MOBILE RADIO

MAINTENANCE MANUAL

LOGIC BOARD 19D432913G1 & G2 (SYNTHESIZED)

(MOBILE AND STATION)

TABLE OF CONTENTS

DESCRIPTION

The logic board controls the operation of the radio and status information (WAIT, READY, CALL, etc.) indicated on the control unit. Additionally, it controls the audible alert tones heard over the speaker. It is located under the expanded cover with interconnections to the system and tone boards being made through the cable harness.

Various strapping arrangements are provided to tailor operation to system requirements. Refer to Schematic and Outline diagrams. One adjustment, clock frequency, is preset at the factory and normally does not require further adjustment.

Figure 1 is a functional block diagram of the logic board and shows the signal flow/control lines between the functional blocks, identifies the IC's that are used to provide the function and the logic board interface points.

CIRCUIT ANALYSIS

CLOCK GENERATOR

The clock generator provides the basic timing functions for the logic board. Refer to the timing diagram shown in Figure 2. Included are clock oscillator U2, counter U3, count decoders U4A, B, and U5A, and buffers. The clock oscillator operates at approximately 88 Hz and is adjusted in frequency by R13. The frequency is set for 11 Hz (90 ±1 millisecond) at TP13. The output of the counter is decoded to generate the clock outputs.

The outputs are CLOCK, $\overline{\text{CLOCK}}$, SLOW CLOCK, 360 MILLISECOND CLOCK, FAST CLOCK, CLOCK GATE, and STROBE. CLOCK is a 90 millisecond pulse, FAST CLOCK is a 45 millisecond pulse and CLOCK GATE is a 180 millisecond symmetrical square wave. STROBE is a nominal 1 millisecond pulse occuring 1 millisecond prior to each clock pulse. STROBE has a repetition rate of 90 milliseconds. Basic timing is generated by timer U2, divided by counter U3, and decoded by gates 4 and 5.

WAIT MODE TIMER (Call Originate Mode Timer)

The wait mode timer consists of counter U2422 which is programmed to count the number of channels in the system. When the channel search generator has searched all the channels, the wait mode timer will terminate the wait mode by resetting the wait mode latch. The counter is programmed for the total number of channels in the system by a series of diodes CR56, through CR60. The appropriate number of diodes are clipped out at the factory to reflect the number of channels in the system. Diodes are weighted as indicated by ( )'s shown on schematic diagram. For example, if a 5 channel system is provided, diodes CR56 and CR58 are left in making a total binary weight of 5. Always leave in the number of diodes required to equal the weight of the total number of channels in the system.

CHANNEL SEARCH GENERATOR

The channel search generator, U1, U33, U34 and Q1-Q8, individually selects each channel in the radio and can be programmed

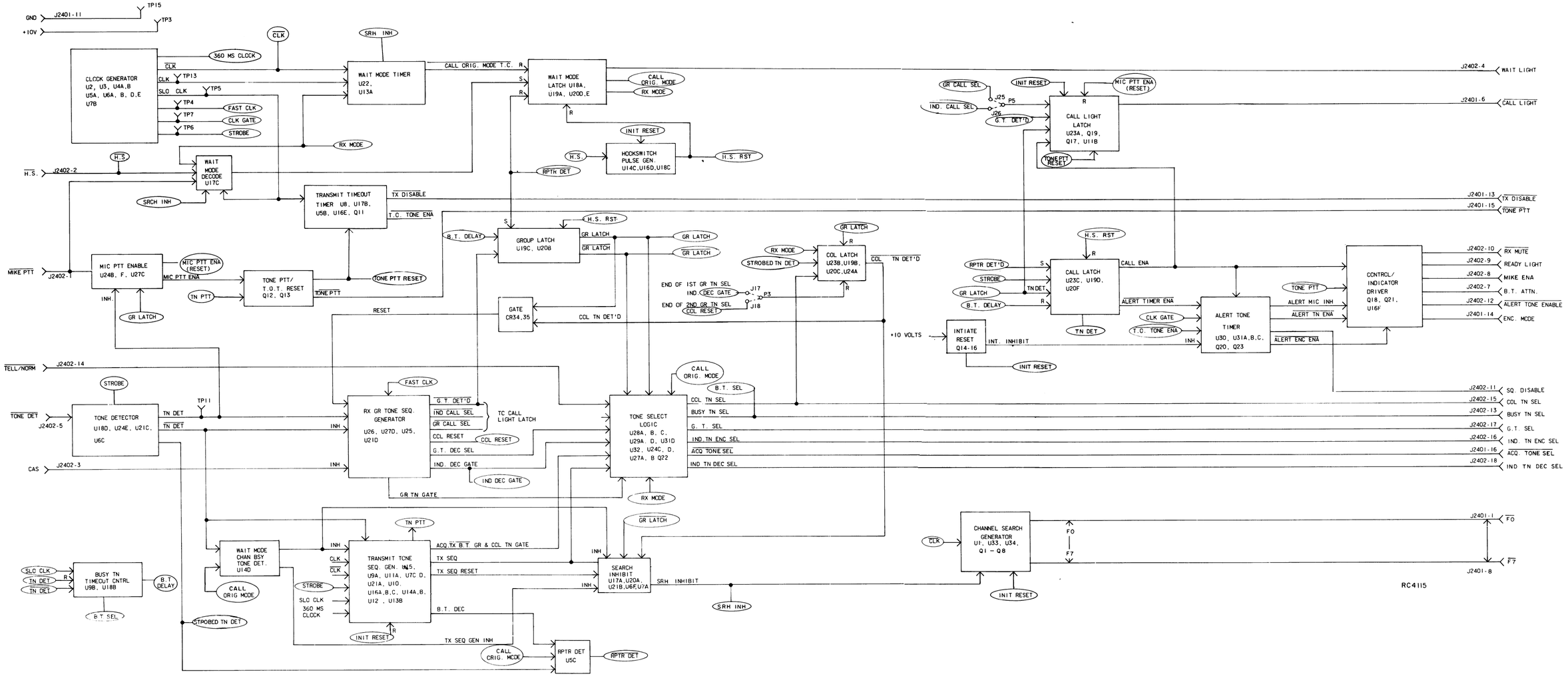

Figure 1 - Functional Block Diagram

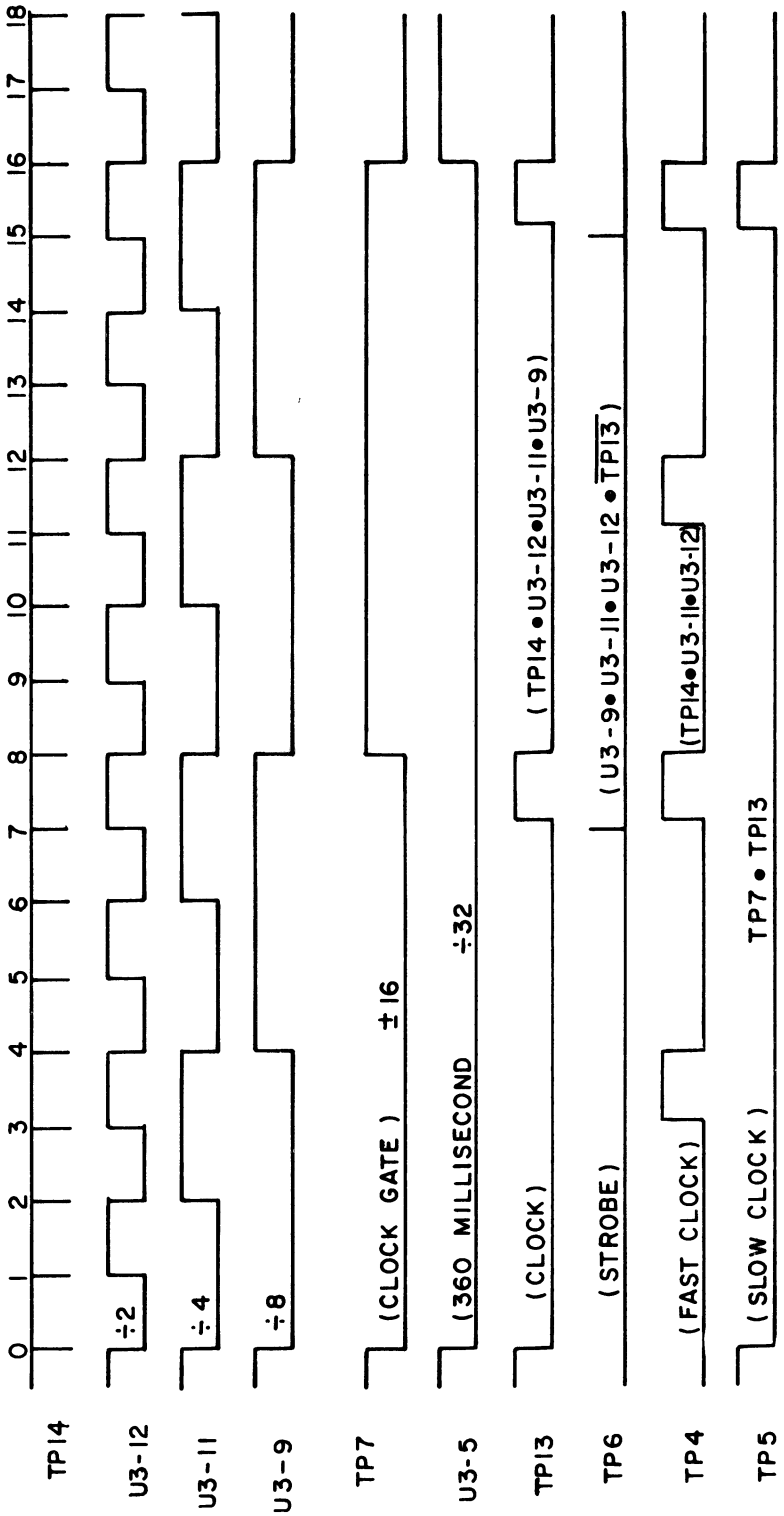

Figure 2 - Timing Diagram

for any number of channels from 1 to 20. BCD counter U1 interfaces with PROM channel selector U34 through level converter U33. The BCD sequentially selects the PROM addresses. Each PROM address contains a binary code identifying the specific customer frequency. The output of the PROM interfaces with eight transistor drivers to drive the synthesizer. Reset is programmed into the PROM by blowing FF (All 1's) following the last channel. For example, in a 5 channel system FF is blown on the sixth slot, corresponding to channel 6. As soon as channel 6 is present the counter immediately resets to channel 1, allowing the generator to search only 5 channels.

