CENTURA & CORONA
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MOBILE RADIO

GE-MARC V™ CLASSIC

TRUNKED MOBILE RADIO COMMUNICATIONS SYSTEM

MAINTENANCE MANUAL LBI31110A

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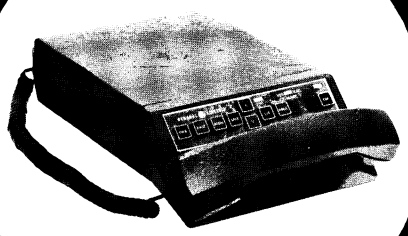
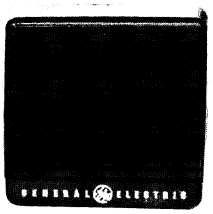


MOBILE RADIO
CLASSIC

800 MHz
30-WATT
TWO-WAY
TRUNKED RADIO
COMBINATION



SPEAKER

File
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GENERAL ELECTRIC

w/ CES
Encoder

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ILLUSTRATIONS

WARNING

Although the highest DC voltage in GE-MARC V Mobile Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

SYSTEM SPECIFICATIONS*

FREQUENCY RANGE	
Transmitter	816.0125-820.9875 MHz (USA-1)
Receiver	861.0125-865.9875 MHz (USA-1)
Transmitter	811.0125-815.9875 MHz (USA-2)
Receiver	856.0125-860.9875 MHz (USA-2)
Transmitter	820.0125-824.9875 MHz (AUSTRALIA)
Receiver	865.0125-870.9875 MHz (AUSTRALIA)
BATTERY DRAIN	
Receiver	
Squelched	0.7 Amperes (Maximum)
Unsquelched	1.1 Amperes (Maximum)
Transmitter	11 Amperes
FREQUENCY STABILITY	0.00025%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSION, LESS ACCESSORIES (H X W X D)	65 mm X 190 mm X 240 mm (2.5 X 7.5 X 9.4 inches)
WEIGHT, LESS ACCESSORIES	2.7 kg (5.0 pounds)
FREQUENCY CHANNEL CAPACITY	29 (Maximum)

TRANSMITTER KT-205-B (USA-1)

POWER OUTPUT	30 WATTS
CHANNEL SPACING	25 kHz
CONDUCTED SPURIOUS	-60 dB
MODULATION	±4.5 kHz
AUDIO SENSITIVITY	55 to 120 Millivolts
AUDIO FREQUENCY CHARACTERISTICS (Per RS-152B)	Within +1 dB to -3 dB of a 6 dB/ octave pre-emphasis from 300 to 3000 Hz per EIA standards.
DISTORTION	Less than 3% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.5 kHz maximum
RF OUTPUT IMPEDANCE	50 ohms

RECEIVER (ER-132-A)

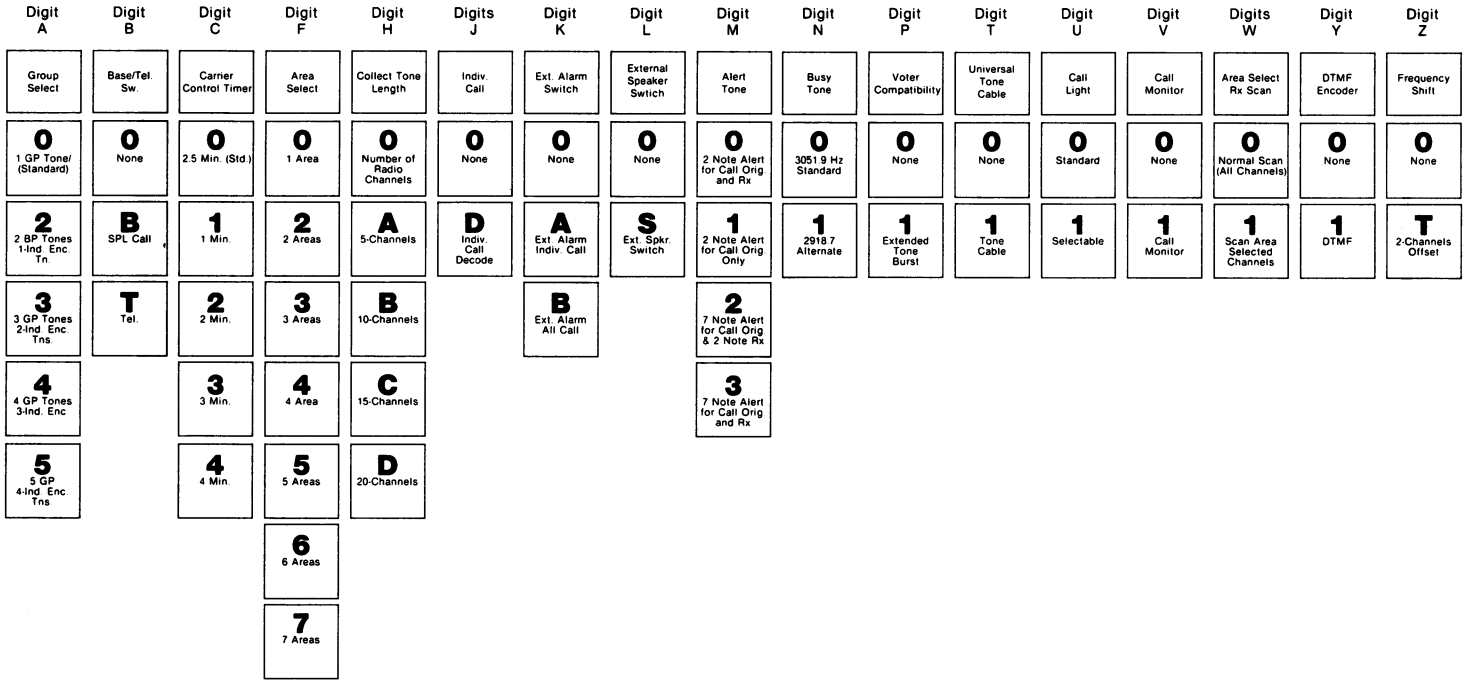
AUDIO OUTPUT (To 4.0 ohms speaker)	3 Watts (less than 5% distortion) EIA 1.5 Watts (less than 5% distortion) CEPT
SENSITIVITY	
12 dB SINAD (EIA Method)	0.30 uV
20 dB (Quieting Method)	0.4 uV
SELECTIVITY	
EIA Two-Signal Method	-75 dB @ ±25 kHz
SPURIOUS RESPONSE	-70 dB
INTERMODULATION	-70 dB
MODULATION ACCEPTANCE	±7 kHz
SQUELCH SENSITIVITY	12 dB SINAD
FREQUENCY RESPONSE	Within +2 and -1.5 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz EIA
RF INPUT IMPEDANCE	50 ohms

* These specifications are intended primarily for use of the serviceman. Refer to the appropriate Specifications Sheet for the complete specifications.

COMBINATION NOMENCLATURE

Digits 1 & 2	Digit 3	Digit 4	Digit 5	Digit 6	Digits 7, 8 & 9	Digit 10	Digit 11	Digit 12	Digit 13	Digit 14	Digit 15	Digit 16	Digit 17
Product Code	Transmit Frequency Range	Receive Frequency Range	Channel Spacing	Type	RF Power Output	Frequency Capacity Channel Plan	Control	Version	Oscillator Stability	Mechanical Package	System Voltage	Receiver Type	Audio Power
M7	**Y** 811-825 MHz	**Z** 856-870 MHz	**2** 25 kHz	**B** Black	**030** 30 Watts	**S** 29 USA-1	**0** Standard	**U** MRPD	**A** ±2.5 PPM	**K** Classic	**0** +12 VDC Neg. Gnd.	**1** 45.0125 MHz IF	**0** 3-Watts
				P Pebble		**T** 29 Australia	**X** Less Personality & Freq. PROM	**P** Private Brandable					
				S Saddle Brown		**R** 29 USA-2							
						W 100 USA-2							
						Y 100 Australia							
						Z 100 USA-1							

STRUCTURED OPTIONS



GENERAL DESCRIPTION

GE-MARC V™ CLASSIC trunked mobile radio combinations are 100% solid state -- utilizing both discrete components and integrated circuits (IC's) for high reliability. The radio is a self-contained FM transmitter/receiver with frequency synthesizer and built-in controls and speaker. Its small size makes it ideal for front mounting in conventional vehicles.

The GE-MARC V™ CLASSIC trunked mobile radios enables the users to share up to 29 half-duplex communications channels. The GE-MARC V radio(s), repeater(s) and control station comprise a basic private channel communications system. A logic board in each mobile radio and control station signals, accesses and controls all communications channels through a repeater and alerts the user to incoming calls.

Standard combinations may be equiped with up to 29 half-duplex communications channels in each area utilizing up to 29 different RF frequencies.

If the radio is equipped with the Area Expander option, the radio may be programmed for up to 20 channels in each of seven areas (100 channels system maximum) and up to 100 different RF frequencies. A plug-in ICOM and a synthesized oscillator provide for ±0.00025% oscillator stability. Channel selection is determined by the logic board and frequency synthesizer. RF frequency codes are stored in the RF frequency PROM.

GE MARC V radio may operate on one of three available channel plans, USA-1, USA-2 or the Australia. Frequencies associated with these channel plans are identified in the table below.

Channel Plan	Transmit Freq (MHz)	Receive Freq (MHz)
USA-1/ USA-1,ZT	816.0125- 820.9875	861.0125- 865.9875
USA-2	811.0125- 815.9875	856.0125- 860.9875
AUSTRALIA	820.0125- 824.9875	865.0125- 869.9875

The radio consists of an effective, heat-dissipating, aluminum die cast chassis similar to an "H" frame on which three circuit boards are mounted. The casting contains a horizontal flat plate located midway between the vertical sides. A back plate, with fins, is attached to the rear of the chassis and provides a means of heat dissipation. The transmitter/receiver board is mounted on the bottom of the chassis and includes the exciter, a separate PA module and receiver circuitry. The synthesizer/ interconnect board is mounted in the top section of the chassis. This board contains the audio processor, FM ICOM, I/O expanders, frequency synthesizer, and provides all interconnections. The logic board is mounted on the top section of the chassis just above the synthesizer/ interconnect board.

The circuit boards plug into each other, eliminating the need for most interconnecting wires. Wiring is for the plug-in leads on the internal speaker and control unit interconnections. The body of the radio is surrounded by interchangeable top and bottom covers. The top and bottom covers slide under the "nose" covers and are screwed to the rear of the chassis. Thirteen screws secure these covers to each other and the chassis. The top control unit cover assembly contains the mechanical springs and tabs to retain the handset.

The control unit is housed within the nose covers and includes the display and control circuitry and a control panel nameplate and nameplate support made of highly durable plastic. The control unit board assembly is secured to the sides of the chassis by two retaining screws and may be rotated 180 degrees to facilitate vertical or overhead mounting of the radio in the vehicle.

The control panel provides access to all operator controls and indicators. A red transmit indicator LED, a green mode indicator (WAIT/READY), a red call received indicator, a green Power On LED, volume control pushbuttons and CLEAR switch are provided as standard equipment.

No power supply is required since the highest supply voltage used in the radio is provided by the vehicle battery. The radio is designed for operation in 12 Volt, negative ground vehicle systems.

NOTE

The 30 Watt 800 MHz radio is not available as an AC mobile due to the limited capability of the power supply. It therefore is not FCC type accepted as such.

The radio is of modular construction. All major modules and tuning adjustments are easily accessible. Loosening the two screws in the rear of

the top cover provides access to the logic and synthesizer/interconnect boards and RF PROM Interface board. Loosening two screws at the rear of the bottom cover provides access to the transmitter/receiver board. An optional set of test probes can be plugged onto the the test pins on the board for alignment and troubleshooting.

A test jack, J2506, located on the synthesizer/interconnect board facilitates system test, checkout and troubleshooting using the Microprocessor Test Set TL5B.

Various structured options are provided as standard equipment. These options are controlled by the microprocessor with specific related information stored in the personality PROM. Any changes to these options or to the RF frequency structure requires that a new personality PROM be programmed to reflect the specific information for all desired options listed in the structured option nomenclature table. (The personality PROM is located on the logic board.) Structured options provided include:

- Carrier Control Timer - 2.5 min. standard
- Area Select ----------1-Area
- Group Tones ----------1-Tone
- Alert Tone ----------2-Note Alert
- Call Light ----------All Calls
- Area Select Scan---Scans All Channels

Structured options provided in the radio may include any of the following variations.

Carrier Control Timer - Turns off the transmitter after the microphone push-to-talk switch has been keyed for an adjustable period of time. The timer is PROM adjustable from 2.5 seconds to 4.0 minutes.

Area Select Option - Permits a customer to operate his system on more than one GE-MARC V system with the following limitations:

- Total number of different frequencies available is 29. (Standard combinations, 100 (W/Area Expander).
- 5 areas (systems maximum), 7 with Area Expander option.
- 15 channels maximum in each area. 20 per area with Area Expander.
- Total number of channels in 5 areas is 25. 100 channels with Area Expander.

Area Select Receiver Scan - Allows the receiver to scan all frequencies programmed in the radio independent of the area position selected, or scan only the channels in the area selected. (This option must be selected if the total number of channels exceeds 20.)

Group Select (Mobiles) - Allows the user to select up to five different encode/decode tone combinations. Group tones two through five are selective call encodes. These tones may be decoded by individual mobiles or groups of mobiles. A group of mobiles may include all assigned to a given area, or as assigned. A fifth selective call encode is assigned as a special call (SPL) and is assigned to group tone six.

SPL Call - Special Call allows the mobile to selectively signal the control station or another mobile by adding another encode tone combination.

Individual Call - Allows the mobile to be signalled by two GE-MARC V tone combinations (additional decode tone combination).

External Alarm - For selected calls, it alerts the operator to a call by blowing the vehicles horn, or activating other alarm devices.

Selectable Call Light - On standard radios a CALL light is turned on when calls are received. Optionally, the radio may be programmed to turn the CALL light on only for selected calls.

Call Monitor - Permits the operator to hang the microphone in the hookswitch after receiving a call without returning the radio to idle mode. Normally the hookswitch is used to initiate calls and reset the radio to idle. This option disables the reset function.

Alert Tone Option - There are 2 audible alert tone sequences available to alert the operator to an incoming call or to indicate CALL origination. One of four combinations may be used. They are:

- Two-note alert for call originate and receive
- Two-note alert for call originate, None for receive
- Seven-note alert for call originate, Two-note for receive
- Seven-note alert for both call originate and receive

Alternate Busy Tone - Prevents radio communications interference between mobiles operating in adjacent areas when using the same RF frequency.

Voter Compatibility Option - The voter compatibility option extends the duration of the initial busy tone burst to 180 milliseconds to allow the voting circuitry to select the best RF path available.

TRANSMITTER

The transmitter consists of an audio processor, synthesizer, exciter and a broadband, fixed-tuned power amplifier module. In the receive mode, the exciter also serves as the receiver first mixer injection.

The RF power output level is adjustable for rated power. After the level is set, a sensing control circuit holds the power constant over temperature and/or voltage variations within specified limits.

Drive for the transmitter PA and the receiver 1st mixer injection are derived from a phase lock loop (PLL) circuit.

Frequency stability for both the transmitter and receiver is maintained by an electronic compensation network in the 2 PPM FM ICOM and the synthesizer reference oscillator.

RECEIVER

The dual conversion receiver consists of a front end section and two mixer/IF sections operating at 45.0125 MHz and 455 kHz. The receiver also contains the squelch and audio sections. Only the CAS function in the squelch circuit is used. The audio section provides a 3 Watt audio output into a 4 ohm load.

SYNTHESIZER

The synthesizer consists of a synthesizer chip, dual modulus counter, a reference oscillator, and a voltage controlled oscillator (VCO). The synthesized frequency is controlled by the RF frequency PROM and applied to the transmit/receive board.

LOGIC

The logic board controls the operation of the radio and contains the microprocessor, personality PROM, tone encoder/decoder, voice tone filtering and I/O expanders. The I/O expanders are located on the synthesizer/interconnect board and the microprocessor, personality PROM, etc., are located on the logic board.

CONTROL UNIT

The control unit contains the control, and display circuits. It interfaces with the synthesizer/interconnect and transmitter/receiver boards through a plug-on harness.

UNIVERSAL TONE CABLE

A Universal Tone Cable is available for use with external encoders and decoders.

When used with external decoders, the speaker muting function is obtained by removing the jumper from H15 to H16 on the Interconnect/Multi-frequency board.

EXTERNAL SPEAKER (OPTIONAL)

A five-inch speaker, contained in a LEXAN® housing, has an impedance of 3.2 ohms. A LEXAN® bracket is supplied for mounting. The speaker leads are connected to pins 3 and 7 of Systems Plug P910. When the external speaker is used, certain jumper modifications are required. Refer to the notes on the Schematic Diagram.

SYSTEM DESCRIPTION

The GE-MARC V™ CLASSIC trunked mobile radio system permits improved access to available RF channels, freedom from annoyance by other users' conversations and a degree of privacy for the user. The GE-MARC V™ system consists of a repeater for each channel and the users' mobile radio units. The system uses tone signalling, with each mobile being assigned a two-tone combination. Groups or fleets of mobiles are assigned the same tones, so that any unit can talk to all the other units in the group. A system block diagram is shown in Figure 1.

