmitter.

QUICK CHECKS

STEP	SYMPTOM	PROCEDURE
1.	Will Not Decode	1. Check that input tone is same as that of selective amplifier, U1401. 2. Check regulated supply voltage. 3. Inject proper tone frequency into Q1401 and using an oscilloscope, trace the signal through Q1401, Q1405, and selective amplifier. Check Q1406, Q1407, Q1409, & Q1417.
2.	Call Light Will Not Reset	1. Check that hookswitch is working. 2. Check to see that there is a short positive 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 and Q1408.
4.	Receiver Will Not Unmute But CALL Light Operates	1. Check Q1410, Q1411, CR1407 and VR1403.
5.	No Tone During Transmit	1. Check Q1416, Q1415, Q1404, Q1403, Q1402 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 Q1405, CR1403, CR1404, selective amplifier U1401, and Q1402.
6.	Automatic Tone Burst Will Not Reset	1. Check CR1408, CR1409, Q1413 and Q1415.
7.	Continuous Tone is Heard While Transmitting	1. Check CR1401
8.	No Voice Modulation From Microphone	1. Check Q1423, Q1424, and Q1402.

VOLTAGE READINGS
(Typical)

TRANSISTOR	RESET			DECODED			ENCODE		
	Emitter	Base	Collector	Emitter	Base	Collector	Emitter	Base	Collector
Q1401	1.4	2.0	5.4	1.4	2.0	5.4	1.6	2.0	5.4
Q1402	0.8	5.4	1.4	4.7	5.4	1.4	4.0	3.5	1.6
Q1403	0.6	1.3	0.8	0.6	0.1	4.7	4.0	0	0.5
Q1404	0	0.2	1.3	0	0.6	0.1	0	0.2	0
Q1405	0	0.6	3.2	0	0.6	3.2	0	0.6	3.2
Q1406	0.2	0.6	8.0	0.9	0.6	8.0			
Q1407	0.5	0.7	8.0	0.6	1.2	0.6			
Q1408	0.5	1.0	8.0	0.6	1.2	8.0			
Q1409	8.0	8.0	0.2	8.0	7.4	8.0			
Q1410	0	0.7	0.1	0	0	13.8			
Q1411	0	0.2	13.8	0	0.7	2.1		(During Reset)	
Q1413	0	0.7	0	0	0.4	12.4	0	0.7	11.0
Q1414	12.7	12.7	8.2	12.7	12.7	6.8	12.7	12.7 (Encode)	7.0
Q1415	0	0.6	0	0	0.7	0	0	0	10.0
Q1416	5.4	4.7	5.4	5.4	4.7	5.4	5.4	10.0	3.5
Q1423	0	0.6	12.0	0	0.5	11.8	0	0.6	12.0
Q1424	4.7	5.2	4.7				6.1	6.6	6.1
	Source	Gate	Drain	Source	Gate	Drain			
Q1412	3.7	2.1	5.4	3.7	2.1	5.4	3.7	2.1	5.4
Q1417	0	0.2	13.8	0	0.7	0.1			
Q1418	13.8	13.8	0.4	13.8	13.8	0			
Q1419	0	0.3	13.8	0	0	13.8			
Q1420	0	0.3	0	0	0	0			
Q1421	0	0.3	.3	13.8	13.0	13.7			



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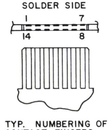
PART OF EXTERNAL ALARM OPTION 9409

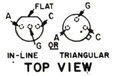


TYP. NUMBERING OF CONTACT FINGERS.

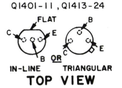
DETAIL "A"

LEAD IDENTIFICATION FOR DIODES AND TRANSISTORS;
CR1411—CR1414

CATHODE LEAD IS IDENTIFIED BY FLAT SIDE OF CASE OR ANODE LEAD IS IDENTIFIED BY DARK CIRCLE.