MIKE PUSH-TO-TALK-ENABLE

The microphone push-to-talk switch does not connect directly to the radio in a GE-MARC V system. Instead it provides a ground signal to the logic board which makes decisions based on the present status of the radio i.e., whether or not to activate the push-to-talk circuits or to start the wait mode. The output of the microphone push-to-talk circuit U24F will allow the transmitter to be keyed only when the radio is in the ready mode and has previously received busy tone as indicated by the presence of GR LATCH at U27C-9. MIC PUSH-TO-TALK ENA provides a reset to the call light latch circuit at Q2419-E.

TONE PUSH-TO-TALK/T.O.T. RESET

The transmitter is keyed by TONE PTT received from the transmit tone sequence generator and outputted by Q2413 or by MIC PTT ENA. MIKE PTT ENABLE is buffered using a Darlington transistor arrangement for power gain and provides the output current to key the transmitter. The reset output from tone push-to-talk Q2413-C resets the transmit time out timer.

TONE DETECTOR

TONE DET from the tone board is buffered and inverted to provide TONE DET. It is then combined with STROBE to generate the STROBED TN DET signal.

BUSY TONE TIME OUT CONTROL

Busy tone time out control U2409B, is a four stage shift register. The 180 millisecond clock input provides a count each time TONE DET goes low (not detected). The counter is reset when tone (detect) is present. When TONE DET U2409B-6 is low the counter begins to count at a 180 millisecond rate. If TONE DET is not present for 4 counts the output of the counter will reset the radio to the idle mode via the group latch, call latch and call light latch. Call light latch, Q2419, is reset through U2420F and U2423A.

WAIT MODE DECODER

When the mobile operator goes off-hook or presses the push-to-talk switch the wait mode decoder U2417C, 18A, combines the off-hook signal with SLO CLK to set the wait mode latch. The radio must be in the idle mode (RX mode) to enable the decoder. Once the latch is set RX MODE goes low and prevents any further inputs from affecting the decoder.

WAIT MODE LATCH

The wait mode latch consisting of U18A, U19A, U20D, E, is reset by one of three different signals: (1) CALL ORIG MODE T.O. from the wait mode timer (occurs after all channels have been tried); (2) H.S. RESET, a pulse generated when the handset is replaced, or (3) RPTR DET generated when the repeater tone is detected. The outputs are: (1) CALL ORIG MODE which goes high during the wait mode, (2) RX MODE which goes low during wait mode, and (3) +10V to the control unit to turn on the wait mode indicator.

HOOKSWITCH PULSE GENERATOR

When the handset is placed on-hook a H.S. RST pulse is generated to clear the radio. The pulse generator consisting of U18C, U14C and U16D provides a 30 millisecond pulse to reset the call, group, and wait mode latches in the radio. A reset pulse is also generated by the initiate reset circuit to initialize the logic circuits when the DC power is first turned on.

GROUP LATCH

Group latch U19C, U20B receives two sets and two resets. The sets are RPTR DET and G.T. DET'd generated by the repeater detector and the receiver group tone sequence generator. The resets consist of the H.S. RST generated by the hookswitch pulse generator and B.T. DELAY generated by the busy tone time out control when it counted down. The resets, when present, clear the radio and return it to the idle mode. Two outputs, GR LATCH and GR LATCH are used to initiate functions internal to the radio. The group latch can be set only after the collect latch has been set.

COLLECT LATCH

Three simultaneous inputs are required to set the collect latch: (1) RX MODE, indicating operation in the search mode, (2) COL TN SEL and (3) STROBED TN DET. There are two resets. The first reset, GR LATCH, occurs after the collect latch U19B is set and the group tone is detected. The group latch will then clear the collect latch. The collect latch consists of U19B, U20C,

U23B and U24A. The second reset is generated by either the first or second group tone depending on a jumper arrangement between P3 and J17 or J18 and occurs if the collect latch had been set previously indicating that the proper collect tone is present, and the group tone is not. The output of the collect latch, COL TN DET'D, is applied to the search inhibit gate U17A, and to group gate CR34 and CR35.

RECEIVE GROUP TONE SEQUENCE GENERATOR

The receive group tone sequence generator consists of U26, U27D, U25 and U21D. U26 is a divide by 10 counter that receives its input from FAST CLK for a 45 millisecond period. It is reset or held in a non counting state until the collect tone has been detected and the group tone has not been detected. It does not begin counting until the collect tone latch has been set and the tone detector indicates that the collect tone is no longer being received.

Group tone detect is inhibited by CAS (carrier activity sensor) to prevent the group tone from being detected in a low signal-to-noise area. If detection occurs in a low signal-to-noise area the user would be able to receive a call but not be able to communicate with the caller. The outputs of the receive group tone sequence generator are G.T. DET'd, IND CALL SEL, GT DEC SEL, IND. DEC. GATE, GR TN GATE, GR CALL SEL, and COL RST. The G.T. DEC SEL, the IND DEC GATE, and the GT TN DET'd gate provide logic steering to pick up the correct group tone signal in the tone board. The COL RST output resets the collect latch. If the receive sequence is completed and did not detect a group tone it will clear the collect latch and return the radio to idle mode.

WAIT MODE CHANNEL BUSY TONE DETECTOR

When the wait mode latch is set the radio will try to acquire a channel or repeater. Before it can search all channels it must first determine if the channel it's on is busy. To make this decision, the wait mode channel busy tone detector U14D compares the TN DET and CALL ORIG MODE signals to determine if busy tone is present on that channel. If busy tone is present it indicates that the channel is busy and a search of the remaining channels will continue until it finds one without a busy tone (detect) signal present. When an available channel is detected, the wait mode channel busy tone detector will send a Tx SEQ GEN INH signal to the search inhibit circuit to stop channel search.

TRANSMIT TONE SEQUENCE GENERATOR

The transmit tone sequence generator consists of primary counter U15 (divide-by-10) and secondary counters U9A, and U10 cascaded to provide time delays. It initiates the following sequence of events. First, it determines whether or not it's on an idle channel. It then generates a PTT and BUSY TN SEL signal to acquire the repeater. It unkeys the transmitter and selects ACQ TN GATE. If ACQ TN GATE is detected from the repeater the sequence will continue and the COL TN GATE is generated for the specific number of milliseconds required to search all channels in the system. (Refer to the schematic diagram for specific timing data.) Following the collect tone the GR TN GATE is generated. The transmit tone sequence generator then unkeys the TONE PTT, selects busy tone decode for 180 ms, and determines if the repeater is still present. If it did not receive the BUSY TN DET the transmit tone sequence generator will reset itself and start the sequence over again on another channel.

REPEATER DETECT

When the busy tone has been detected in the transmit sequence, the output of repeater detector, U2405C, will set the group and call latches and clear the wait mode latch to place the radio in the wait mode. The alert tone timer is also set indicating to the radio operator that the repeater has been acquired.

CALL LATCH

After the correct collect and group tones have been detected, the group latch is set. The call latch, U19D, U23C and U20F, then must determine whether or not the correct busy tone is being received before permitting the radio to receive a call. If a valid busy tone is being received the operator is alerted via an alert tone and optionally a call light indicator. To make this determination the call latch stores the group call information long enough to verify that the B.T. DELAY signal has been decoded. The B.T. DELAY signal sets the call latch. To enter the ready mode (talk mode), both the group latch and call latch must be set. The call latch is set by RPTR DET or GR LATCH. The group latch is set by RPTD DET or GR LATCH. Both are cleared by either H.S. RESET or B.T. DELAY. Once the conversation is ended and the repeater drops off the air the busy tone time out control initiates count down and resets the radio to the idle mode within 750 milliseconds. The B.T. DELAY output clears the call latch and the radio reverts to idle mode (search mode). The call latch outputs are CALL ENA and ALERT TIMER ENA. CALL ENA controls the transmit/receive functions and the ALERT TIMER ENA turns on the alert tone timer to signal the operator that a channel has been acquired.

