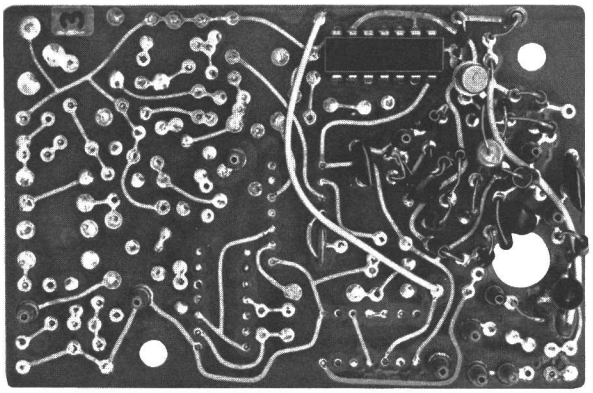
MOBILE RADIO

MASTR PROGRESS LINE

SEARCH-LOCK MONITOR 19A127557-G4
(Option 7050)



SPECIFICATIONS *

Search Rate (Each Channel)	Four Times per second
Sample Time	125 milliseconds
Input Power	20 milliamperes at +10 volts DC
Transistors	4
Integrated Circuit Modules	1
Temperature Range	-30°C to +60°C
Dimensions (H X W)	2-3/8" X 3-3/4"

SEARCH-LOCK MONITOR

*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

SPECIFICATIONS ..... COVER

DESCRIPTION 1

OPERATION 1

LOGIC CIRCUITS 1

CIRCUIT ANALYSIS 3

MAINTENANCE 4

SYSTEM MODIFICATION 4

LOGIC & SCHEMATIC DIAGRAM FOR INTEGRATED CIRCUIT 5

OUTLINE DIAGRAM 6

SCHEMATIC DIAGRAM 7

PARTS LIST 8

PRODUCTION CHANGES 8

TROUBLESHOOTING PROCEDURE 9

WARNING

Under no circumstances should any person 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.

DESCRIPTION

General Electric Search-Lock Monitor 19A127557-G4 provides two-frequency monitoring when used with MASTR Professional Series mobile combinations.

The Search-Lock Monitor (SLM) provides two-channel monitoring by alternately sampling each of the two receiver frequencies at a nominal rate of four times per second. When a signal is received on either frequency, the SLM "locks" on that frequency for the duration of the signal.

NOTE

The Search-Lock Monitor will operate only with the receiver squelched. When the receiver is unsquelched, the Search-Lock monitor will "lock" on either F1 or F2.

The SLM assembly mounts under the back cap on the system frame at the back of the receiver.

OPERATION

Operation of the SLM is controlled by the SEARCH-OFF switch and the frequency selector switch marked (F1-F2) on the mobile control unit. The SEARCH-OFF switch controls the operation of the SLM, and the frequency selector switch selects the operating channel when the SLM is disabled.

Placing the SEARCH-OFF switch in the OFF position applies +10 volts through the F1-F2 switch to the selected crystal-switching diode in the receiver oscillator. The +10 volts also overrides the SLM. The F1-F2 switch also connects the crystal-switching diode of the transmitter oscillator to ground, so that the radio will operate on the frequency determined by the selected transmitter and receiver oscillator.

Placing the SEARCH/OFF switch in the SEARCH position applies no voltage to either receiver crystal-switching diode, and the SLM operates. The SLM then provides two-channel monitoring by alternately switching +10 volts between the two receiver crystal-switching diodes at a rate of approximately four times a second. When a signal is received on either channel, the SLM will "lock" on that frequency for the duration of the signal.

LOGIC CIRCUIT

This section contains a detailed description of the logic circuits contained in the Integrated Circuit Module used in the SLM board. It is suggested that the serviceman study the following information carefully as a good understanding of basic logic circuitry is essential for servicing the SLM.

TRANSISTOR SWITCH & INVERTER

The high value of "off" resistance and the low value of "on" resistance make the transistor invaluable for switching applications. When no base current is applied to the transistor switch shown in Figure 1, and the collector has the proper voltage applied, the open circuit resistance of the transistor approaches several megohms. If sufficient base current is suddenly applied to drive the transistor into saturation (turned ON), the collector-emitter resistance will drop to as low as 1.0 ohm. Voltage across the transistor under these conditions may be only a few tenths of a volt.

The transistor stage shown in Figure 1 can also be used as an inverter for reversing the polarity of the input signal. A positive signal applied to the base-emitter junction will cause the collector voltage to drop from +6 volts to near ground potential.

GATING CIRCUITS

Formal logic requires that a statement be either true or false; no other condition can exist for the statement. A logic circuit is basically a switch or gate that is either closed or open; no other condition can exist for the circuit. By logical arrangement of these gating circuits, electrical functions can be performed in a predetermined sequency by opening or closing the gates at the proper time.