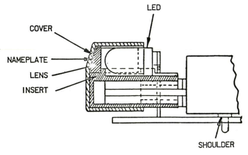
TOP VIEW



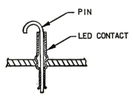
TOP VIEW

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

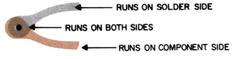
TOP VIEW

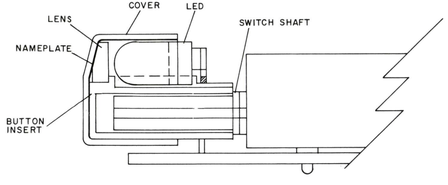


SHOWN IN OVERTRAVEL POSITION



RC-3011

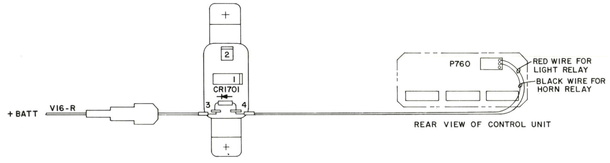




NOTES:
1. REPLACE CR1401 BY "DA" WIRE IN DECODE ONLY APPLICATIONS.
2. TO DELETE AUTO-BURST OPTION 9414, REMOVE OR CUT "DA" WIRE BETWEEN H3 AND H4 AND CONNECT BETWEEN H4 AND H5

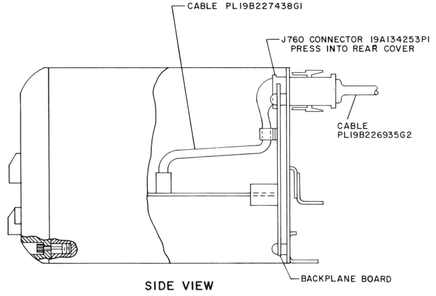
(19D424501, Rev. 2)

EXTERNAL RELAY

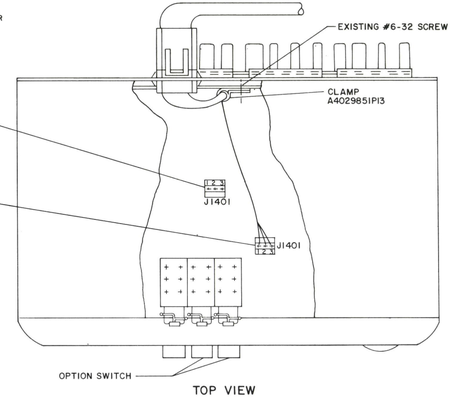


REAR VIEW OF CONTROL UNIT

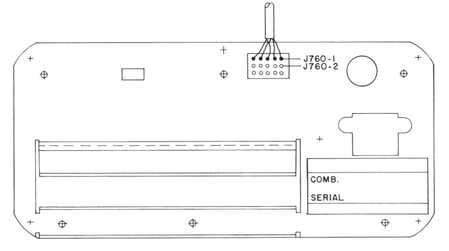
(19B227439, Rev. 1)