CALL LIGHT LATCH

Call light latch U23A, Q19, Q17 and U11B provides the latched function to the

control unit to light indicators or control other options in the control unit. Both the call latch and call light latch are set by GR LATCH. The call light latch can be programmed to latch from a group tone or individual tone. After the call is completed the radio will return to idle mode. However, the call light latch will remain latched until the radio enters the ready mode, and is cleared with the first depression of the push-to-talk switch. Therefore, if the operator leaves his vehicle and a call is received he will be alerted by a latched line that will cause the call light in his control unit to flash on and off. It will continue flashing until the radio is turned off or a call is initiated. The radio enters the ready mode when receiving or placing a call.

SEARCH INHIBIT

The search inhibit circuit (U17A, U20A, U21B) stops channel search generator during a transmit sequence, during a receive sequence, and when the radio is in ready mode (talk mode) as controlled by GR LATCH. Under these conditions CLK applied to the channel search generator is inhibited.

INITIATE RESET SWITCH

When the power is turned on the initiate reset circuit Q14-Q16 applies a nominal 200 millisecond pulse to the hookswitch reset pulse generator to generate a master clear signal. This initializes all logic circuitry and assures proper start up operation.

TONE SELECT LOGIC

The tone select logic consists of a group of gates (identified on the block diagram) which provide the logic necessary to select the correct operating tones for all operating modes. An external input from the control unit TEL/NORM switch determines whether the radio transmits a GR TN SEL or IND TN SEL. All other gates provide timing for particular tones. The tone select outputs are applied to the tone board.

ALERT TONE TIMER

The alert tone timer consists of U30, U31A, B, C, Q20 and Q23. There are three different types of alerting signals: (1) a one second continuous tone signifying all channels are busy, (2) a one second interrupted tone signifying an incoming call, and (3) a 20-second interrupted tone signifying operation of the transmit time out timer. At the end of this tone the transmitter is DISABLED. The output of the alert tone timer, ALERT MIC INH, disables the microphone and prevents the alert tone from being retransmitted via the microphone should the PTT switch be depressed. An ALERT ENC ENA signal is applied to the tone board to enable the tone oscillator. A SQ DISABLE signal is applied to the system board to turn on the audio PA so the alert tone can be heard in the speaker.

CONTROL UNIT INDICATOR DRIVERS

The control unit indicator drivers consist of transistor amplifiers used as buffers to provide drive and interface functions for CMOS, LEDS, relays, etc.

MAINTENANCE

Maintaining the logic board is facilitated using the Quick Checks and the Troubleshooting Flow Charts. The Flow Charts perform a step-by-step fault analysis of the logic board and usually will identify a malfunctioning circuit or component. Troubleshooting with the flow charts require the use of the GE-MARC V Logic Board Test Fixture.

NOTE

The Logic Board Test Fixture is not available from the factory as a pre-assembled unit; but rather it must be constructed in the field using the parts identified on the Parts List. Refer to LBI30980.

CAUTION

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

TROUBLESHOOTING QUICK CHECKS

Verify +10V at input of all IC's, i.e. TP's 1-3. Using oscilloscope check waveform at testpoints. The output waveforms should be 0+1 volt or VCC ±1 volt. A voltage reading of approximately 1/2 VCC indicates a defective IC however, it must

further be determined whether the output gate is defective or an input gate on the following IC. To determine this place a 10K resistor from the output pin to ground. If the voltage deteriorates further the output gate is defective and that IC is bad. If not, one of the input gates feeding from the output gate is bad.

It should be remembered that all gates are not active at all times -- it depends on the mode of operation i.e., ready, wait or idle.

NOTE

A logic IC package containing NAND gates may not always be used to perform the NAND function. In some cases the NAND gate may be used to perform the -OR function or as inverters. Refer to Figure 3.

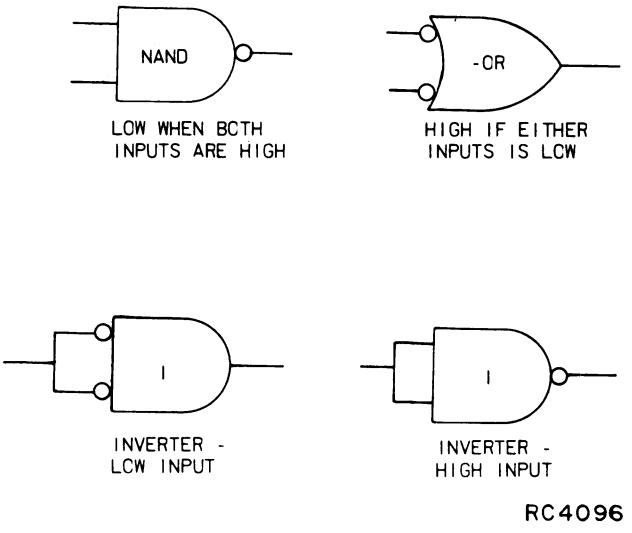

Figure 3 - Alternate Functions of NAND GATES

If the above method does not isolate the malfunction or defective IC check logic board using Logic Board Test Fixture and Troubleshooting Flow Chart.

CAUTION

DO NOT SHORT GATES OF CMOS IC'S DIRECTLY TO GND OR VCC WHILE OPERATING.

TROUBLESHOOTING PROCEDURES

Troubleshooting the logic board can best be accomplished by first performing the "Troubleshooting Quick Checks" followed by the step-by-step sequence provided by the flow charts. Use of the flow charts is based on the availability and use of the Logic Board Test Fixture.

1. Record the location of all jumpers listed below and reconnect them as follows:

   P2-J16, Tx Time out Enable

   P3-J17, Single Group Tone

   P4-J24, 20 CH collect tone gate

   P5-J26, Individual tone call latch

   TP16-TP14, Fast time out timer count, causes time out timer to time out in 11 sec.

NOTE

Either of two methods may be used to verify proper operation of the channel search circuit. (1) A substitute test PROM may be used to replace existing PROM to limit channel search to a 1 of 8 sequence. (2) Using the customers PROM refer to the GE-MARC V Test Set (TL59) manual and decode the frequency as indicated by the Channel Search LED display on the Logic Board Test Fixture. LED ON = ϕ.

2. If test PROM is to be used (Frequency Synthesized Units only) replace the customers PROM with test PROM if available. If not, refer to GE-MARC V Test Set manual as needed to decode frequency displayed.

3. When the troubleshooting procedure has been completed successfully reconnect all jumpers to connection points recorded above and replace test PROM with customers PROM.

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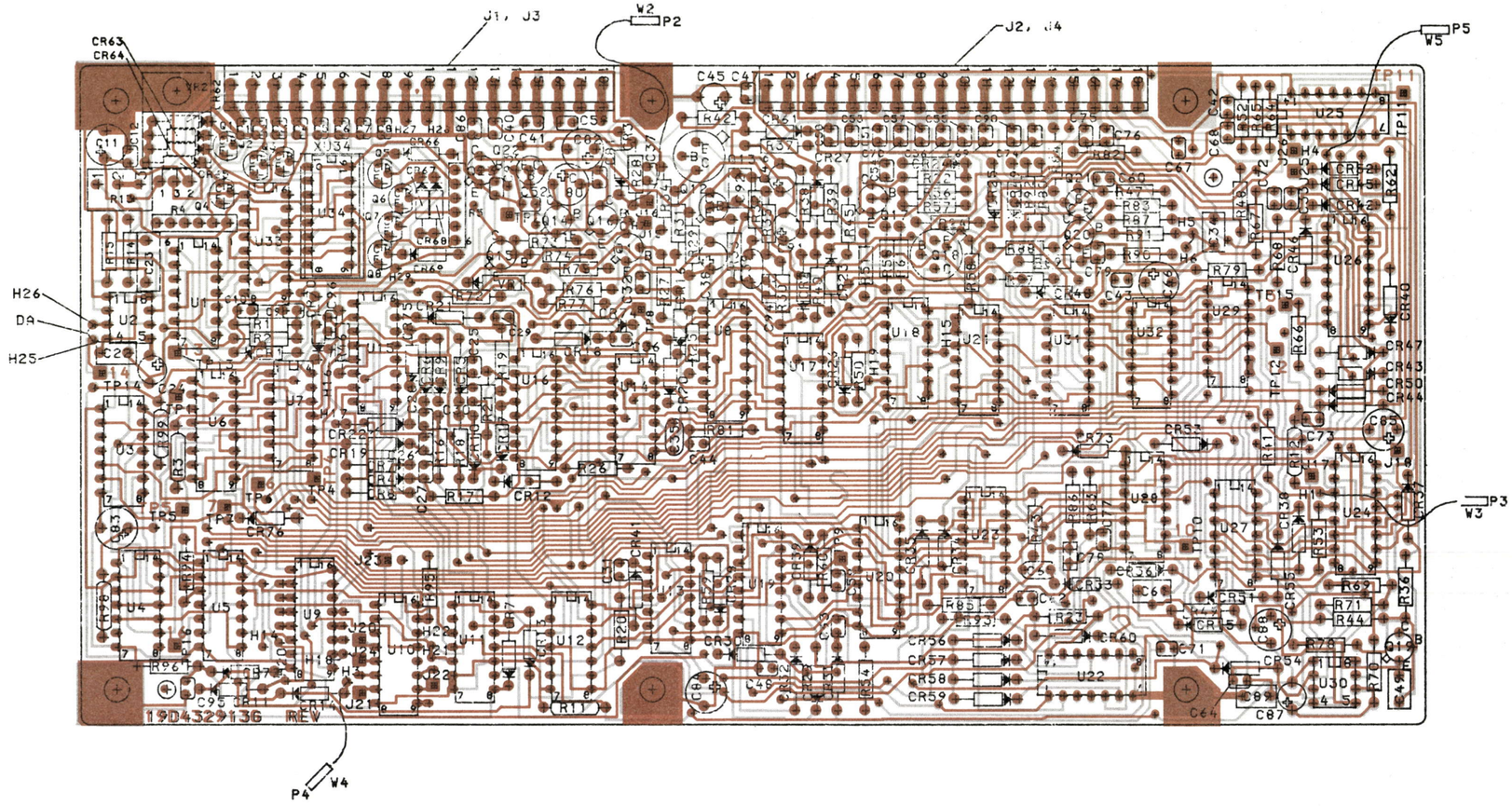
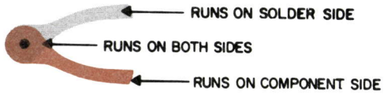
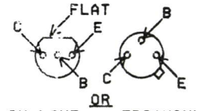