When originating a call, the mobile identifies an idle repeater channel and interrogates it with a single burst of "busy" tone. Upon receipt of the first (busy) tone, the repeater keys its transmitter and sends a burst of "acquisition" tone back to the mobile unit. When the interrogating mobile receives the acquisition tone, it then transmits a "collect" tone and "group" tone, which the repeater passes to all idle mobile units in the system. The idle mobiles, which continually scan all channels, will stop on the active channel if they recognize the collect tone, and wait for the group tone. If the correct group tone is detected, the mobiles will open their audio circuits and alert the operator of an incoming call. If either the collect or group tone is not recognized, the idle

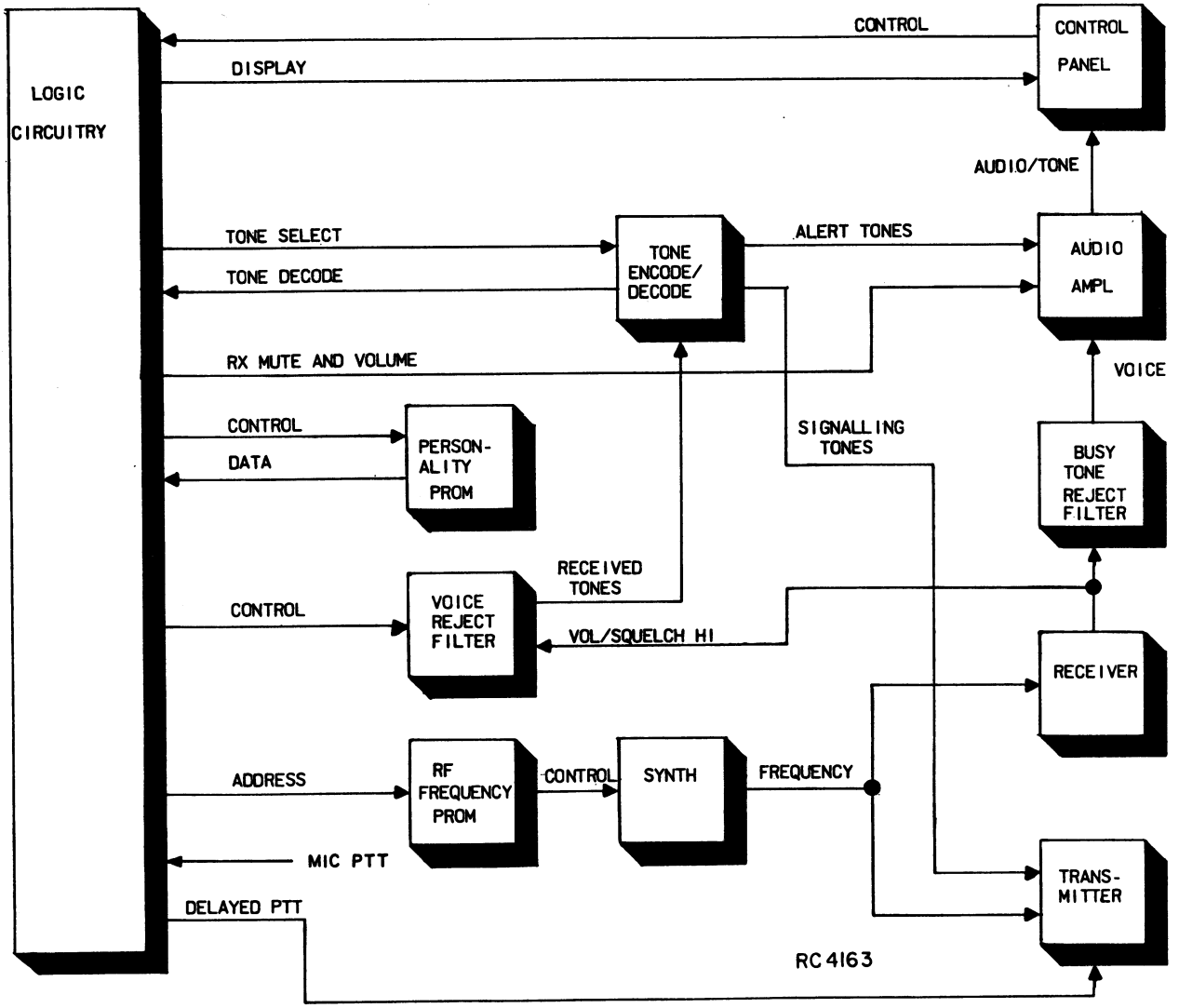


Figure 1 - GE-MARC V Mobile Radio Block Diagram

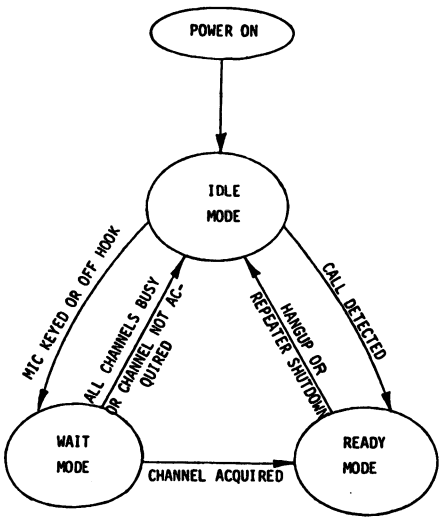
units will resume their scan of the channels. Once a mobile is "locked" on a channel, it will remain there until the repeater times out or the operator hangs up the microphone.

The radio will always be in one of three operational modes: idle, wait, or ready. The radio enters the idle mode when power is turned on and begins scanning channels for incoming calls. The wait mode is entered when the user places a call. The radio remains in the wait mode until a channel is acquired or it determines that all channels are busy. The ready mode or conversation mode is indicated by an alert tone and the mode indicator.

Figure 2 identifies the three operational modes and the conditions that cause the radio to transfer from one mode to another. Figure 3 defines the signal timing when originating and receiving a call. Figures 4 through 6 are the sequence flow charts for each operational mode.

IDLE MODE

When the radio is in the idle mode, the speaker is muted and all channels are sequentially scanned for an incoming call. An incoming call is first identified by the presence of a collect tone on one of the channels. Upon receipt of a collect tone, the mobile looks for a group or individual tone on the channel for a brief interval. If the group or individual tones are not detected, the mobile will advance to the next channel an continue looking for an incoming call.



IDLE MODE - UNIT IS SCANNING CHANNELS FOR CALLS.

WAIT MODE - UNIT ACQUIRES A CHANNEL AND TRANSMITS SIGNALLING TONES.

READY MODE - UNIT IS LOCKED ON A CHANNEL, ALLOWING VOICE COMMUNICATION.

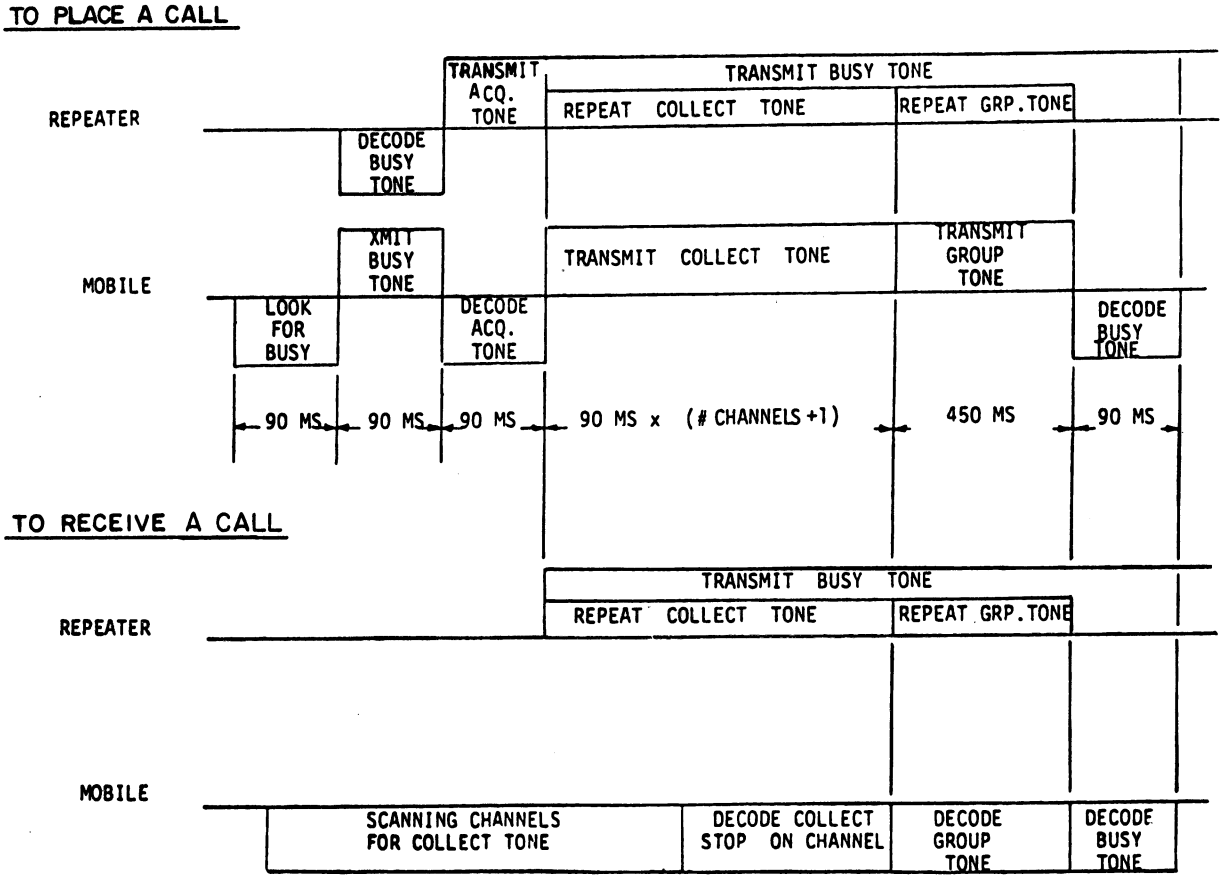
RC4158

Figure 2 - Operational Modes

If both the collect and group or individual tones are detected, the mobile then looks for a busy tone. (Detection of an individual tone establishes a personal "line" between the mobile radio and the control station.) If a busy tone is detected, the mobile sounds the alert tone, turns on the RDY indicator and CALL light (if programmed) and enters the ready mode. The radio may now be used in the conventional push-to-talk mode, and will remain on the channel until the operator hangs up or until the repeater drops the busy tone causing the radio to revert to the idle mode. If busy tone is not detected, the mobile unit remains in the idle mode and continues scanning the channels for an incoming call.

WAIT MODE

When the mobile is in the "idle" mode either depressing the push-to-talk switch or lifting the microphone off-hook will transfer the unit immediately to wait mode, initiating execution of a sequence which scans for an idle channel. In the "wait" mode, the mobile looks for busy tone on the channel for a brief interval; if busy tone is detected, the unit advances to the next channel. If an idle channel is not found, the unit reverts to the idle mode.



RC 4159

Figure 3 - Signal Timing

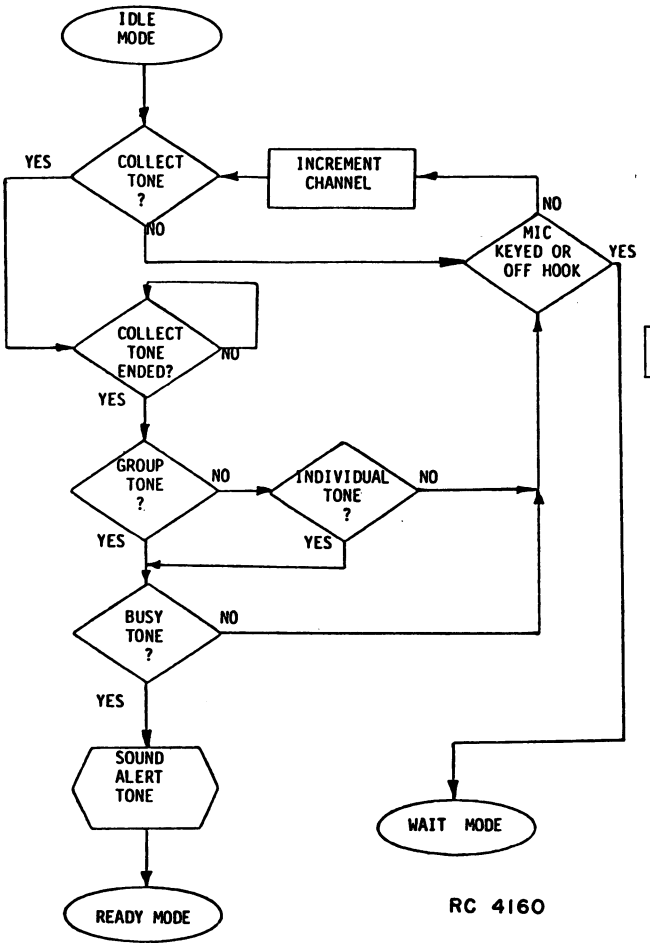


Figure 4 - Idle Mode

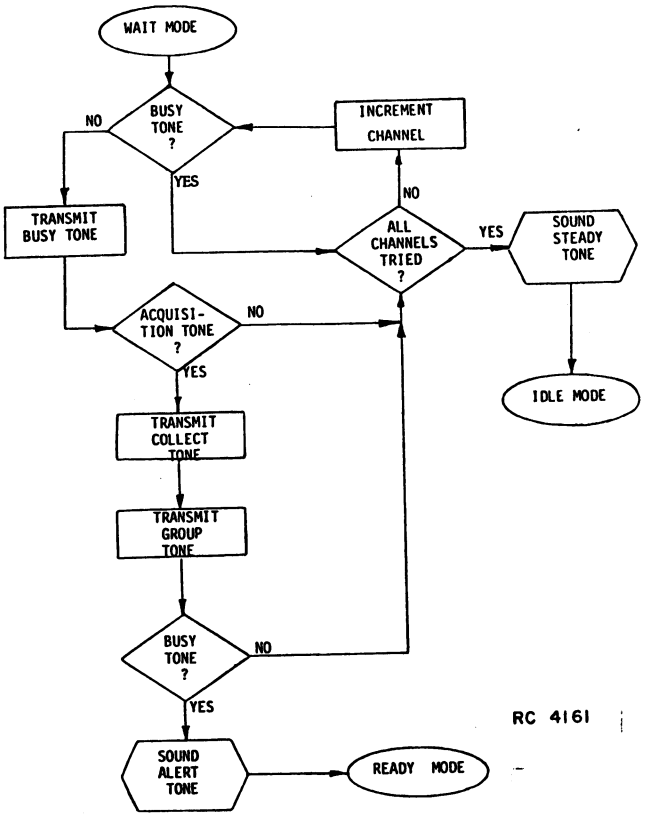


Figure 5 - Wait Mode

When a idle channel is found, the mobile transmits a burst of busy tone to acquire the repeater, to which the repeater responds with a burst of acquisition tone. Upon receipt of the acquisition tone, the mobile proceeds with transmission of collect tone and group tone, after which it once again looks for busy tone from the repeater. If busy tone is detected, the unit alerts the operator and enters the ready mode. If busy tone is not detected, the unit advances to the next channel and tries again. If no channel can be acquired, the radio reverts to the idle mode and a steady one-second tone will alert the operator that a channel was not acquired.

READY MODE

When an incoming call has been detected, or an idle channel has been acquired, the mobile enters the ready mode. In this mode the audio and push-to-talk circuits are enabled, the speaker is unmuted, and the operator is alerted by a READY light and an alert tone. The radio can then be used in the conventional push-to-talk manner, and will remain on the channel until the operator hangs up or the repeater drops busy tone causing the unit to revert to idle mode.

POWER DISTRIBUTION SYSTEM

Battery voltage enters the radio through J910-1 (Receive) and J910-11 (Transmit) on the synthesizer/ interconnect board. Both inputs are connected to reverse polarity protection diodes. The ground lead passes through J910-6 to a "fusable" PWB run which will open if the ground wire is connected to A+ BATT accidently. A power distribution diagram is shown in Figure 7.

The A+ input goes directly from the synthesizer/interconnect board through a feed through capacitor and Molex connector to the RF PA. The receive A+

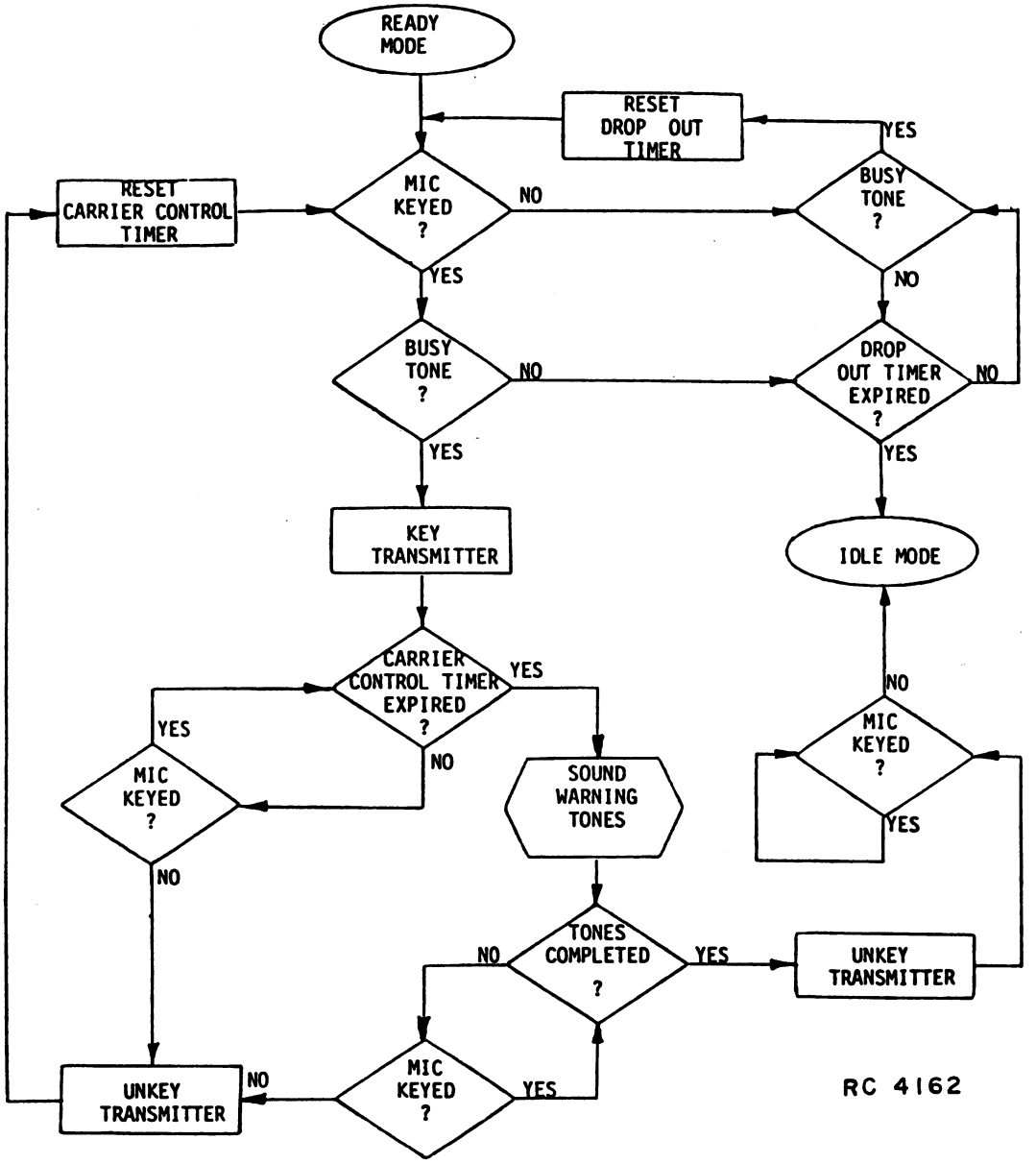


Figure 6 - GE-MARC V Mobile Radio Ready Mode

input from the synthesizer/interconnect board feeds through to the Tx/Rx board and serves two functions. One branch supplies the audio amplifier and passes through an RC-ripple filter and one section of the on/off switch. The other section of the on/off switch controls the voltage to a voltage regulator consisting of a fixed monolithic 8V regulator adjusted to 8.5V and a second 5 volt regulator for the logic circuitry and display current. Unswitched A+ is also fed to a second 5 volt regulator on the logic board to provide memory for up-down volume, audio and group select when the radio is turned off. Regulated 8.5V is switched to either 8.5V Rx or 8.5V Tx by the antenna relay. The antenna relay is also supplied by the 8.5V regulated supply.

GLOSSARY OF GE-MARC V SYSTEM TERMS (AS APPLIED TO MOBILES AND CONTROL STATIONS)

IDLE MODE - The "standby" condition for a mobile or control station, inactive, but prepared to call or be called. Trunked radios are IDLE upon turn-on, and remain IDLE until they enter another mode or are turned off.

WAIT MODE - The "attempting origination" condition. WAIT mode is entered from IDLE mode (only) as the user presses PTT or comes "off-hook". If successful, the unit becomes READY. Otherwise, the unit is IDLE after all channels are tried.