A single-pole, single-throw switch is equivalent to a binary device with only two possible operating conditions: either open or closed. If point "C" of Figure 2 is to be made equal to potential V, switches A and B must be closed. It can then be said that A AND B = C. If switches A and B are considered as gates, then potential V is said to be gated to "C" when both gates are closed. By representing the closed state of a switch or gate as "1" and the open

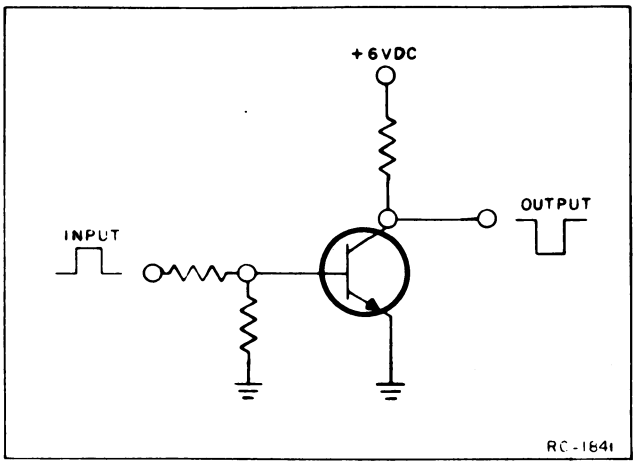


Figure 1 - Transistor Switch & Inverter

state of a switch or gate as "0", then all possible conditions for the AND gate are shown in the Truth Table in Figure 2.

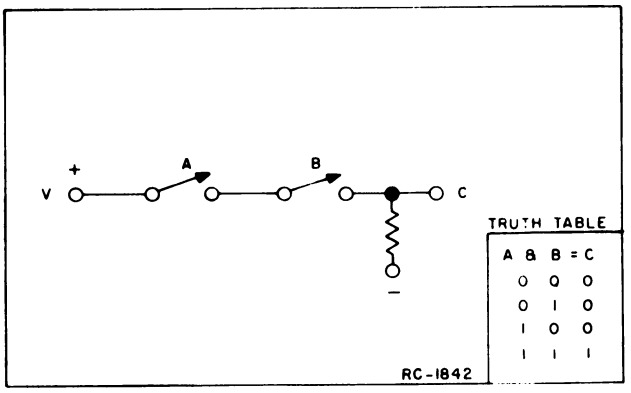


Figure 2 - Simple AND Gate

AND Gate

A simple diode AND gate is shown in Figure 3. The same conditions exist in this circuit as in the switch gate of Figure 2. Application of a positive potential to the diodes at all inputs will result in a positive potential to the diodes at the output. This represents the "1" state of the gate. Application of a positive potential to one or two terminals will result in no potential developed, representing the "0" state of the gate.

NAND Gate

The basic logic circuitry used in the SLM is the NAND gate (NOTE-AND). A NAND gate is simply an AND gate with a transistor inverter (NOT) stage added (see Figure 4). Applying a positive potential to inputs A and B back biases diodes CR1 and CR2, permitting inverter Q1 to conduct. When conducting, the collector of Q1 drops to near ground potential.

Additional buffer or amplifier stages are usually added to the NAND gate to provide better isolation and increased gain. These additional stages are connected so that the logical output of the inverter is not changed.

FLIP-FLOP

Two NAND gates connected as shown in Figure 5 will provide the same logic functions as the conventional flip-flop (bistable multivibrator).

Assume that a positive potential is applied to all inputs. Momentarily grounding the cathode of CR4 turns off Q2, causing its collector voltage to rise to approximately +6 volts. This turns on Q1, causing its collector voltage to drop to near ground potential, keeping Q2 turned off. The flip-flop will remain in this state until CR1 is grounded.

Usually, two or more of the flip-flops are connected in a "master-slave" configuration (one flip-flop driving the other) for additional flexibility. Terminal identification for the flip-flop is shown in Figure 6A. However, the flip-flops used in the SLM are actually connected as shown in Figure 6B, with external connections from input terminal 3 to output terminal 5, and from