WIRE CHART		
FROM	TO	WIRE
P2(H7)	J16	W2
P3(H1)	J17	W3
P4(H3)	J21	W4
P5(H4)	J25	W5
◆H5	H6	DA
H14	H15	ST24-G
H18	H19	ST24-G
H25	H26	DA



LEAD IDENTIFICATION
FOR Q1 THRU Q23



IN-LINE OR TRIANGULAR

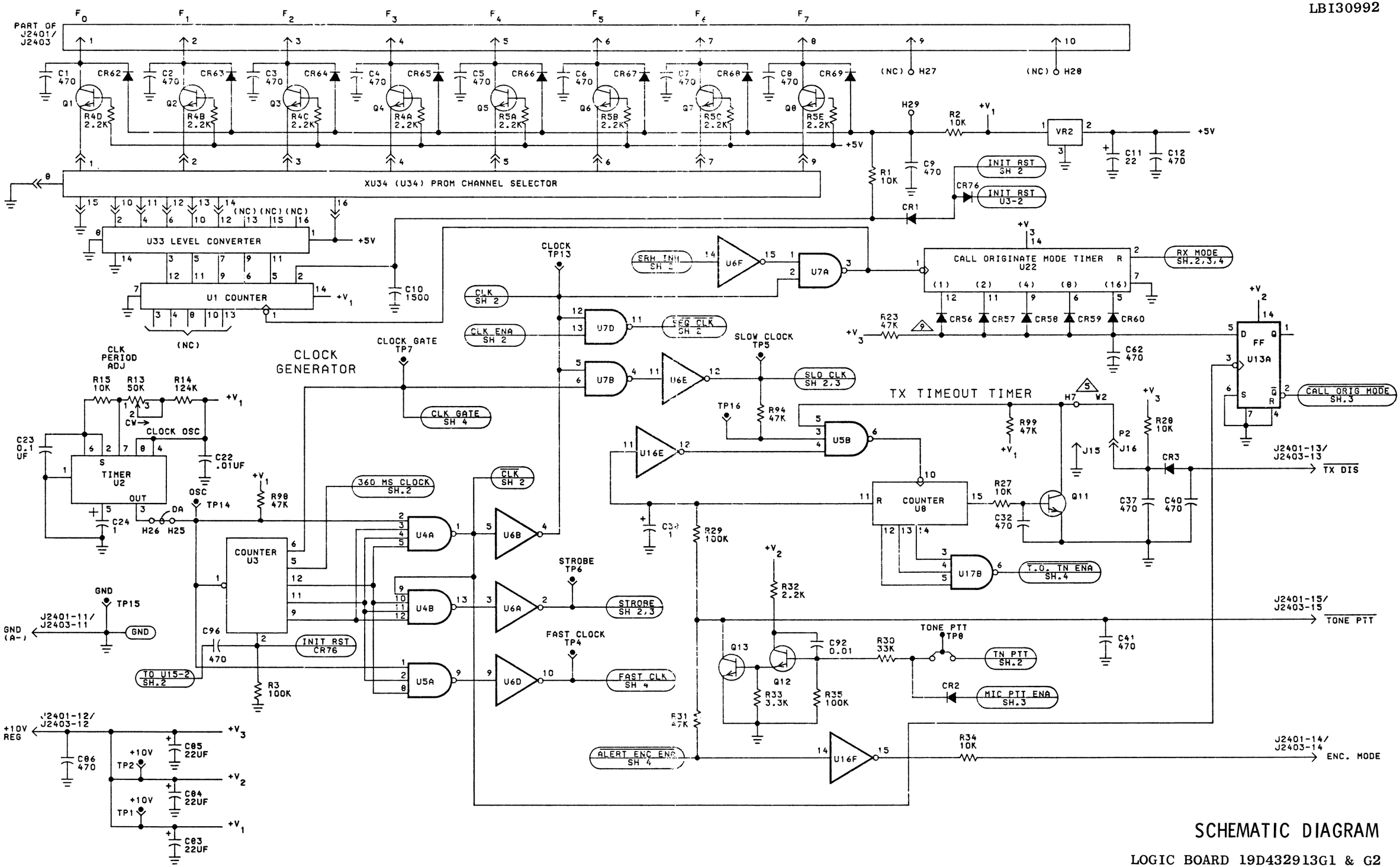
TOP VIEW

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

(19D432914, Rev. 2)
(19A143920, Sh. 1, Rev. 2)
(19A143920, Sh. 2, Rev. 2)

OUTLINE DIAGRAM

LOGIC BOARD 19D432913G1 & G2

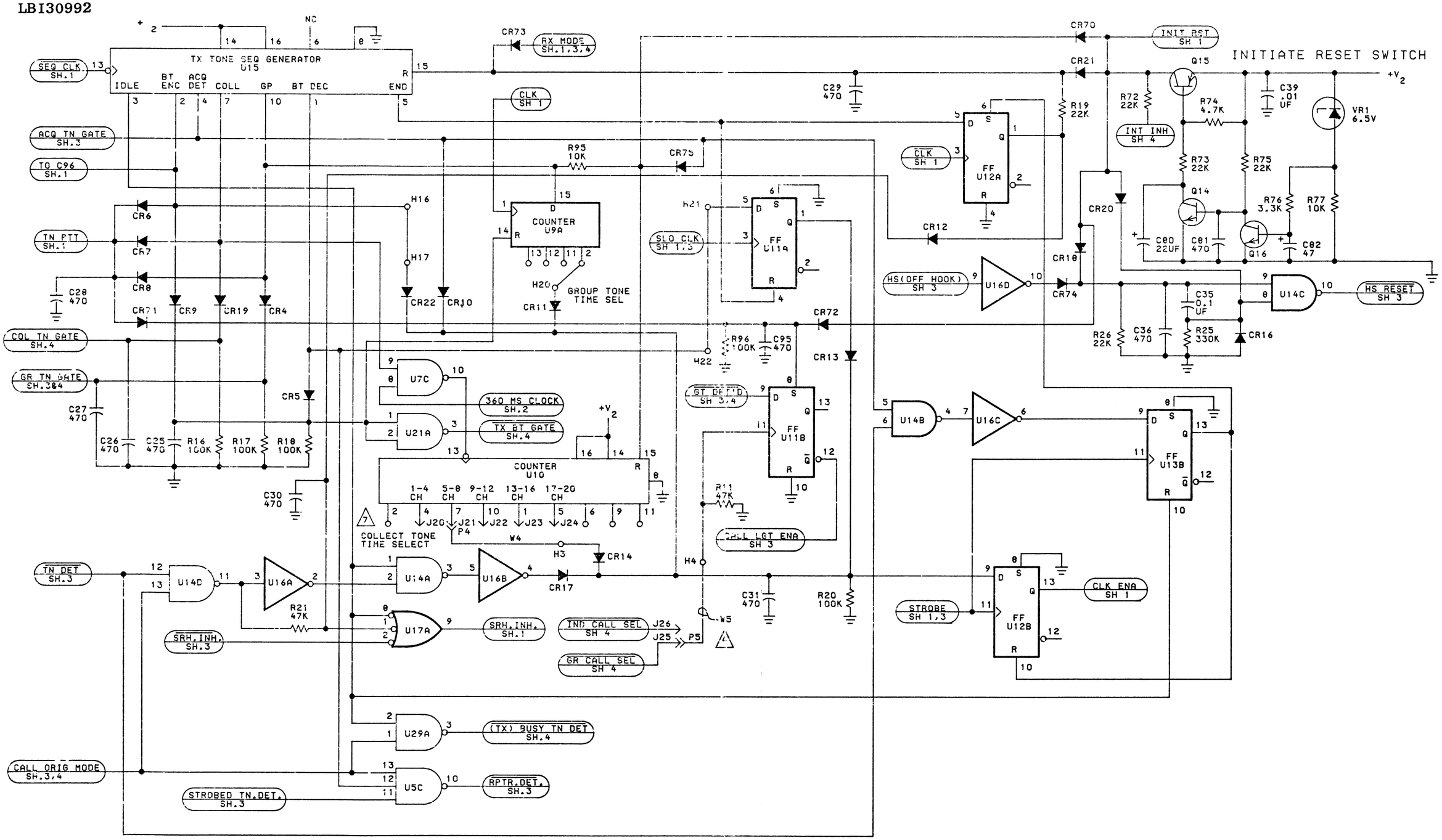


SCHEMATIC DIAGRAM

LOGIC BOARD 19D432913G1 & G2

Issue 2

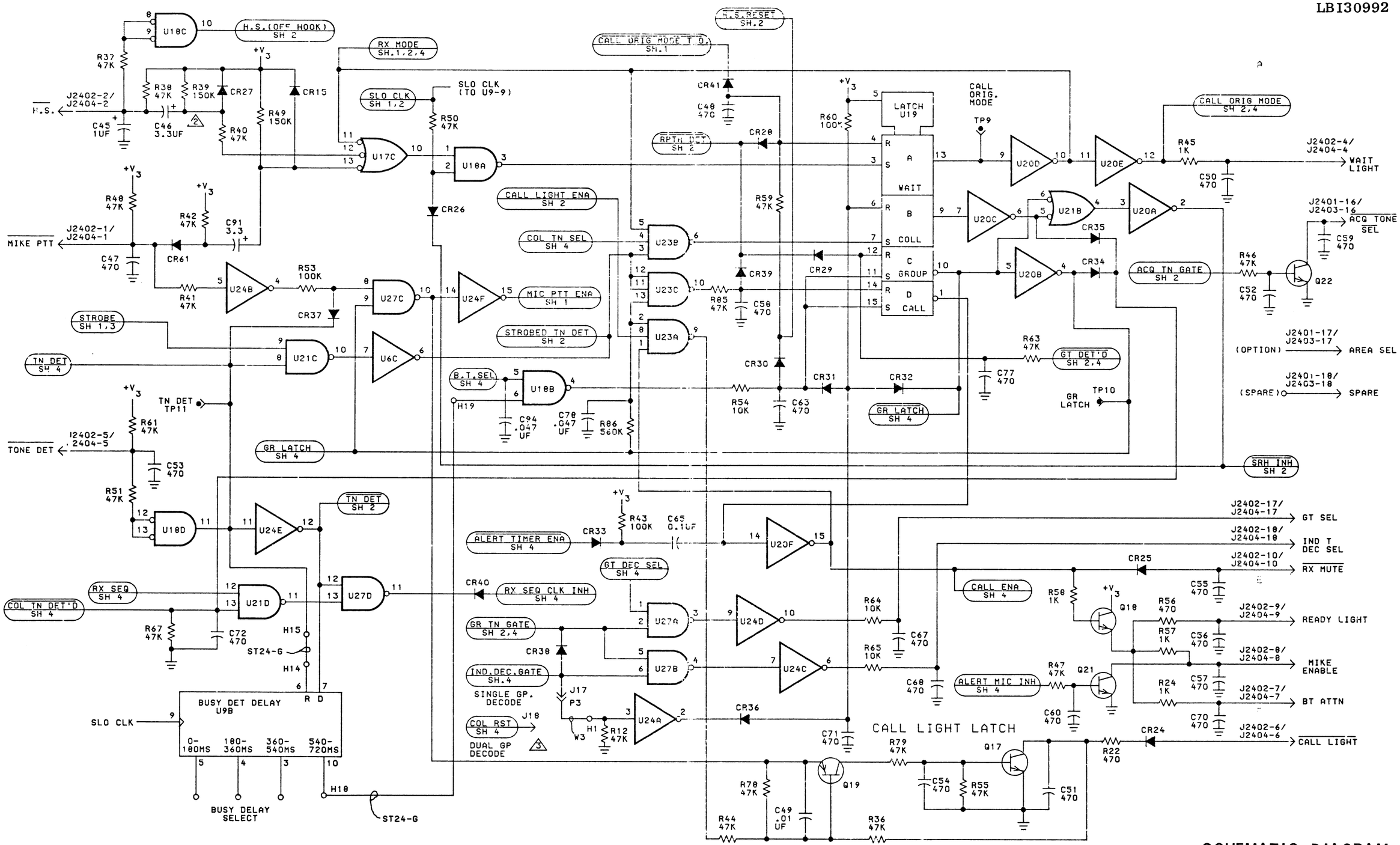
(19D432923, Sh. 1, Rev. 2)



SCHEMATIC DIAGRAM

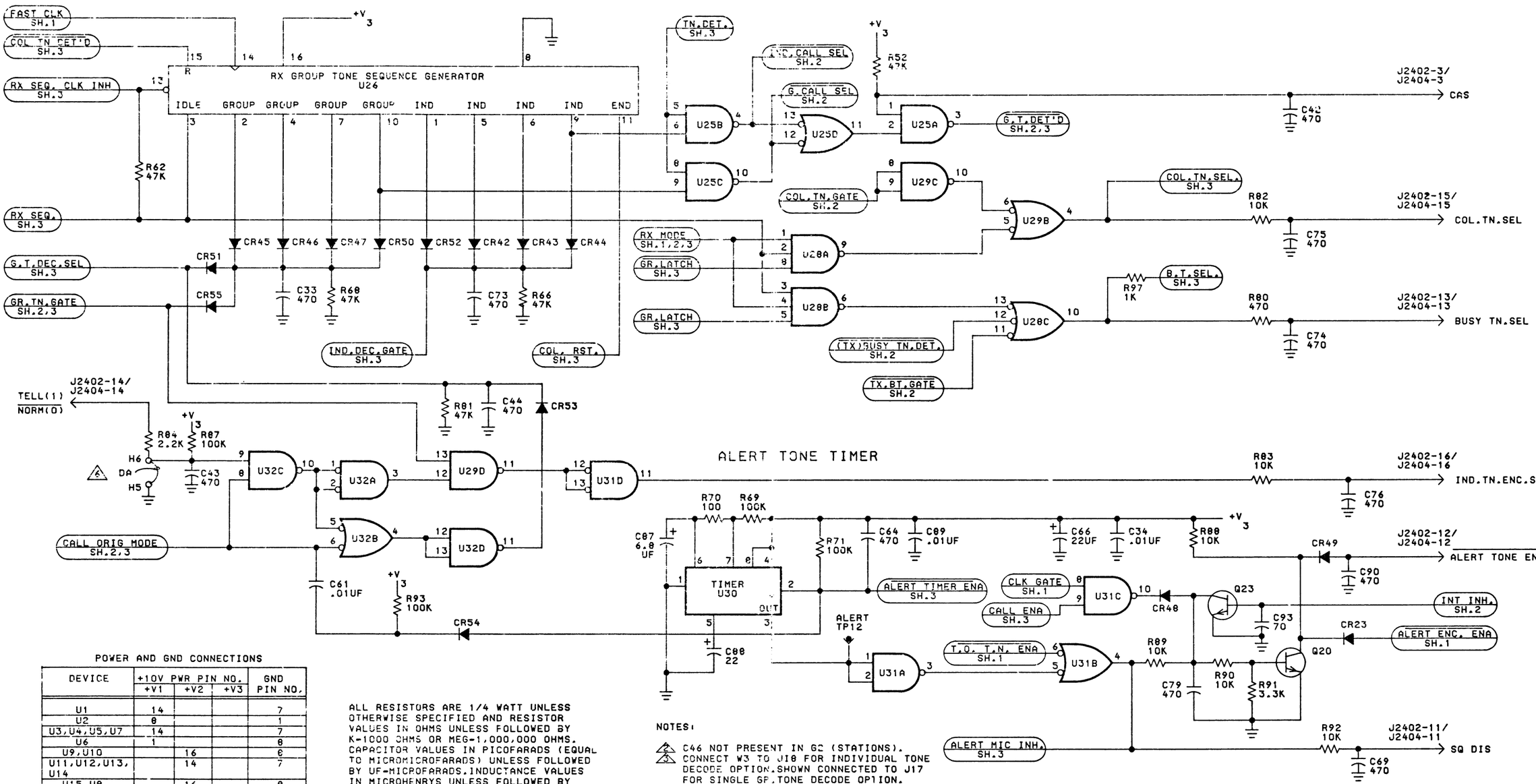
LOGIC BOARD 19D432913G1 & G2

(19D432923, Sh. 2, Rev. 3)



SCHEMATIC DIAGRAM

LOGIC BOARD 19D432913G1 & G2



POWER AND GND CONNECTIONS

DEVICE	+10V PWR PIN NO. +V1	+V2	+V3	GND PIN NO.
U1	14			7
U2	8			1
U3,U4,U5,U7	14			7
U6	1			8
U9,U10		16		8
U11,U12,U13, U14		14		7
U15,U8		16		8
U16		1		8
U17,U18,U21 U22,U23,U25, U27,U28,U29, U31,U32			14	7
U19,U26			16	8
U20,U24			1	8
U30			8	1

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.

MODEL NO.	APPLICATION	REV. LTR.
PL19D43291361	MOBILE	C
PL19D43291362	STATION	C

NOTES:

4. C46 NOT PRESENT IN G2 (STATIONS).
3. CONNECT W3 TO J18 FOR INDIVIDUAL TONE DECODE OPTION. SHOWN CONNECTED TO J17 FOR SINGLE GP. TONE DECODE OPTION.
4. JUMP W5 TO J25 FOR CALL LATCH DECODE FROM GROUP TONE DET.
   JUMP W5 TO J26 FOR CALL LATCH DECODE FROM IND. TONE DET.
5. CONNECT W2 TO J15 TO DEFEAT T.O. TX. DISABLE.
6. CUT DA JUMPER, H5 TO H6 FOR INDIVIDUAL TONE ENCODE OPTION.
7. CONNECT W4 TO CORRESPOND WITH NUMBER OF CHANNELS, 1-4 CH. J20, 5-8 CH. J21, 9-12 CH. J22, 13-16 CH J23, 17-20 CH. J24, SHOWN CONNECTED FOR 5-8 CH.
8. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 2400 SERIES EXAMPLE: C1-C2401, R1-R2401, ETC.
9. CLIP DIODES TO PROGRAM COUNTER FOR NUMBER OF CHANNELS USED. EXAMPLE: FOR 20 CH. CLIP CR56,57 AND 59. WEIGHT OF DIODES IN-NUMBER OF CHANNELS.

(19D432923, Sh. 4, Rev. 5)

SCHEMATIC DIAGRAM

LOGIC BOARD 19D432913G1 & G2

PARTS LIST

LOGIC BOARD
19D432913G1 MOBILE REV C
19D432913G2 STATION REV C
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2401 thru C2409	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2410	19A116192P10	Ceramic: 1500 pf ±10%, 50 VDCW; sim to Erie 8121-A050-W5R-152K.
C2411	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C2412	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2422	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2423	19A700004P2	Metallized polyester: 0.1 µf ±10%, 63 VDCW.
C2424	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C2425 thru C2433	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2434	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2435	19A116192P14	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to USCC CW20C-104-M2.
C2436 and C2437	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2438	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C2439	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2440 thru C2444	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2445	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C2446	19A143486P7	Tantalum: 3.3 µf ±20%, 15 VDCW.
C2447 and C2448	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2449	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2450 thru C2460	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2461	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2462 thru C2464	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2465	19A116192P14	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to USCC CW20C104-M2.
C2466	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C2467 thru C2477	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2478	19A116192P17	Ceramic: 0.047 µf ±10%, 50 VDCW; sim to Erie 8121-M050-W5R-473K.
C2479	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2480	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C2481	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2482	19A701534P9	Tantalum: 47 µf ±20%, 6.3 VDCW.
C2483 thru C2485	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C2486	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2487	19A143486P1	Tantalum: 6.8 µf ±20%, 6 VDCW.
C2488	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C2489	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2490	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2491	19A143486P7	Tantalum: 3.3 µf ±20%, 15 VDCW.
C2492	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C2493	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C2494	19A116192P17	Ceramic: 0.047 µf ±10%, 50 VDCW; sim to Erie 8121-M050-X5P-473K.
C2495 and C2496	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR2401 thru CR2476	19A700028P1	Silicon, fast recovery: Fwd. current 75 mA, 75 PIV.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J2401 and J2402	19A116659P160	Connector, printed wiring: 18 contacts; sim to Molex 09-75-1181.
J2403 and J2404	19A116659P161	Connector, printed wiring: 18 contacts; sim to Molex 09-65-1181.
J2415 thru J2418	19A701785P5	Contact, electrical.
J2420 thru J2426	19A701785P5	Contact, electrical.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2402		(Part of W2402).
P2403		(Part of W2403).
P2404		(Part of W2404).
P2405		(Part of W2405).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q2401 thru Q2408	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q2411 and Q2412	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q2413	19A115300P4	Silicon, NPN.
Q2414	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q2415	19A700022P1	Silicon, PNP; sim to Type 2N 3906.
Q2416 and Q2417	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q2418	19A115300P4	Silicon, NPN.
Q2419	19A700022P1	Silicon, PNP; sim to Type 2N3906.
Q2420 thru Q2423	19A700023P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2401 and R2402	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2403	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2404 and R2405	19A701630P6	Resistor, network: 2.2K ohms ±2%; sim to Bourns 4306R-101-222.
R2411 and R2412	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2413	19A116559P208	Variable, cermet: 50K ohms ±20%, 0.5 w; sim to CTS Series 360.
R2414	19C314256P21243	Metal film: 124K ohms ±1%, 1/4 w.
R2415	19C314256P21002	Metal film: 10K ohms ±1%, 1/4 w.
R2416 thru R2418	19A700019P61	Composition: 100K ohms ±5%, 1/4 w.
R2419	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2420	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2421	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2422	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2423	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2424	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2425	19A700019P67	Deposited carbon: 330K ohms ±5%, 1/4 w.
R2426	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2427 and R2428	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2429	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2430	19A700019P55	Deposited carbon: 33K ohms ±5%, 1/4 w.
R2431	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2432	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R2433	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R2434	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2435	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2436 thru R2438	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2439	19A700019P63	Deposited carbon: .15 MEG ohms ±5%, 1/4 w.
R2440 thru R2442	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2443	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2444	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2445	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2446 thru R2448	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2449	19A700019P63	Deposited carbon: .15 MEG ohms ±5%, 1/4 w.
R2450 thru R2452	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2453	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2454	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2455	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2456	19A70009P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2457 and R2458	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2459	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2460	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2461 thru R2463	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2464 and R2465	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2466 thru R2468	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2469	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2470	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R2471	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R2472 and R2473	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2474	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R2475	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2476	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R2477	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2478 and R2479	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2480	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2481	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2482 and R2483	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2484	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R2485	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2486	19A700019P70	Deposited carbon: 560K ohms ±5%, 1/4 w.
R2487	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2488 thru R2490	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2491	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R2492	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2493	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2494	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2495	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2496	19A700019P61	Deposited carbon: 100K ohms ±5%, 1/4 w.
R2497	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2498 and R2499	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP2401 and TP2402	19A701785P5	Cotter pin.
TP2403	19A134552P1	Jack, tip.
TP2404 thru TP2416	19A701785P5	Cotter pin.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U2401	19A700029P18	Digital, 7 Stage Binary Counter: Identification No. 4024B.
U2402	19A134827P1	Linear, Dual In-Line 8 Pin Mini Dip Package; sim to EXAR XR-L555CN.
U2403	19A700029P18	Digital, 7 Stage Binary Counter: Identification No. 4024B.
U2404	19A700029P8	Digital, Dual 4-Input Nand Gate: Identification No. 4012B.
U2405	19A700029P17	Digital, Triple 3-Input Nand Gate: Identification No. 4023B.
U2406	19A700176P1	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049UB.
U2407	19A700029P56	Digital, Quad 2-Input Nand SCHMITT TRIGGER; Identification No. 4093B.
U2408	19A700029P28	Digital, 12-Stage Binary Ripple Counter: Identification No. 4040B.
U2409	19A700029P11	Digital, Dual 4-Stage Static Shift Register: Identfication No. 4015B.
U2410	19A700029P12	Digital, Decade Counter Divider: Identification No. 4017B.
U2411 thru U2413	19A700029P9	Digital, Dual "D" Flip-Flop With Set/Reset: Identification 4013B.

SYMBOL	GE PART NO.	DESCRIPTION
U2414	19A700029P56	Digital, Quad 2-Input Nand Schmitt Trigger: Identification No. 4093B.
U2415	19A700029P12	Digital, Decade Counter Divider: Identification No. 4017B.
U2416	19A700176P1	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049UB.
U2417	19A700029P17	Digital, Triple 3-Input Nand Gate: Identification No. 4023B.
U2418	19A700029P56	Digital, Quad 2-Input Nand Schmitt Trigger: Identification No. 4093B.
U2419	19A700029P31	Digital, Quad 3-State Nand R.S. Latch: Identification No. 4044B.
U2420	19A700176P1	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049UB.
U2421	19A700029P7	Digital, Quad 2-Input Nand Gate: Identification No. 4011B.
U2422	19A700029P18	Digital, 7 Stage Binary Counter: Identification No. 4024B.
U2423	19A700029P17	Digital, Triple 3-Input Nand Gate: Identification No. 4023B.
U2424	19A700176P1	Digital, Hex Buffer/Converter (Inverting): Identification No. 4049UB.
U2425	19A700029P56	Digital, Quad 2-Input Nand Schmitt Trigger: Identification No. 4093B.
U2426	19A700029P12	Digital, Decade Counter Divider: Identification No. 4017B.
U2427	19A700029P7	Digital, Quad 2-Input Nand Gate: Identification No. 4011B.
U2428	19A700029P17	Digital, Triple 3-Input Nand Gate: Identification No. 4023B.
U2429	19A700029P7	Digital, Quad 2-Input Nand Gate: Identification No. 4011B.
U2430	19A134827P1	Linear, Dual In-Line 8 Pin Mini Dip Package; sim to EXAR XR-L555CN.
U2431 and U2432	19A700029P7	Digital, Quad 2-Input Nand Gate: Identification No. 4011B.
U2433	19A700029P35	Digital, Hex Buffer/Converter (Non-Inverting): Identification No. 4050B.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR2401	19A700025P8	Zener: 400 mW, 7.2 v. max.
VR2402	19A134717P1	Integrated circuit, linear: 1.5 amp, 35 v. max.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W2402	19B233428G2	Cable: approx 2 inches long. Includes P2402).
W2403	19B233428G2	Cable: approx 2 inches long. Includes P2403).
W2404	19B233428G2	Cable: approx 2 inches long. (Includes P2404).
W2405	19B233428G2	Cable: approx 2 inches long. (Includes P2405).
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XU2434	19A134667P1	Socket, integrated circuit: 16 contacts; sim to Augat No. 316-AG39D.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A701332P4	Insulator, washer: nylon. (Used with Q2413 & Q2418).
		ASSOCIATED PARTS
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U2434	19A143246G1	PROM, digital: sim to Signetics 82S23F/C.