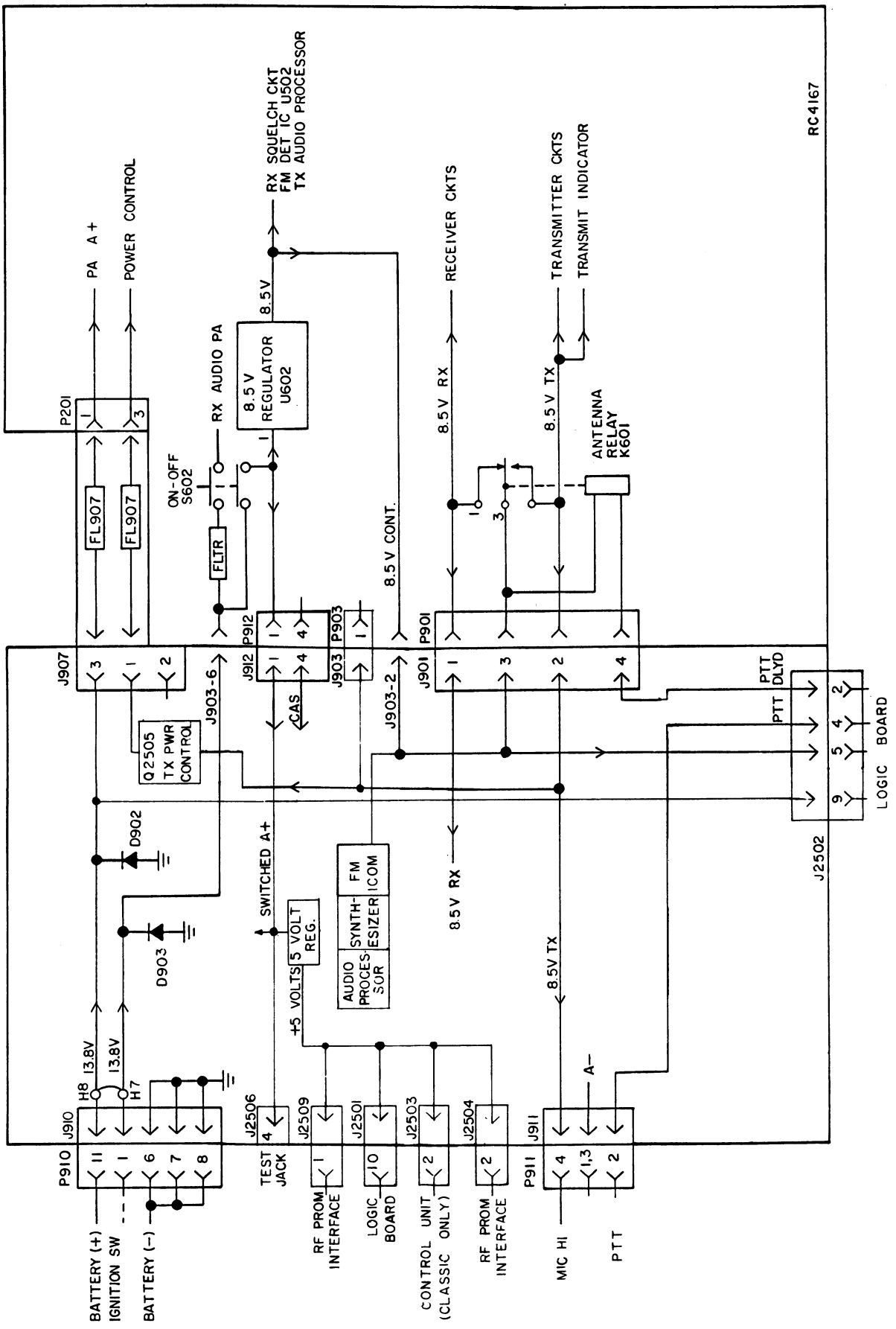


Figure 7 - Power Distribution Diagram

READY MODE - The "operating" condition. READY is entered from IDLE via WAIT when calling, and directly from IDLE when called. READY mode ends (the radio reverts to IDLE) with loss of received Busy Tone from the repeater. This normally occurs when the repeater shuts down after communication is complete.

BUSY TONE- A "voice-plus" tone (3051.9 Hz standard; 2918 Hz alternate) which modulates mobile (also control station) and repeater transmitters at low level (+/- 1 kHz deviation) continuously. This tone, like Channel Guard is filtered from received audio. Busy Tone "holds" communicating units to their channel and excludes "outsiders" from the channel.

ACQUISITION TONE - A tone (1962.9 Hz) sent at full deviation (duration 50 ms) by the repeater transmitter. It is used as acknowledgement (handshake) from the repeater to a calling unit.

COLLECTION TONE - A tone (chosen from 33 standardized frequencies ranging from 604.2 Hz to 2672.9 Hz) used as the FIRST tone in a two-tone addressing sequence. Collection Tone is encoded (full deviation) by the calling unit, repeated by the repeater, and decoded by the called unit. Duration varies with the number of channels in the GE-MARC V trunked system.

GROUP TONE OR INDIVIDUAL TONE - A tone (chosen from frequencies also used as Collection Tones) which is the SECOND tone of the address. This tone is also encoded (full deviation) by the calling unit, repeated by the repeater, and decoded by the called unit. Duration is 450 ms.

OPERATION

ALERT TONES

CALL RECEIVED - The "Call Received" tone consists of a musical 2-tone or 7-tone alert.

CHANNEL ACQUISITION - Same as "Call Received".

CARRIER CONTROL TIMER - The carrier control timer is a pulsed tone that is sounded when the microphone has been keyed continuously for the preprogrammed time of 2.3 seconds to 4.0 minutes (typically 2.5 minutes). When the time expires the microphone is muted and approximately 18 seconds of alert tone is sounded to notify you that you have timed out. Just unkey and key again to continue talking.

CHANNEL BUSY/OUT-OF-RANGE - The channel "busy"/out-of-range tone is a continuous 1 second tone burst.

WARNING TONE - The "warning tone" consists of approximately 12 seconds of beeps from the repeater and is sounded after the channel has been in use beyond an allowed period, if all channels are busy. The warning tone indicates that other users may need the channel, and that your conversation will be cut off.

CHANNEL DISCONNECT

The repeater continually looks for a busy tone from the mobile or station, to determine if the channel is busy or idle. If a busy tone is not received for approximately five seconds, the repeater assumes the channel is idle and disconnects. If the conversation was not completed, the call must be placed again. It is suggested that a procedure be established that designates the originator of a call be the one to re-establish communications.

NOTE

Its possible for two or more operators originating a call simultaneously may come up on two different channels. Communications under these conditions are impossible.

Complete operating instructions for the two-way radio are provided in a separate Operator's Manual. The basic procedure for receiving and transmitting messages is as follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by pressing the POWER switch.
2. Adjust VOLUME up/down controls (Λ ,V) for a suitable listening level. There are eight discreet levels available. An internal control permits further adjustment.

NOTE

An audible alert tone normally precedes each incoming message.

The radio is now ready to receive messages from other radios in the system.

3. To clear the radio and return to the idle mode, press the clear pushbutton or replace handset.

TO TRANSMIT A MESSAGE

1. Turn the radio on by pressing the POWER switch.
2. Select the desired group (Optional).
3. Select the appropriate area (Optional).
4. Select the desired mode of operation.
   SPL CALL (Optional)
   Depending on option provided.
5. Remove the handset from the hookswitch and, when READY indicator lights, press the PTT switch.

NOTE

When a channel is acquired, the ready mode indicator will light and an alert tone will be sounded.

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by an electronics technician who holds an appropriate FCC license (where required).

TRANSMITTER ADJUSTMENT

The adjustment for the transmitter includes measuring the forward and reflected power and adjusting the antenna length for optimum ratio, then setting the transmitter to rated power output. For complete transmitter adjustment, refer to the Alignment Procedure (see Table of Contents).

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. For the Receiver Adjustment Procedure, refer to the Alignment Procedure (see Table of Contents).

RE-INSTALLATION

If the mobile combination is ever moved to a different vehicle, always check the battery polarity of the new system.

SYSTEM CHECKOUT

See instruction manual for Microprocessor Control Set TL5B.

MAINTENANCE

CAUTION

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

PREVENTIVE MAINTENANCE

To ensure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. Preventive Maintenance should include the checks listed in the Table of Maintenance Checks.

DISASSEMBLY

- To service the transmitter receiver (Tx/Rx) board, remove the two screws securing the bottom cover at the rear of the radio. Then slide the cover out from under the edge of the front panel and lift off.
- To service the synthesizer/interconnect board, remove the two screws at the rear of the radio and slide the cover out from the edge of the front control panel and lift off. Remove the synthesizer shield.

MAINTENANCE CHECKS	INTERVAL	
	6 Months	As Required
CONNECTIONS - Ground connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low impedance. A high impedance may cause excessive voltage drops and alternator noise problems.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery will often cause excessive noise or faulty operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and parts to make sure that nothing is working loose.	X	
ANTENNA - The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antennas or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to applicable Alignment Procedure and troubleshooting sheet for typical voltage readings.		X
FREQUENCY CHECK - Check transmitter frequency and deviation, as required by FCC. Normally, these checks are made when the unit is first put into operation, after the first six months and once a year thereafter.		X

- To remove the Tx/Rx board:

1. Remove the top and bottom cover.
2. Remove the three screws holding the antenna connector and unsolder the connector from the board.
3. Remove the four screws securing the front panel to the "H" frame. Disconnect the speaker plug and remove the panel.
4. Remove the eight screws securing the RF shield.
5. Remove the screw in the receiver front end casting.
6. Remove the two screws securing the driver module and two screws securing the PA transistor.

CAUTION

When removing the Tx/Rx board, be sure the seal (silicon grease) between the driver module and casting is broken to prevent damage to the driver module. Use a scribe (or equivalent) to loosen the module from the casting and slowly lift the transmit/receive board out of the radio.

7. Remove the nine screws securing the Tx/Rx board and carefully lift the board up off of the interconnection pins.

- To remove the synthesizer/interconnect board:

1. Remove the top cover.
2. Remove the front cap, logic board and synthesizer shield.

3. Remove the 11 screws securing the board and carefully lift the board up to disconnect the interconnection pins.

- To access the control unit:

1. Remove the nose covers by removing the seven screws securing these covers to each other and the chassis.

DRIVER MODULE REPLACEMENT (U201)

NOTE

Always check out the associated circuitry carefully before replacing the module. The module is a very reliable device and normally will not need to be replaced.

To remove the module:

1. Remove two screws securing U201 to printed wire board.
2. Using a desoldering tool, unsolder the ground strap across the end of U201 and located next to Q201. Leave A201 in place.
3. Unsolder the five leads bridging U201 to the PWB while lifting each lead. NOTE: These leads are soft and can be bent very easily.
4. Lift U201 on the Q201 (PA transistor) side and slip out from under A201. Be careful not to lose the spacer under U201. It may also stick to the chasssis. Clean all old silicone grease from chassis and spacer.
5. To install U201, apply silicone grease to both mounting surfaces of the spacer.
6. Position spacer properly on the chassis.
7. Position U201 properly by slipping the end under A201 and aligning the screw holes and the leads of U201 with the PWB.
8. Replace ground strap across the end of U201.
9. Replace the two screws securing U201 to the PWB and tighten to 0.5 $\pm$0.1 Newton meter (5 inch pounds).
10. Solder ground strap and the five leads of U201.
11. Apply a small amount of silicone seal (or an acceptable substitute) between the case of U201 and the ground strap. This prevents the leads of U201 bending if the PWB is removed from the chassis.

WARNING

The module contains Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, exercise caution since the dust may be hazardous if inhaled. Use care when replacing the module.

PA TRANSISTOR REPLACEMENT

1. Remove two retaining screws securing PA transistor to chassis assembly.
2. Unsolder and remove capacitors C208 then C211. Use a desoldering tool as necessary while lifting up using a small screwdriver or pick. Discard old capacitors.
3. Unsolder emitter, base and collector leads of transistor and remove.
4. Remove all excess solder from board and clean the holes to allow the new transistor to be positioned properly and the capacitors to snap into proper locations. Refer to Figure 8 and trim leads of Q201 as shown.
5. Apply silicon grease to back of transistor.
6. Place transistor in slot.
7. Torque transistor mounting screws to .5 n/m.
8. Tack solder the 4 base wings to the PWB. Use minimum solder.
9. Install C209, C208, C210, C211 into their proper mounting holes flush to the board.
10. Solder the cap bodies to the PWB by first soldering the outside edge, then holding the iron to the outside edge, touch the solder to the inside edge of the capacitor.

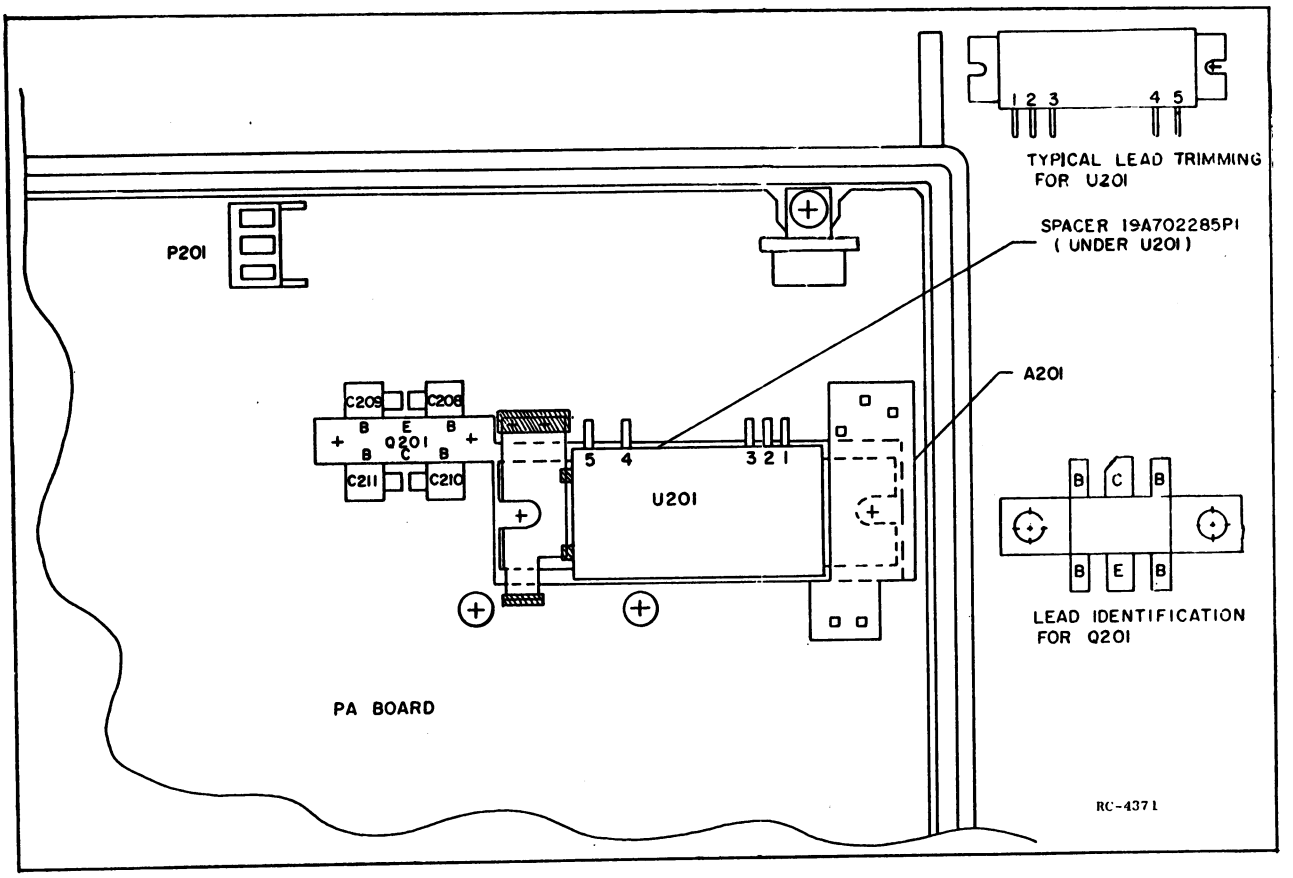


Figure 8 - Lead Forming and Identification

11. Solder the emitter and collector connections and capacitor tabs.

12. Remove any flux left on board.

NOTE

Take care in all soldering not to create solder bridges on the front and rear of caps.

REMOVING IC's

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

TEST AND TROUBLESHOOTING PROCEDURES

Maintenance of your GE-MARC V radio is facilitated by use of the Troubleshooting Flow Charts and servicing techniques unique to this radio. The Troubleshooting Chart is designed to lead you rapidly to the defective component or circuit. Typical voltage readings are provided on the Schematic Diagram where applicable.

Troubleshooting charts are provided for most major problems that might arise in the radio. Refer to the Table of Contents for information when servicing the transmitter or receiver.

SERVICING TECHNIQUES

The high density plug-in design of the modular radio lends itself well to rapid isolation of malfunctions in the voltage and signal paths. Due to the modular construction of the radio, i.e., transmit/receive board, synthesizer/interconnect board, logic board, etc., a majority of the signals and voltages pass through the connectors on the synthesizer/interconnect board.

To isolate a signal or voltage path to determine loading effects, locate short circuits, etc., carefully insert an insulator (plastic wand, toothpick) between the appropriate pins of the related molex connector or to create and

open circuit. Signal paths that may be isolated include: CAS, MIC HI, VOLUME SQ HI, filtered VOLUME SQUELCH HI, PTT, Rx MUTE, and SPKR HI. Voltage paths may also be opened.

A test probe kit is available to aid in servicing the radio. The kit includes an RF signal probe, Rx RF detector probe, DC probe, various tuning tools and test cables used in conjunction with the Microprocessor Control Set TL5B. (The test set is equipped with a cable and plugs into radio Test Jack J2506).

CHANNEL PLANS AND FREQUENCIES

GE-MARC V radios may operate on one of there channel plans, USA-1, US1-3 or AUSTRALIA and use one of two high IF frequencies. The IF Frequency depends on which synthesizer/interconnect board is used. Tables 1 and 2 below identify the channel plan, and associated RF and crystal frequencies associated with the different groups of synthesizer/ interconnect boards.

FREQUENCY PLAN	TRANSMIT FREQ (MHz)	RECEIVE FREQ (MHz)	IF FREQ (MHz)	SYNTH/ INT. BD.	ICOM FREQ (MHz) U2603	ICOM PART NUMBER
USA-1	816.0125-820.9875	861.0125-865.9875	45.0000	19D900241G2	61.067708	19A701712G2
USA-1	816.0125-820.9875	861.0125-865.9875	45.0125	19D900241G4	61.067708	19A701712G9
AUST	820.0125-824.9875	865.0125 824.9875	45.0125	19D900241G6	61.40104	19A701712G10
USA-2	811.0125-815.9875	856.0125 860.9875	45.0125	19D900241G8	60.642708	19A701712G11
USA-1 (ZT*)	816.0125-720.9875	861.0125 865.9875	45.0125	19D900241G10	61.063542	19A701712G12

* OPTION - Alternate RF Channel Frequencies for USA-1 Channel Plan

TABLE 1 - FREQUENCY PLAN VERSUS SYNTHESIZER/INTERCONNECT BOARD

RADIO	STANDARD	WITH OPTION ZT
29 Channel CLASSIC	19A701922G1	19A701922G2
100 Channel CLASSIC	19A702785G1	19A702785G2

TABLE 2 - RF FREQUENCY PROM IDENTIFICATION

TEST POINTS

Test points are provided to aid in troubleshooting the radio and to facilitate alignment of the transmitter and receiver. The test points are located on the synthesizer/interconnect board and the transmitter/receiver board and are identified in the table below.