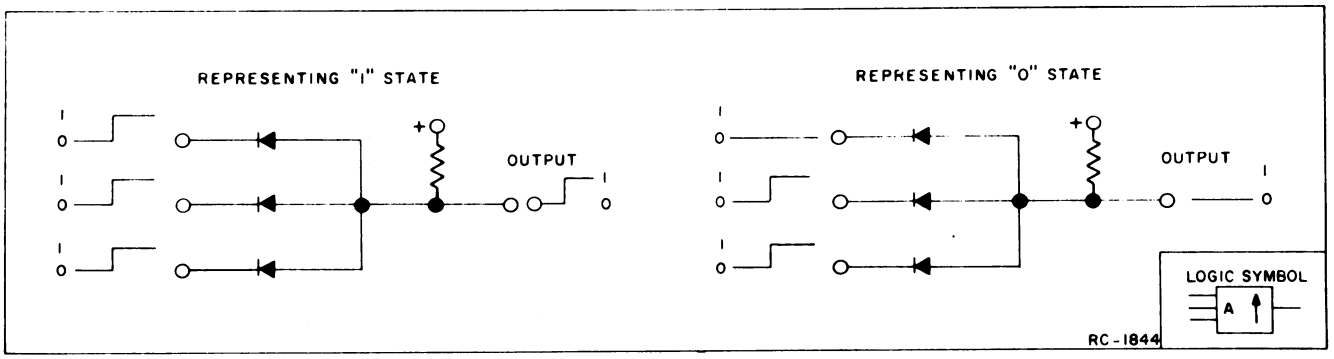


Figure 3 - Diode AND Gate

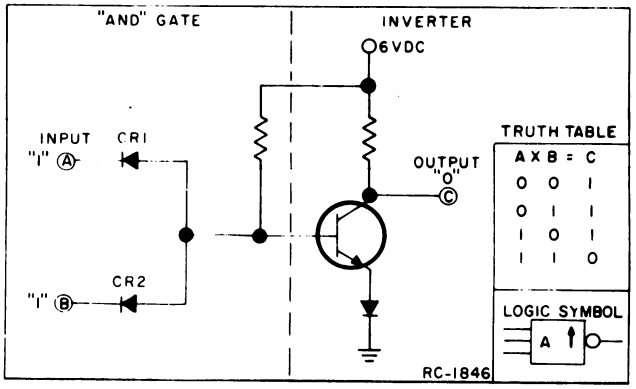


Figure 4 - Simplified NAND Gate

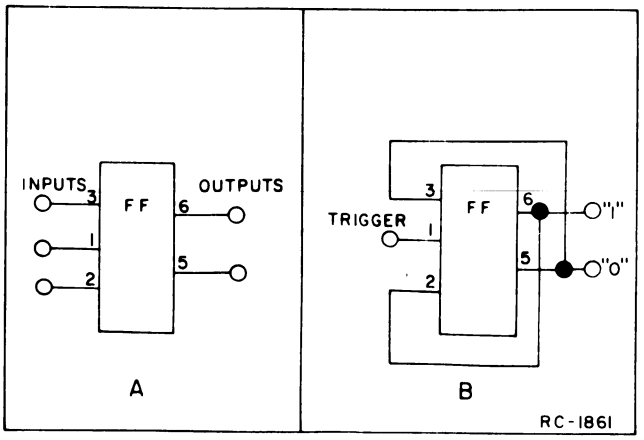


Figure 6 - Flip-Flop Terminal Identification

input terminal 2 to input terminal 6. This leaves terminal 1 as the input terminal or "Trigger". A flip-flop connected in this manner (J-K connected) will change state each time a pulse is applied to the trigger (terminal 1).

For purposes of simplicity, supply and ground terminals (as well as any unused terminals) are not shown in the logic diagrams.

CIRCUIT ANALYSIS

The Search-Lock Monitor is fully transistorized, using both discrete components and an Integrated Circuit module (IC). Discrete components are used in the Pulse Generator and Driver Circuits. The Integrated Circuit module (IC) is used as the Channel Flip-Flop.

References to symbol numbers mentioned in the following text may be found on the Outline Diagram, Schematic Diagram and Parts List (see Table of Contents).

Supply voltage for the SLM is provided by the 10-volt regulator in the mobile power supply. +10 volts is required for operating the discrete transistor stages. The IC is supplied by the output of the 5.4-volt regulator circuit composed of C4, CR2, and R7.