PRODUCTION CHANGES

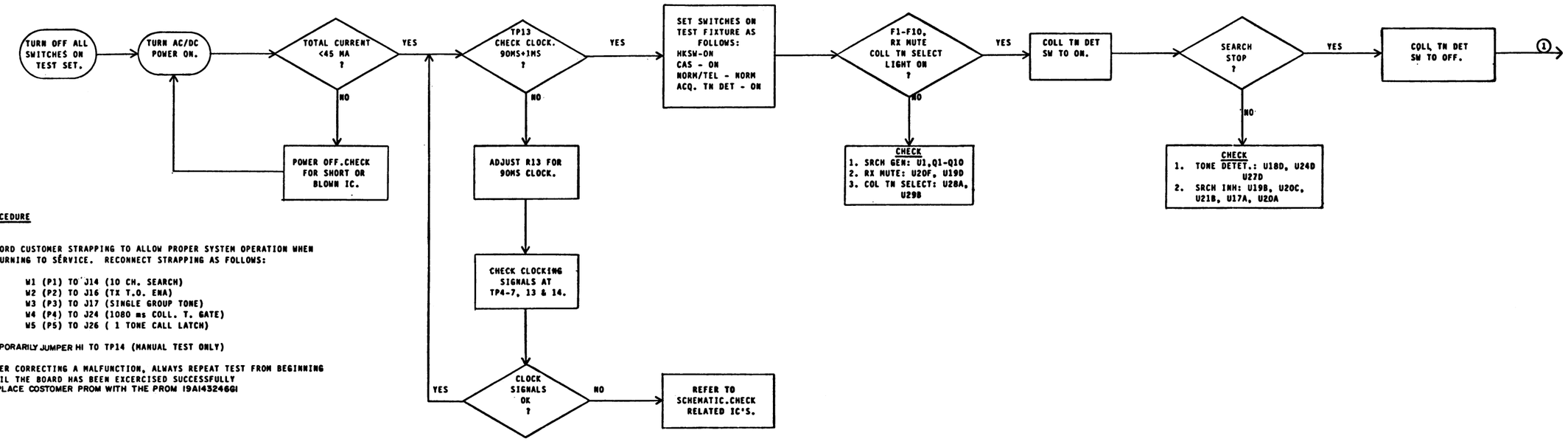
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - Logic Board 19D432913G1 & G2

To improve operation. Changed R2439 and R2449. R2439 was: 19A700019P60, Deposited carbon: 82K ohms ±5%, 1/4 W. R2449 was: 19A700019P60, Deposited carbon: 82K ohms ±5%, 1/4 W.

REV. B - To improve operation of collect tone counter, U10, during acquisition tone sequence. Added CR2475.

REV. C - To extend the duration of the collect tone and to facilitate manufacturing. Added C2496, CR2476, R2403, R2411, R2412, R2498 and R2499. Deleted TP2403. Changed J2415-J2418, J2420-J2426, TP2401, TP2402, TP2404-TP2418 and U2407. TP2401 was: N503P304F15, Cotter pin. TP2402 and TP2403 was: 19A134552P1, Jack, tip. TP2404 thru TP2414 was: N503P304F15, Cotter pin. TP2415 was: 19A134552P1, Jack, tip. TP416 was: N503P304F15, Cotter pin. J2415 thru J2418 was: 19A142706P5, Contact, electrical. J2420 thru J2426 was: 19A142706P5, Contact, electrical. U2407 was: 19A700029P7, Digital, Quad 2-Input Nand Gate: Identification No. 4011B.



PROCEDURE

RECORD CUSTOMER STRAPPING TO ALLOW PROPER SYSTEM OPERATION WHEN RETURNING TO SERVICE. RECONNECT STRAPPING AS FOLLOWS:

W1 (P1) TO J14 (10 CH. SEARCH)
W2 (P2) TO J16 (TX T.O. ENA)
W3 (P3) TO J17 (SINGLE GROUP TONE)
W4 (P4) TO J24 (1080 ms COLL. T. GATE)
W5 (P5) TO J26 (1 TONE CALL LATCH)

TEMPORARILY JUMPER HI TO TP14 (MANUAL TEST ONLY)

AFTER CORRECTING A MALFUNCTION, ALWAYS REPEAT TEST FROM BEGINNING UNTIL THE BOARD HAS BEEN EXCERCISED SUCCESSFULLY
REPLACE COSTOMER PROM WITH THE PROM 19A143246G1

TABLE 1

P1 TO	CHANNELS SEARCHED
J5	ONE CHANNEL
J6	TWO CHANNEL
J7	THREE CHANNEL
J8	FOUR CHANNEL
J9	FIVE CHANNEL
J10	SIX CHANNEL
J11	SEVEN CHANNEL
J12	EIGHT CHANNEL
J13	NINE CHANNEL

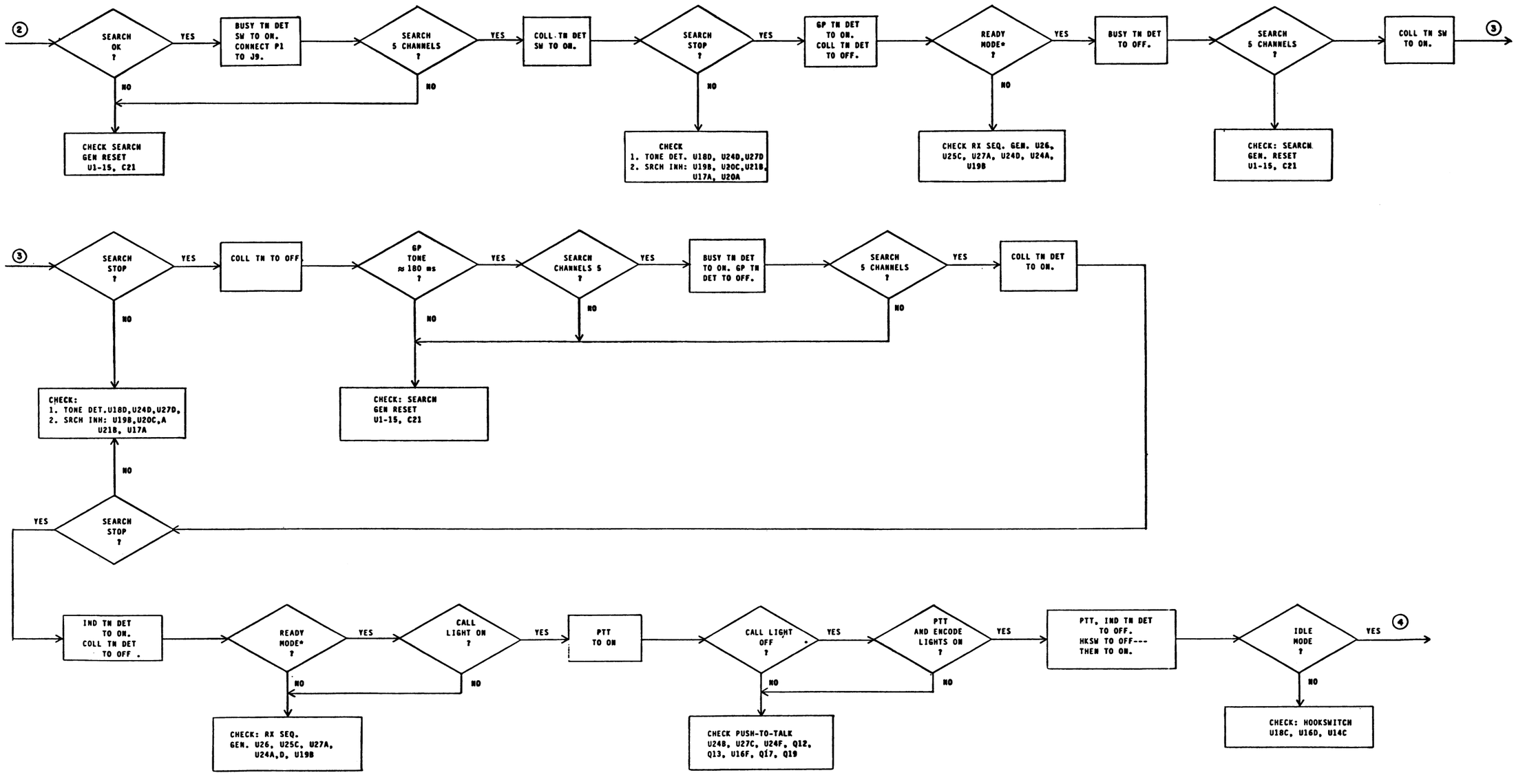
SWITCH IDENTIFICATION

S1 PUSH-TO-TALK
S2 HOOKSWITCH
S3 C.A.S.
S4 TONE DET.
S5 NORM/TEL
S6 BUSY TONE DET.
S7 COLLECT TONE DET.
S8 GROUP TONE DET.
S9 REPEATER ON/OFF
S10 INDIVIDUAL TONE DET.
S11 ACQUISITION TONE DET.