SIDE VIEW



TOP VIEW

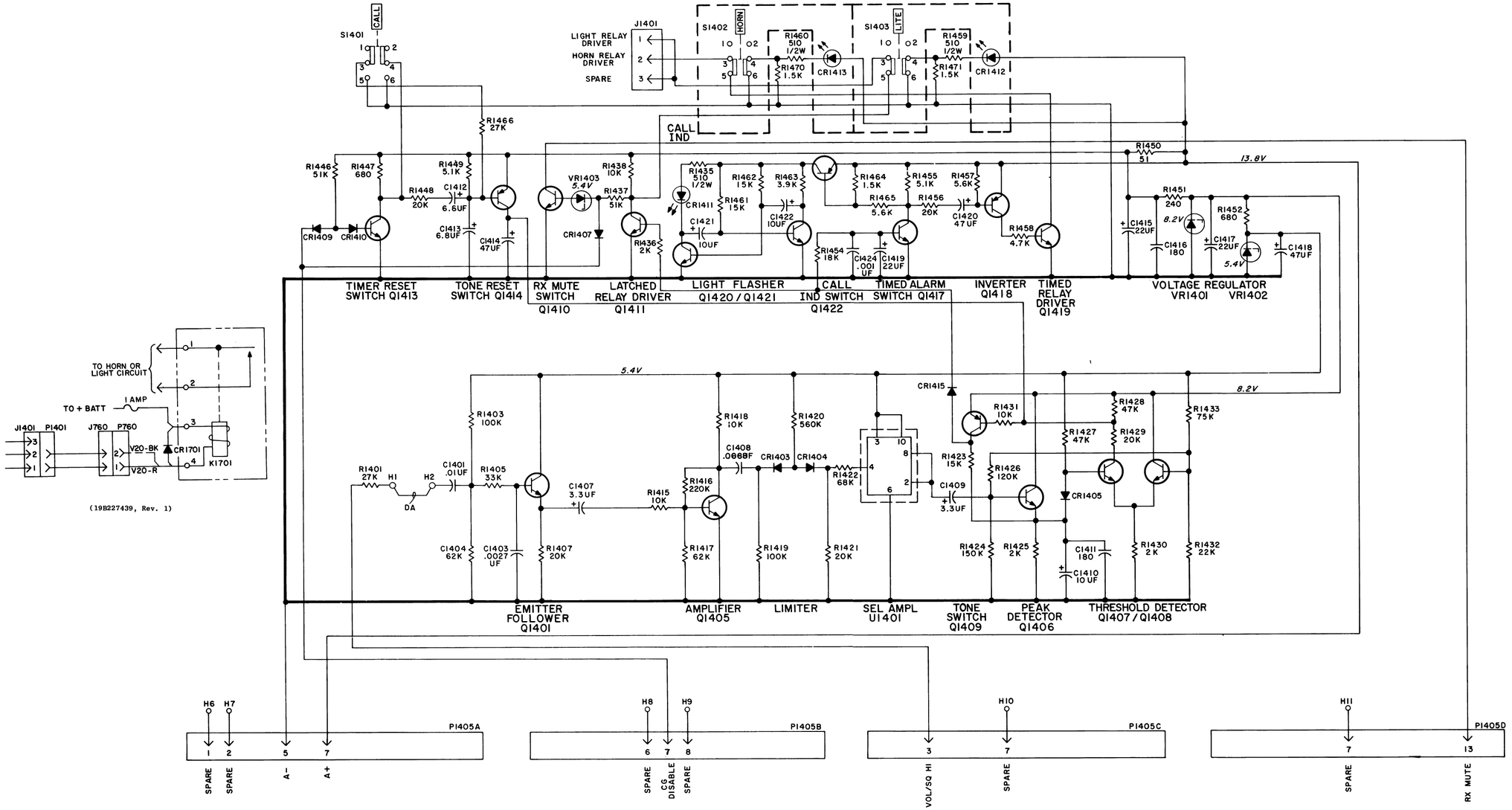


REAR VIEW

RC-3090

OUTLINE & INSTALLATION DIAGRAM

TYPE 90 TONE ENCODER & DECODER



(19R622114, Rev. 6)

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.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417858G2	