TEST POINT	LOCATION	FUNCTION	TYPICAL READING
TP2601	Synth/int.	Synthesizer Control	4.10 - 6.0 Volts
TP2602	Synth/int.	Tx FREQ Monitor	41.6 MHz (Freq 30 on test set)
TP2603	Synth/int.	Tx AMPL Tuning	0.7 Volts
TP2604	Synth/int.	Tx Tripler Tuning	0.5 Volts
TP101	Tx/Rx	Tx Doubler Tuning	5.6 Volts
TP103	Tx/Rx	Exciter Tuning	1.6 Volts
TP401	Tx/Rx	1st MIXER	0.16 VRMS (No Signal Input)
TP501	Tx/Rx	2nd IF	2.7 VDC (No Signal Input)
TP2401	Logic Bd.	ALE	238.636 kHz asymmetrical clock (crystal frequency 15)
TP2402	Logic Bd.	Vol/Sq. Hi	Approximately 4.25 VDC
TP2403	Logic Bd.	Voice Rej. Fil out	Approximately 4.25 VDC, 1000 Hz - 35 dB below level at TP2402. 3051/2918 Hz - ±3 dB with reference to level at TP2402.
TP2404	Logic Bd.	Tone Rej. Filter	Approximately 4.25 VDC, 1000 Hz - +3, -1 dB referenced to level at TP2402 3051/2918 - 30 dB below level at TP2402
TP2405	Logic Bd.	Vol/Sq. Hi	Approximately 4.25 VDC. Audio signals dependent on mode of operation.
TP2406	Logic Bd.	Tone Hi	
TP2407	Logic Bd.	Tone Det.	Digital Signal - Detected = 0.6 VDC Non Detected = 5.0 VDC

	Collector	Base	Emitter	Gate 1	Gate 2	Source	Drain
Q401	3.2 VDC	0.8	GRD				
Q402	-----	---	---	GRD	3.3	0.7	7.3
Q501	-----	---	---	GRD	4.2	0.9	8.4

IC U501	
U501-1,14	7.4 VDC
U501-2,13	7.1 VDC
U501-3	3.9 VDC
U501-4	3.2 VDC
U501-6,9	4.1 VDC
U501-7	6.1 VDC
U501-8	7.7 VDC
U501-5,10	GRD
U501-11	2.2 VDC
U501-12	1.4 VDC

RECEIVER DC BIAS VOLTAGES

CAUTION

Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed:	20 Volts
Transmitter keyed (50 ohm resistive load):	18 Volts
Transmitter keyed (no load or non-resistive load):	15.5 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages 13.6 VDC for loads of 6 to 16 amperes: Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulations and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering may be usable when operated in parallel with a 12 Volt automotive storage battery.

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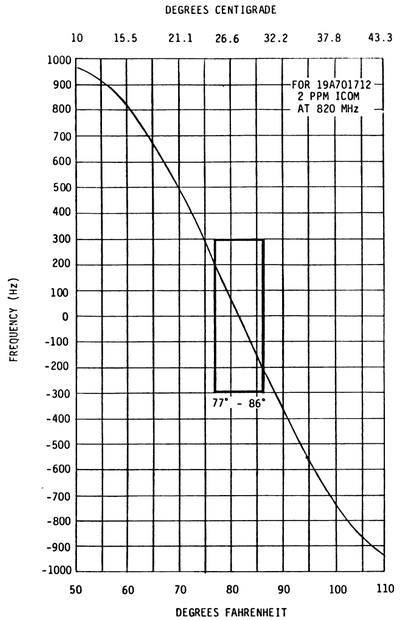


ICOM FREQUENCY CORRECTION CURVE FOR 820 MHz

RC-4455

Synthesizer/Int. Bd.	Reference Osc. Freq (C2607)	ICOM Transmit Frequency (L2-U2603)	Receiver Offset Freq (R2663)
19D900241G1-4	41.6 MHz	816.0125 MHz	816.000 MHz
19D900241G5, 6	41.6 MHz	820.0125 MHz	820.000 MHz
19D900241G7, 8	41.65 MHz	811.0125 MHz	811.000 MHz
19D900241G9, 10	41.625 MHz	816.0125 Mhz	816.000 MHz

TABLE 3 - FREQUENCY IDENTIFICATION

TRANSMITTER ALIGNMENT

TEST EQUIPMENT

1. 50 ohm Wattmeter
2. DC Probe (19C330165G1)
3. Voltmeter
4. Power supply (13.8 V Regulated)
5. Audio Signal Generator
6. Frequency Counter
7. RF Signal Probe (19C330129G1)
8. FM Communications Monitor
9. Microprocessor Control Test Set TL5B
10. Thruline Wattmeter

PRELIMINARY CHECKS AND ADJUSTMENT

NOTE

Refer to photographs to locate CONTROLS, TEST POINTS and FM ICOM..

1. Make sure that FM ICOM U2603 is installed.
2. Connect thruline wattmeter and 50 ohm load to antenna jack.
3. Pre-set the following controls:
   a. Set slug in L2602 on the synthesizer/interconnect board to center of coil form.
   b. Set slug of L2611 so top of slug is flush with the top of the coil form.
   c. Set C2675 to minimum capacitance.
   d. Set L2615 and L2616 so that the slugs are tuned out of the casting.
   e. Set slugs of L101, L102 and L103 1 1/4 turns down from top of helical casting and then set 1 1/4 turns down.
   f. Set slugs of L107, L108 and L109 out of casting.
   g. Set C125, C127, C133 and C134 to minimum capacitance (plates unmeshed).
   h. Install the RF signal probe on TP2602 and connect it to the frequency counter.
4. Set power adjust control R203 to minimum (fully counterclockwise).
5. Plug the microprocessor control Test Set TL5B into the radio synthesizer/interconnect board test jack. Set the controls to frequency 30 and tone 00 in the tone select mode.

NOTE

All adjustments are made with the transmitter unkeyed unless directed to key the transmitter.

ALIGNMENT PROCEDURE

STEP	TEST POINT	TUNING CONTROL	INDICATION	PROCEDURE
				NOTE: The following controls and test points are located on the synthesizer/interconnect board.
1.				Apply +13.8 Volts to J910-1 and 11. Connect A- to J910-6.
2.	TP2602	C2607	REF OSC. Freq.	Adjust C2607 to obtain REF OSC. Frequency ±10 Hz (Table 3) on the counter. When complete remove the signal probe.
3.	TP2601	L2602	4.1 VDC	Adjust L2602 to obtain 4.10 ±0.1 volts on TP2601.
4.	TP2603	L3 (U2603)	Peak	Tune L3 (Level) of U2603 for a peak voltage reading on TP2603.
5.	TP2604	L2611	Peak	Tune L2611 for a peak voltage reading on TP2604.
6.	TP2604	C2675	Dip	Tune C2675 for a dip in voltage reading on TP2604. The dip will be sharp and of small deviation.
7.	TP2604	L2615	Peak	Tune L2615 for peak in voltage at TP2604. The peak will be sharp and of small deviation.
8.	TP2604	L2616	Dip	Tune L2616 for a dip in voltage at TP2604. The dip will be sharp and of small deviation.
				NOTE: The following controls and test points are located on the transmit/receive board.

ALIGNMENT PROCEDURE (Con't)

STEP	TEST POINT	TUNING CONTROL	INDICATION	PROCEDURE
9.	TP101	L101, L102, L103	Dip	Select Channel 31 and tone 00. Alternately tune L101 then L102 and L103 for a dip in meter reading.
10.	TP101	L101, L102 L103	Dip	Carefully re-tune L101, L102, and L103 for a maximum dip in meter reading.
11.	TP101	L107	Dip	Tune L107 for a small but sharp dip in meter reading.
12.	TP101	L108	Peak	Tune L108 for a small but sharp peak in meter reading.
13.	TP101	L109	Dip	Tune L109 for a small dip in meter reading. Do NOT retune L107, L108 or L109.
14.	TP103	C125, C127 C133 and C134	Maximum	Key the transmitter and tune C125, C127, C133 and C134 for maximum meter reading. Unkey the transmitter between adjustments to avoid overheating.
15.	TP103	C125, C127 C133 and C134	Maximum	Key the transmitter and slightly retune C125, C127, C133 and C134 for maximum meter reading. Unkey the transmitter between adjustments to avoid overheating.
		POWER AMPLIFIER		
16.	Wattmeter at ANT jack J601	R212, R203 POWER CONTROL	See Procedure	Key the transmitter and adjust for rated power output. NOTE: R212 is factory preset and normally does not require field adjustment. Should it be necessary to adjust R212, disconnect the 50 ohm load from the thruline wattmeter and replace with a shorted connector. (If a shorted connector is not available, the output connector may be shorted inside the radio using a wideblade brass screwdriver). Key the transmitter and set R212 for 10 watts forward power. Supply current should not exceed 5 amperes. Reconnect watt meter.
		FINAL SYNTHESIZER		
17.	Antenna-jack	L2 (U2603)	Correct Frequency	Select Channel 30 and tone 00. Key the transmitter and tune L2 (Freq) of the ICOM to correct transmit frequency shown in Table 3. See Figure 9 for ICOM Frequency Correction curve at 820 MHz.
18.	TP2603	L3 (U2603)	Peak	Retune L3 (level) of the ICOM for a peak voltage reading at TP2603 and again check the frequency.
		RX OFFSET FREQUENCY		
19.	TP401	R2663	Correct Frequency	Unkey the transmitter and monitor TP401 on the Tx/Rx board. Adjust R2663 on the Synthesizer/ Interconnect board for the correct RF offset frequency shown in Table 3.
20.	Antenna	R2636	3.5 kHz	Apply a 1 volt RMS signal at 1 kHz to J911-4. Key the transmitter and adjust R2636 for 3.5 kHz ±0.1 kHz deviation at the transmitter output.

FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 27.0°C (80.6°F). Refer to Steps 17 thru 19 of the Transmitter Alignment Procedure.

NOTE

The frequency should be set when the transmitter is first keyed. If delayed until the heatsink has caused the temperature of the frequency element to rise above the ambient temperature, the frequency setting will be in error unless consideration is given to the temperature of the frequency element. See Figure 9.

TEST EQUIPMENT

1. 50 ohm load
2. Microprocessor control set TL5B
3. Frequency counter

To set the frequency:

1. Connect wattmeter and frequency counter to antenna jack.
2. Install the RF signal probe on TP2602 and connect it to a counter.
3. Adjust C2607 to obtain REF OSC frequency specified in Table 3. When complete remove the signal probe.
4. Adjust L2602 to obtain 4.10 ±0.1 volts on TP2601.
5. Tune L3 of U2603 for a peak voltage reading on TP2603.
6. Key the transmitter and tune 12 (FREQ) of U2603 ICOM frequency specified in Table 3.
7. Retune L3 (LEVEL) of U2603 for a peak voltage reading at TP2603 and again check the frequency.

MODULATION LEVEL ADJUSTMENT

TEST EQUIPMENT

1. Audio Oscillator
2. Deviation Monitor
3. Microprocessor Control Set TL5B

PROCEDURE

1. Plug microprocessor control set into test jack on synthesizer/interconnect board and set controls for frequency 30 and tone select to 00.
2. Connect the audio oscillator and the AC voltmeter across audio input terminals J911-4 (Hi) and J911-3 (Lo) on the synthesizer/interconnect board.
3. Adjust the audio oscillator for a 1 Volt RMS at 1000 Hz.
4. Connect 50 ohm load to antenna jack.

AUDIO DEVIATION ADJUSTMENT

NOTE

MOD ADJUST CONTROL R2636 has been adjusted to the proper setting before shipment and normally does not require readjustment. This setting permits approximately 75% modulation for the average voice level.

Using the test set, set the tone select to tone "0" for zero tone deviation. Key transmitter and set MOD ADJUST control R2636 for 3.5 kHz deviation using the deviation polarity that provides the highest reading on the deviation monitor.

TONE DEVIATION ADJUSTMENT

1. On microprocessor control set select tone "9" for busy tone.
2. Key the transmitter and adjust DEV control R2471 on the logic board for 1.0 kHz ±0.1 kHz deviation.
3. Reset the select to 00 (no tone) and step through each tone present in the radio checking deviation for 2.5 kHz to 5.0 kHz. (Deviation for Tone 9 will be as set in Step 2.)

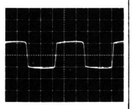
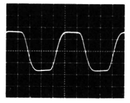
AUDIO CHECKS

TEST EQUIPMENT

- Audio Oscillator
- Oscilloscope
- Microprocessor Control Test Set TL5B
- AC Voltmeter
- Deviation Monitor

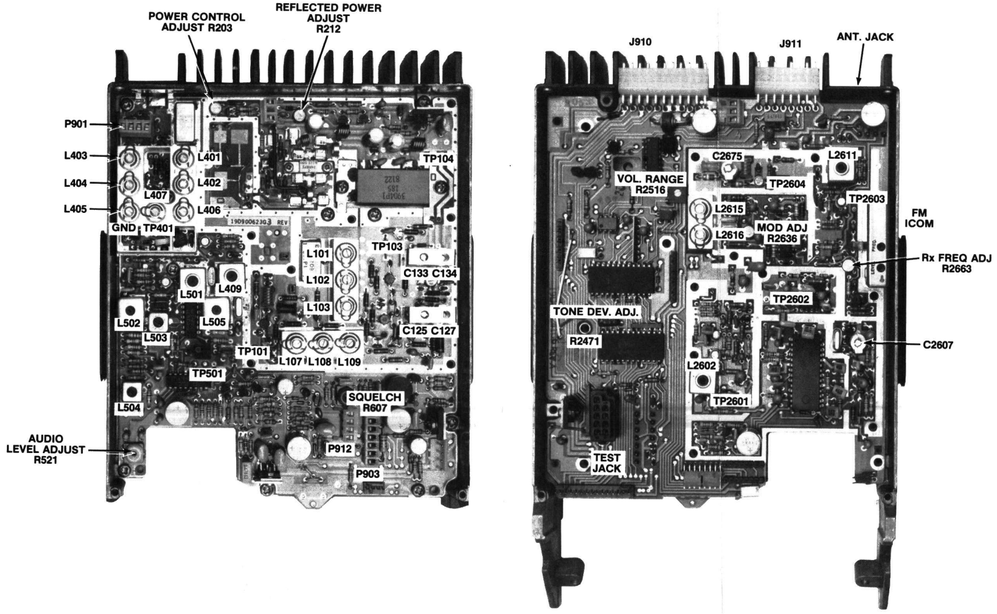
AUDIO AC VOLTAGES

1. Connect audio oscillator output across J911-4 (MIC HI) and J911-3 (MIC LO).
2. Connect TL5B to test jack. Select channel 30 and tone 00.

		U2604-7	C2656 (+)
SCOPE SETTING	HORIZONTAL	200 U SEC/DIV	200 U SEC/DIV
	VERTICAL	2 VOLTS/DIV	2 VOLTS/DIV
SET AUDIO OSCILLATOR AT 1000 Hz WITH OUTPUT OF 1.0 VRMS. R2636 ADJUSTED FOR 3.5 kHz DEVIATION. NOTE: AN RMS OR PEAK READING VOLTMETER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS			

AUDIO SENSITIVITY

1. Connect audio oscillator output across J911-4 (MIC HI) and J911-3 (MIC LO). Adjust output for 1000 Hz at 1.0 VRMS.
2. Reduce generator output until deviation falls to 2.25 kHz. Voltage should be less than 120 millivolts.



RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. RF Signal Generator (45.0125 MHz and 851-870 MHz)
2. Analog DC Voltmeter (with high input impedance and millivolt scale)
3. Frequency counter (up to 1000 MHz with 0.05 Volt sensitivity)
4. Receiver RF Detector Probe 19C330130G1
5. RF Signal Probe 19C330129G1
6. Microprocessor Control Set Test TL5B
7. AC Voltmeter

PRELIMINARY ADJUSTMENTS

1. Connect RF Detector Probe from TP501 to the DC Voltmeter.
2. Connect RF Signal Probe from TP401 to the RF Signal Generator.
3. Preset the slugs in L409, L412, L501, L502 and L505 eight complete turns up from the top of the coil.
4. Preset the slugs in front end coils L401 through L408 flush with the top rim of the casting. Set the Signal Generator for 45.0125 MHz output with ±3 kHz deviation and 1 kHz modulation.
5. Set Microprocessor Control Set to frequency 31 and tone 00.

> **NOTE**
>
> Keep the Signal Generator adjusted so that the DC voltage reading will remain between 0.5 to 1.0 volt during the alignment procedure.

ALIGNMENT PROCEDURE

STEP	TEST POINT	TUNING CONTROL	METER READING	PROCEDURE
		NOTE: MAKE SURE THAT THE TRANSMITTER IS PROPERLY ALIGNED AND BEFORE ALIGNING THE RECEIVER.		
1.	TP501	L412	Maximum	Tune L412 for maximum meter reading.
2.	TP501	L409, L501	Maximum	Alternately tune L409 and L501 for maximum meter reading.
3.	TP501	L502, L503	Maximum	Alternately tune L502 and L503 for maximum meter reading.
4.	TP501	L505	See Procedure	Remove RF detector probe from TP501. Connect RF signal probe from TP501 and to the frequency counter. Remove the modulation from input signal and set the RF signal level to 1 millivolt. Next, tune L505 for a reading of 455 kHz on the counter, and then remove the RF signal probe from TP501.
5.	TP401	L407, L408	Maximum	Remove the RF signal probe from TP401, and connect the RF detector probe from TP401 to the DC voltmeter. Next, alternately tune L407 and L408 for maximum voltage reading (normally a few hundred millivolts).
6.			See Procedure	Re-connect the RF detector probe to TP501. Apply an 863.5125 MHz, USA-1, 858.5125, USA-2, or 867.5125 MHz, Australia (Channel 31) signal to the antenna jack with 3 kHz deviation and 1 kHz modulation. Keep voltmeter reading between 0.5 and 1 volt DC.
7.	TP501	L401, L402 L403, L404 and L405	Maximum	Alternately tune L403, L404 and L405 for maximum meter reading, then alternately tune L401 and L402 for maximum. Peak L403-L405.
8.	TP501		See Procedure	Remove the RF detector probe from TP501 and connect the RF signal probe from TP501 to the frequency counter. Remove the modulation from the input signal and increase the input level to 1 millivolt. The frequency counter should read 455 kHz. Service Note: If reading is not 455 kHz ±200 Hz, check the transmitter alignment.
9.	TP501	L409, L412 L501, L502 and L503	Maximum	Remove the RF signal probe and reconnect the RF detector probe to TP501. Re-apply 1 kHz modulation to the input signal and retune L409, L412, L501, L502 and L503 for maximum meter reading, keeping meter reading between 0.5 and 1 volt DC.
10.		VOLUME CONTROL (on front (panel)	See Procedure	Disconnect speaker plug P905 and connect a 4 ohm resistor across the audio output jack J905 and connect an RMS voltmeter across the resistor. Set Audio Level control R521 to mid range. Apply a 1 millivolt on-frequency signal with ±3 kHz deviation and 1 kHz modulation to the antenna jack. Adjust VOLUME Control for a meter reading 1 volt RMS.
11.		L504	Maximum	Tune L504 for maximum audio output voltage on RMS voltmeter.
12.	P903-3	Audio Level Control R521	See Procedure	Connect the RMS voltmeter to P903-3 (VOL/SQ HI) and adjust R521 for a meter reading of 300 millivolts RMS. With RMS voltmeter across the 4 ohm resistor, set VOLUME control to level 8 (next highest). Output level should be 3 Watts (3.46 VRMS). Adjust R2516 if necessary to obtain correct reading. Measure audio distortion using Distortion Analyzer. Distortion should be less than 5%. Disconnect all test equipment.