NOTE:

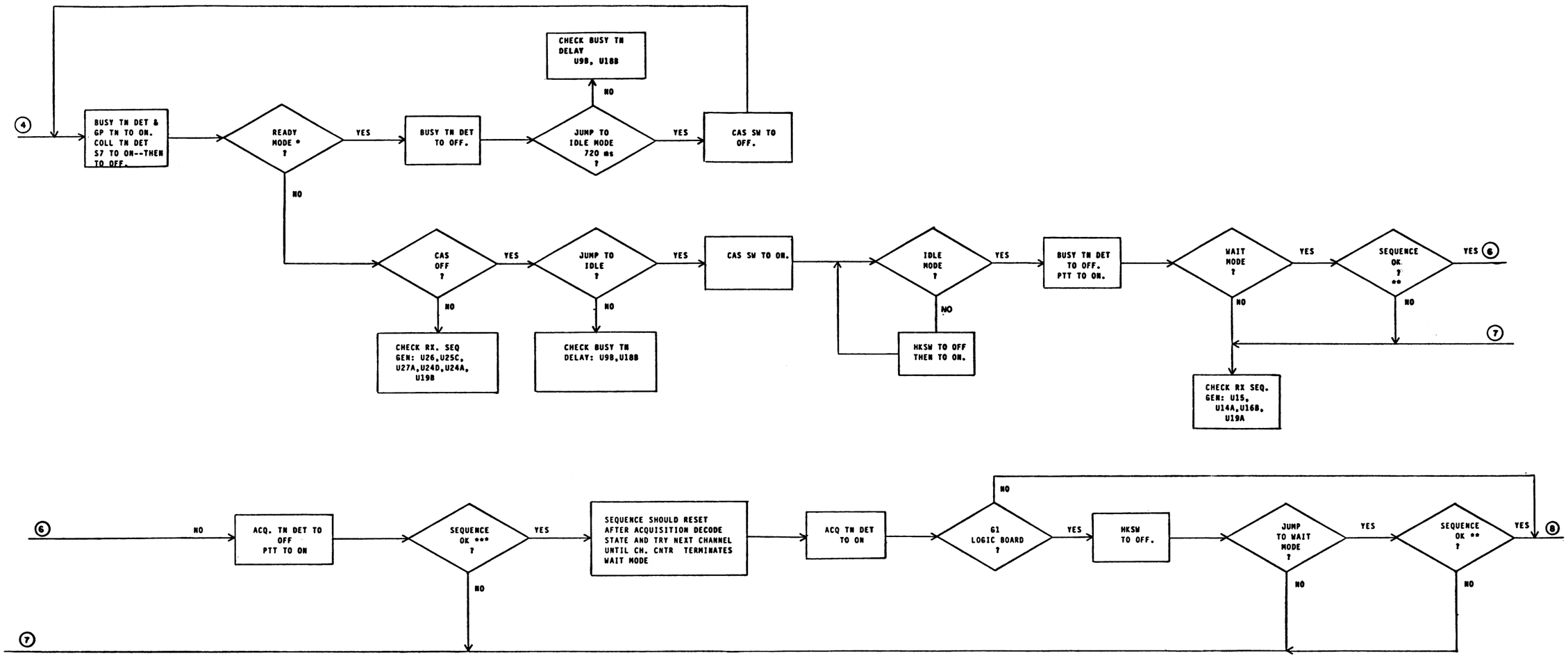
1. THIS PROCEDURE REQUIRES THE USE OF LOGIC BOARD TEST FIXTURE.

(RC-4110, Sh. 1)



(RC-4110, Sh. 2)

TROUBLESHOOTING FLOW CHART



* REVIEW THE FOLLOWING SEQUENCE BEFORE PROCEEDING. IT MAY BE NECESSARY TO REPEAT SWITCH OPERATIONS TO OBSERVE THE FOLLOWING:

READY LIGHT ON

RX MUTE LIGHT OFF

MIC ENA LIGHT ON

BUSY TONE ATT ON

SEARCH STOPS

ALERT TONE LIGHT BLINKS 4-5 TIMES

SQUELCH DIS & ENCODE LIGHT ON FOR DURATION OF ALERT TONE

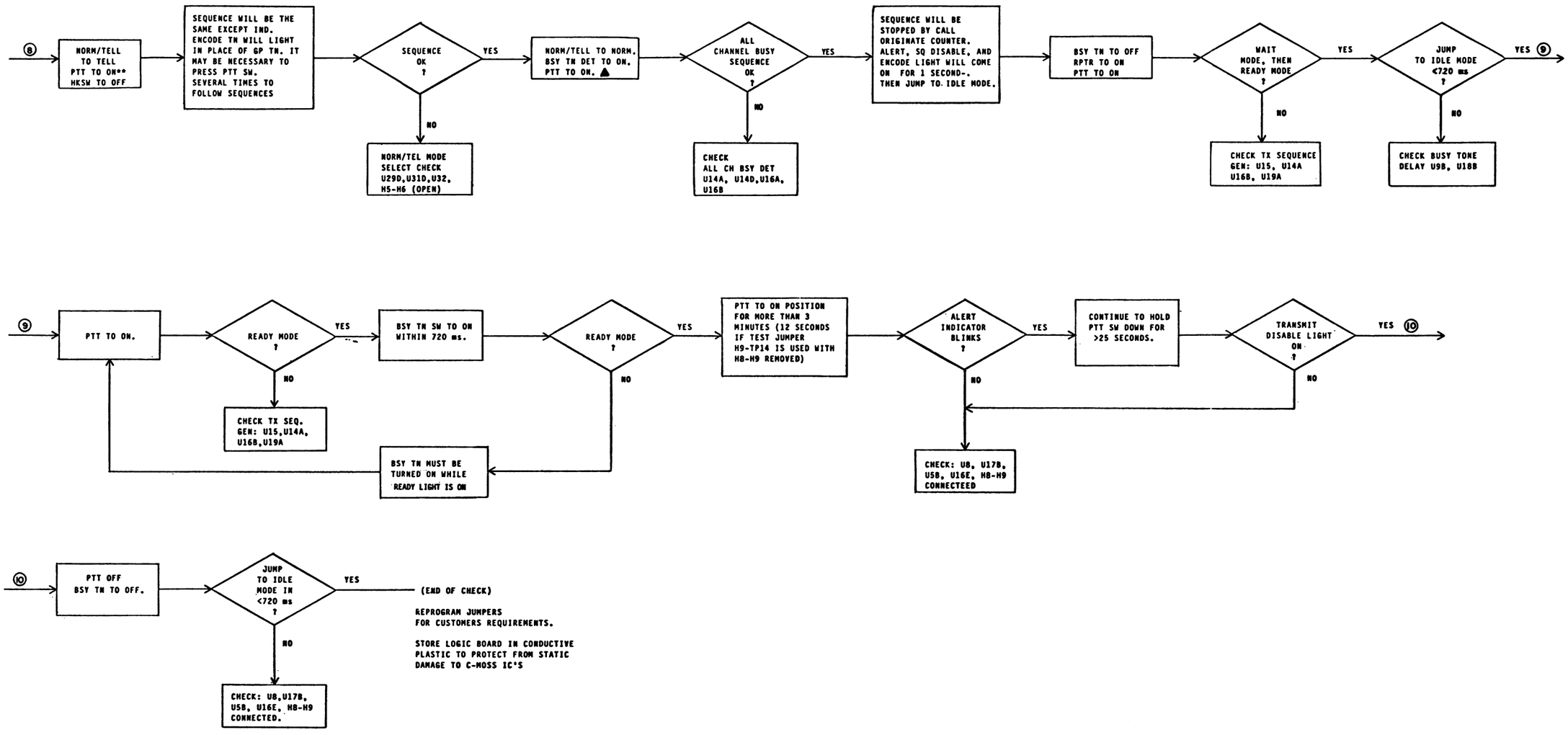
**REVIEW THE FOLLOWING SEQUENCE BEFORE PROCEEDING. IT MAY BE NECESSARY TO REPEAT SWITCH OPERATIONS TO OBSERVE THE FOLLOWING:

***
- WAIT LIGHT ON
- CHANNEL LIGHT ON (1 OF 5)
- BUSY TONE SELECT ON (90 MS DECODE)
- PTT LIGHT ON (90 MS)
- ENCODE LIGHT ON (90 MS)
- ACQUISITION TONE SELECT ON (90 MS DECODE)

ENCODE & PTT LIGHT ON FOR 900 MS
COLLECT TONE SEL ON (450 MS ENCODE)
GROUP TONE SEL ON (450 MS ENCODE)
BUSY TONE SEL ON (180 MS DECODE)

NOTE: THE LOGIC BOARD WILL TRY NUMBER OF CHAN PROGRAMMED INTO COUNTER U22.

(RC-4110, Sh. 3)



▲ ALL CHANNEL BUSY SEQUENCE

WAIT LIGHT ON
BUSY TONE SELECT ON
RX MUTE LIGHT ON
CHANNEL LIGHT SEARCHING 1 OF 5. (DOES NOT STOP EACH CHANNEL)
ALERT AND SQELCH DISABLE LIGHT WILL COME ON FOR APPROXIMATELY 1-SECOND.

(RC-4110, Sh. 4)

TROUBLESHOOTING FLOW CHART