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

SCHEMATIC DIAGRAM

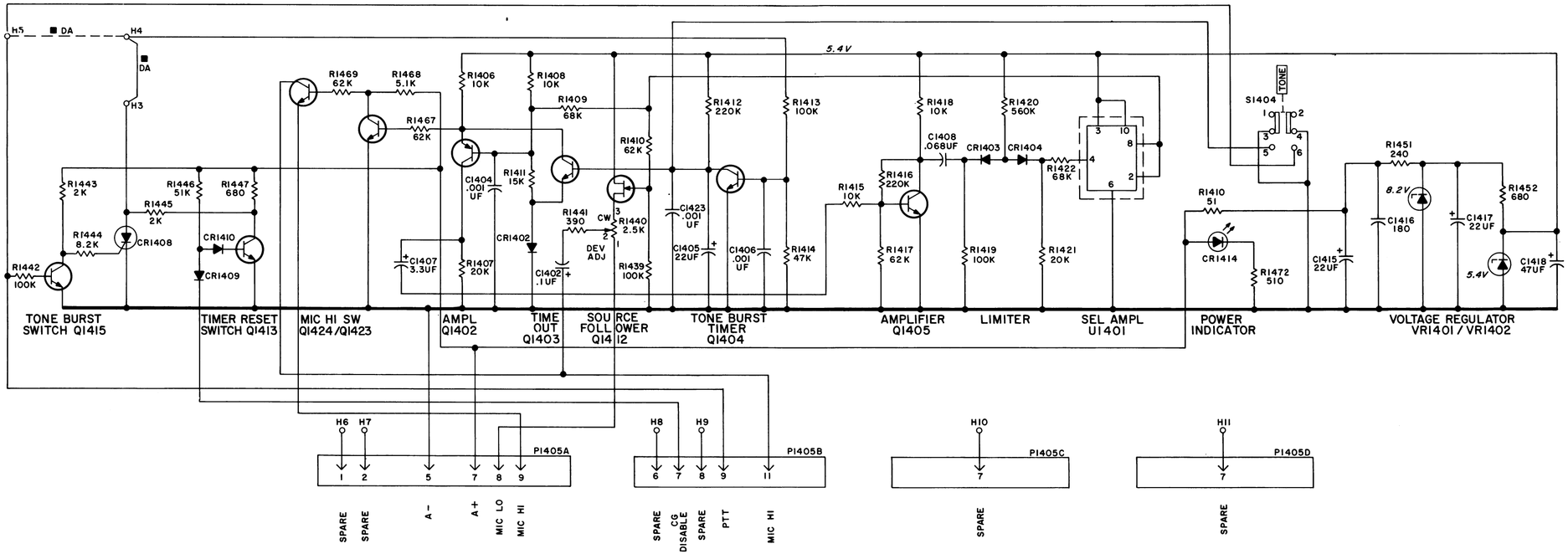
TYPE 90 TONE DECODER

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.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D41785863	

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

■ FOR TONE ENCODE DURING EACH TRANSMISSION, REMOVE JUMPER FROM H3 TO H4 AND ADD SLEEVED JUMPER FROM H4 TO H5.

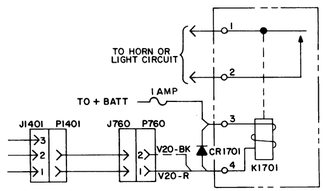


(19R622115, Rev. 4)

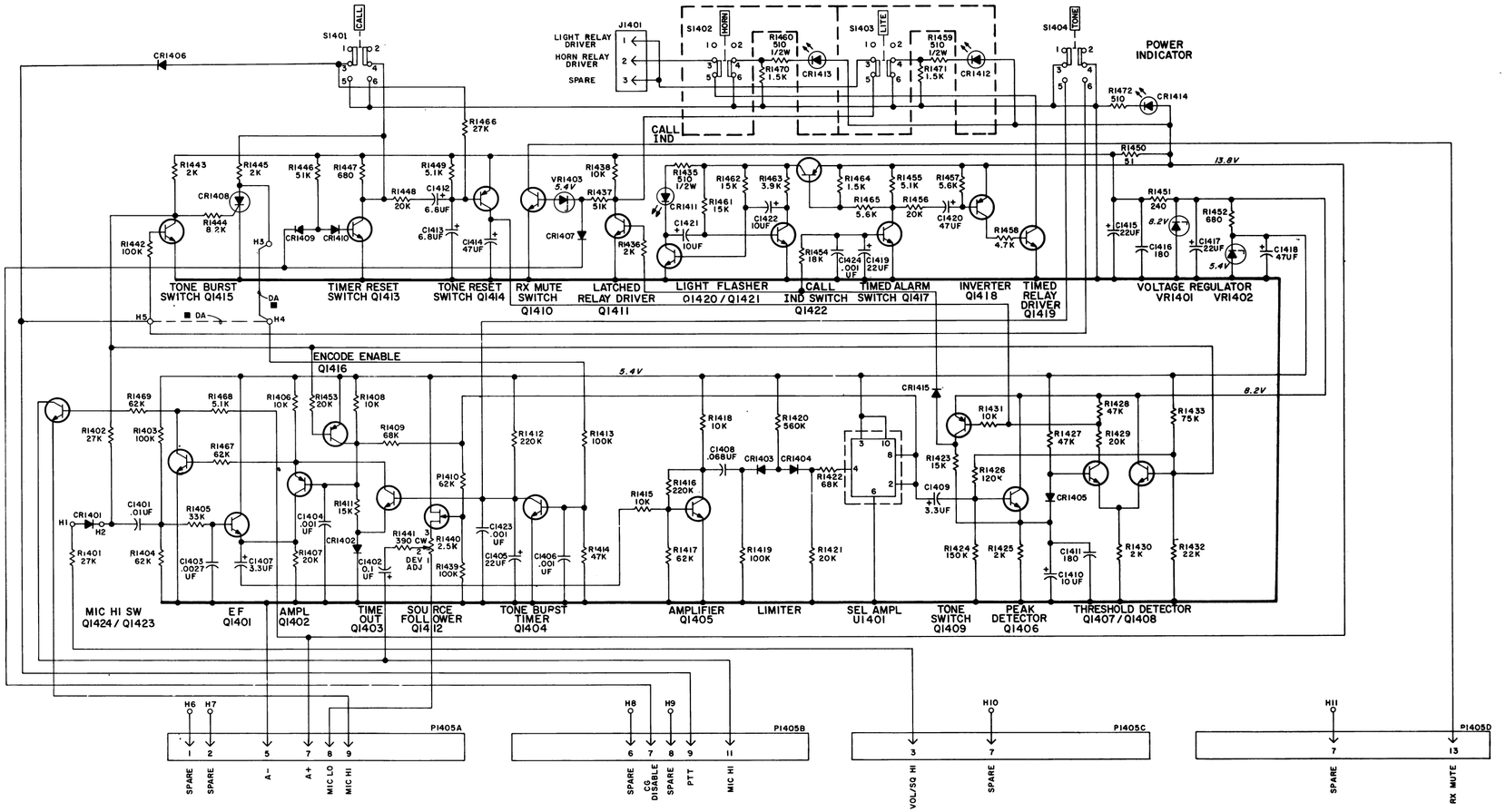
SCHEMATIC DIAGRAM

TYPE 90 TONE ENCODER

10 Issue 1



(19B227439, Rev. 1)



(19R622113, Rev. 6)

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.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417858G1	

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

■ FOR TONE ENCODE DURING EACH TRANSMISSION, REMOVE JUMPER FROM H3 TO H4 AND ADD SLEEVED JUMPER FROM H4 TO H5.

SCHEMATIC DIAGRAM

TYPE 90 ENCODE/DECODE

PARTS LIST

LBI-30279

TYPE 90 TONE
19D417858G1 ENCODER/DECODER
19D417858G2 DECODER
19D417858G3 ENCODER

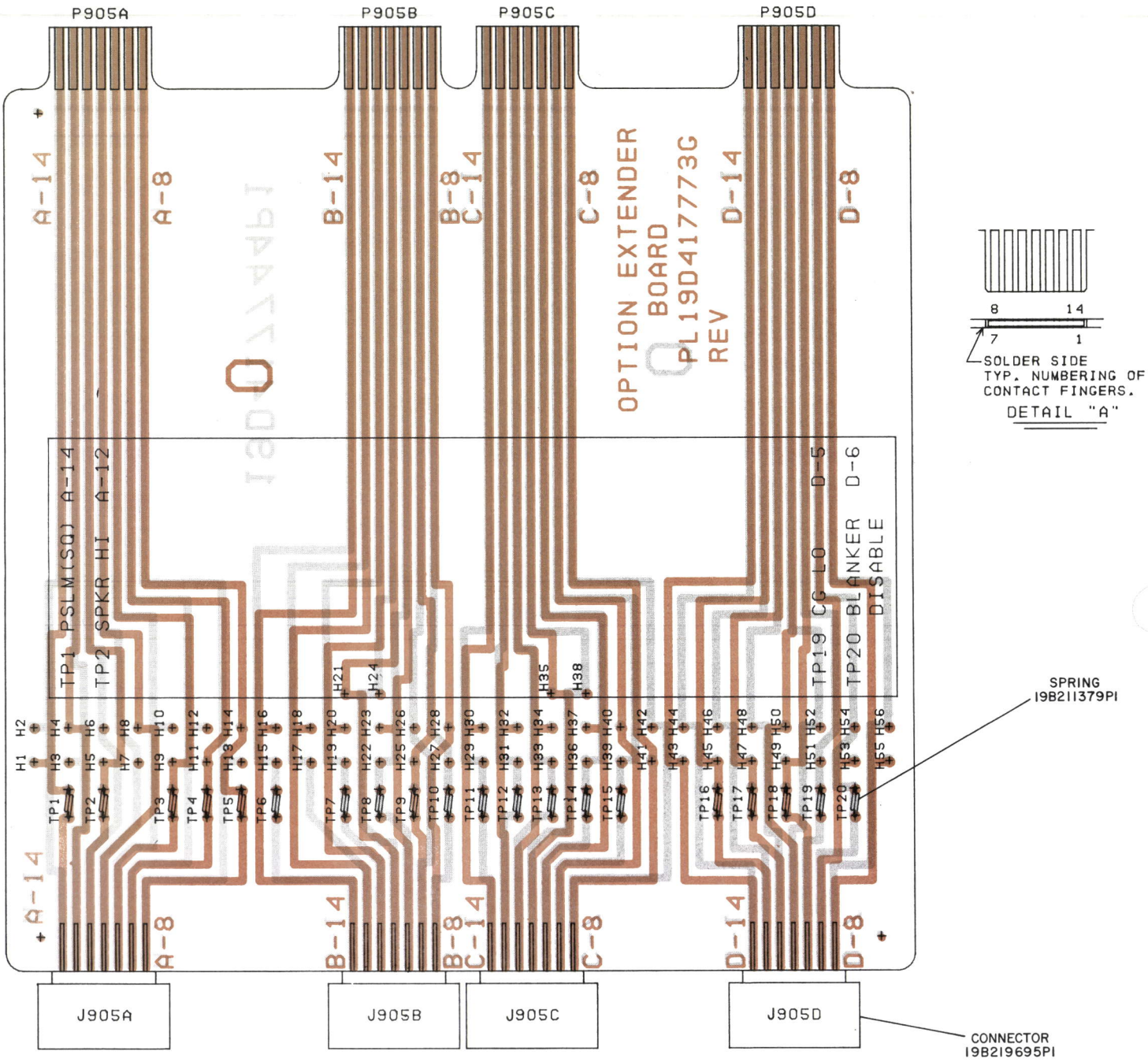
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1401	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C1402	5491674P1	Tantalum: 1.0 µf +40% -20%, 10 VDCW; sim to Sprague Type 162D.
C1403	5494481P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1404	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	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
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	7489162P33	Silver mica: 180 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
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.
C1419	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1420	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C1421 and C1422	5491674P40	Tantalum: 10 µf ±20%, 20 VDCW; sim to Sprague Type 162D.
C1423 and C1424	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1401 thru CR1407	19A115250P1	Silicon.
CR1408	19A116642P1	Thyristor, silicon controlled: sim to Type 2N5064.
CR1409 and CR1410	19A115250P1	Silicon.
CR1411	19A134146P4	Diode, optoelectronic: red; sim to Opcoa LSM-6L.
CR1414	19A134146P14	Diode, optoelectronic: yellow; sim to Opcoa LSM23L-101.
CR1415	19A115250P1	Silicon.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1401	19A116659P26	Connector, printed wiring: sim to Molex 09-64-1031.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - 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	19A134137P3	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	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1418	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1419	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q1420 and Q1421	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1422	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1423 and Q1424	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1401 and R1402	3R152P273J	Composition: 27,000 ohms ±5%, 1/4 w.
R1403	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R1404	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R1405	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R1406	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1407	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1408	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1409	3R152P683J	Composition: 68,000 ohms ±5%, 1/4 w.
R1410	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R1411	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R1412	3R152P224J	Composition: 0.22 megohm ±5%, 1/4 w.
R1413	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R1414	3R152P473J	Composition: 47,000 ohms ±5%, 1/4 w.
R1415	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1416	3R152P224J	Composition: 0.22 megohm ±5%, 1/4 w.
R1417	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R1418	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1419	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R1420	3R152P564J	Composition: 0.56 megohm ±5%, 1/4 w.
R1421	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1422	3R152P683J	Composition: 68,000 ohms ±5%, 1/4 w.
R1423	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R1424	3R152P154J	Composition: 0.15 megohm ±5%, 1/4 w.
R1425	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1426	3R152P124J	Composition: 0.12 megohm ±5%, 1/4 w.
R1427 and R1428	3R152P473J	Composition: 47,000 ohms ±5%, 1/4 w.
R1429	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1430	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1431	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.

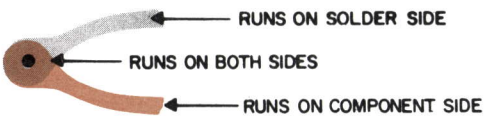
SYMBOL	GE PART NO.	DESCRIPTION
R1432	3R152P223J	Composition: 22,000 ohms ±5%, 1/4 w.
R1433	3R152P753J	Composition: 75,000 ohms ±5%, 1/4 w.
R1435	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R1436	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1437	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R1438	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1439	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R1440	19B209358P104	Variable, carbon film: approx 100 to 2500 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R1441	3R152P391J	Composition: 390 ohms ±5%, 1/4 w.
R1442	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R1443	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1444	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
R1445	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1446	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R1447	3R152P681J	Composition: 680 ohms ±5%, 1/4 w.
R1448	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1449	3R152P512J	Composition: 5100 ohms ±5%, 1/4 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	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1454	3R152P183J	Composition: 18,000 ohms ±5%, 1/4 w.
R1455	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R1456	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1457	3R152P562J	Composition: 5600 ohms ±5%, 1/4 w.
R1458	3R152P472J	Composition: 4700 ohms ±5%, 1/4 w.
R1459 and R1460	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R1461 and R1462	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R1463	3R152P392J	Composition: 3900 ohms ±5%, 1/4 w.
R1464	3R152P152J	Composition: 1500 ohms ±5%, 1/4 w.
R1465	3R152P562J	Composition: 5600 ohms ±5%, 1/4 w.
R1466	3R152P273J	Composition: 27,000 ohms ±5%, 1/4 w.
R1467	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R1468	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R1469	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R1470 and R1471	3R152P152J	Composition: 1500 ohms ±5%, 1/4 w.
R1472	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1401	19B209563P3	Push: 2PDT, momentary action; sim to Switchcraft Series 70,000.
S1404	19B209563P3	Push: 2PDT, momentary action; sim to Switchcraft Series 70,000.
		- - - - - - - - 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.

SYMBOL	GE PART NO.	DESCRIPTION
		ASSOCIATED ASSEMBLIES
		EXTERNAL RELAY ASSEMBLY 19B223025G2
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR1701	4037822P2	Silicon.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1701	7486515P2	Armature, enclosed: 12 VDC nominal, 85 to 90 ohms at 25°C, 1 form A contact, without mounting screws.
		SWITCH ASSEMBLY 19B227037G7
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR1412 and CR1413	19A134146P14	Diode, optoelectronic: yellow; sim to Opcoa LSM-23L-101.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J760	19A134253P1	Connector: sim to AMP 1-480621-9.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P760	19B226935G2	Cable: 2 conductor, approx 12 feet long.
P1401	19B227438G1	Cable: approx 11 inches long.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1402 and S1403	19B209563P2	Push: 1 station; 2PDT, alternate action; sim to Switchcraft Series 70,000.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B226334P1	Pushbutton. (S1401 and S1404).
	19C321004P1	Lens. (S1401 and S1404).
	19B226331P1	Actuator. (S1401 and S1404).
	NP276459P23	Nameplate, plastic. (CALL).
	NP276459P24	Nameplate, plastic. (HORN).
	NP276459P25	Nameplate, plastic. (LITE).
	NP276459P26	Nameplate, plastic. (TONE).
	4029851P13	Clip loop. (Used with Switch Assembly).
	19B209260P12	Terminal, solderless: wire range No. 22-16; sim to AMP 41310. (Used with External Relay Assembly).
	19B226454G1	Fused Lead. (Used with External Relay Assembly).
	19A129833P1	Support. (K1701).
	N130P1608C6	Tap screw: No. 10-16 x 1/2. (Secures K1701 support).
	N80P13005C6	Tap screw: No. 6-32 x 5/16. (Secures K1701 to support).
	N404P13C6	Lockwasher, internal tooth: No. 6. (Secures K1701 to support).
	N402P37C13	Flatwasher: No. 6. (Secures K1701 to support).
	4036555P1	Insulator, washer: nylon. (Used with Q1411 and Q1419).
	19A115010P3	Contact, electrical. (Sockets for CR1411-CR1414).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