These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad, and 4.0 ohm, 5 Watt resistor
- Test Set TL5B

PRELIMINARY ADJUSTMENTS

NOTE

These procedures are written around the Heathkit Distortion Analyzer. If a Distortion Analyzer other than the Heath IM-12 is used, measure the sensitivity and modulation acceptance bandwidth in accordance with manufacturer's instructions.

Plug in Test Set and Select RF frequency for test. There are three test frequencies programmed in the Frequency PROM.

TEST SET	USA-1/ USA-1, ZT	USA-2	AUSTRALIA
FREQ 30	816.0125 MHz	811.0125 MHz	820.0125 MHz
FREQ 31	818.5125 MHz	813.5125 MHz	822.5125 MHz
FREQ 32	820.9875 MHz	815.9875 MHz	824.9875 MHz

NOTE

The receive frequency is always 45 MHz above the transmit frequency.

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1000 microvolt, on-frequency test signal modulated by 1,000 Hz with ±3.5 kHz deviation to antenna jack J601.

B. With 3 Watt Speaker

Disconnect speaker plug if present.

Connect a 4.0 ohm, 5 Watt load resistor across J910-3 & 7.

Connect the Distortion Analyzer input across the resistor.

C. Set VOLUME control to level 8 (next highest). Output should be 3 watts (3.46 VRMS) using the Distortion Analyzer as a voltmeter. If power output ±5% is not achieved, adjust R2516 on synthesizer/interconnect board for rated output power, 3.45 VRMS.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 3 Watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure).

G. FM Detector Alignment (Refer to Receiver Alignment).

STEP 2

USABLE SENSITIVITY (12 DB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3.5 kHz deviation to J601.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. Set signal generator output to 0.3 V. Switch the RANGE control from SET LEVEL to the distortion range. Readjust Distortion Analyzer SET LEVEL as required until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 1.5 Watts (0.56 Volts RMS across the 4.0 ohm receiver load using the Distortion Analyzer as a Voltmeter).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure.

STEP 3

MODULATION ACCEPTANCE (BANDWIDTH (IF BANDWIDTH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

B. Set the Range control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

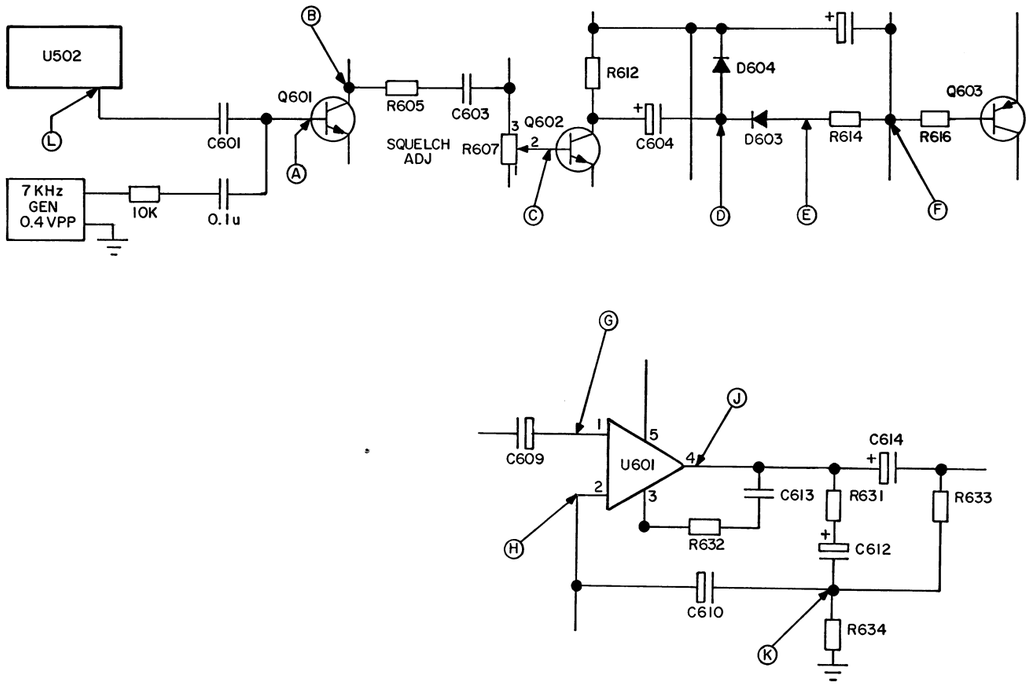
C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±6.5 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, refer to the Receiver Troubleshooting Procedure.

AUDIO AND SQUELCH WAVEFORMS



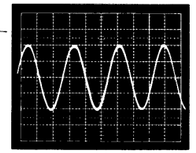
RC-4198

SQUELCH CIRCUIT TEST WITH 7 kHz SIGNAL

PRELIMINARY STEPS

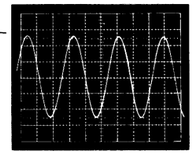
1. Quiet receiver with 1000 uV unmodulated signal.
2. Squelch Adjust R607 to maximum (Rotate control toward rear of radio.)
3. Squelch pushbutton in OUT position.
4. Use 10 megohm probe.

A



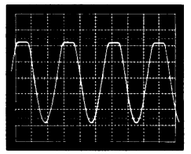
HOR. 50 µSEC/DIV
VERT. 0.1 V/DIV
(0.4 V P-P)

B



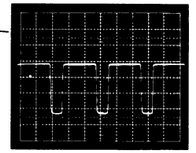
HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(10 V P-P)

C



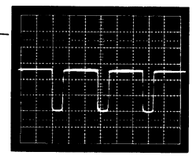
HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5 V P-P)

D



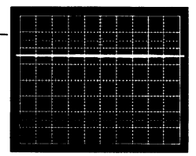
HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(6.2 V P-P)

E



HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(2.5 V P-P)

F



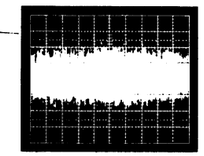
HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5.5 VDC)

SQUELCH CIRCUIT CHECKS WITH NOISE

PRELIMINARY STEPS

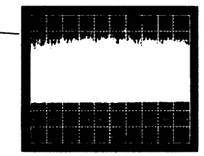
1. No input signal applied.
2. Squelch Adjust R607 to maximum (Rotate toward rear of radio.)
3. Squelch pushbutton in OUT position.
4. Use 10 megohm probe.

A



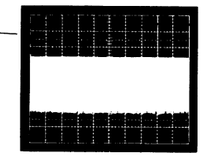
HOR. 1 MS/DIV
VERT. 0.5 V/DIV
(≈ 2 V P-P)

B



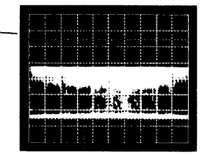
HOR. 1 MS/DIV
VERT. 5 V/DIV
(≈ 20 V P-P)

C



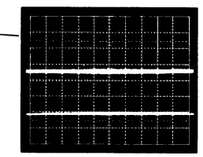
HOR. 1 MS/DIV
VERT. 2 V/DIV
(6.8 V P-P)

D



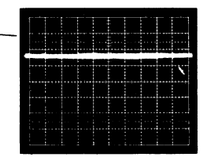
HOR. 1 MS/DIV
VERT. 2 V/DIV
(6.2 V P-P)

E



HOR. 1 MS/DIV
VERT 1 V/DIV
(2.6 V P-P)

F



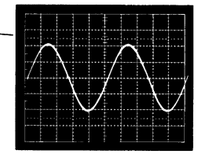
HOR. 1 MS/DIV
VERT. 1 V/DIV
(5.6 VDC)

AUDIO CIRCUIT CHECKS

PRELIMINARY STEPS

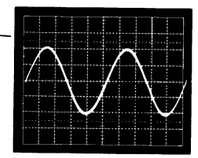
1. Apply 1000 uV on frequency signal with 1000 Hz modulation and 3 kHz deviation to antenna jack J601.
2. Squelch pushbutton "IN".
3. Output set for 3-Watts (3.46 VRMS) into 4-ohm load.
4. Use 1 megohm probe.

G



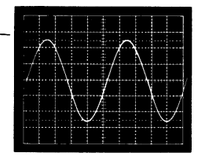
HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(84 MV P-P)

H



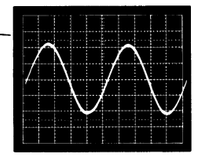
HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(84 MV P-P)

J



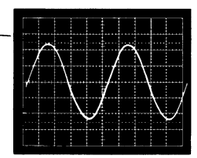
HOR. 0.2 MS/DIV
VERT. 2 V/DIV
(9.8 V P-P)

K



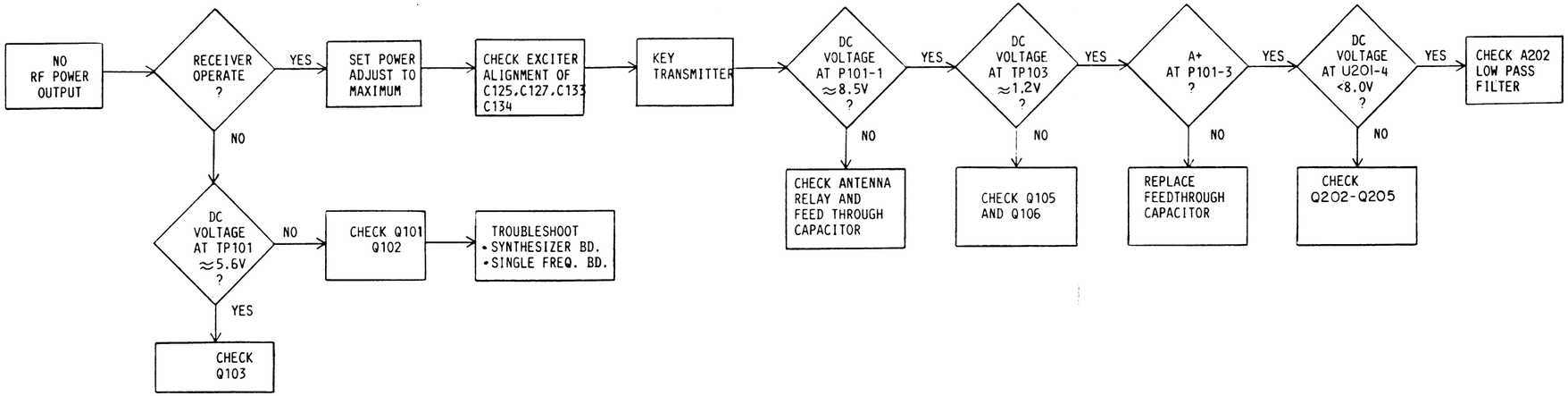
HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(86 MV P-P)

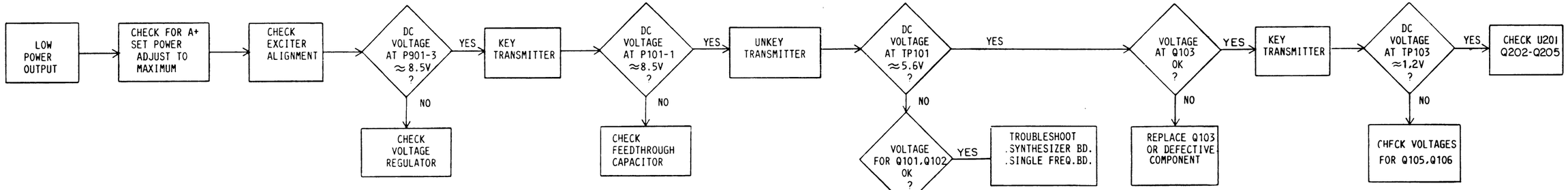
L

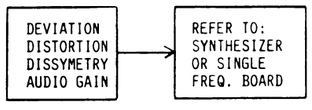


HOR. 0.2 MS/DIV
VERT. 0.2 V/DIV
(0.92 V P-P)

RECEIVER AUDIO AND SQUELCH WAVEFORM CHECKS







TEST PROCEDURE

1. CONNECT AUDIO OSCILLATOR OUTPUT ACROSS J911-4 (MIC HI) AND J911-3 (MIC LO).
2. SET OSCILLATOR FOR 1000 HZ AT 1.0 VRMS AND DEVIATION TO 4.5KHz(CENTURY II 800 MHz RADIOS) OR 3.5KHz FOR GE MARC V RADIOS.

NOTE

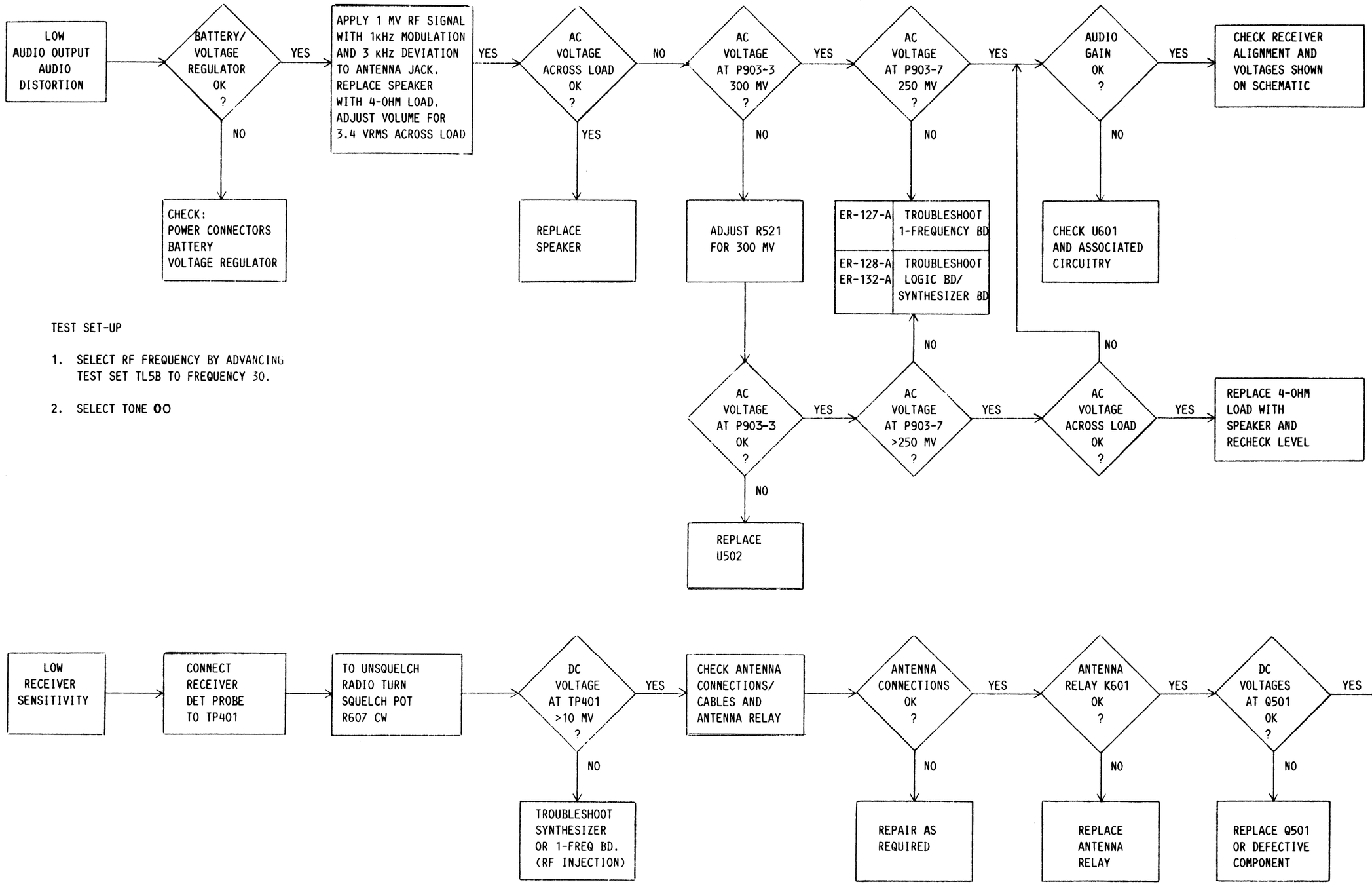
AN RMS OR PEAK READING VOLTOHMETER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READING