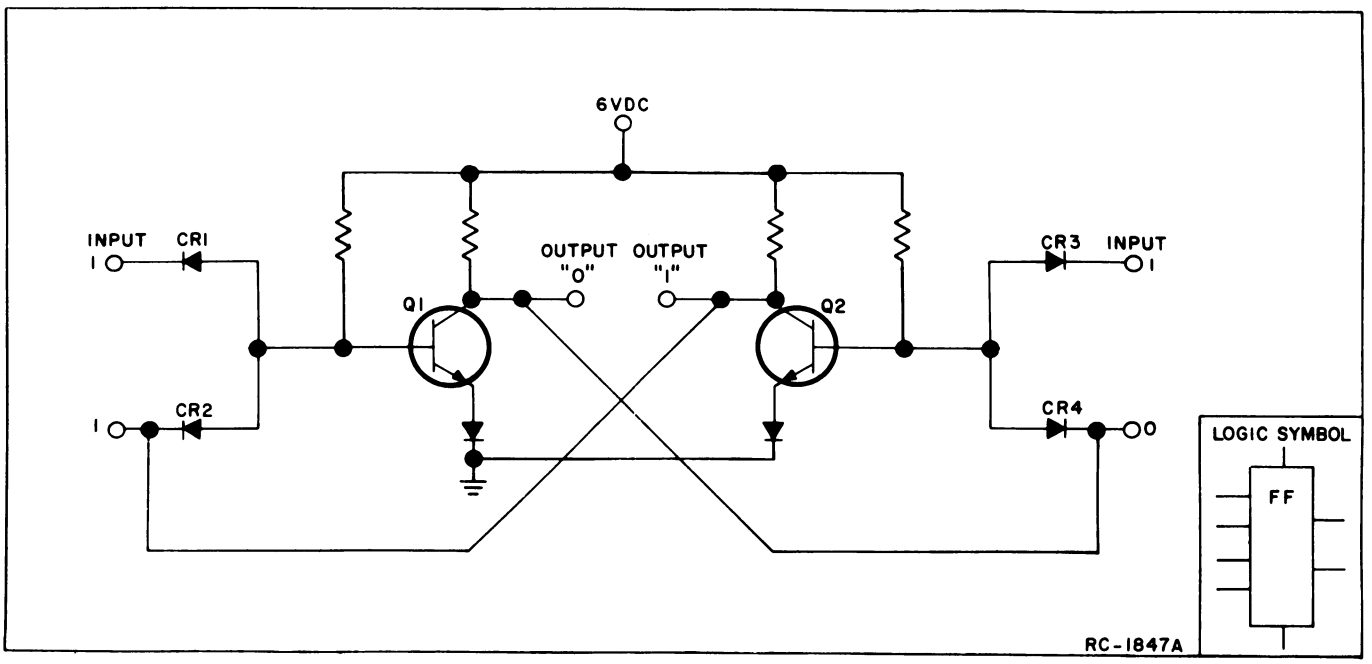


Figure 5 - NAND Gate Flip-Flop

The SLM circuitry consists basically of Pulse Generator Q1, Channel Flip-Flop, IC-1, and Driver transistors Q5 and Q6.

PULSE GENERATOR

The pulse generator consists of unjunction transistor Q1, resistors R1 through R4 and capacitor C1. When the receiver is squelched, C1 charges up and causes Q1 to conduct (emitter to base-1). This quickly discharges C1, causing Q1 to stop conducting until C1 charges up again through R1 and R2. This cycle is repeated as long as power is applied to the circuit and the receiver remains squelched. The Pulse Generator provides a positive output pulse to the Channel Flip-Flop every 125 milliseconds (8 Hz).

MODES OF OPERATION

There are three different modes of operation for the SLM. The different modes are:

- Receiver Squelched
- Receiver Unsquelched
- SLM Disabled

Receiver Squelched

When the receiver is squelched (no signal applied), the SLM alternately monitors each channel four times per second for a duration of 125 milliseconds. Timing waveforms for this mode of operation are shown in Figure 7.

The base of Inverter Q14 is tied to the Mon-Lock input (collector of DC amp Q9 in the MASTR receiver). When the receiver is squelched, approx. 8.5 Volts is applied to the base of PNP inverter Q14, keeping Q14 turned off. When turned off, the emitter of Q14 is at a positive potential. This positive potential is applied continuously to the emitter of Q1, permitting the Pulse Generator to operate.

Positive pulses from the Pulse Generator trigger the Channel Flip-Flop every 125 milliseconds. Triggering the flip-flop alternately grounds the base of Q5 and Q6, turning on the F1 and F2 Drivers. This alternately applies +10 volts to the receiver F1 and F2 oscillators for 125 milliseconds to monitor the channel. The SLM will continue switching until a signal unsquelches the receiver.

Receiver Unsquelched

When a signal is received on either channel, the SLM locks on that channel for the duration of the message (until the receiver squelches).

Assume that a signal is received on the F1 channel. The signal unsquelches the receiver, causing receiver DC amp Q9 to conduct. This grounds the base of Inverter Q14, turning it on. When turned on, the emitter voltage of Q14 drops to ground potential, blocking the Pulse Generator and preventing the Channel Flip-Flop from being triggered. This causes the SLM to remain locked on the F1 channel until the message is completed and the receiver squelches.