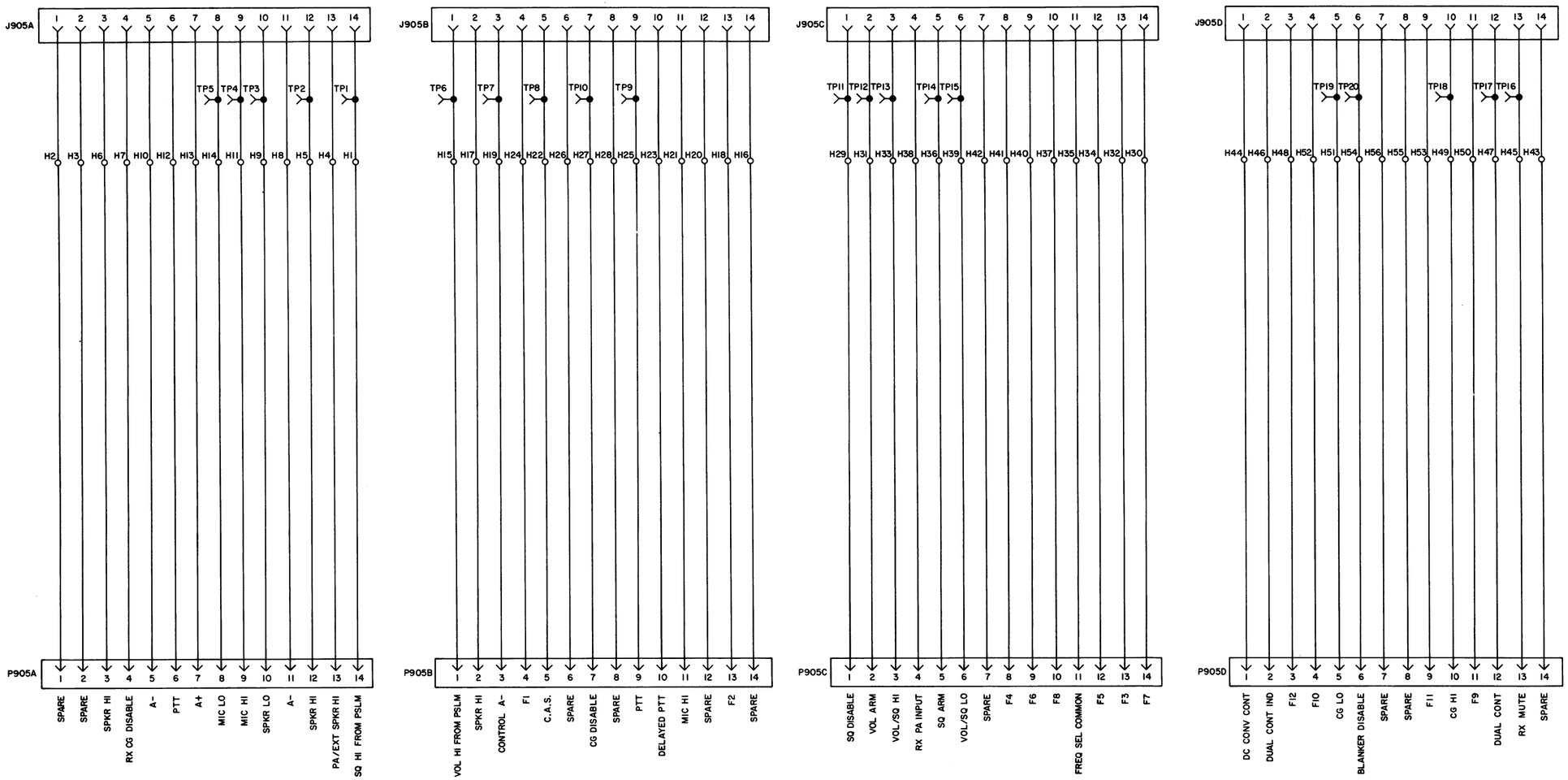


(19D424211, Rev. 0)
(19B226451, Sh. 2, Rev. 0)
(19B226451, Sh. 3, Rev. 0)



OUTLINE DIAGRAM

OPTION EXTENDER BOARD
19D417773



THIS ELEM DIAG APPLIES TO	
MODEL NO PL19D417773	REV LETTER

(19R622088, Rev. 1)

SCHEMATIC DIAGRAM

OPTION EXTENDER BOARD 19D417773

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 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 Authorized GE Communication Equipment Sales Office of the General Electric Company.

DF-5048

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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