3. FOR GE MARC V ADVANCE CONTROL SET TL5B TO POSITION 30 AND TONE TO 00.

RC 4365A

TROUBLESHOOTING PROCEDURE

TRANSMITTER FLOW CHART



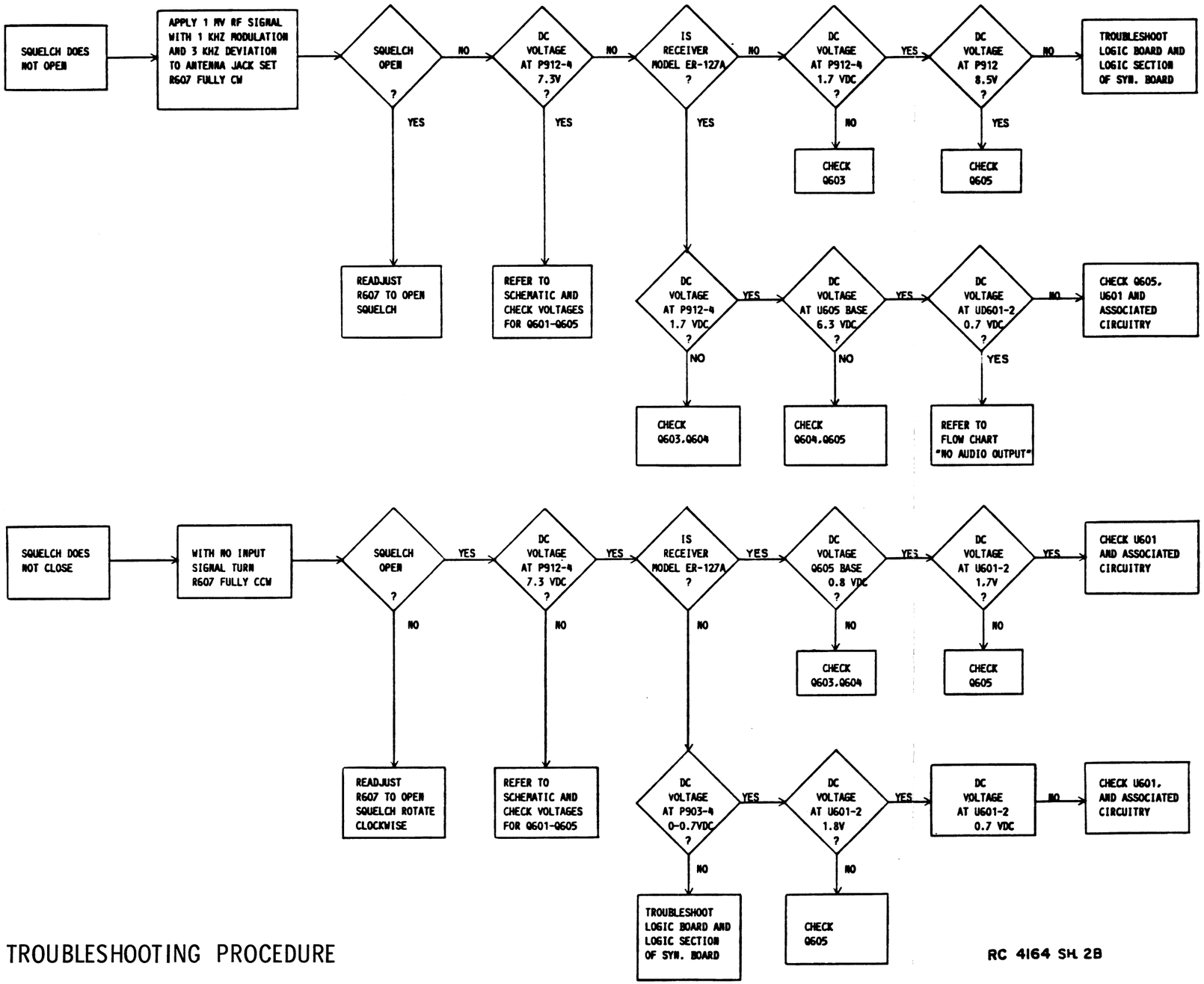
TEST SET-UP

1. SELECT RF FREQUENCY BY ADVANCING TEST SET TL5B TO FREQUENCY 30.
2. SELECT TONE OO

TROUBLESHOOTING PROCEDURE

RC 4164A SH.1

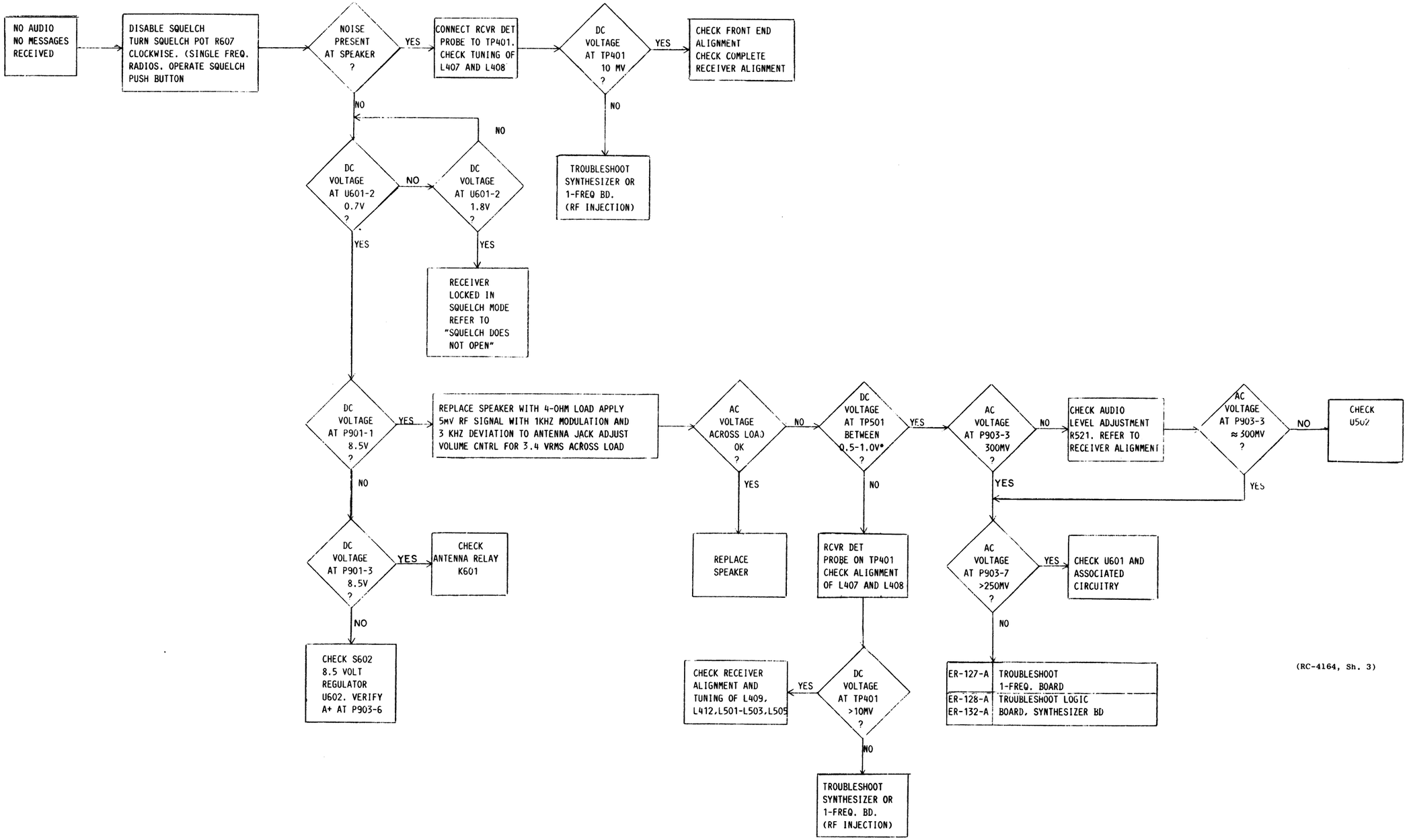
RECEIVER FLOW CHART (RC-4164A Sheet 1)



RC 4164 SH 2B

TROUBLESHOOTING PROCEDURE

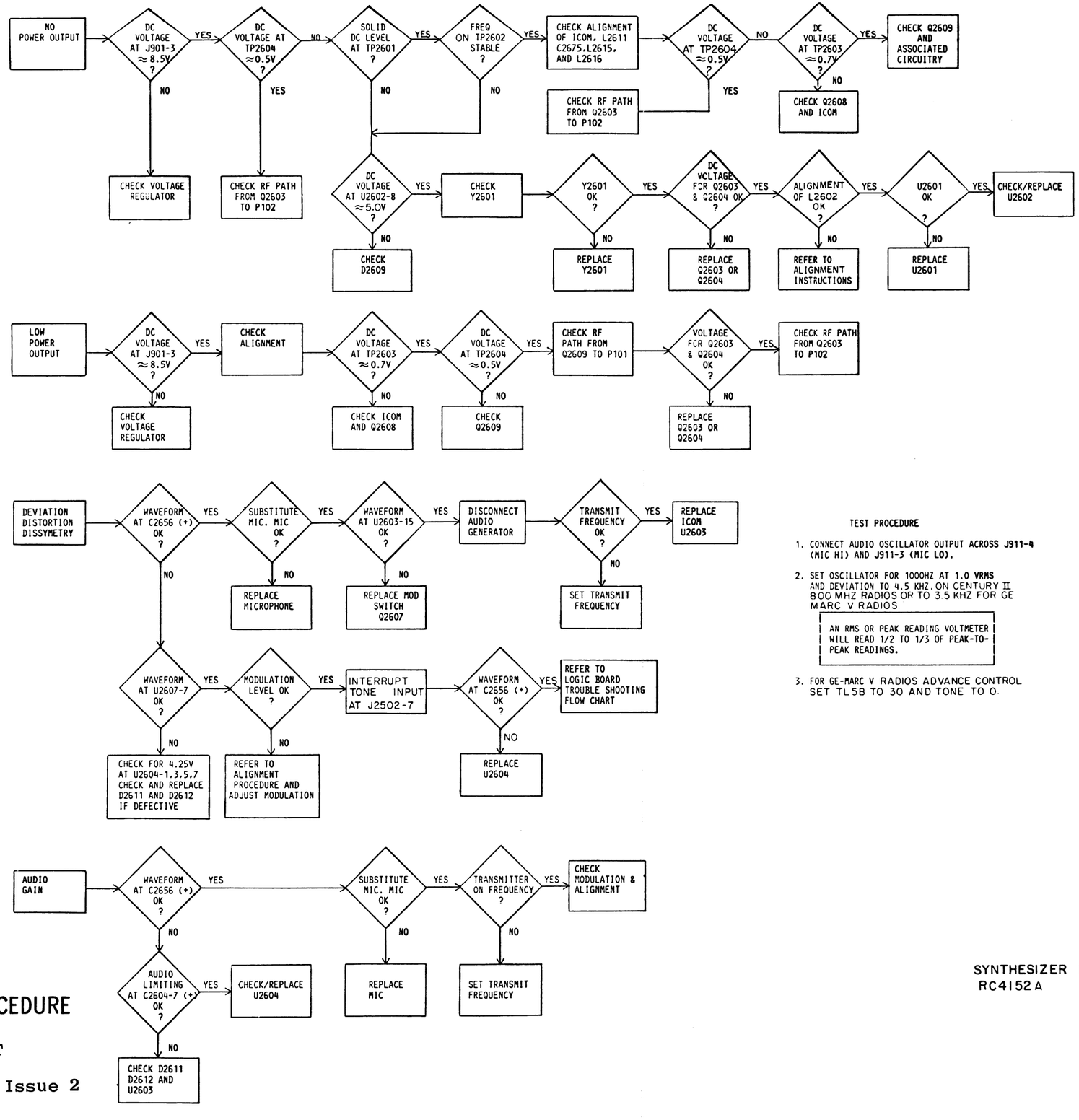
RECEIVER FLOW CHART
(RC-4164, Sheet 2B)



(RC-4164, Sh. 3)

TROUBLESHOOTING PROCEDURE

RECEIVER FLOW CHART (RC-4164, Sheet 3)



TEST PROCEDURE

1. CONNECT AUDIO OSCILLATOR OUTPUT ACROSS J911-4 (MIC HI) AND J911-3 (MIC LO).
2. SET OSCILLATOR FOR 1000HZ AT 1.0 VRMS AND DEVIATION TO 4.5 KHZ. ON CENTURY II 800 MHZ RADIOS OR TO 3.5 KHZ FOR GE MARC V RADIOS

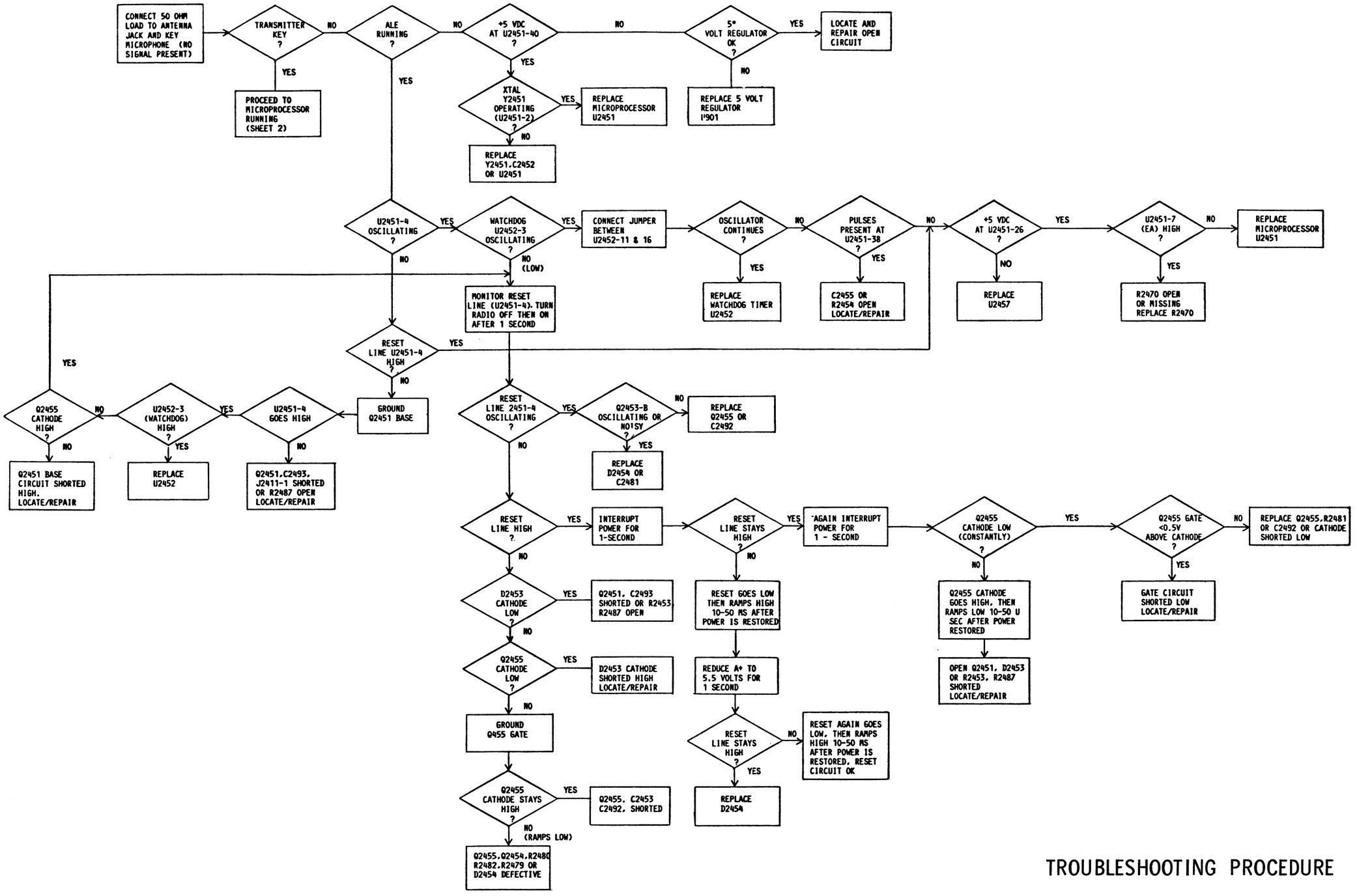
AN RMS OR PEAK READING VOLTMETER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS.

3. FOR GE-MARC V RADIOS ADVANCE CONTROL SET TL5B TO 30 AND TONE TO 0.

SYNTHESIZER BD.
RC4152A

TROUBLESHOOTING PROCEDURE

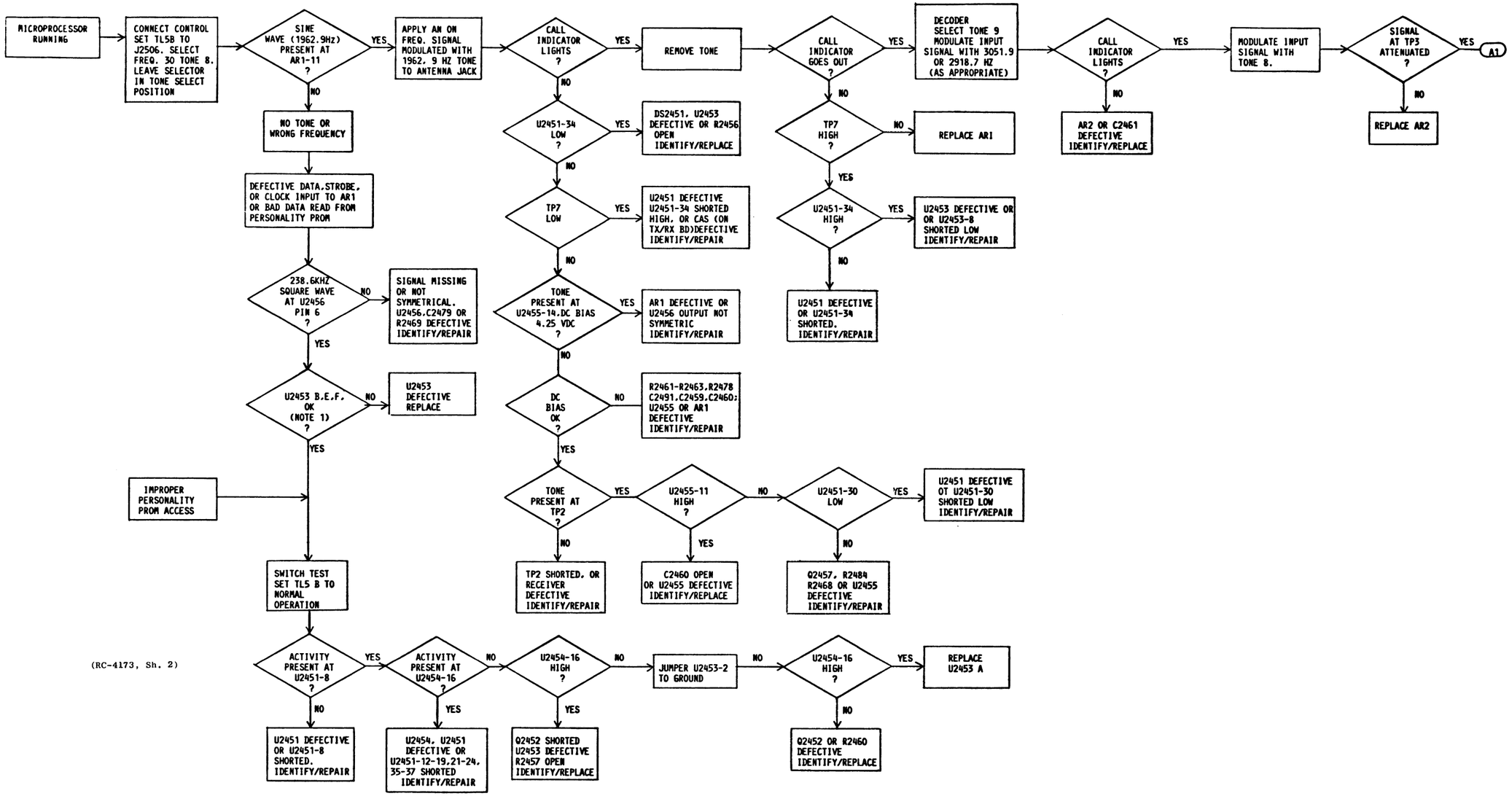
SYNTHESIZER FLOW CHART



(RC-4173, Sh. 1)

TROUBLESHOOTING PROCEDURE

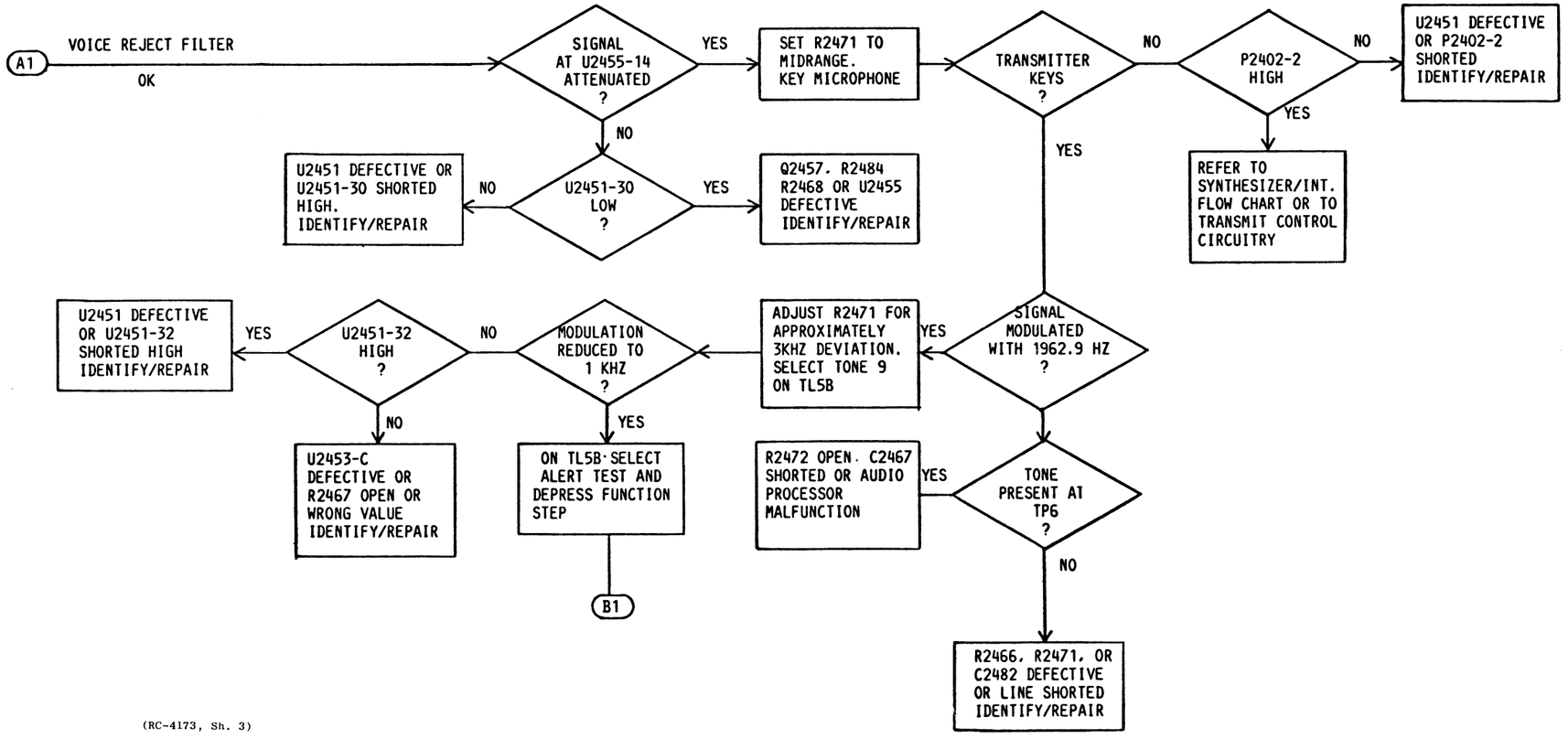
LOGIC FLOW CHART
(RC-4173, Sheet 1)