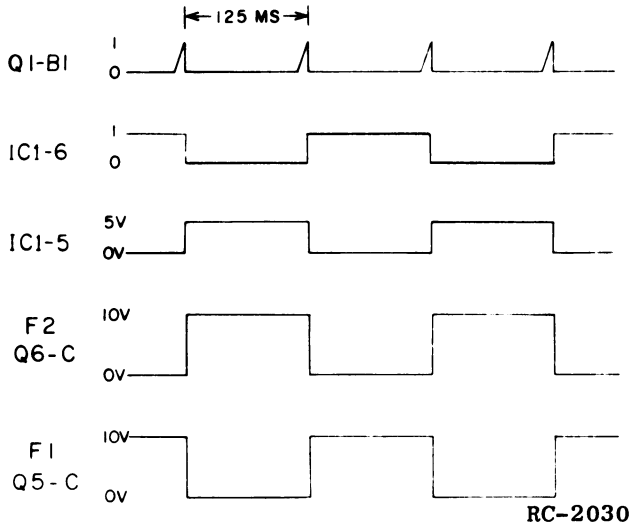


Figure 7 - Receiver Squelched Waveforms

SLM Disabled

Placing SEARCH-OFF switch S710 on the mobile control unit in the OFF position applies a continuous +10 volts to the SLM board and the selected receiver oscillator. With the frequency selector switch in the F1 position, the +10 volts is applied to the F1 oscillator and to J5 on the SLM board. The +10 volts at J5 keeps Driver Q6 from conducting even when the receiver is squelched and the Channel Flip-Flop is operating. When the F2 channel is selected, the +10 volts at J6 keeps Driver Q5 from conducting.

MAINTENANCE

DISASSEMBLY

To gain access to the SLM board for servicing, remove the four screws in the back cover and remove the cover.

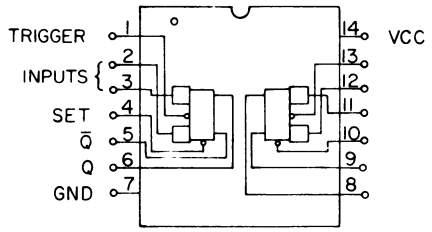
TROUBLESHOOTING

Procedures for troubleshooting the SLM include DC voltage readings and waveforms. Refer to the Troubleshooting Procedure as listed in the Table of Contents.

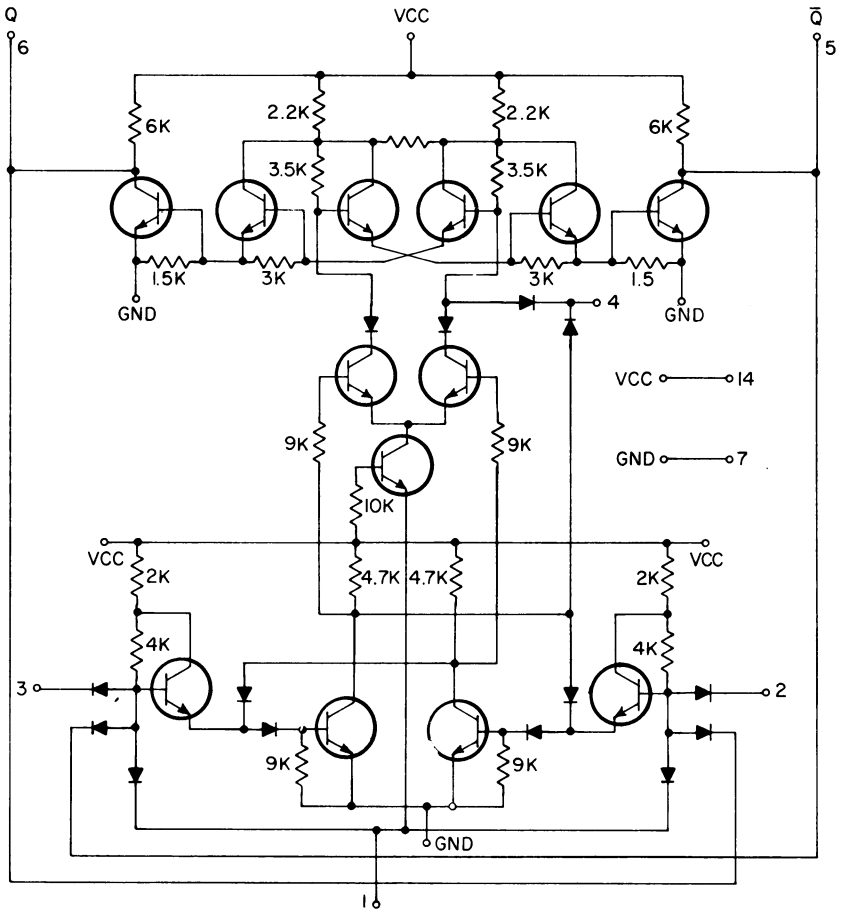
SYSTEM MODIFICATION

One change was made in the system wiring when the SLM was installed. The jumper from TB901-1 to TB901-4 was removed.

MASTER-SLAVE FLIP-FLOP
19A115913-P10



LOGIC DIAGRAM

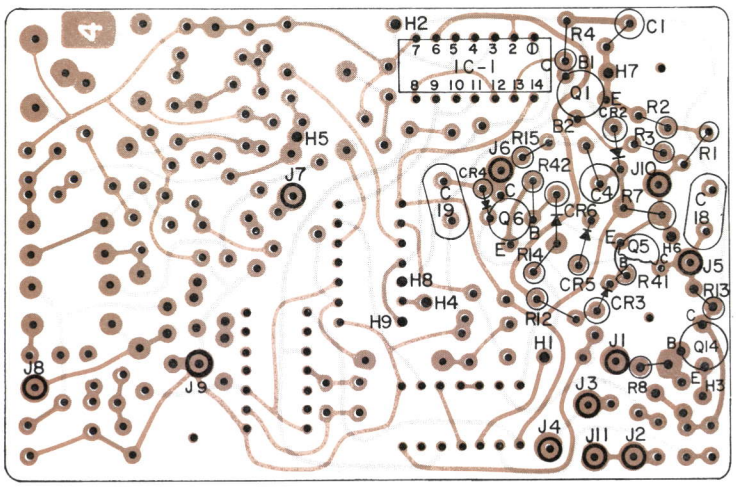


TYPICAL SCHEMATIC DIAGRAM
(ONE FLIP-FLOP ONLY)

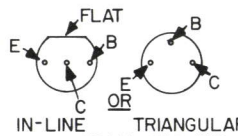
RC-1873

LOGIC & SCHEMATIC DIAGRAMS

FOR INTERGRATED CIRCUIT MODULES
SEARCH-LOCK MONITOR

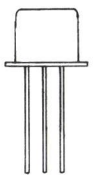


LEAD IDENTIFICATION
FOR Q3 THRU Q6



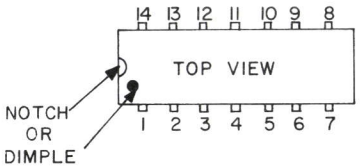
IN-LINE TRIANGULAR
VIEW FROM LEAD END

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

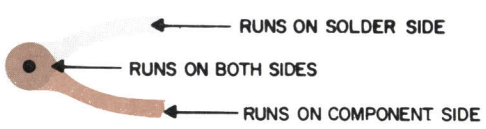


LEAD IDENTIFICATION
FOR Q1

INTEGRATED CIRCUIT
LEAD IDENTIFICATION



(19C317545, Rev. 3)
(19B216562, Sh. 1, Rev. 4)
(19B216562, Sh. 2, Rev. 6)



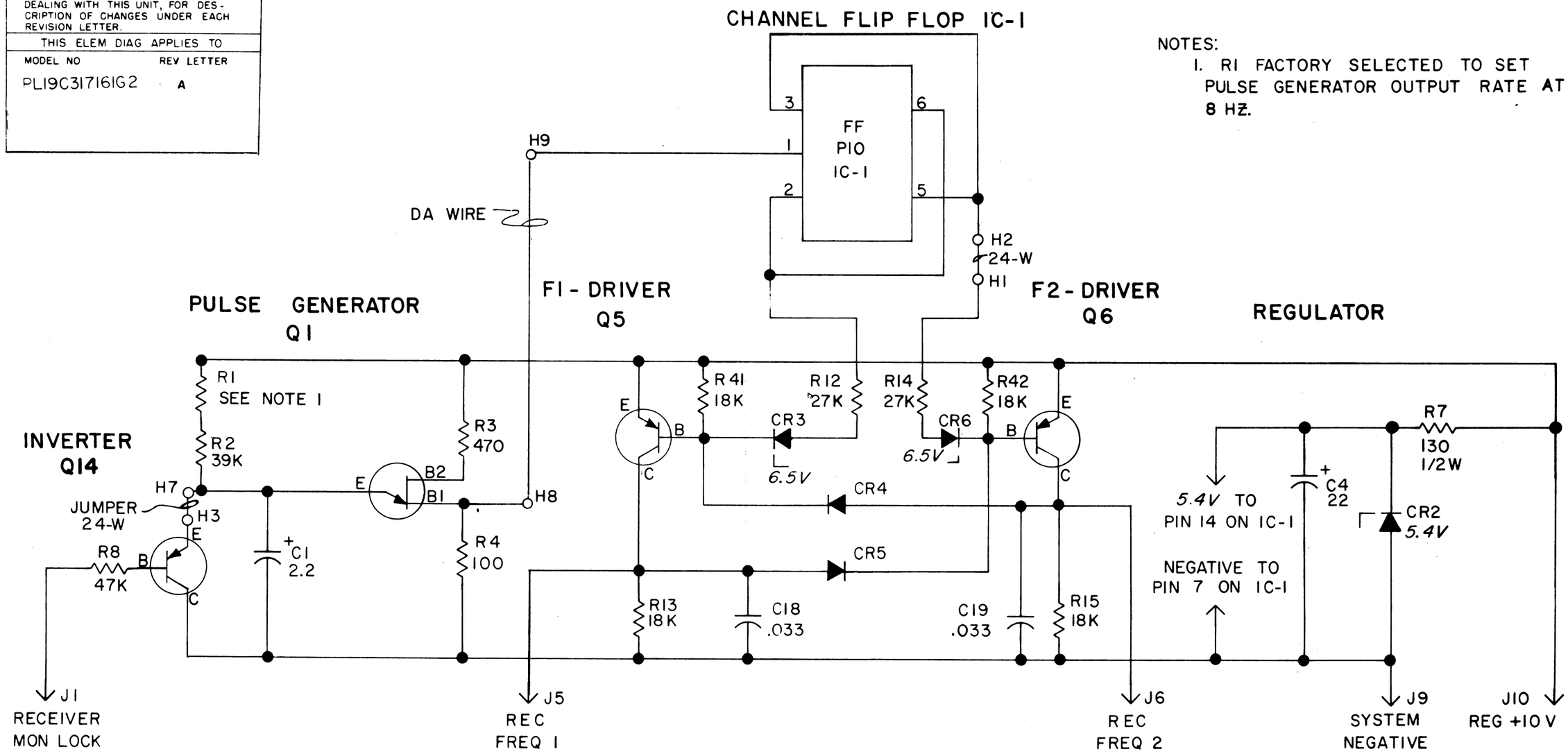
OUTLINE DIAGRAM

SEARCH-LOCK MONITOR

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19C317161G2	A



NOTES:

1. R1 FACTORY SELECTED TO SET PULSE GENERATOR OUTPUT RATE AT 8 HZ.

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

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS.

CAPACITOR VALUES IN UF

(19C317543, Rev. 3)

SCHEMATIC DIAGRAM

SEARCH-LOCK MONITOR

Issue 1

PARTS LIST

LBI-4193

SEARCH LOCK MONITOR
19A127557-G4

SYMBOL	GE PART NO.	DESCRIPTION
		SEARCH LOCK MONITOR BOARD 19C317161-G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	5496267-P213	Tantalum: 2.2 µf ±10%, 20 VDCW; sim to Sprague Type 150D.
C4	5496267-P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C18 and C19	19A116080-P4	Polyester: 0.033 µf ±20%, 50 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR2	4036887-P5	Silicon, Zener.
CR3	4036887-P6	Silicon, Zener.
CR4 and CR5	19A115250-P1	Silicon.
CR6	4036887-P6	Silicon, Zener.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
IC1	19A115913-P10	Monolithic, Dual 945 Flip-Flop; sim to DTL 093.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1 thru J11	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115364-P1	Unijunction: N Type; sim to 2N2656.
Q3 *	19A115123-P1	Silicon, NPN; sim to Type 2N2712. Deleted by Rev. A.
Q5 and Q6	19A115768-P1	Silicon, PNP; sim to Type 2N3702.
Q14*	19A115768-P1	Silicon, PNP; sim to Type 2N3702. Added by Rev. A.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1A	3R152-P432J	Composition: 4300 ohms ±5%, 1/4 w.
R1B	3R152-P822J	Composition: 8200 ohms ±5%, 1/4 w.
R1C	3R152-P123J	Composition: 12,000 ohms ±5%, 1/4 w.
R1D	3R152-P163J	Composition: 16,000 ohms ±5%, 1/4 w.
R1E	3R152-P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1F	3R152-P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R1G	3R152-P273J	Composition: 27,000 ohms ±5%, 1/4 w.
R1H	3R152-P303J	Composition: 30,000 ohms ±5%, 1/4 w.
R1I	3R152-P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R1J	3R152-P363J	Composition: 36,000 ohms ±5%, 1/4 w.
R1K	3R152-P393J	Composition: 39,000 ohms ±5%, 1/4 w.
R1L	3R152-P433J	Composition: 43,000 ohms ±5%, 1/4 w.
R2	3R152-P393J	Composition: 39,000 ohms ±5%, 1/4 w.
R3	3R152-P471K	Composition: 470 ohms ±10%, 1/4 w.
R4	3R152-P101K	Composition: 100 ohms ±10%, 1/4 w.
R7	3R77-P131J	Composition: 130 ohms ±5%, 1/2 w.
R8	3R152-P473K	Composition: 47,000 ohms ±10%, 1/4 w.
R12	3R152-P273K	Composition: 27,000 ohms ±10%, 1/4 w.
R13	3R152-P183K	Composition: 18,000 ohms ±10%, 1/4 w.
R14	3R152-P273K	Composition: 27,000 ohms ±10%, 1/4 w.
R15	3R152-P183K	Composition: 18,000 ohms ±10%, 1/4 w.
R41 and R42	3R152-P183K	Composition: 18,000 ohms ±10%, 1/4 w.
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C317190-G2	Harness: approx 2 feet long, includes (5) 4029840-P2 contacts.
	7150186-P202	Spacer: No. 8.
	N80P15007C13	Phillips screw: No 8-32 x 7/16.
	19A127558-P1	Insulator, pressure sensitive.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

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

REV. A - To provide for proper SLM operation in receivers with Channel Guard. Replaced NPN transistor Q3 with PNP transistor Q14, and changed the control voltage at J1 from COS to MON-LOCK.

WAVEFORMS

All waveforms are taken at Test Points (A) thru (D) as shown in Figure A. The waveforms are shown for three different modes of operations as follows:

1. Receiver Squelched (SLM Searching)
2. Receiving F1 Channel
3. Receiving F2 Channel

NOTE

All waveforms are taken using Internal Sync.

TEST POINT	RECEIVER SQUELCHED	RECEIVING F1 CHANNEL	RECEIVING F2 CHANNEL
A	50ms/Div. 2V/Div.	50ms/Div. 2V/Div.	50ms/Div. 2V/Div.
B	50ms/Div. 2V/Div.	50ms/Div. 2V/Div.	50ms/Div. 2V/Div.
C	50ms/Div. 5V/Div.	50ms/Div. 5V/Div.	50ms/Div. 5V/Div.
D	50ms/Div. 5V/Div.	50ms/Div. 5V/Div.	50ms/Div. 5V/Div.

TROUBLESHOOTING PROCEDURE

Preliminary Checks

1. Check for a regulated +10 volts DC at J10.
2. Check for ±5.4 volts DC at Pin 14 to IC1.

SYMPTOM	PROCEDURE
No receiver audio	Check the receiver in a different system (with or without SLM).
No 1st oscillator activity	Check waveforms at Test Points C and D with search mode disabled.
Fails to receive F1 or F2 channel	Check voltage readings and waveforms at C and D .
Missed syllables on the first part of transmissions	Check waveform at Test Point A for incorrect sample rate. Resistor R1 is selected at the factory for an output of 8 Hz (±5%). See Parts List for values of R1.

VOLTAGE READINGS

All voltage readings are DC readings measured with a 20,000 ohm-per-volt VOM with reference to system negative (J9).

Preliminary Checks

1. Check for +10 volts at J10.
2. Check for +5.4 volts at Pin 14 of IC1.

Test Point	Reading with Receiver Squelched	Reading with Receiver Unsquelched (on F1 Channel)	Reading with Receiver Unsquelched (on F2 Channel)
A	.35 V	.25 V	.25 V
B	2.2 V (P)	4.9 V (P)	5.0 V
C (J5)	5.0 V (P)	0.2 V (P)	10.0 V
D (J6)	5.0 V (P)	10.0 V (P)	0 V

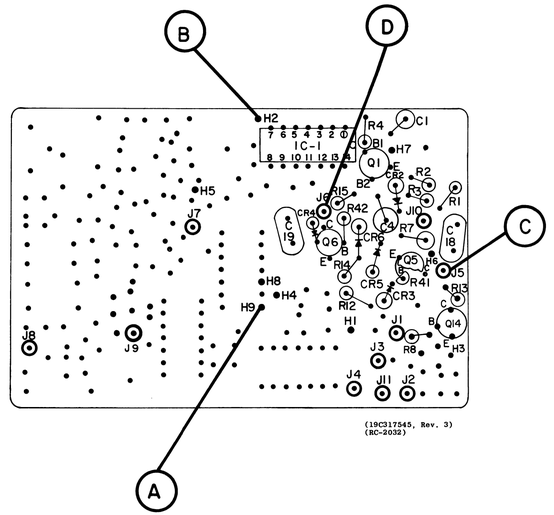


Figure A - Chassis Test Points

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 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.

MAINTENANCE MANUAL

LBI-4192

DF-8401

GENERAL ELECTRIC

MOBILE RADIO DEPARTMENT LYNCHBURG, VIRGINIA 24502 CABLE GECOMPROD

(In Canada, Canadian General Electric Company, Ltd., 100 Wingold Ave., Toronto 19. Ontario)

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