(RC-4173, Sh. 2)

TROUBLESHOOTING PROCEDURE

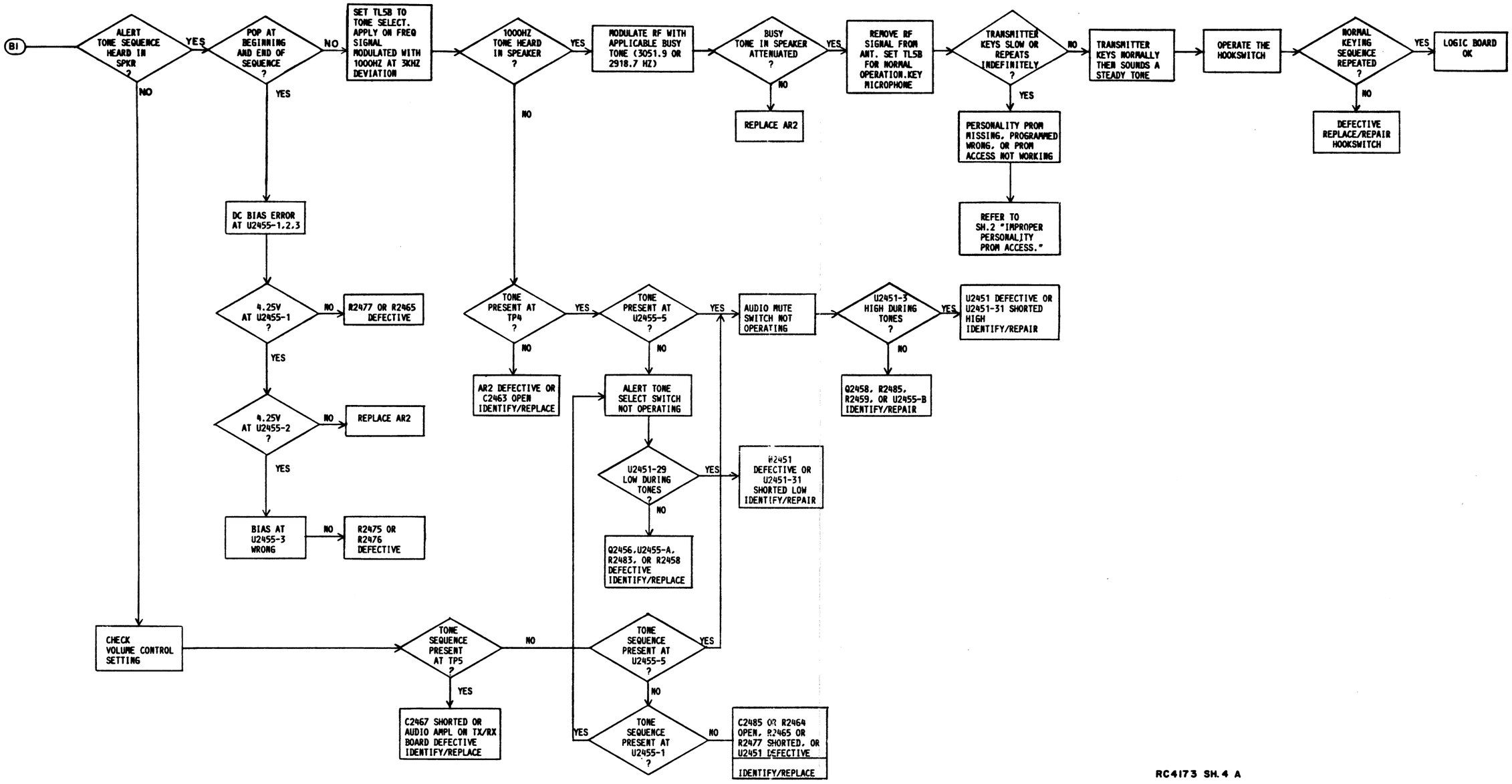
LOGIC FLOW CHART
(RC-4173, Sheet 2)



(RC-4173, Sh. 3)

TROUBLESHOOTING PROCEDURE

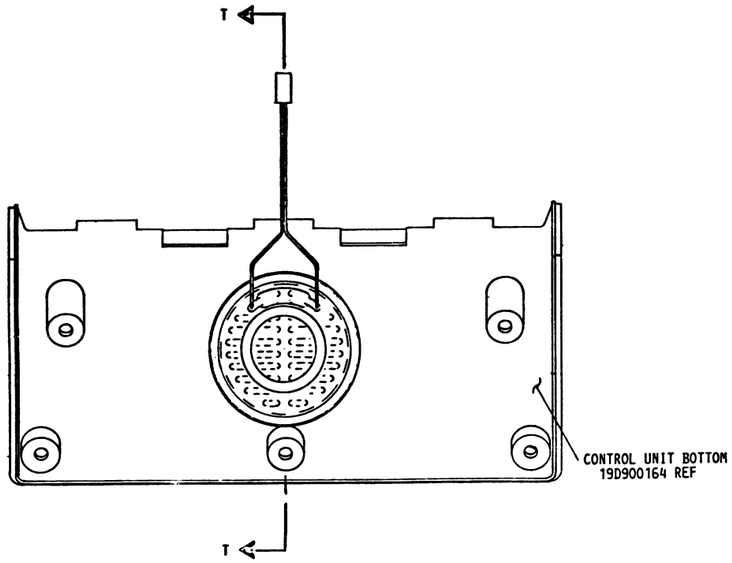
LOGIC FLOW CHART
(RC-4173, Sheet 3)



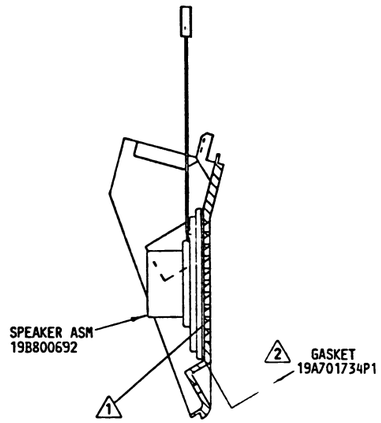
RC4173 SH.4 A

TROUBLESHOOTING PROCEDURE

LOGIC FLOW CHART
(RC-4173, Sheet 4A)



TOP VIEW OF CONTROL UNIT BOTTOM
WITH CONTROL UNIT TOP REMOVED

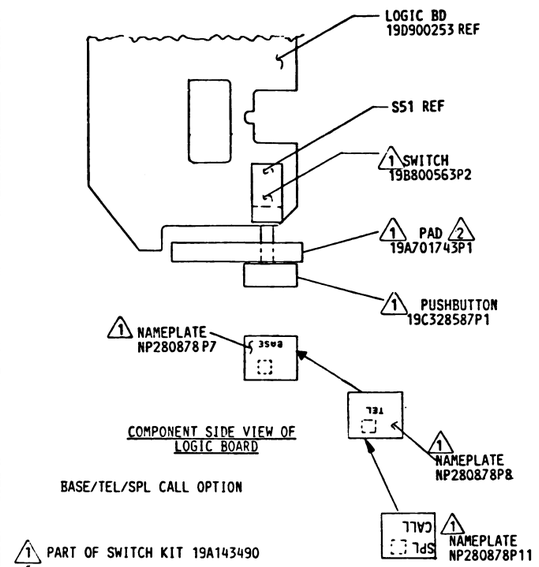


SECTION T-T

INTERNAL SOUNDER

NOTES:

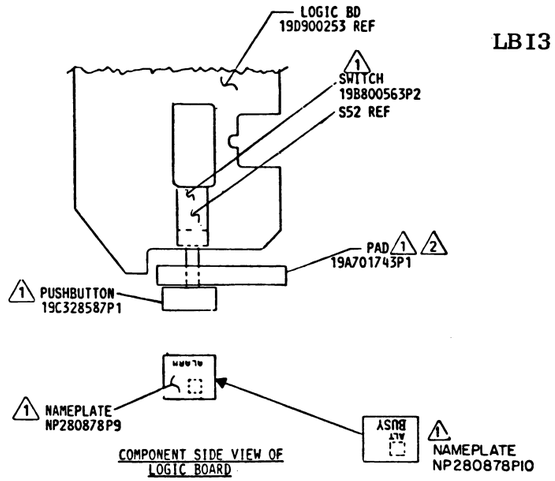
1. GASKET IS TO SET FLUSH ON RECESSED SURFACE OF ITEM 2. OUTSIDE EDGE OF SPEAKER IS TO LIE WITHIN OUTSIDE EDGE OF GASKET.
2. PART OF HARDWARE KIT 19A701522.



COMPONENT SIDE VIEW OF LOGIC BOARD

BASE/TEL/SPL CALL OPTION

1. PART OF SWITCH KIT 19A143490
2. DISCARD ONE PAD IF BOTH P10 & P11 APPL ASM ARE APPLIED

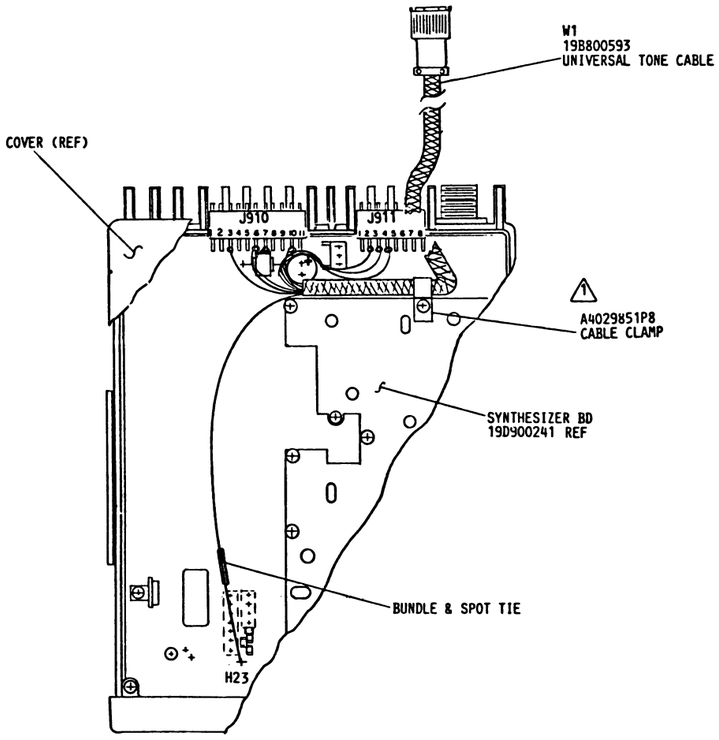


COMPONENT SIDE VIEW OF LOGIC BOARD

EXTERNAL ALARM OR ALTERNATE BUSY TONE OPTION

NOTES:

1. PART OF SWITCH KIT 19A143490
2. DISCARD ONE PAD IF BOTH P10 & P11 APPL ASM ARE APPLIED.



TOP VIEW, LOGIC BOARD REMOVED

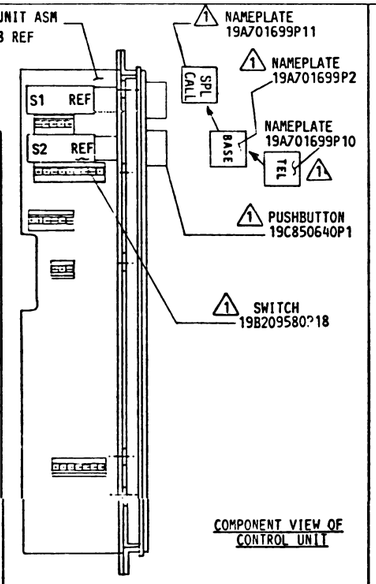
TONE CABLE TO RADIO CONNECTION CHART

FROM	TO	WIRE COLOR	NOTES
W1	J910-3	O	SOLDER
W1	J910-6	W-O	SOLDER
W1	J910-7	BK	SOLDER
W1	J910-10	W-G	SOLDER
W1	J911-2	W-O-R	SOLDER
W1	J911-3	SHIELD	SOLDER
W1	J911-4	W-G(SHIELDED)	SOLDER
W1	H23	W-BR	SOLDER

UNIVERSAL TONE CABLE

NOTES:

1. PART OF CABLE KIT 19B800593.
2. DISCARD RUBBER CHANNEL SUPPLIED IN KIT.

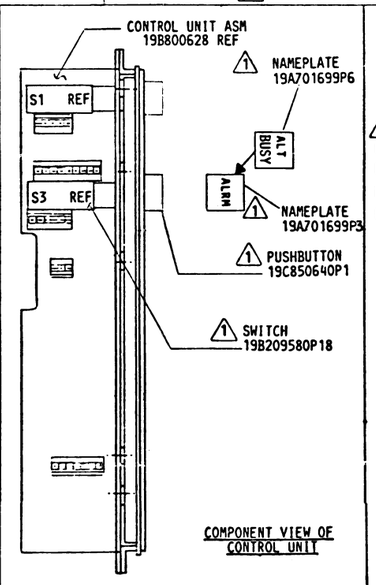


COMPONENT VIEW OF CONTROL UNIT

BASE/TEL/SPL CALL OPTION

NOTES:

1. PART OF SWITCH KIT 19A143490 (FOR FIELD INSTALLATION ONLY)

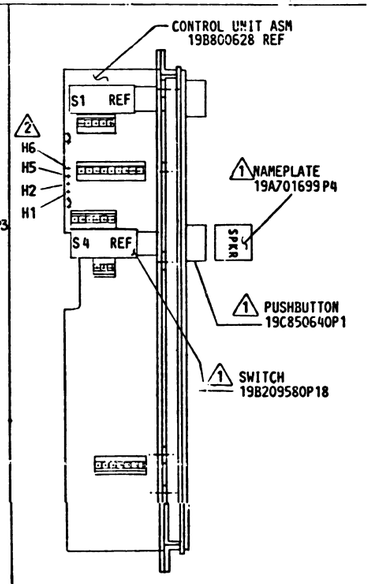


COMPONENT VIEW OF CONTROL UNIT

EXTERNAL ALARM OR ALTERNATE BUSY TONE OPTION

NOTES:

1. PART OF SWITCH KIT 19A143490 (FOR FIELD INSTALLATION ONLY)



EXTERNAL SPEAKER OPTION

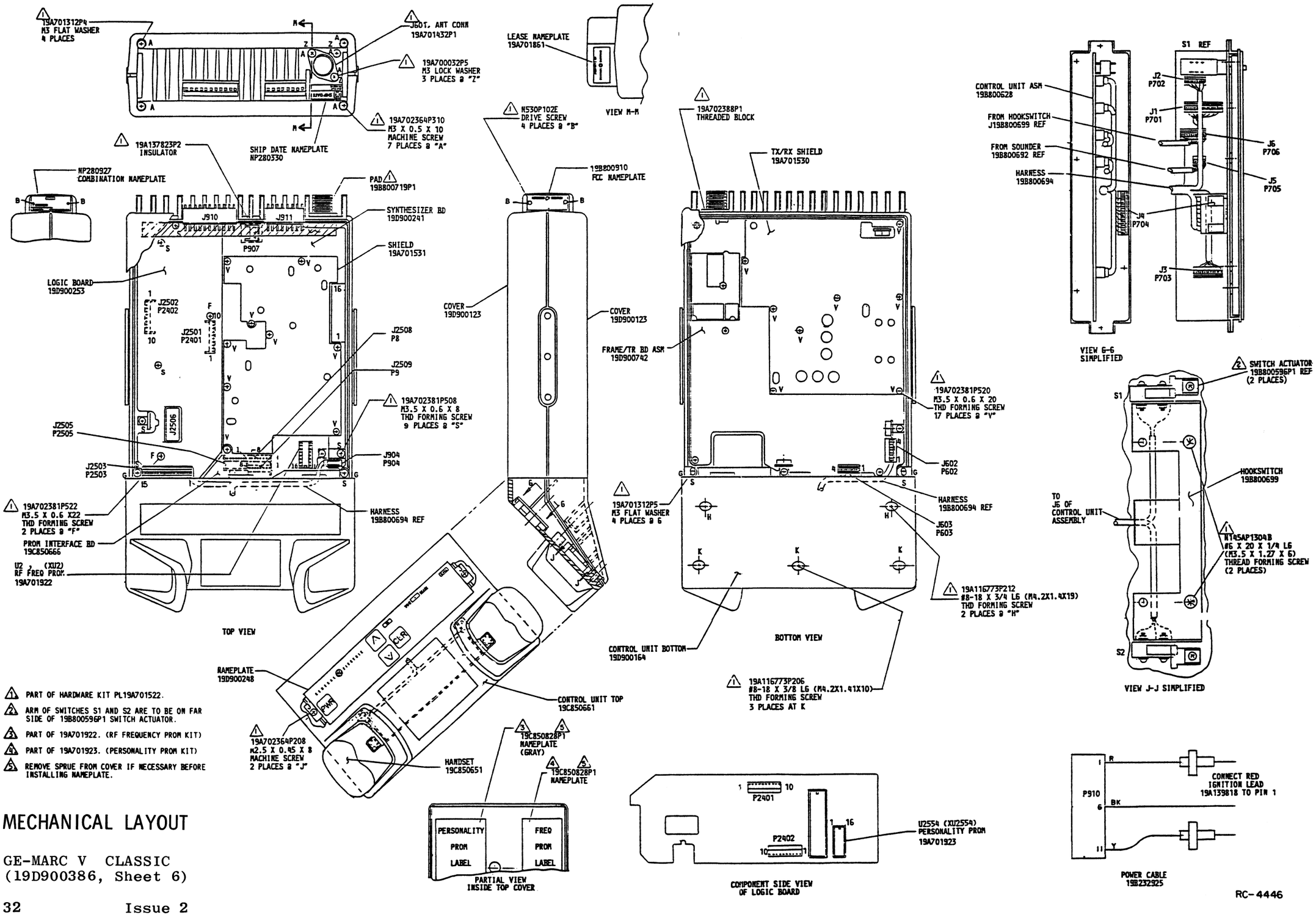
NOTES:

1. PART OF SWITCH KIT 19A143490 (FOR FIELD INSTALLATION ONLY)
2. DELETE JUMPERS H1 TO H2, H5 TO H6.

(19D900386, Sh. 4, Rev. 5)

MECHANICAL LAYOUT

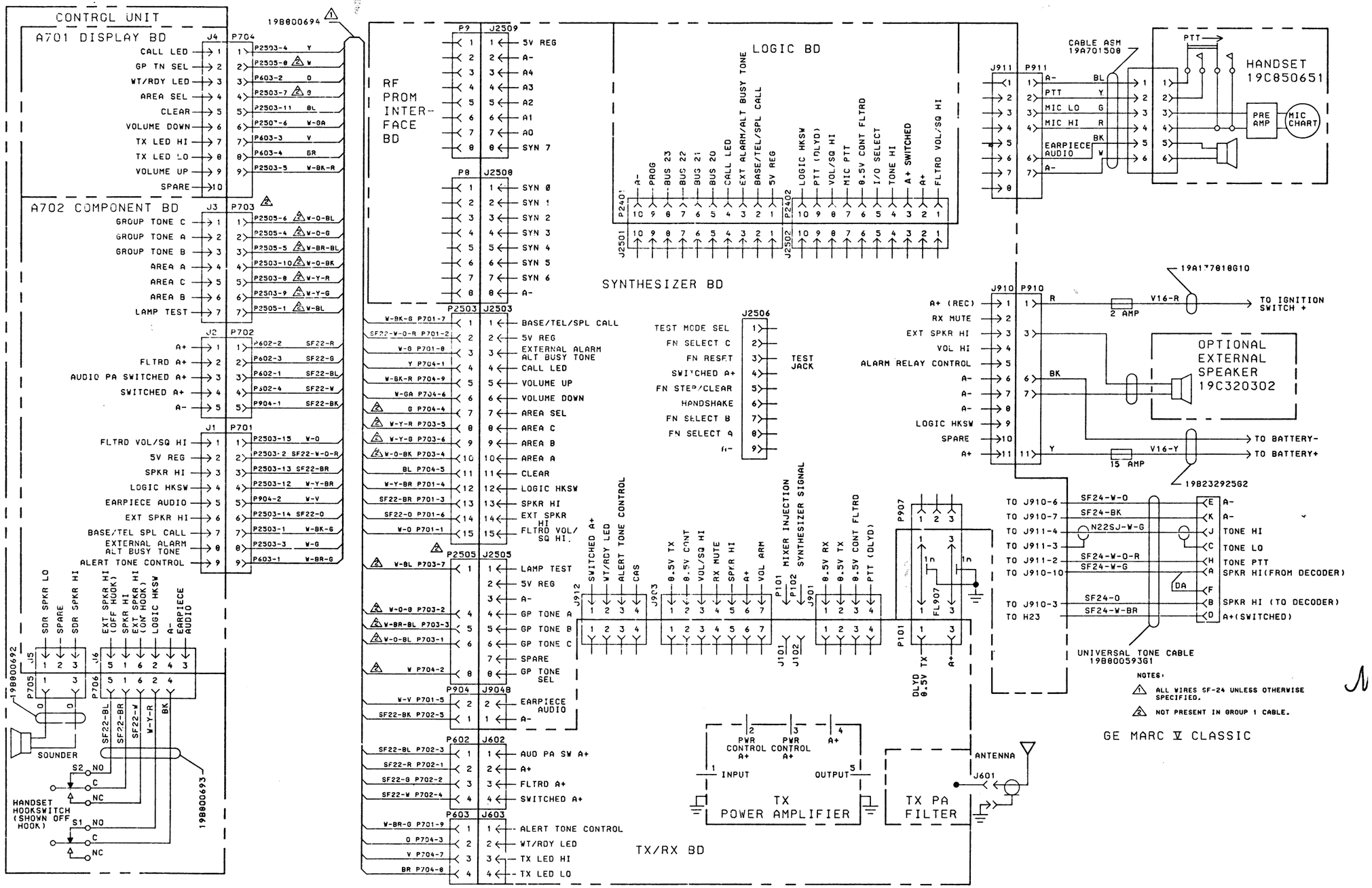
GE-MARC V CLASSIC
(19D900386, Sheet 4)



1. PART OF HARDWARE KIT PL19A701522.
2. ARM OF SWITCHES S1 AND S2 ARE TO BE ON FAR SIDE OF 19B800596P1 SWITCH ACTUATOR.
3. PART OF 19A701922. (RF FREQUENCY PROM KIT)
4. PART OF 19A701923. (PERSONALITY PROM KIT)
5. REMOVE SPRUE FROM COVER IF NECESSARY BEFORE INSTALLING NAMEPLATE.

MECHANICAL LAYOUT

GE-MARC V CLASSIC
(19D900386, Sheet 6)



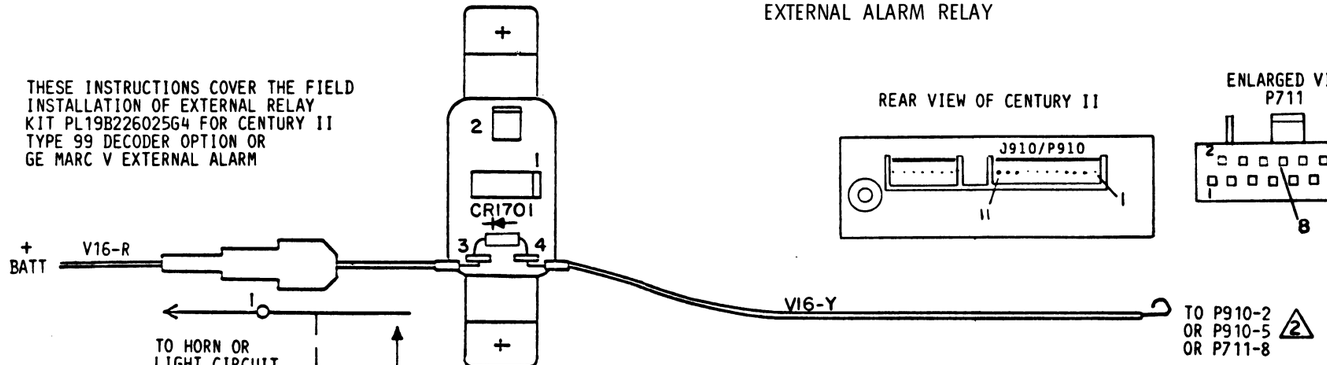
SYSTEM INTERCONNECTION DIAGRAM

(19D900324, Rev. 4)

GE-MARC V CLASSIC

EXTERNAL ALARM RELAY

THESE INSTRUCTIONS COVER THE FIELD INSTALLATION OF EXTERNAL RELAY KIT PL19B226025G4 FOR CENTURY II TYPE 99 DECODER OPTION OR GE MARC V EXTERNAL ALARM



REAR VIEW OF CENTURY II

ENLARGED VIEW P711

INSTRUCTIONS:

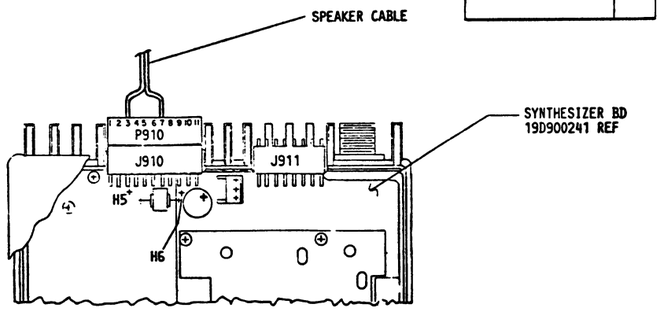
1. FASTEN RELAY IN DESIRED LOCATION USING SELF TAPPING SCREWS:

2. RUN YELLOW LEAD ATTACHED TO LUG 4 OF RELAY, TO P910-2 (TYPE 99 DECODER) OR P910-5 (GE MARC V EXT ALARM) OF POWER CABLE ON THE REAR OF THE RADIO. INSERT THE CONTACT ON LEAD FLAT SIDE DOWN INTO APPROPRIATE HOLE IN P910 UNTIL IT LOCKS. FOR TRUNK MOUNT GE MARC V CENTURY II, CONNECT TO P711-8 IN CONTROL UNIT.

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 REALY. 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.

(19B233673, Rev. 3)



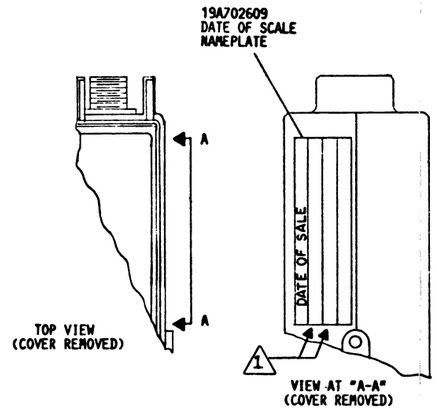
TOP VIEW

EXTERNAL SPEAKER APPLICATION

NOTES:

1. CONNECT SPEAKER LEADS TO P910-3 AND P910-7. TO DISCONNECT INTERNAL SPEAKER (GE MARC V AND FIELD ONLY) REMOVE JUMPER H5 TO H6.

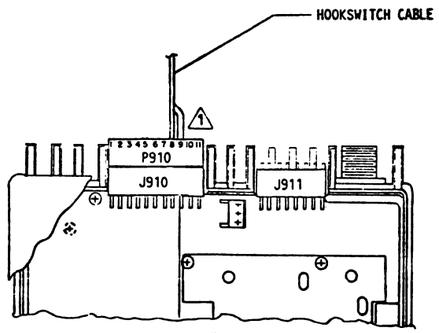
2. FOR EXTERNAL SPEAKER WITH THE AC POWER SUPPLY, REMOVE JUMPER IN POWER CABLE BETWEEN P910-3 & P910-10 AND CONNECT PER NOTE 1.



DEALER OPTION

1. STAMP THIS RADIO'S MICROCOMPUTER DRAWING AND PART NUMBER ON THE DATE-OF-SALE NP ON LINES SHOWN AND ON BOTTOM RIGHT HAND SECTION OF THE RADIO PRODUCTION TAG (PART THAT IS ATTACHED ON OUTSIDE OF SHIPPING CARTON). SEE SHEET 1 VIEW OF LOGIC BOARD FOR LOCATION OF DRAWING AND PART NUMBER.

EXAMPLE: MICROCOMPUTER 19J706206P4



TOP VIEW

GE MARC V HOOKSWITCH APPLICATION

NOTES:

1. CONNECT HOOKSWITCH TO P910-8 AND P910-9.

(19D900386, Sh. 3, Rev. 5)

INSTALLATION INSTRUCTIONS

EXTERNAL ALARM RELAY, EXTERNAL SPEAKER & HOOKSWITCH

PARTS LIST

LBI-31134A

GE MARC V 30 WATT CLASSIC

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J601	19A701432P1	Receptacle: coax; sim to UG58AU. (30-watt Classic).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C850620G2	Chassis.
	19D900169P1	Handset case, top, black.
	19D900169P2	Handset case, top, pebble.
	19D900169P3	Handset case, top, saddle brown.
	19D900170P1	Handset case, bottom, black.
	19D900170P2	Handset case, bottom, pebble.
	19D900170P3	Handset case, bottom, saddle brown.
	19B800609P1	Printed board. (Located in grip of handset).
	19A701476P1	Support, handset board.
	19A701847P305	Screw, thd. forming. (Holds top & bottom cases together).
	19J706212P203	Screw, thd. forming: No. 4 x 7.94MM. (Secures A1 & A2).
	19J706212P202	Screw, thd. forming: No. 4 x 6.35MM. (Secures speaker handset).
	19A701485P1	Rubber washer. (Located between case & A1).
	19D900123P1	Cover, top & Bottom. (BLACK).
	19D900123P2	Cover, top & Bottom. (PEBBLE).
	19D900123P3	Cover, top & Bottom. (SADDLE BROWN).
	19D900164P1	Bottom housing. (BLACK).
	19D900164P2	Bottom housing. (PEBBLE).
	19D900164P3	Bottom housing. (SADDLE BROWN).
	19A701530G1	Transmit/Receive shield.
	19A701531G1	Shield. (Located over Synthesizer board).
	19A701508P1	Handset cable, black: 6 conductor, includes (1) 641089 AMP & (1) 09-50-3081 Molex connector. (Includes P1 & P2).
	19A701508P2	Handset cable, ivory: 6 conductor, includes (1) 641089 AMP & (1) 09-50-3081 Molex connector. (Includes P1 & P2).
	19A701508P3	Handset cable, brown: 6 conductor, includes (1) 641089 AMP & (1) 09-50-3081 Molex connector. (Includes P1 & P2).
	19A700036P508	Screw, thd. forming: No. 3.5-0.6 x 8. (Secures front cap).
	19A701312P5	Flatwasher: M3.5. (Secures front cap).
	19A700031P308	Machine screw, metric: M2.5-.45 x 8. (Secures faceplate).
	19A116773P206	Screw, thd. forming: No. M4.2-1.4 x 10. (Secures Control Unit bottom - forward edge - Quantity 3).
	19A116773P212	Screw, thd. forming: No. M4.2-1.4 x 10. (Secures Control Unit bottom - rear edge - Quantity 2).
	N145AP1304B	Screw, thd. forming: No. M3.5-1.27 x 6. (Secures Hookswitch).
	19A700036P520	Screw, thd. forming: No. M3.5-0.6 x 20. (Secures shields).
	19A700031P410	Machine screw: No. M3-0.5 x 10. (Secures J601 & covers at rear of radio).
	19A701312P4	Flatwasher: 3.2 ID. (Secures covers at rear of radio).
	19A700032P5	Lockwasher, internal tooth: No. 3MM. (Secures J601).
	19A702388P1	Threaded block. (Located behind J601).
	19A700036P522	Screw, thd. forming: No. 3.5-0.6 x 22. (Secures Logic Board).
	19B800719P1	Dust pad. (Located behind J601, J910, J911).
	19A137823P2	Plate, insulator. (Used with P907).
	N530P102E	Drive screw: No. 00 x 1/8. (Secures FL1 & combination nameplate).
	19D900248P1	Nameplate. (PWR-CLR).
	19D900248P2	Nameplate. (PWR-BASE-CLR).
	19D900248P3	Nameplate. (PWR-ARM-CLR).
	19D900248P4	Nameplate. (PWR-SPKR-CLR).
	19D900248P5	Nameplate. (PWR-BASE-ALRM-CLR).
	19D900248P6	Nameplate. (PWR-BASE-SPKR-CLR).
	19D900248P7	Nameplate. (PWR-ALRM-SPKR-CLR).
	19D900248P8	Nameplate. (PWR-BASE-ALRM-SPKR-CLR).
	19D900248P9	Nameplate. (PWR-CLR-GRP).
	19D900248P10	Nameplate. (PWR-BASE-CLR-GRP).
	19D900248P11	Nameplate. (PWR-ALRM-CLR-GRP).
	19D900248P12	Nameplate. (PWR-SPKR-CLR-GRP).
	19D900248P13	Nameplate. (PWR-BASE-ALRM-CLR-GRP).
	19D900248P14	Nameplate. (PWR-BASE-SPRK-CLR-GRP).
	19D900248P15	Nameplate. (PWR-ALRM-SPKR-CLR-GRP).
	19D900248P16	Nameplate. (PWR-BASE-ALRM-SPKR-CLR-GRP).
	19D900248P17	Nameplate. (PWR-CLR-AREA-GRP).
	19D900248P18	Nameplate. (PWR-BASE-CLR-AREA-GRP).
	19D900248P19	Nameplate. (PWR-ALRM-CLR-AREA-GRP).
	19D900248P20	Nameplate. (PWR-SPKR-CLR-AREA-GRP).
	19D900248P21	Nameplate. (PWR-BASE-ALRM-CLR-AREA-GRP).
	19D900248P22	Nameplate. (PWR-BASE-SPKR-CLR-AREA-GRP).
	19D900248P23	Nameplate. (PWR-ALRM-SPKR-CLR-AREA-GRP).
	19D900248P24	Nameplate. (PWR-BASE-ALRM-SPKR-CLR-AREA-GRP).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

EXTERNAL ALARM RELAY
19B226025G4
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1701	4037822P2	Silicon, 1000 mA, 600 PIV.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K1701	7486515P2	Armature, enclosed: 12 VDC nominal, 85 to 90 ohms coil res, 1 form A contact, rated at 15 amps; sim to R.B.M. Co.
		FUSED LEAD 19B226454G1
	1R16P3	Quick blowing: 1 amp at 250 v; sim to Littelfuse 312001 or Bussmann AGC -1.
	19A115776P6	Fuseholder: sim to Bussmann 9835.
	19A115776P5	Knob: sim to Bussmann 99531/2.
	19A115776P7	Spring: sim to Bussmann 1A1853.
	19A115776P3	Contact, electrical: sim to Littelfuse 904-88. (Crimped on wires inside holder).
		WIRE ASSEMBLY 19A129937G2
	19B209260P12	Terminal, solderless: wire range No. 22-16; sim to AMP 41310.
	19A116781P5	Contact, electrical: wire range No. 18-24 AWG; sim to Molex 08-50-0106.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	N80P13005C6	Machine screw: No. 6-32 x 5/16. (Secures relay to support).
	N404P13C6	Lockwasher, internal tooth: No. 6. (Secures relay to support).
	N402P37C13	Flatwasher: No. 6. (Secures relay to support).
	N80P15005C6	Machine screw: No. 8-32 x 5/16. (Secures wires to relay terminals).
	19A129833P1	Support. (K1701).
	N130P1608C6	Tap screw, thd. forming: No. 10-16 x 1/2. (Secures relay support).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

UNIVERSAL TONE CABLE
19B800593G1
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
	7489183P7	Plug: 9 contacts rated at 7.5 amps max; sim to Winchester M9P-LS-H19CS.
	19A701863P4	Cable clip: sim to Weckesser Co. 3/16-4-128.
	19A701430G1	Rubber channel.
	19A700136P6	Insulated sleeving, electrical. (Specify length).
	7134854P4	Wire stranded. (Shield).
	19A115871P1	Wire, stranded, white-orange.
	19A115871P3	Wire, stranded, white-brown.
	19A115871P5	Wire, stranded, white-green.
	19A115871P9	Wire, stranded, white-orange-red.
	19A115871P29	Wire, stranded, orange.
	19A115871P30	Wire, stranded, black.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

SPEAKER
OPTIONAL EXTERNAL - BLACK
19C320302G9
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS2	19A116910P1	Permanent magnet: 5 inch, 3.2 ohms ±15% imp, 5 w. max operating; sim to Pioneer 002009.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1	19A129414G1	2 conductor cable: approx 5 feet long, includes (2) 19A116781P5 contacts.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227593G2	Housing.
	19B219692G2	Grille.
	19C320016P2	Mounting bracket. (Mounts speaker to mounting surface).
	N187P16010C6	Machine screw: No. 10-32 x 5/8. (Secures speaker to mounting bracket).
	N403P19C6	Lockwasher, internal tooth: No. 10. (Secures speaker to mounting bracket).
	N402P39C6	Flatwasher: No. 10. (Secures speaker to mounting bracket).
	N130P1610C6	Screw, thread forming: No. 10-16 x 5/8. (Secures mounting bracket to mounting surface).
	19A116986P108	Screw, thread forming, assembled washer: Phillips POZIDRIV®, HI-LO thread, No. 7-19 x 1/2. (Secures speaker to grille).
	19A116986P112	Screw, thread forming, assembled washer: Phillips POZIDRIV®, HI-LO thread, No. 7-19 x 3/4. (Secures housing to grille).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES