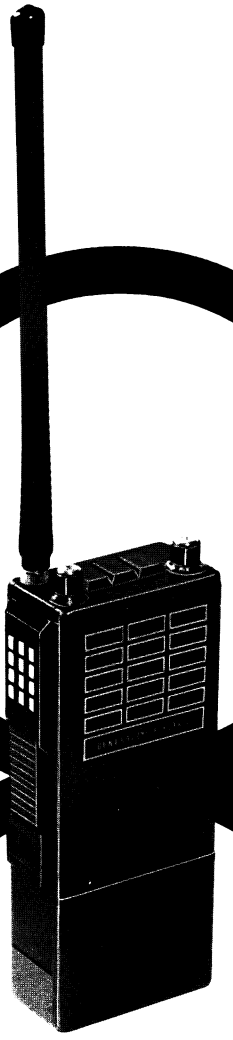
MOBILE RADIO

MPR

MAINTENANCE MANUAL LBI 30770

DATAFILE FOLDER DF9047



138–174 MHz
PERSONAL
TWO-WAY FM RADIO
PO1A COMBINATIONS

GENERAL ELECTRIC

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SPECIFICATIONS

SYSTEM

Dimensions (H x W x D)		
(Less Battery Pack)	4.4" x 2.85" x 1.5" 11.18 cm x 7.24 cm x 3.81 cm	
(With 700 mAh battery pack)	6.60" x 2.85" x 1.5" 16.69 cm x 7.24 cm x 3.81 cm	
(With 1200 mAh battery pack)	7.95" x 2.85" x 1.5" 20.19 cm x 7.24 cm x 3.81 cm	
Weight		
(Less battery pack)	19 oz	538 grams
(With 700 mAh battery pack)	26 oz	737 grams
(With 1200 mAh battery pack)	30 oz	850 grams
Operable Temperature Range	-30 to +60°C	
Current Drain (Less Options)		
Standby	23 milliamps	
Receive (Rated Audio)	160 milliamps	
Transmit		
2.5 Watts	1.2 amperes	
6.0 Watts	2.4 amperes	

TRANSMIT

Type Numbers	KT167A	KT168A
Power Output (Adjustable)	1 to 2.5 Watts	1 to 6 Watts
Spurious		
Radiated	-70 dB	-74 dB
Conducted	-70 dB	-74 dB
Multiplication	X 3	
RF Load Impedance	50 ohms	
Modulation Deviation	5 kHz (Factory set at 4.5 kHz)	
Audio Sensitivity	12 millivolts at 1 kHz (typical)	
Audio Frequency Response	Within +1 and -3 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz.	
Audio Distortion	Less than 3% at 300 to 3000 Hz and 3 kHz deviation.	
Maximum Frequency Spread	24 MHz (measured at UDC Jack)	

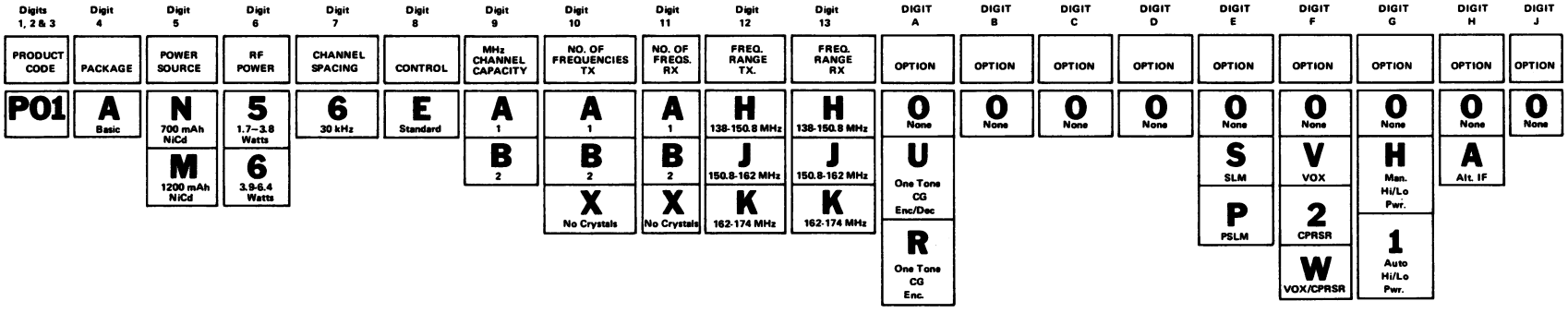
RECEIVE

Frequency Range	Type Numbers	
138-174 MHz	ER109A (High Intermodulation)	ER110A (High Sensitivity)
Sensitivity		
20 dB NQ	0.5 µV	0.25 µV
12 dB SINAD	0.35 µV	0.18 µV
Critical Squelch	0.25 µV	0.13 µV
Selectivity		
20 kHz	-70 dB	-65 dB
25 kHz	-85 dB	-80 dB
30 kHz	-95 dB	-90 dB
Intermodulation	-80 dB	-75 dB
Spurious & Image	-80 dB	-75 dB
Maximum Frequency Spread		
Maximum Performance	2 MHz	4 MHz
1 dB degredation	3 MHz	6 MHz
3 dB degredation	4 MHz	10 MHz
6 dB degredation	8 MHz	12 MHz
Channel Spacing	30 kHz	
Audio Output	500 milliwatts	
Audio Frequency Response	Within +2 and -8 dB of a 6 dB/octave de-emphasis from 300 to 3000 Hz (1000 Hz reference)	
Audio Distortion	Less than 5% at 1000 Hz	
Modulation Acceptance	+7 kHz	

BATTERY PACK

Capacities	700 & 1200 mAh
Maximum Charge Rate	1 hour
Fuse Rating	5 amperes
Charging Temperature Range	+5° to 45°C
Discharging Temperature Range	-30° to +60°C

COMBINATION NOMENCLATURE



DESCRIPTION

General Electric's MPR radio is a completely modularized, two-way, FM communication system, designed to afford performance specifications equivalent or, more generally, superior to both domestic and international specification requirements. The MPR radio offers outstanding advances in reliability, Option flexibility and repairability.

Each MPR radio, depending on the combination, uses approximately 15 plug-in circuit modules. Each module utilizes a thick film monolythic hybrid integrated circuit, containing, when possible, the complete electronic function; not requiring any externally mounted components to make it work. Each circuit module plugs into a specific socket on the system board.

The MPR transmit circuit employs FM modulated third mode oscillator modules to achieve stability and low distortion. A phase-lock-loop module and a voltage controlled oscillator module insure the correct operating frequency. A power control module insures the correct level of power output at the antenna. The only adjustments are frequency, modulation and power level. No RF tuning of the transmit circuit is required or possible. The maximum multi-frequency switching range is limited only by the ability to control the voltage controlled oscillator frequency. MPR provides a 24 MHz bandwidth with no RF tuning. Practically, the transmit frequency range is limited only by the antenna VSWR.

Two power levels are available in the MPR transmit circuit and are designated by transmit type numbers, KT167A and KT168A. KT167A provides 1 to 2.5 watts output while KT168A provides 1 to 6.0 watts output.

The MPR receive circuit is a single conversion circuit using fifth mode oscillator modules to reduce spurious and provide a wide frequency switching range. A 21.4 MHz IF is the standard IF. Alternate IF's of 20.2 MHz and 23 MHz are also available.

There are eight tuning adjustments in the receive circuit, all in the front end. Four of the adjustments are RF helical resonators tuned for maximum receive quieting. The other four adjustments are in the injection frequency multiplier chain. Three of these adjustments are helical resonators tuned for best injection signal. The other adjustment is a slug tuned coil for interstage coupling. There is one metering test point provided for this adjustment.

Two receive circuits are available in the MPR and are designated by receive type numbers ER109A and ER110A. The ER109A is a high intermodulation circuit. ER110A is a high sensitivity circuit.

The power supply for the MPR radio is a rechargeable 7.5 VDC battery pack. Two battery packs are available: a 700 mAh capacity and a 1200 mAh capacity, as the application demands. A voltage regulator module supplies a continuous 5.4 VDC and a keyed 5.4 VDC both short circuit protected.

The MPR radio consists of seven assemblies plus a battery pack (see Figure 1). The seven assemblies can easily be disassembled in the field to replace any damaged or defective parts. All parts of similar MPR radios are directly interchangeable.

Radio Assembly

The radio assembly consists of a multilayered system board and all modules for the transmit, receive, voltage regulation and option circuits.

The system board has four layers of printed wire pattern. The layer on the module side of the board is a ground plane. The layer on the back side of the board is for DC distribution. The two center layers of printed wire pattern are for signal interconnections. Fifty ohm strip line is used for all high frequency connections.

The buried layers of printed wire pattern on the system board limits circuit pattern tracing for troubleshooting, to DC distribution. A technician must relay on the schematic diagram, outline diagram and other troubleshooting aids provided in this manual.

Control Assembly

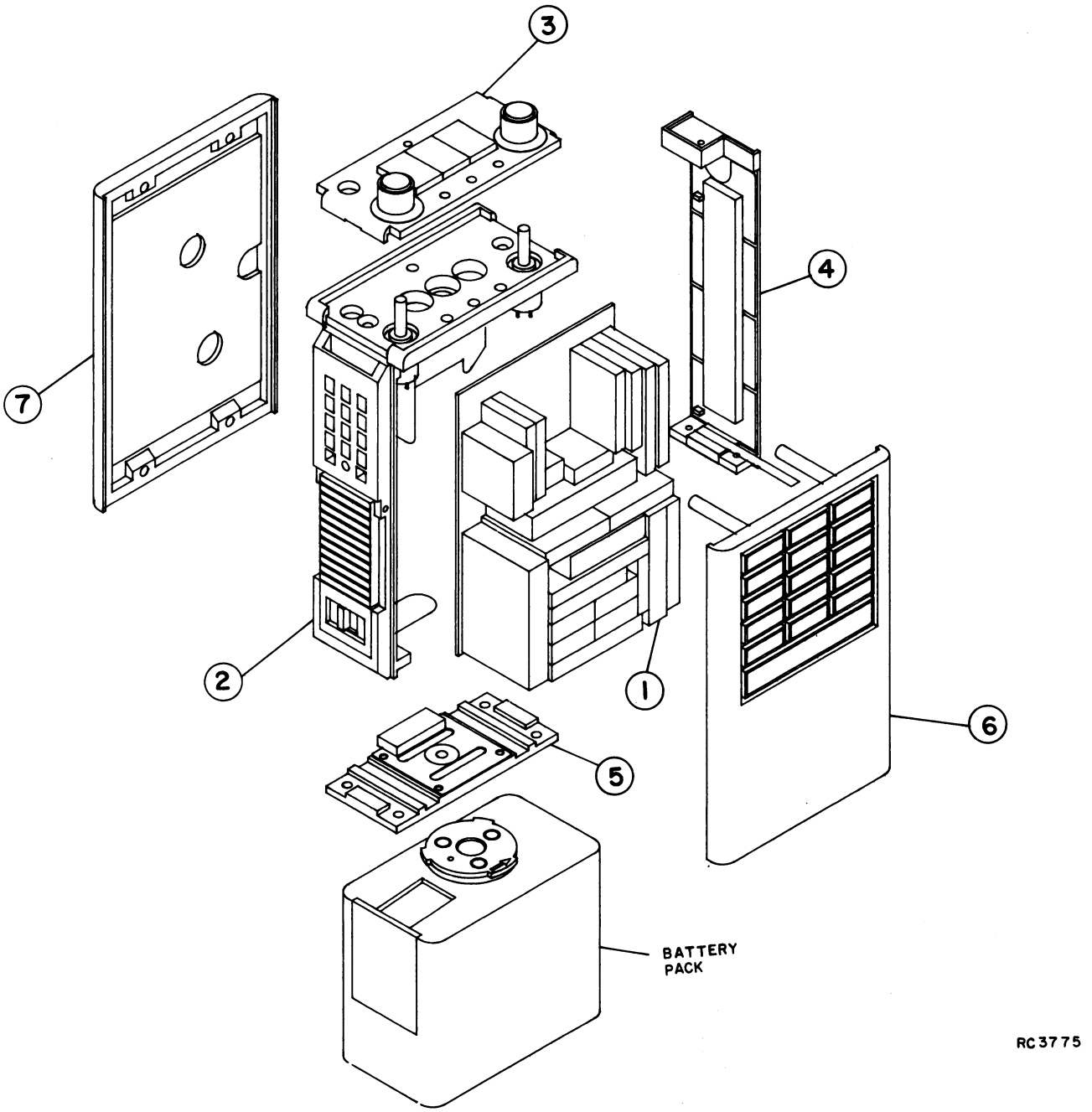
The Control Assembly consists of a molded Lexan® side rail, a molded Lexan® top plate and a flexible printed wire board. The side rail provides a UDC accessory jack, PTT Bar, radio power, ON-OFF slide switch and an antenna mounting stud. The top plate provides a volume control, squelch control, and a red LED transmit indicator. Two toggle switches are also available for option control.

The flexible printed wire board is folded around the radio assembly and makes all major interconnections between the radio assembly, UDC accessory jack and all operating controls including option controls. The flexible printed wire board does not make coax power output connections, speaker connections and the PA DC feed jumper.

Many control leads accessible on the flexible printed wire board, can be used to expedite isolation of defective modules.

Top Cover Assembly

The top cover is a decorative molded Lexan® top cap snapped in place over the



1. Radio Assembly
2. Control Assembly
3. Top Cover Assembly
4. Right Side Rail Assembly
5. Base Assembly
6. Front Cover Assembly
7. Back Cover Assembly

Figure 1 - MPR Assemblies

top plate. When in place, the top cover seals the volume, squelch and option controls against water and provides the proper identification of each control.

Right Side Rail Assembly

The right side rail consists of a molded Lexan® side rail.

Base Assembly

The Base Assembly fastens to the bottom of the MPR housing and provides the female portion of the battery pack fastener. The assembly consists of a die cast base, a stainless steel contact spring, a rubber seal and a contact assembly.

Front Cover Assembly

The Front Cover Assembly fastens to the front of the MPR housing and mounts the system speaker and local microphone. The assembly consists of a die cast aluminum cover, speaker grille, speaker, microphone, a rubber boot for both the speaker and the microphone, providing isolation from vibration, a retaining clip, fastener, stand-offs and Ensolite® foam shock pads.

The aluminum front cover assembly provides additional heat sinking for the transmit exciter and PA.

Rear Cover Assembly

The Rear Cover Assembly consists of a rear cover, a thin polyester insulator to prevent projecting sockets from shorting against the rear cover and an Ensolite® foam shock pad, identical to those in the front cover assembly. The rear cover fastens to the four stand-offs in the front cover.

The outside of the rear cover has stainless steel receptical plate for attaching an optional swivel mount, hand strap or pocket clip. A customer identification plate, a combination nameplate, an FCC compliance statement and an intrinsically safe nameplate may also be present.

Battery Pack Assembly

The Battery Pack Assembly consists of a molded Lexan® case and side slide, a stainless steel latch spring, a steel fastener plate, three round contact strips for charging contacts and six nickle-cadmium batteries. A thermistor, diode and fuse is also included in the Battery Pack Assembly. The fuse is accessable from outside the case.

The steel latch spring is operated by a side slide. The side slide on the opposite side of the case is for decorative purposes only.

Assembly

The top plate, control side rail and system board are interconnected by the flexible printed wire board. This assembly is "folded up" and mounted together with two screws from the top control panel into the two side rail assemblies, and four screws through the base plate assembly into the side rail assemblies. The system board is nested between shock pads in the side and base assemblies. After all modules are plugged into the system board, the front and rear covers are fastened together (after connecting the speaker and microphone) with four screws through the rear cover into the four standoffs on the front cover. The Lexan® top cover is snapped on the top of the top plate and the volume and squelch knobs are assembled. The antenna is screwed on to the antenna stud and the battery pack attached. The MPR Communication System is now ready for use.

OPERATION

TO RECEIVE A MESSAGE

1. Disable any options by placing the option control toggle switch(es) into a disabling position.
2. Rotate the volume control to approximately half of its rotation.
3. Rotate the squelch control fully clockwise.
4. Place the slide ON/OFF switch in the ON position. A hissing noise should be heard from the speaker.
5. Adjust the volume control so the noise is easily heard but not annoyingly loud.
6. Rotate the squelch control counter-clockwise until the noise just stops. DO NOT rotate the squelch control any further. To much squelch could prevent receiving messages.
7. Place the option controls back into the ON position.
8. If the radio has two receive channels, place the channel select toggle switch into the desired position. Your MPR receive circuit is now ready to receive messages.

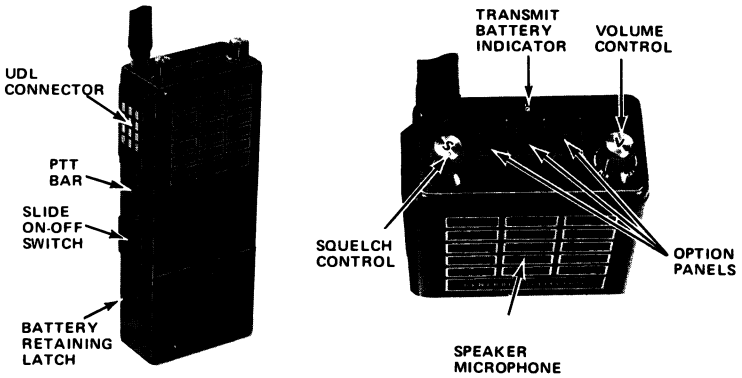


Figure 2 - Operating Controls

TO SEND A MESSAGE

1. Turn the radio on and select the desired channel as instructed in TO RECEIVE A MESSAGE.

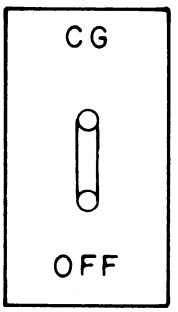
2. LISTEN to insure no one is transmitting on the selected channel. NEVER interrupt another transmission.

3. While holding the radio so the antenna is vertical, press the Push-To-Talk (PTT) bar and speak directly into the Speaker grill or across the face of an external microphone. Use a normal tone of voice. Release the PTT bar as soon as you stop talking. Messages cannot be received when the PTT bar is pressed.

OPTIONS

Channel Guard

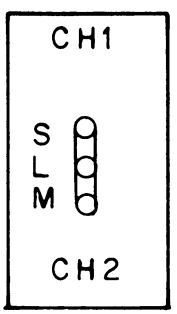
If your radio is equipped with a Channel Guard (CG) option, you have, on the control panel, a two position switch labeled CG-OFF. With the switch in the CG position the decoder permits you to hear only those calls that are tone-coded on your Channel Guard frequency. The encoder permits you to communicate with other radios in your system equipped with Channel Guard decoders, tone-coded on your Channel Guard frequency. Moving the switch to the OFF position permits you to hear all calls on the channel. When sending, with the switch in the OFF position, you will still transmit a Channel Guard tone. Before sending a message, listen or observe the optional LED Carrier activity indicator to insure no one is using the channel.



Search Lock Monitor

If your radio is equipped with a Search Lock Monitor (SLM) option, you have, on the top cover, a three position switch labeled CH1-SLM-CH2. With the switch in the SLM position and a signal is not present, the SLM alternately searches between receive channels. The SLM LED indicator blinks at a fast rate. When a signal is present, the SLM locks on the active channel and the LED indicator stops blinking. When a signal is no longer present, the SLM resumes searching. Before transmitting, the Search must be defected by placing the switch into the CH1 or the CH2 position. When the switch is in the CH1 or CH2 position, the radio transmits on or monitors only the channel selected.

Although search should be defected before transmitting, the transmit circuit will key on channel 1 if the switch is in the SLM position.



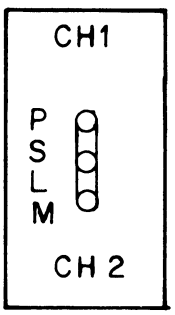
Priority Search Lock Monitor

If your radio is equipped with a Priority Search Lock Monitor (PSLM) Option, you have, on your top cover, a three position switch labeled CH1-PSLM-CH2. When the

switch is in the PSLM position, and a signal is not present, the PSLM alternately searches between receive channels. The PSLM LED indicator blinks at a fast rate. When a signal is present, the PSLM locks on the active channel. If the active channel is Channel 1, the normal priority channel, the LED indicator lights. If the active channel is a non-priority channel, the PSLM continues to search the priority channel while monitoring the non-priority channel. If a signal occurs on the priority channel while monitoring the non-priority channel, the PSLM switches to monitor the priority channel. Before transmitting, the search must be defeated by placing the switch into the CH1 or the CH2 position.

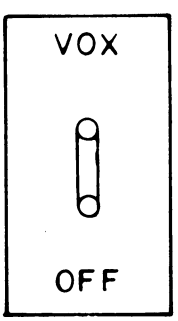
When the switch is in the CH1 or the CH2 position, the radio transmits on or monitors only the channel selected.

Although search should be defected before transmitting the transmit circuit will key on Channel 1 if the switch is in the PSLM position.



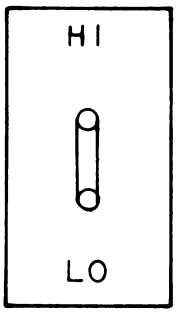
Voice Control

If your radio is equipped with a Voice Control (VC or VOX) option, you have on the top cover, a two position switch labeled VOX-OFF. With the switch in the VOX position, speaking into the external microphone keys the transmitter. When the switch is in the OFF position speaking into the external microphone will not key the transmitter.



HI/LO Power

If your radio is equipped with a manual HI/LO Power option, you have, on the top cover, a two position switch labeled HI-LO. With the switch in the HI position the RF power output is a maximum. With the switch in the LO position the RF power output is a predetermined reduced power.



Operation with the HI/LO Power switch in the LO position will extend battery life when the higher power output is not necessary for reliable communication.

REPLACEMENT OF BATTERY PACKS

To remove the battery pack from the radio:

1. Turn the radio OFF.
2. Press the battery pack retaining latch away from the battery pack, and turn the battery pack one-quarter turn to the left. The battery pack can now be detached from the radio.

To re-connect the battery pack to the radio:

1. Hold the battery pack at a 90° angle to the radio as shown in Figure 3.
2. Align the large tab marked with an arrow on the battery pack connector with the large cut-out on the radio socket.
3. Press the battery pack connector into the socket on the radio and turn the battery pack one-quarter turn to the right until the latch clicks.

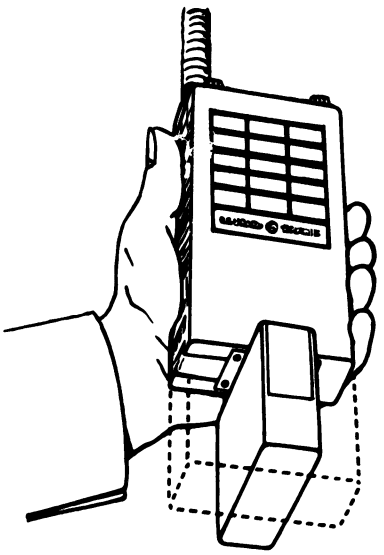


Figure 3 - Battery Pack Replacement

RE-CHARGING BATTERY PACKS

The MPR radio is equipped with a battery pack transmit voltage LED indicator. This indicator blinks rapidly while transmitting with a fresh charged battery pack. As the battery pack gets weaker, the indicator will blink slower. When the battery pack needs recharging, the indicator will not light.

There are several chargers and charge rates available for charging, the MPR battery packs. For specific instructions refer to the applicable charger Operating Manual.

OPERATING TIPS

The following conditions tend to reduce the effective range of Two-Way Radios, and should be avoided whenever possible.

- Operating the radio in low areas of the terrain, or while under power lines or bridges.
- Operating the radio inside of a vehicle, or in a metal or steel-framed building unless using an outside antenna.
- Obstructions such as mountains or buildings between the person sending and the person receiving the messages.

In areas where transmission or reception is poor, some improvement maybe obtained by insuring the antenna is vertical. Moving a few yards in another direction or moving to a higher elevation may also improve communication.

SYSTEM ANALYSIS

General Electric's MPR radio is a completely modularized, two-way, FM communication system, utilizing a multi-layered system board. The system board contains all circuit modules for the transmit, receive, voltage regulation and option circuits. A flexible printed wire board folds around the system board to make all interconnections between the system board and radio controls.

Many control leads, accessible on the flexible printed wire board, can be used to expedite isolation of defective circuit modules. Refer to the Troubleshooting Procedures.

All control leads for the MPR radio are "barred", such as $\overline{\text{PTT}}$ or $\overline{\text{CAS}}$. This means the lead is in a low voltage condition when the function name is true. For example, $\overline{\text{PTT}}$ is low when the radio is keyed. Refer to the Table of Contents for a list of Control leads and a discription of their function.

A Signal lead has its name chosen so the function of the lead is obvious, such as:

VOL - DC voltage used to control volume

SQ - DC voltage used to control squelch

DISCR - DC and audio from discriminator

PWR CONT - DC output from power control used to control the transmit gain

Circuit illustrations shown in the following text are simplified representatives of actual circuits. They are intended only to illustrate basic functions.

TRANSMIT CIRCUIT

The MPR transmit circuit, as shown in Figure 4 - Block Diagram, consists of the following integrated circuit modules:

Audio Processor (Tx-AA)

Optional Speech Compressor/Voice Control (SC/VC)

Oscillator Module (Tx-X0)

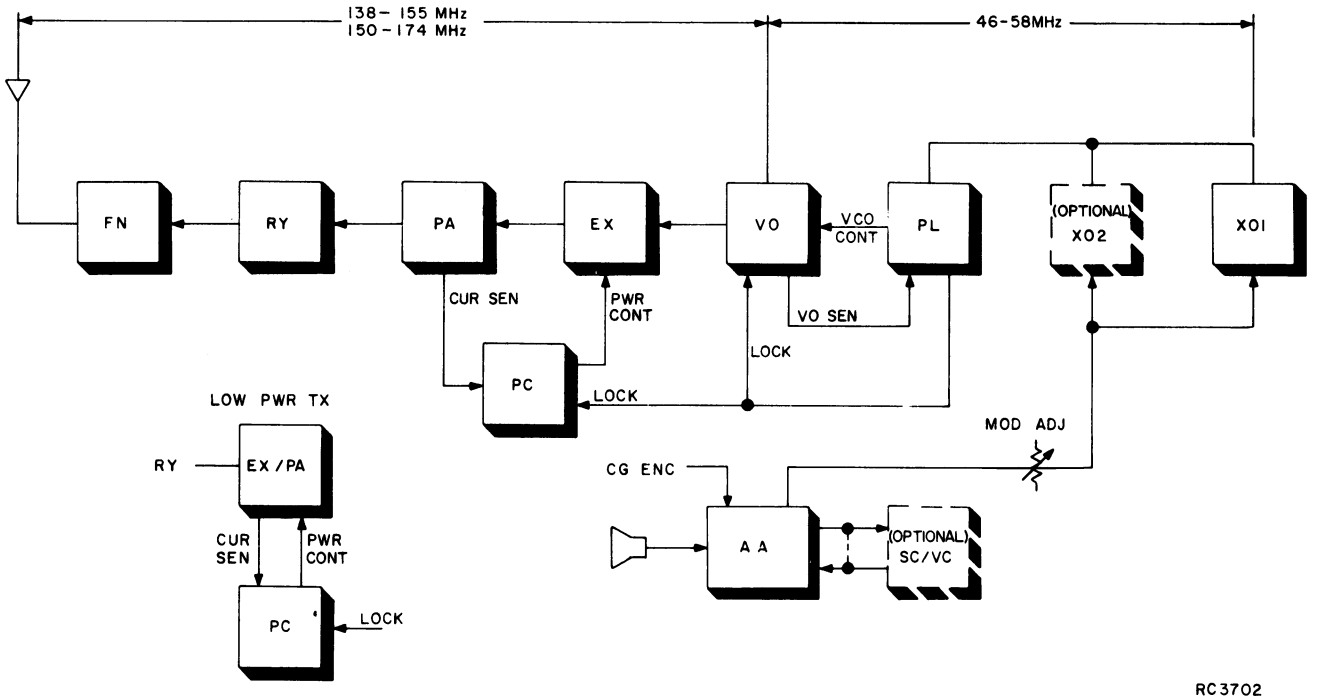


Figure 4 - Transmit Circuit Block Diagram

Phase-Lock-Loop (PL)

Voltage Controlled Oscillator (VO)

Exciter (EX)

Power Amplifier (PA)

Power Control (PC)

Antenna Relay (RY)

Filter Network (FN)

Audio Processor Module (TX-AA)

The audio processor module provides an audio input designated EXT MIC at Pin 13 for an external microphone and an audio input designated INTL MIC at Pin 14 for an internal microphone (refer to Figure 5). Normally, audio is accepted from the external microphone unless, the $\overline{\text{PTT}}$ lead is in a low voltage condition. The $\overline{\text{PTT}}$ lead in a low voltage condition means the radio has been keyed by the PTT bar on the control side of the radio. Keying the radio with the PTT bar gates off the external microphone and gates on the internal microphone. Microphone gating is typically -55 dB.

Audio from either microphone input is amplified and brought out of the processor at the output designated PRE-AMPL OUT at Pin 9. The audio is jumpered to the input designated AUDIO IN at Pin 6 unless, an optional speech compressor is used. An additional 10 dB of microphone gain can be obtained by connecting a 3.6K resistor in series with a 2.2 mfd tantalum capacitor between the MIC GAIN lead and ground.

Audio jumpered to Pin 6 is connected through an active pre-emphasis amplifier and an active peak-to-peak clipper limiter circuit. The limiter output can be attenuated by more than 60 dB by pulling the lead designated $\overline{\text{MIC MUTE}}$ at Pin 4 to ground. The $\overline{\text{MIC MUTE}}$ lead is used to mute microphone inputs when options are used which transmit data. The output of the limiter circuit is applied to the input of a summing amplifier. The summing amplifier provides two inputs for modulation. One input, designated ENC at Pin 5, is the input for Channel Guard modulation and is added to the fixed output from the limiter circuit. The input, designated TONE INP at Pin 7 is intended for touch tone or optional multiple tone Channel Guard encoders. The output of the summing amplifier passes through an active post limiter filter and out of the processor at the lead designated AUDIO OUT, Pin 2. The output of the audio processor is applied through MOD ADJ pot R904 to the inputs of the Oscillator modules designated AUD INP at Pin 7.

A battery indicator circuit is also part of the audio processor. LED transmit

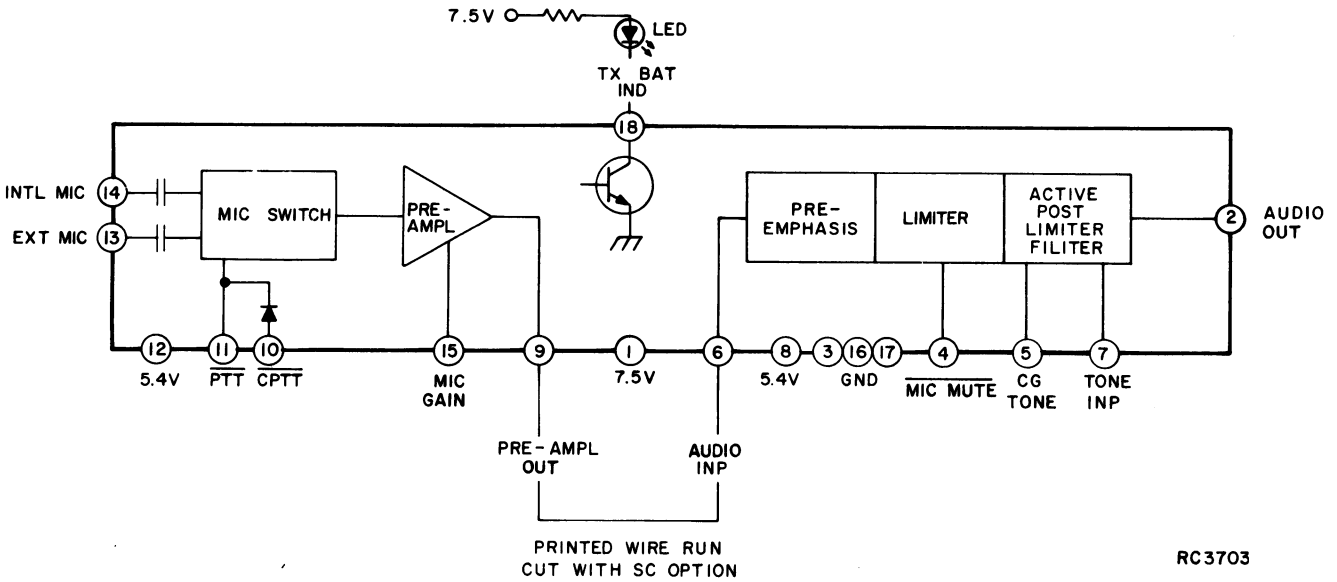


Figure 5 - Audio Processor

indicator DS701 connects to the audio processor module at the lead designated Tx BAT IND at Pin 18. During transmit, the battery pack voltage is measured and the transmit indicator blinks at a rate determined by the voltage under load. A rapidly blinking indicator indicates a fully charged battery pack with the blink rate slowing as the voltage decreases. The indicator will not light when the end of the voltage has been reached and the battery must be recharged.

Optional Speech Compressor Module (SC)

The speech compressor module provides a constant audio input level to the amplifier-limiter circuits in the audio processor module. This input level is typically, 45 millivolts at the threshold of compression, and holds the transmitter deviation approximately 2 to 3 dB into limiting; typically, 3.8 kHz of deviation. The compressor will hold the level constant over a 30 dB increase in level over threshold.

There is no discernable difference in audio quality between a radio with a speech compressor and a radio without. The frequency response of the SC module is flat from 300 to 3000 Hz. The SC module also provides 12 dB of gain below compression, for either external or internal microphones. Audio from Pin 9 of the audio processor module is connected to Pin 8 of the SC module. When the SC module is used, the printed wire run between Pin 6 and Pin 9 of the audio processor is cut (Refer to Figure 5).

Keying the transmit circuit applies 5.4 Volts to Pin 9 of the SC module (See Figure 6). Below compression, the SC circuit behaves like an amplifier with 12 dB gain. The output of the AC amplifier is insufficient to cause the DC amplifier to operate. In compression, the AC amplifier output is sufficient to cause the detector and DC amplifier to provide a gain control DC voltage to the attenuator, resulting in a constant 45 millivolt output on Pin 1. Pin 1 of the SC module is connected to Pin 6 of the audio processor module.

The recovery time for the SC is typically 800 milliseconds.

Optional Voice Control Module (VC or VOX)

The optional voice control module keys the transmit circuit when the operator speaks into the external microphone. To be operational, the VC module must have the Option Control switch in the VOX position and the $\overline{\text{RUS}}$ control lead must be in a high state indicating the receiver is in a squelched condition. This prevents the receive audio from causing the transmit circuit to key.

Audio from Pin 9 of the audio processor module is connected to Pin 8 of the VC module (see Figure 7). The audio is coupled to the input of a selective amplifier. The selective amplifier has a maximum sensitivity of 4.0 millivolts input to the MIC switch at an audio frequency of 650 Hz. This results in a deviation of a 1 kHz when a compressor is not used. The output

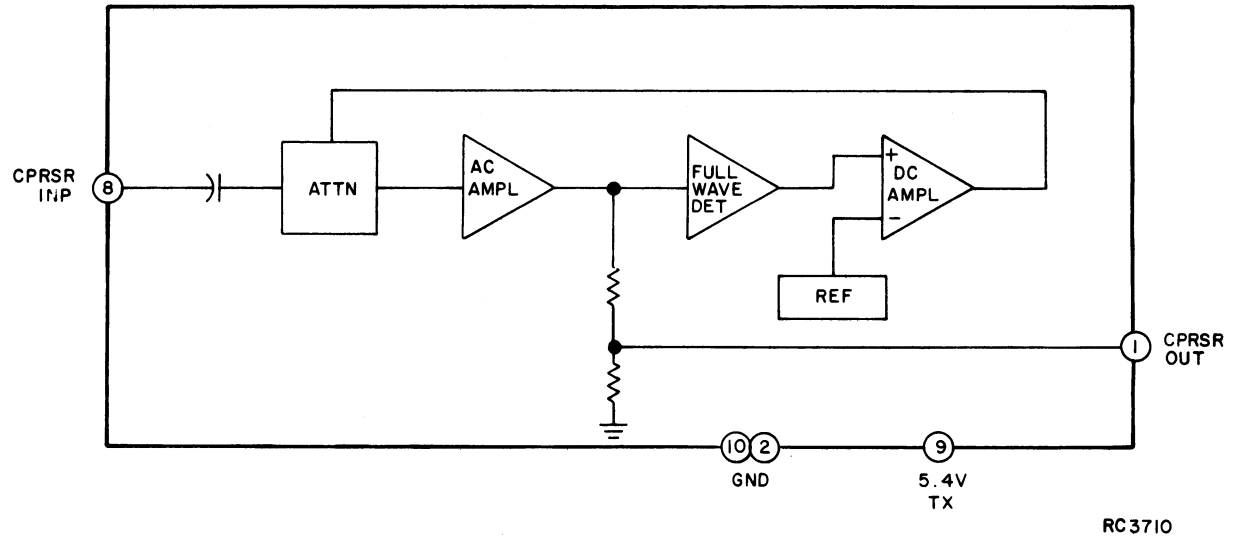


Figure 6 - Speech Compressor

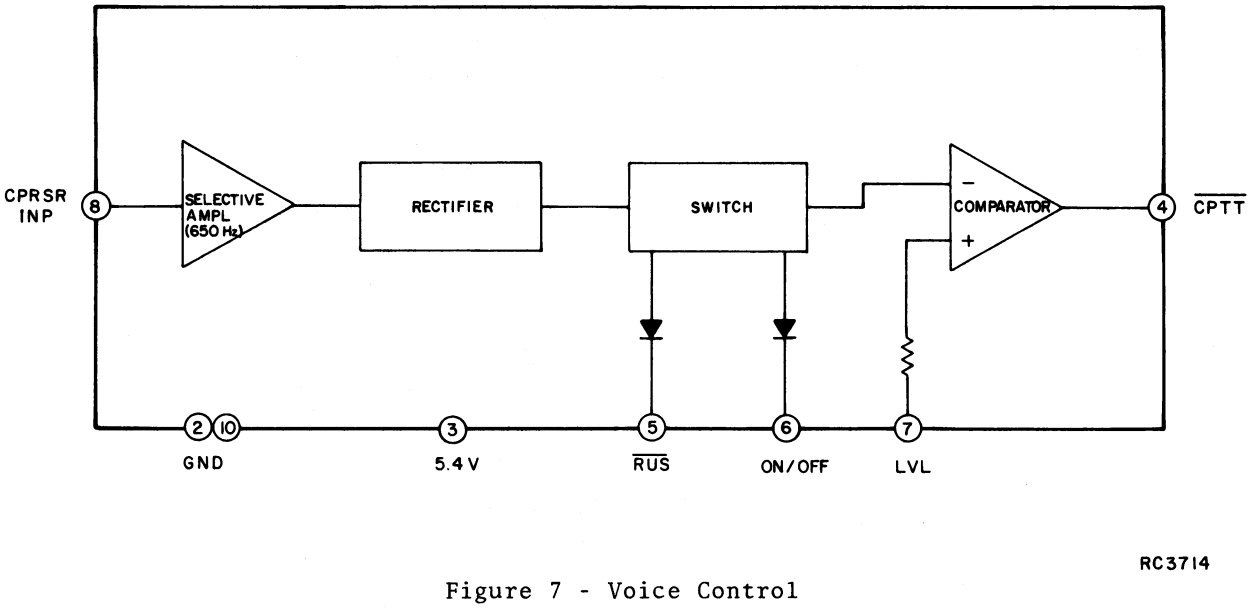


Figure 7 - Voice Control

of the selective amplifier is connected to a rectifier circuit where it is rectified and applied to a switch. If the Option Control switch is in the OFF position and the $\overline{\text{RUS}}$ control lead is high, the DC voltage is connected through the switch to the negative (-) input of a comparator amplifier. When the current flowing through the negative input of the comparator amplifier is greater than the current flowing through the positive (+) input, the output on Pin 4 will pull the $\overline{\text{CPTT}}$ lead low and key the transmit circuit.

The gain of the comparator amplifier and the sensitivity of the VC module is determined by resistor R2102 connected between Pin 7 and system ground. For optimum gain R2102 is 43K. If R2102 were larger, the gain would be greater and if R2102 were smaller, the gain would be less. An acceptable range for R2102 is from 0 ohms to 80K ohms.

The attack time for the VC module is approximately 20 milliseconds. An RC time constant in the comparator amplifier holds the release time at 1 second.

Oscillator Module (Tx-XO)

The Oscillator Module is self-contained, FM modulated and fully temperature compensated (See Figure 8). A basic colpitts third mode oscillator circuit operates in the frequency range of 46 to 58 MHz. The output of the oscillator circuit is connected through a cascade common base buffer circuit to Pin 3 of the module. The output is typically one milliwatt into a 400 ohm load.

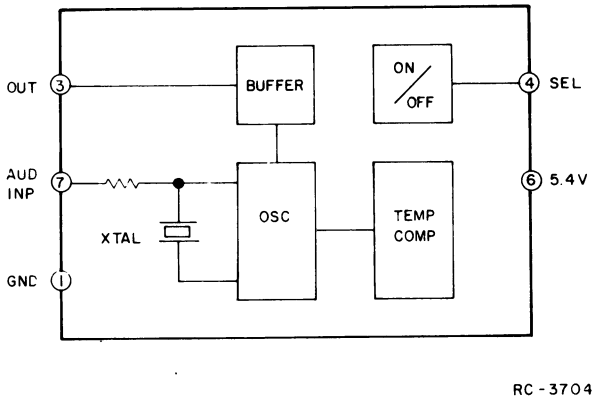


Figure 8 - Oscillator Module

Temperature compensation for the oscillator circuit is achieved by biasing a voltage variable capacitive diode with a correction voltage. The correction voltage is derived from an "S" shaped correction voltage curve VS temperature.

The module frequency is trimmed using a slug tuned coil molded into the oscillator header providing multi-turn resolution. Audio modulation from the audio processor is DC coupled to Pin 7 of the oscillator module with an input impedance of 120K ohms between Pin 7 and ground.

The modulation sensitivity is 0.93 kHz/volt rms for the third mode oscillator circuit.

The modulated output of the oscillator module is connected to Pin 8 of the phase lock loop module.

Phase Lock Loop Module (PL) and Voltage Controlled Oscillator Module (VO)

The phase lock loop module and the voltage controlled oscillator module using the transmit oscillator frequency as a reference, generates and controls the transmit RF carrier.

Initially, when the transmit circuit is keyed, a ramp generator circuit in the PL module applies a ramp voltage from Pin 4 of the PL module to Pin 3 of the VO module (See Figure 9). This voltage causes a FET oscillator in the VO module to sweep across the entire frequency range of the split. The frequency output of the VO module is looped back from Pin 5 to Pin 6 of the PL module, where it is amplified, divided by three and applied to a phase detector circuit. The reference frequency from the transmit oscillator circuit is connected to pin 8 of the PL module and is also applied to the phase detector circuit. When the reference frequency from the transmit oscillator and the VO frequency are the same, the phase detector circuit shuts the ramp generator down. DC voltage from the phase detector (2 to 5 volts DC) completes the loop back from Pin 4 of the PL module to Pin 3 of the VO module, holding the RF carrier at exactly the third harmonic of the reference frequency. Simultaneously the phase detector circuit pulls the $\overline{\text{UNLOCK}}$ lead to a high voltage state. The $\overline{\text{UNLOCK}}$ lead is connected from Pin 2 of the PL module to Pin 1 of the VO module and Pin 1 of the Power Control Module (PL). When the $\overline{\text{UNLOCK}}$ lead goes high, a gate in the VO module opens allowing a minimum of 50 milliwatts of RF drive to be applied from Pin 9, of the VO module, to Pin 11 of the transmit Exciter module (EX).

The $\overline{\text{UNLOCK}}$ lead high, on Pin 1 of the PC module, turns on the supply voltage to enable the first stage in the EX or EX/PA.

The complete phase lock occurs, typically, within five milliseconds from the activation of the PTT bar.

If at any time the phase lock loop should break lock, the transmit output will immediately be inhibited by the phase detector, pulling the $\overline{\text{UNLOCK}}$ lead to a low state.

If a transmit oscillator module should fail, the phase detector will continue sweeping the VO module, but will not enable the transmit output stages.

Exciter Module (EX)

The EX module is a two stage RF amplifier module with an input and output impedance of 50 ohms. The first stage has its DC power supplied by the Power Control Module (PC).

The 50 milliwatts of RF drive from Pin 9 of the VO module to Pin 11 of the EX module is coupled to the input of the first RF amplifier stage (See Figure 10). The first RF amplifier stage amplifies the 50 milliwatts to approximately 550 milliwatts. The output of the first RF amplifier stage is connected to the input of the second RF amplifier stage. The second RF amplifier stage amplifies the 550 milliwatts to approximately 1.8 watts (1.5 watts minimum). The 1.8 watts output from Pin 1 of the EX module is connected to Pin 8 of the Power Amplifier Module (PA).

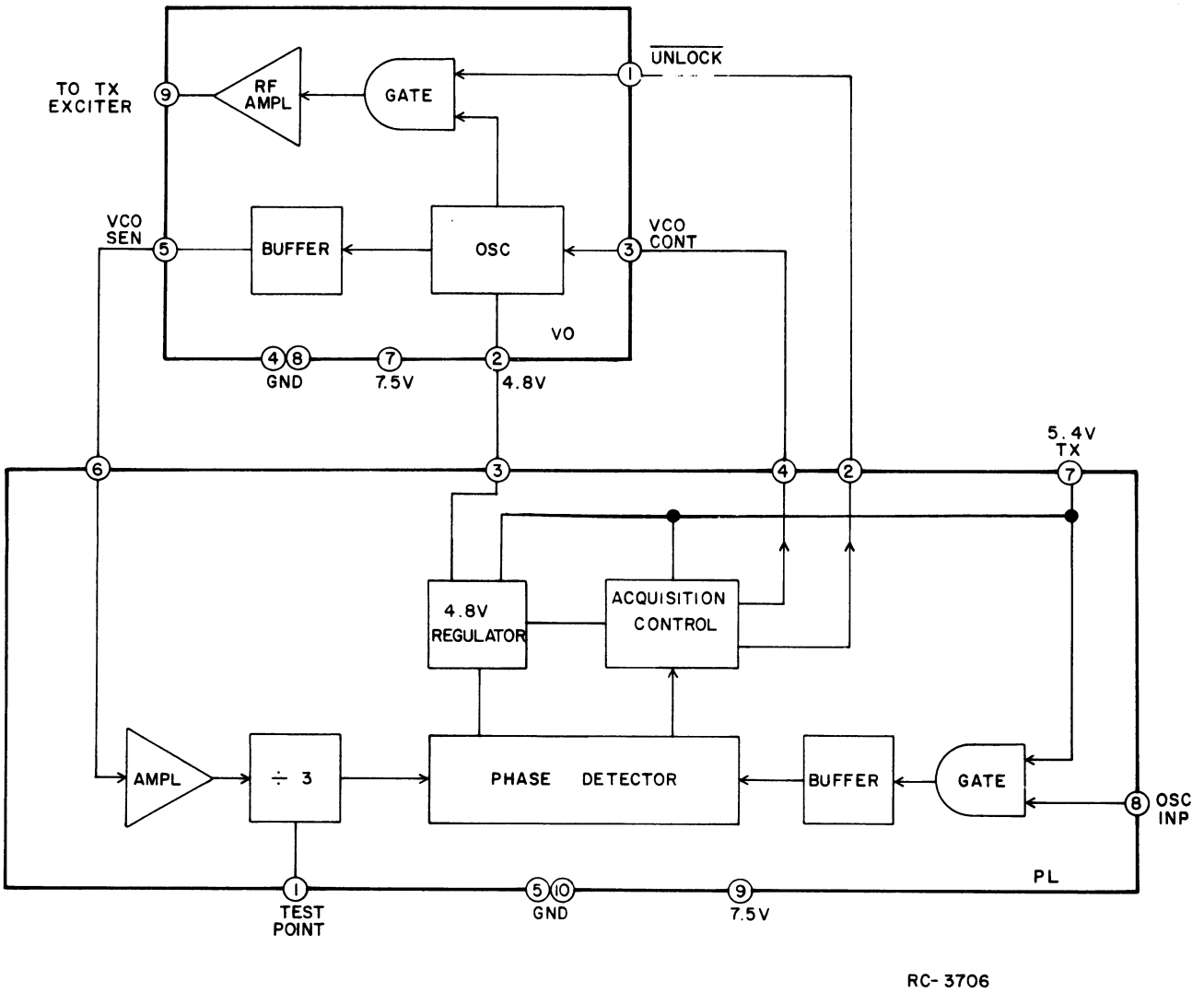


Figure 9 - Phase Lock Loop and Voltage Controlled Oscillator

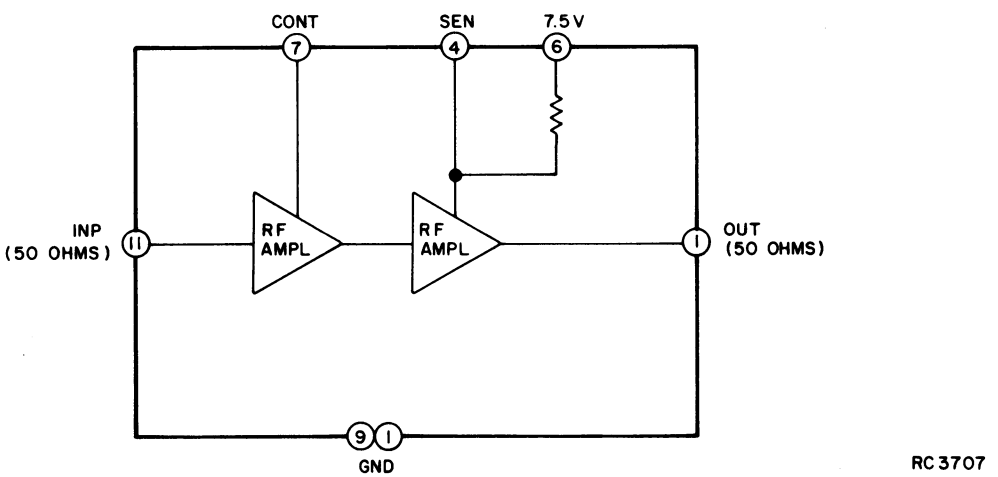


Figure 10 - Exciter

Exciter/Power Amplifier Module (EX/PA)

The EX/PA module is used in low power applications and is identical, except for the output stage, to the EX module. The output RF amplifier stage, in the EX/PA module, amplifies the 550 milliwatts on its input to, typically, 3.0 watts (2.5 watt minimum).

A current sensing metering resistor is in the DC power feed of output stage for the Power Control Module (PC).

Power Amplifier Module (PA)

The PA module is single stage RF amplifier module and like the exciter module has an input and output impedance of 50 ohms. The RF power output from Pin 1 of the EX module is connected to Pin 8 of the PA module where it is applied to the input of the RF power amplifier stage (See Figure 11).

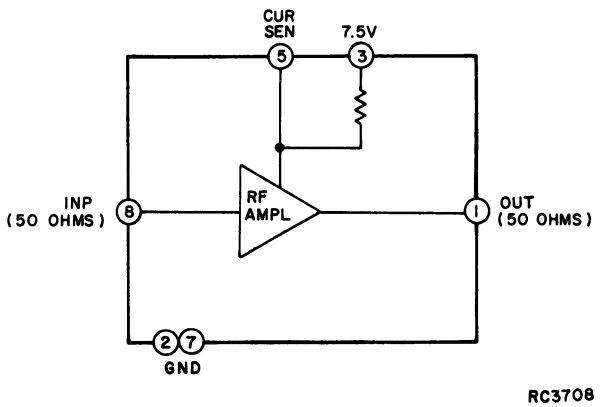


Figure 11 - Power Amplifier

The RF power amplifier stage amplifies the 1.8 watt input from the EX module to a minimum power output level of 6.5 watts at Pin 1. The output at Pin 1 is connected through the antenna relay (RY) to Pin 1 of the filter network module (FN).

Power Control Module (PC)

The RF power output of the MPR radio is regulated by sensing variations in the current drain of the transmit final PA module to control the supply voltage of an earlier driver stage. Supply voltage cannot be applied to the driver stage until the transmit circuit is keyed, applying 5.4 volts to Pin 5 of the PC module. Also, the $\overline{\text{UNLOCK}}$ lead at Pin 1 of the PC module must be high, indicating that the VO is running on the correct operating frequency.

When the transmit circuit is keyed, the output of a reference generator, dedetermined by the HI and LO power adjust concontrols, is applied to the positive (+) input of a comparator amplifier (See Figure 12). The current sensing element in the final PA module is connected to Pin 7 of the PC module and to the negative (-) input of the comparator amplifier. The amplifier is enabled when the $\overline{\text{UNLOCK}}$ lead goes high. Until then, the output of the amplifier is high and the series regulator is held off. When the $\overline{\text{UNLOCK}}$ lead goes low, the output of the amplifier goes low causing the series regulator to conduct and apply maximum supply voltage to the driver stage.

As the PA module begins to draw more current and the temperature increases, the

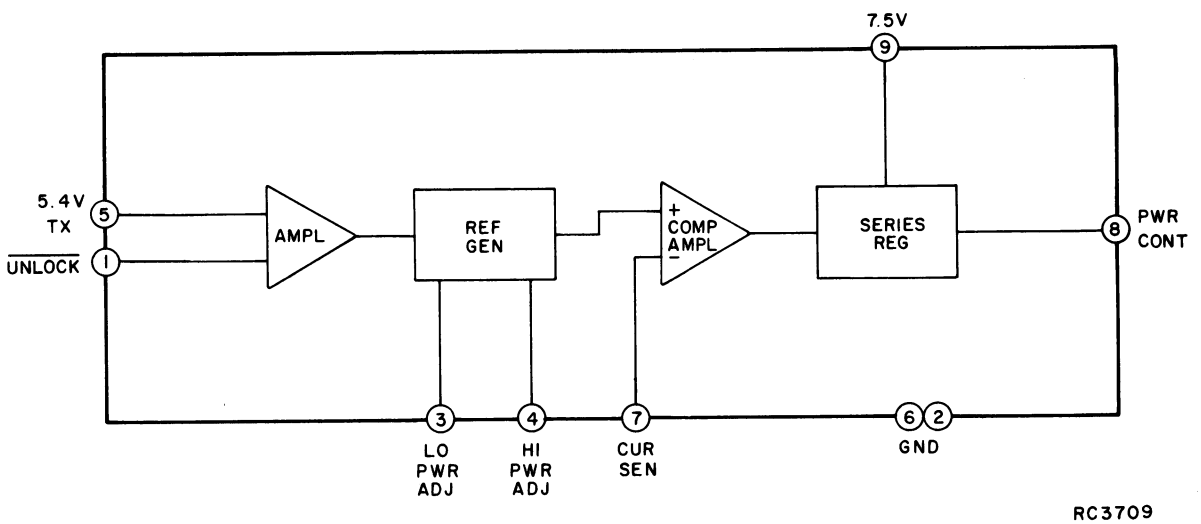


Figure 12 - Power Control

changing voltage drop across the sensing element causes the series regulator circuit to regulate the supply voltage to maintain constant current flow through the PA module and constant RF power output.

Filter Network Module (FN)

The output of the EX/PA module or the output of the PA module is connected to Pin 1 of the filter network module (FN). The FN module is a passive L/C general parameter low pass filter with an insertion loss of less then .4 dB in the pass band range of 138 - 174 MHz. It also has a rejection of greater than 45 dB in the stop band range of 276 - 1740 MHz. The output of the FN module on Pin 7 is connected to the system antenna.

Optional Carrier Controlled Timer (CT)

The carrier controlled timer module provides a transmit interrupt, 30 seconds after the transmit circuit has been keyed. Other time periods of 60 or 90 seconds can be obtained by replacing the printed run between H907 and H908, on the system board, with a resistor (See Figure 13).

Keying the transmit circuit causes the $\overline{\text{PTT}}$ lead on Pin 8, of the CT module to go low and start the time-out timing sequence. When the time period for the transmit interrupt has elapsed, a time-out signal to the regulator circuit unkeys the transmit circuit. The $\overline{\text{SQ OVER RIDE}}$ lead on Pin 11, of the CT module, will go low, defeating the receive squelch circuit and opening the receive audio. A DC voltage on Pin 12, of the CT module, will mute the receive audio and an alert tone, also on Pin 12 of the CT module, will be applied to the receiver audio. The alert tone will be heard from the speaker as long as the PTT bar is pressed. A momentary release of the PTT bar resets the CT module.

RECEIVE CIRCUIT

The MPR receive circuit, as shown in Figure 14 consist of the following integrated circuit modules:

Oscillator Module(s) (Rx-XO)

Frequency Multiplier Module (FX)

Filter Network (Rx-FN)

Optional RF Preamplifier Module (RA)

Receive Converter Module (RC)

IF Pre-amplifier Module (IA-1)

IF Amplifier Module (IA-2)

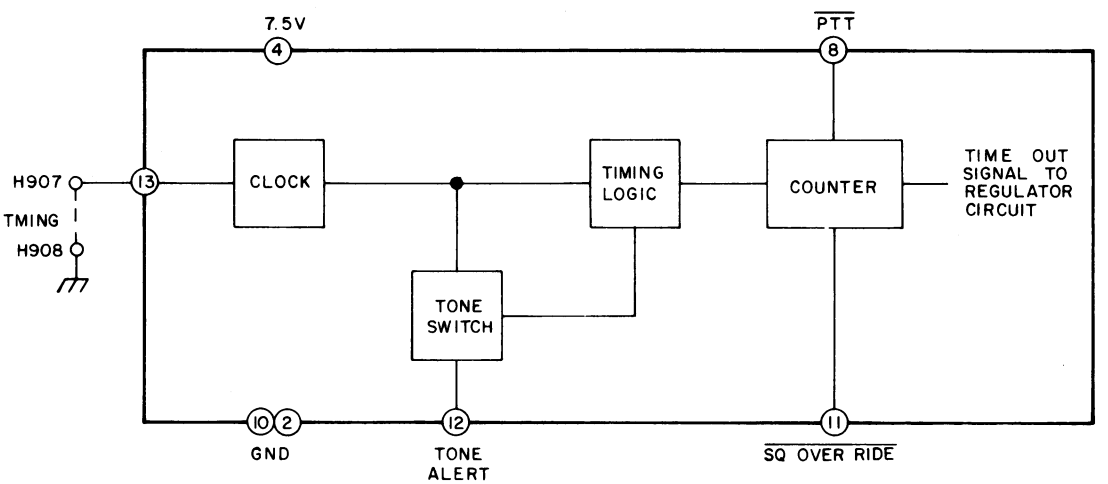
Crystal Discriminator Module (XD)

Audio Amplifier Module (Rx-AA)

Squelch Module (SQ)

Optional Channel Guard Module (CG)

Optional Search Lock Monitor Module (SP)



TMING	RESISTOR VALUE CONNECTED BETWEEN H907 AND H908	GE PART NO.
60 SECONDS	430K	3R151P434J
90 SECONDS	820K	3R151P8245

RC3723

Figure 13 - Carrier Controlled Timer

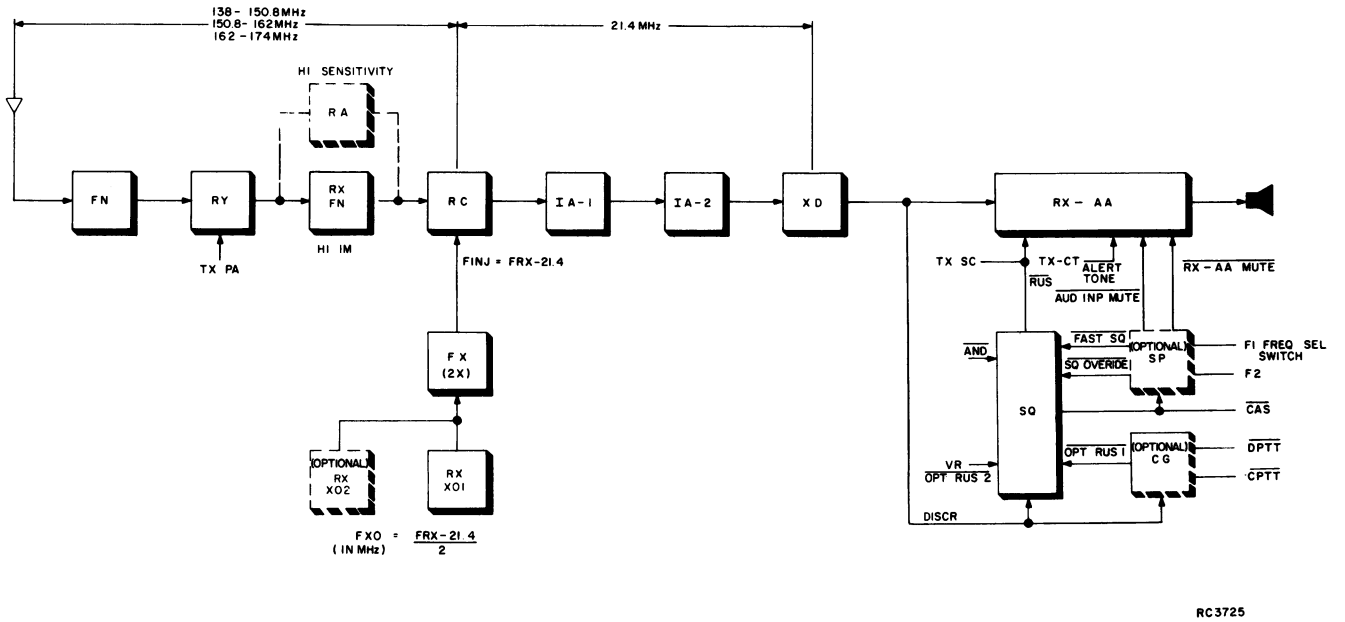


Figure 14 - Receive Circuit Block Diagram

Oscillator Module (Rx-XO)

The oscillator module is self-contained and fully temperature compensated (See Figure 15). A basic colpitts fifth mode oscillator circuit operates in the frequency range of 53 to 76 MHz. The output of the oscillator circuit is connected through a cascade common base buffer circuit to Pin 3 of the module. The output is typically 1 milliwatt.

Temperature compensation for the oscillator circuit is achieved by biasing a voltage variable capacitive diode with a correction voltage. The correction voltage is derived from a "S" shaped, correction voltage vs temperature curve.

The frequency of the oscillator module is trimmed using a slug tuned coil molded into the oscillator header providing a multi-turn resolution.

The output of the oscillator module is connected to Pin 3 of the frequency multiplier module (FX).

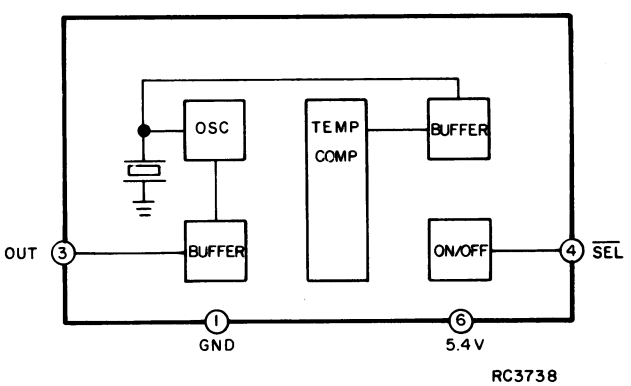


Figure 15 - Rx Oscillator

Frequency Multiplier Module (FX)

The frequency multiplier module doubles the oscillator frequency. The oscillator frequency on Pin 3 of the multiplier module is amplified and multiplied by a buffer and multiplier stage (See Figure 16). A slug tuned coil molded into the header of the module provides interstage matching. A test point is provided for this adjustment. Three helical resonators provide output filtering of the +7 dBm injection signal to the receiver converter module (RC).

Optional RF Pre-amplifier Module (RA)

The optional RF pre-amplifier module is used in the high sensitivity receive circuit, type ER110A, to provide an additional 10 dB of RF gain.

RF from the antenna is coupled through transmit low-pass filter FN and antenna

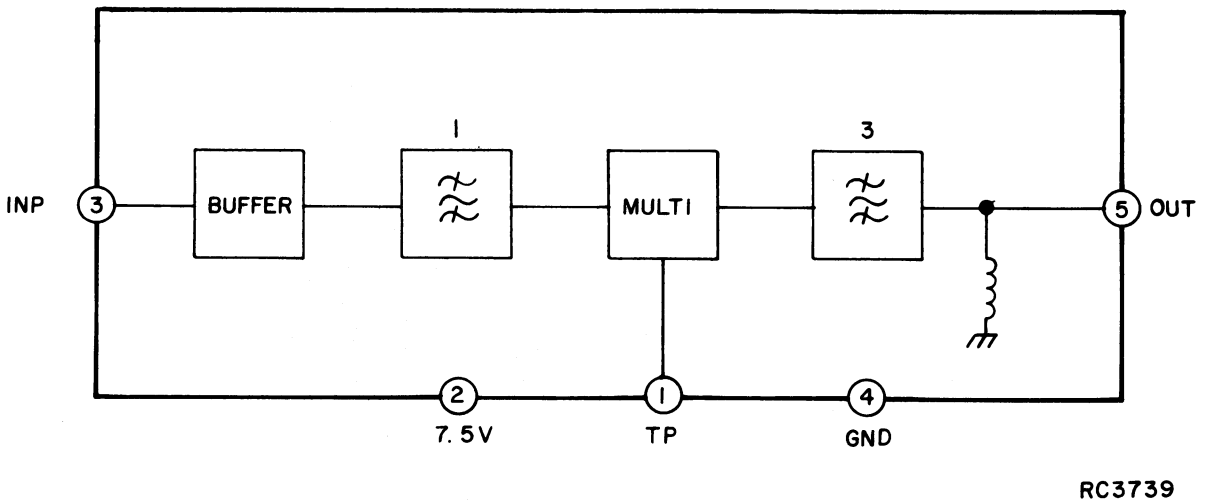


Figure 16 - Frequency Multiplier

relay RY to the input of the RA module (See Figure 17). The transmit low-pass filter is used in the receive circuit because of the 3rd mode response of the helical resonators in the Receive Converter module.

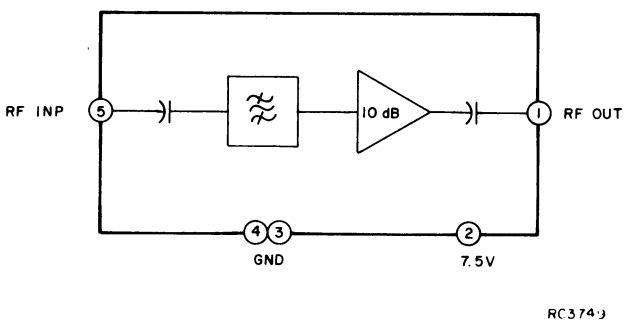


Figure 17 - RF Pre-amplifier

The low-pass filter also provides additional selectivity for the receive circuit.

A bandpass filter in the RA module insures image and spurious rejection. Both input and output of the RA module have an impedance of 50 ohms. The output of the RA module is coupled through a buried 50 ohm stripline, on the system board, to the input of the Receive Converter Module (RC).

Filter Network Module (Rx-FN)

The filter network module replaces the RA module in the high-intermodulation (HI-IM) receive circuit, type ER109A. This module is used to reject IF images.

Receive Converter Module (RC)

The receive converter module contains four helical resonators, tuned for best receive circuit quieting, and a passive, doubly balanced, diode mixer circuit mounted in a plated zinc casting (See Figure 18). The 138-174 MHz RF signal on the RF input of the RC module and the 116.2-115.2 MHz low side injection frequency on the injection frequency input provides a difference of 21.4 MHz as an IF on the output. The RC module has a typical conversion loss of 6 dB between the RF input and the IF output. All inputs and the IF output of the RC module have 50 ohm impedances. The +7 dBm injection level provided by the FX module is connected to the injection frequency input of the RC module through a buried 50 ohm stripline.

The output of the RC module is connected to the input of IF pre-amplifier module (IA-1).

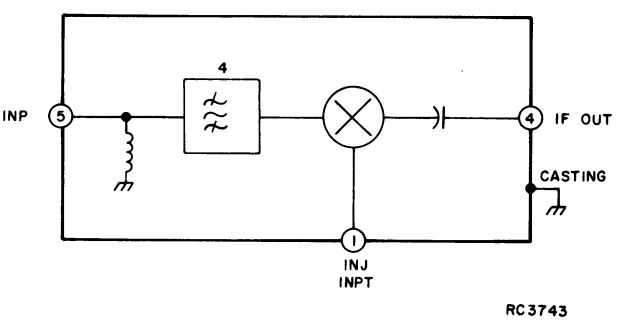


Figure 18 - Receive Converter

IF Pre-amplifier Module (IA-1)

The IF Pre-amplifier module contains an amplifier circuit and a four pole crystal filter (See Figure 19). The 21.4 MHz IF signal from the RC module feeds the input of an amplifier stage providing a 15 dB power gain. The 21.4 MHz IF is connected through the crystal filter with the output on Pin 1. The IA-1 module has an input impedance of 50 ohms and an output impedance of approximately 1200 ohms. The output of the IA-1 module is connected to the input of IF amplifier module IA-2.

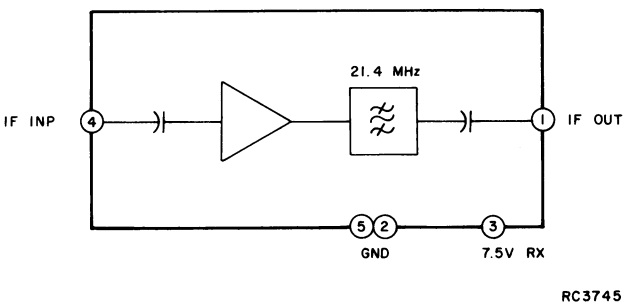


Figure 19 - IF Amplifier

IF Amplifier Module (IA-2)

IF Amplifier module IA-2 contains a 45 dB power gain stage and a 4-pole crystal filter. Input and output impedances of this module are approximately 1200 ohms. The input to the IA-2 module is fed from the output of the IA-1 module. Both input and output pins of the IA-2 module are AC coupled, with the output driving the crystal discriminator module (XD).

Crystal Discriminator Module (XD)

The crystal discriminator module contains two additional IF amplifier stages for an added 80 dB gain. The discriminator module also contains a crystal resonator, audio detector circuit and audio amplifier circuit (See Figure 20). The 21.4 MHz IF input is connected to the input of the IF amplifier stages for gain and limiting. The output of the amplifier stages is connected through the crystal resonator to the audio detector circuit.

The recovered audio from the detector circuit is amplified and buffered to a 1K impedance and drives the DISC output lead. This lead feeds the audio to the squelch, audio, and optional tone modules. A typical audio level of 200 millivolts rms is achieved with a 3 kHz deviation at an audio frequency of 1 kHz. The frequency response is flat within ±1 dB over the useful audio range of 70-3000 Hz.

Audio Amplifier Module (Rx-AA)

The audio amplifier module contains an active low-pass filter, an active notch filter, an attenuator circuit and an audio power amplifier circuit (See Figure 21). Audio from the DISCR lead is connected through the low-pass filter to de-emphasize the audio high frequencies and provide the desired audio response. The output of the low-pass filter is connected to the input of the notch filter. The notch filter eliminates the presence of any Channel Guard tone in the recovered audio. The output of the notch filter is connected to the input of the attenuator circuit.

The attenuator circuit is DC voltage controlled and provides a greater than 70 dB

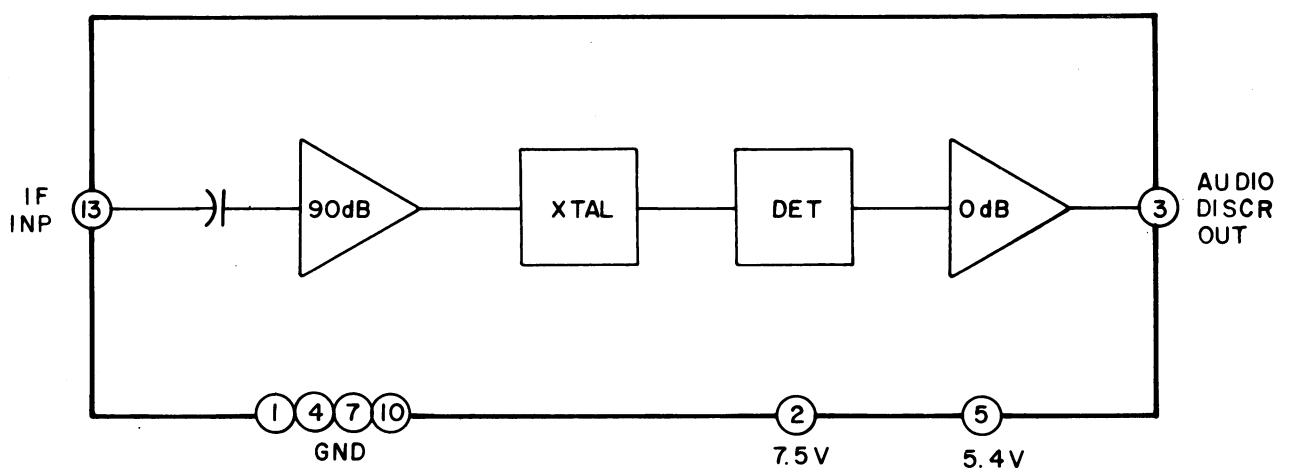


Figure 20 - Crystal Discriminator

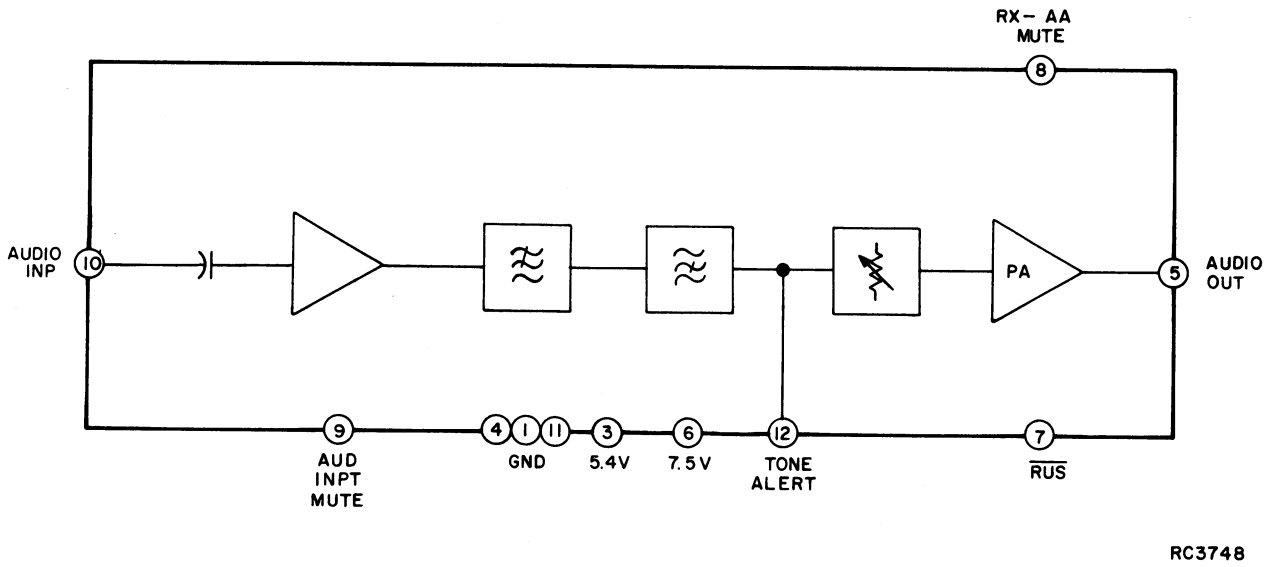


Figure 21 - Audio Amplifier

range for the volume control. The module provides filtering for the DC control voltage, reducing any noise from a dirty control. The output of the attenuator circuit is connected to the input of the audio power amplifier circuit.

The audio power amplifier circuit provides 500 milliwatts audio output, with 5% maximum distortion, into a capacitor coupled eight ohm speaker.

The output of the audio power amplifier has thermal overload protection making it indestructable into open or shorted loads.

The audio power amplifier is controlled by the $\overline{\text{RUS}}$ control lead. When the lead is high the amplifier is in the standby mode. The $\overline{\text{RUS}}$ lead shuts down the current to the attenuator circuit and the audio power amplifier circuit. The $\overline{\text{Rx-AA MUTE}}$ lead shuts down the current to the power audio amplifier muting the audio output and is used with a priority Search Lock Monitor option (PSLM). The $\overline{\text{AUD INPT MUTE}}$ signal lead is also used with the PSLM option and mutes audio from the discriminator approximately 65 dB preventing popping during priority channel search.

Squelch Module (SQ)

The squelch module contains an attenuator circuit, limiter circuit, high-pass filter, level detector and rectifier circuit, fast/slow squelch circuit, $\overline{\text{CAS}}$ switch and logic circuit (See Figure 22).

Audio and noise is applied to the input of the attenuator circuit. The attenuator circuit is DC controlled by squelch control R702 connected to the $\overline{\text{SQ}}$ lead. The control voltage is from 2.5 to 4.5 VDC with the $\overline{\text{SQ}}$ lead indicating a low voltage for a squelch condition. The output of the attenuator circuit is connected to the input of the limiting circuit. The output of the limiting circuit is connected through the high-pass filter to filter out any audio signal present, preventing squelch clipping.

The filter is peaked at approximately 8 kHz. The noise from the output of the filter is connected to the input of the detector.

The detector senses the noise level present and controls the $\overline{\text{FAST SQUELCH}}$ and $\overline{\text{CAS}}$ outputs. When squelched the $\overline{\text{FAST SQUELCH}}$ control lead is low and the $\overline{\text{CAS}}$ control lead is high. The detector also has hysteresis that prevents instant squelching of the receive circuit when there is a sudden loss of signal. The squelch tail is 50-500 milliseconds depending on how close the squelch control is set to critical. When the signal strength is 20 dBNQ the fast/slow squelch comparator circuit defeats the hysteresis making the squelch tail approximately 8 milliseconds.

The output of the squelch circuit is connected to the input of the logic circuit and to the carrier activity sensor ($\overline{\text{CAS}}$) output. When the input to the $\overline{\text{CAS}}$ output is low, the LED channel busy indicator lights.

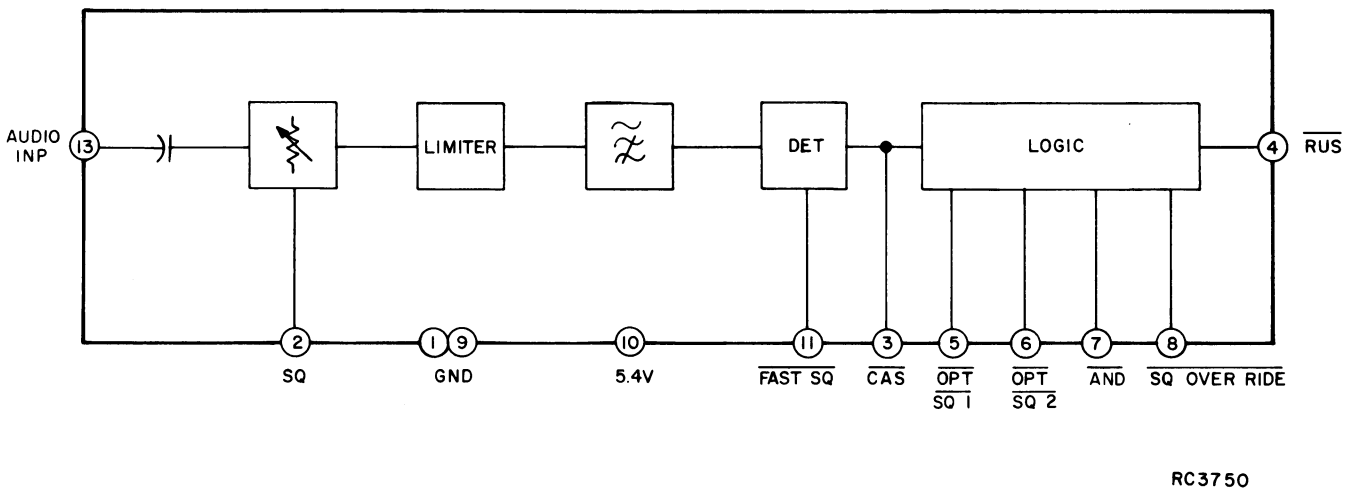


Figure 22 - Squelch

The logic circuit preforms all system control of the RUS lead, using inputs from two external tone option modules, SQUELCH OVERRIDE and noise squelch from the squelch switch.

The external tone decoder inputs, OPT SQ1 and OPT SQ2, are normally high and are pulled low by external tone decoders which have not decoded. The radio automatically converts to the normal noise squelch when an external decoder is removed from the circuit. Grounding the SQUELCH OVERRIDE forces the squelch to open regardless of any decoder or noise squelch condition.

If two external tone decoders are used, the AND as well as the OR functions of these decoders may be controlled by the AND control lead. In any case, the noise squelch must be open before RUS will be pulled low.

Optional Channel Guard Module (CG)

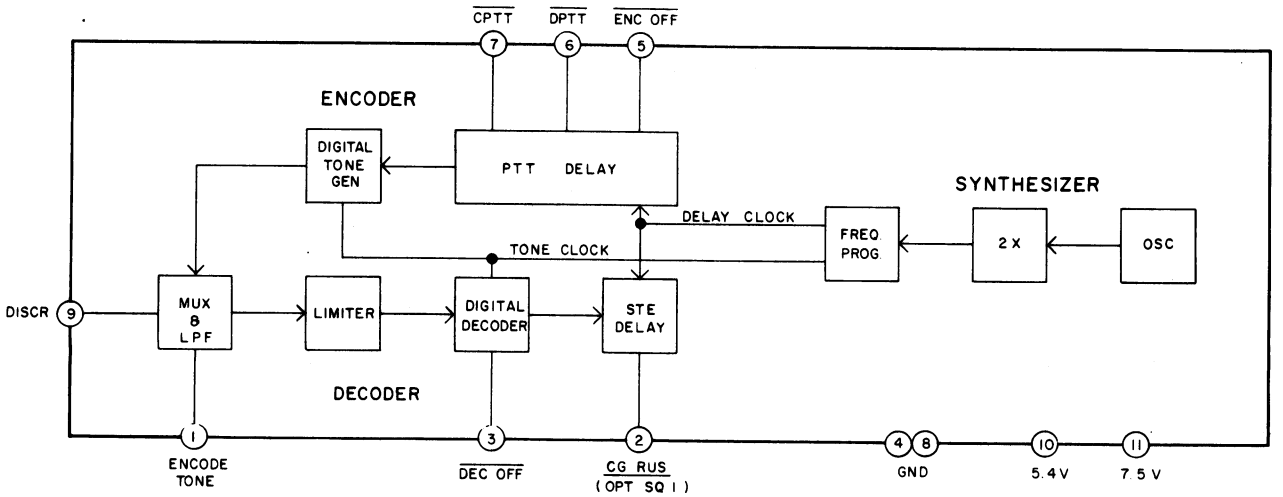
The Channel Guard module contains a tone frequency synthesizer, encoder, decoder and Squelch Tail Eliminator circuitry (See Figure 23). The synthesizer is programmable to produce Channel Guard tones from 67 to 210.7 Hz in 0.25 Hz increments. The synthesizer uses a crystal controlled 32,768 Hz reference to produce the desired clock inputs to the encoder and decoder circuits and produce digitally generated time delays for the STE circuitry.

When the transmit circuit is keyed, the CPTT lead is pulled low and the Channel Guard module responds by pulling the DPTT lead low, holding the transmit circuit in a keyed condition. The encoder circuit generates a sine wave encode tone which passes through a low pass filter to remove any clock and tone harmonics. This output tone is connected by the CG ENC lead to the transmit audio processor module (Tx-AA).

When the radio is unkeyed, the CPTT lead goes high but the PTT delay circuit holds the transmit circuit in a keyed condition for an additional 160 milliseconds by holding the DPTT lead low during this time. During this 160 millisecond time, the encode circuit sends the tone with a 135^0 phase shift. This combination of 135^0 phase shift and 160 millisecond delay causes the CG decoder in other receivers to squelch the receiver audio prior to loss of RF signal. This reduces or eliminates the receiver noise burst.

During receive, the receive circuit audio on the DISCR lead is fed to the CG module where it passes through a 212 Hz low pass filter to remove voice information. This prevents voice falsing or clipping in the decoder circuit. The digital decoder compares the frequency of the incoming tone to a reference clock produced by the synthesizer. If the correct tone is detected, the module responds by releasing the CG RUS lead which is normally held in a low voltage condition when the correct tone is not detected.

After decoding the tone, the decoder then looks for a phase shift to occur. If the phase shift occurs, the decoder responds by pulling CG RUS low for 200 milliseconds using the STE delay circuit. This forces the receive circuit to squelch for 200 ms during which time the received carrier should disappear.



RC-3751

Figure 23 - Channel Guard

Optional Priority Search Lock Monitor (SP)

The priority search lock monitor allows the receive circuit to monitor each receive channel every 40 milliseconds. This is accomplished by alternately switching on each receive oscillator module (See Figure 24).

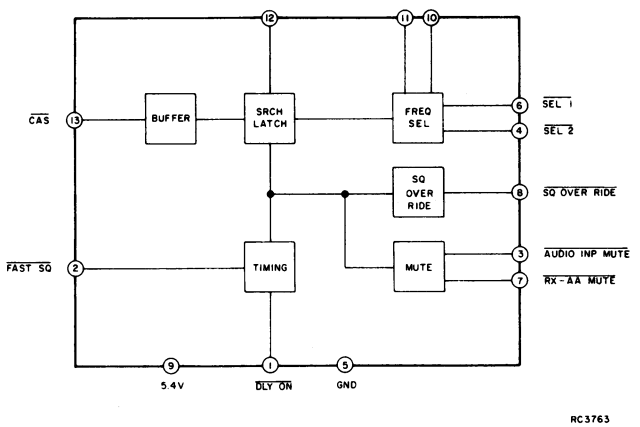


Figure 24 - Priority Search Lock Monitor

If the squelch circuit detects a carrier, the CAS control lead on Pin 13 of the SP module will go low. The CAS control lead going low causes the SP module to stop the search, locking on the active receive channel. If the active channel is the non-priority channel, the SP module will continue to search the priority channel for 8 milliseconds every 240 milliseconds. During the priority search, the RX-AA MUTE control lead and the AUD INP MUTE signal lead are pulled low to mute the receiver.

The SQ OVERRIDE control lead is also pulled low to prevent the fast squelch from closing during the search. This reduces noise during search to an almost inaudible tick.

If the active channel is a priority channel, the SP module will immediately lock on the priority channel.

Resumption of search on either channel is delayed 640 milliseconds. This delay can be defeated by connecting a jumper between H6 and H7 on flexible printed wire board A701. This jumper connects 5.4 V to Pin 1 of the SP module.

The priority channel, normally channel one, can be changed to channel two by connecting a jumper between H8 and H9 on A701. This jumper connects 5.4 V to Pin 12 of the SP module.

The transmit channel is predetermined by internal connections to make the search stop on the priority channel, normally channel one, as soon as the PTT bar is pressed and 5.4 V is applied. To transmit on the non-priority channel the search must be disabled.

With search, on and no channels are active, the search LED indicator will blink at a fast rate. If the priority channel is active the indicator will remain on. If the active channel is non-priority the indicator will remain off.

POWER DISTRIBUTION

Power for the MPR is supplied by a 7.5 Volt battery pack connected to connector

J702 (See Figure 25). The negative terminal of the battery pack connects through the shell of connector J702 and a flexible metal strap to the system board ground pattern. The positive terminal of the battery pack connects through the system ON/OFF switch and flexible printed wire board to the system board for distribution. All distribution leads are on the back side of the multi-layered system board.

Some modules on the system board operate directly from the battery voltage or through a R-C de-coupled 7.5 volt lead for noise reduction. During transmit, an additional regulated 4.8 Volts is generated by the PL module to run the VO module. A continuous and keyed 5.4 volts is also provided by voltage regulator module (VR).

The 7.5 Volts from the battery connects through relay K901 and resistor R903 to the receive RF amplifier module (RA), frequency multiplier module (FX), IF amplifier modules (IA-1 and IA-2) and discriminator module (XD).

Voltage Regulator Module (VR)

The voltage regulator module, powered from the 7.5 volts supply, current limited and highly stable, generates a continuous 5.4 volt output (See Figure 26). During transmit, when the DPTT lead is low, the regulator module also provides a keyed 5.4 volt output for transmit functions. When the transmit circuit is keyed the regulator module activates the system relay by saturating a keying transistor.

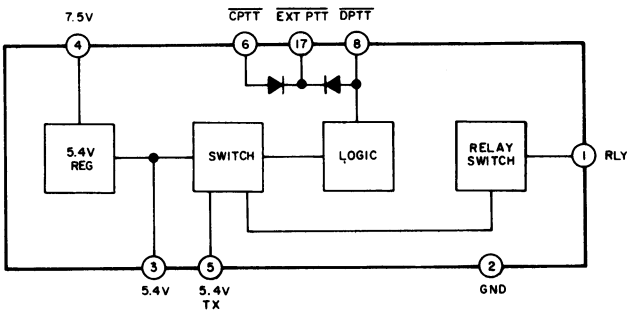


Figure 26 - Voltage Regulator

External Power

An external power source can be connected at J701-12. When Pin 12 of J701 is pressed, battery voltage is removed from the radio. The radio may now be powered by an external 7.5V source, completely bypassing ON/OFF switch S701. In vehicular chargers, the radio is turned on and off from the charger. The DC return should be the ground contact on the battery pack.

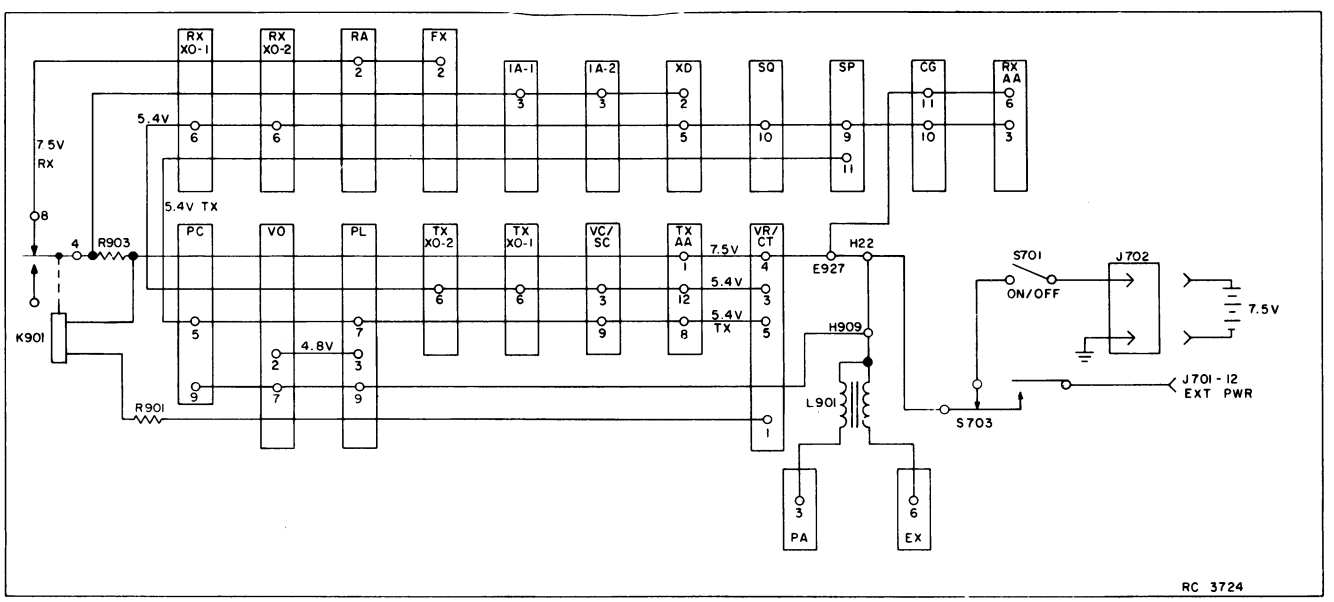


Figure 25 - Power Distribution

WARNING

When powering the radio from an external supply for service purposes, use a suitable fused 5 Amp supply or a 3 amp current limited supply. DO NOT USE a PE battery pack because a system short can cause unrepairable damage to the multi-layered system board or to the flexible printed wire board.

BATTERY PACK

Two battery packs, one with 700 mAh capacity and one with 1200 mAh capacity are available for use with the MPR radio. Both battery packs contain six nickel cadmium battery cells to provide a nominal 7.5 volts DC output.

To protect the battery pack from external short circuits, the positive (+) charging contact is diode protected and the positive output terminal is fused. The fuse is replaceable.

An internal thermistor senses variations in battery pack temperature to automatically control a charger and provide a maximum charge without overheating the battery pack. Both battery packs can be re-charged in one hour.

The battery pack is fully charged and shipped to the customer ready for use. If the battery pack is stored for any length of time it should be fully re-charged before placing into service.

Charger combinations for re-charging the MPR battery packs are available with charge times of 1-hour, 3-hours and 14-hours. A combination can be a single unit desk or a vehicular charger. It can also be a wall or bench mounted rack charger with a multiple of charge units.

CONTROL LEADS

$\overline{\text{AND}}$ - Receiver audio is heard only when the noise squelch and a tone option open simultaneously. When two tone options are present, the tone option can use the AND function and the noise squelch can use an OR function.

$\overline{\text{CAS}}$ - Carrier Activity Sensor goes low when the noise squelch is open. This does not mean the receiver audio can be heard.

$\overline{\text{CPTT}}$ - This is an OR function of $\overline{\text{PTT}}$ and $\overline{\text{EXT PTT}}$.

$\overline{\text{DEC OFF}}$ - A low on this lead turns a Channel Guard decoder off. The DEC OFF lead is grounded by a switch on the Control panel, placed in the MONITOR position.

$\overline{\text{DLY ON}}$ - Delays the resumption of search by the SP until the radio is squelched.

$\overline{\text{DPTT}}$ - Delayed PTT control lead from a tone module used for squelch tail elimination.

$\overline{\text{ENC - OFF}}$ - A low on this lead turns off a Channel Guard encoder off.

$\overline{\text{EXT - PTT}}$ - External PTT lead from UDC connector.

$\overline{\text{FAST SQ}}$ - A low on this lead indicates the priority fast squelch has not detected a carrier.

$\overline{\text{FIXED PRI}}$ - When low, priority channel is fixed. When high, the priority channel is set by the channel select switch.

$\overline{\text{LOW POWER}}$ - A low on this lead, with the low power option, indicates the transmit circuit is in the low power condition.

$\overline{\text{MIC MUTE}}$ - A low on this lead mutes all transmit microphone inputs. This enables data to be transmitted through the tone input signal lead with the microphone muted.

$\overline{\text{OPT SQI}}$ - This lead is normally high on a noise squelch only unit; meaning, an external tone option has not caused the squelch to close. This lead is pulled low by a tone option when it is installed and has not decoded.

$\overline{\text{OPT SQ2}}$ - This lead is the same as $\overline{\text{OPT SQI}}$ except for a second tone option.

$\overline{\text{PTT}}$ - Internal Push-to-talk; a low on this lead indicates the unit has been keyed by the side PTT bar.

$\overline{\text{RUS}}$ - Receiver Unsquelch Signal goes low when the receive audio amplifier is on.

$\overline{\text{RX-AA MUTE}}$ - A low on this lead turns off the receiver audio amplifier.

$\overline{\text{SEL-1}}$ - A low on this lead indicates channel one has been keyed.

$\overline{\text{SEL-2}}$ - A low on this lead indicates channel two has been keyed.

$\overline{\text{SQUELCH OVERRIDE}}$ - A low on this lead forces the audio to open regardless of the noise squelch or tone decoder condition.

$\overline{\text{SRCH ON}}$ - A low on this lead turns the SP on.

$\overline{\text{UNLOCK}}$ - A low on this lead occurs when phase lock has not been achieved, holding the transmit PA stages in an off condition.

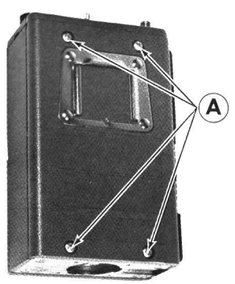
$\overline{\text{VOX OFF}}$ - A low on this lead defeats VOX.

DISASSEMBLY PROCEDURE

Caution: Always remove the battery pack before removing any component board to avoid blowing the fuse.

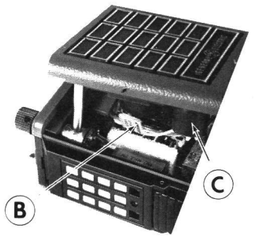
Equipment Required

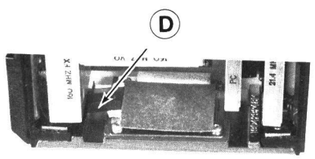
- Small Phillips-head screwdriver.
- Small flat-blade screwdriver.
- Needlenose pliers.
- Allen-head wrench for removing set screws.
- Pencil-type soldering iron (40-60 watts) with a fine tip.



STEP 1.

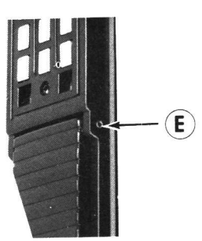
To gain access to the radio, loosen, but do not remove, the four captive screws at (A). Carefully remove the back cover. For normal radio alignment, the back cover is all that need be removed. When tightening the captive screws, they should be no tighter than 4 ±.5 inch-pounds.





STEP 2.

To gain access to the module side of the radio, step 1 must be completed and the radio turned over. Carefully remove the front cover and disconnect the speaker at (B).
When replacing the front cover the speaker leads must be routed as shown. The rubber microphone cover should be pushed in at (C) to allow the cover to snap shut. Also the flexible printed wire board may require lifting at (D) to allow the standoff to fit into the slot in the housing.

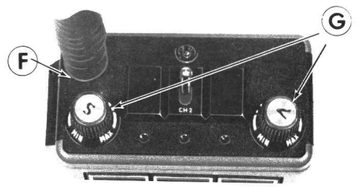


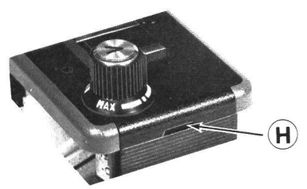
STEP 3.

To remove the PTT switch, push out pin at (E). The PTT bar should come right out.

STEP 4.

To replace the speaker and microphone remove the four Phillips-head screws holding the speaker retaining plates and remove the speaker. The microphone is held in place only by the rubber mike boot and can easily be removed.

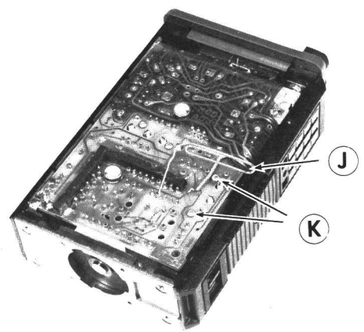




STEP 5.

To replace controls and LED indicators, remove the antenna by unscrewing the antenna at (F) and remove it from the antenna stud.

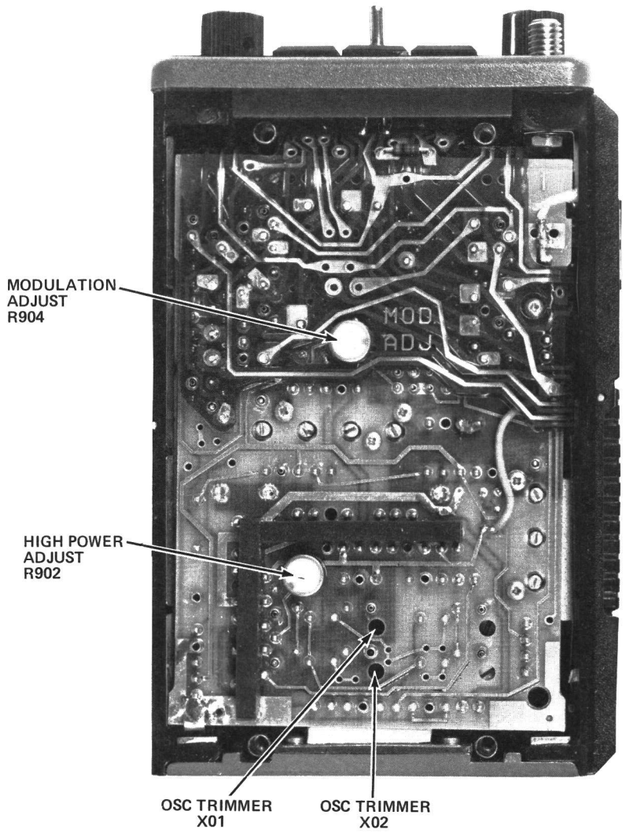
Loosen set screws at (G) and remove knobs. With a flat-blade screw driver snap top cover off at (H). The slotted nuts holding the controls are easily accessible. When disconnecting Option controls remove the leads from the control and not the flexible printed wire. The Volume control, Squelch control and LED indicators must be unsoldered from the printed wire board.



STEP 6.

To remove modules from the system board, remove both front and back covers. A simple bent paper clip can be used as a tool to push a module from the board. A number 64 drill bit in a pin vise makes a sturdier and more permanent tool. A piece of .036 steel wire can be used in place of the drill bit. Ground pins with knockout bottoms are present on the system board for each module except for the Ex and PA modules. To remove a module, take the paper clip, insert it into the ground pin of the module to be removed (J) and push the module from the board. To remove the Ex or PA module insert the paper clip into a hole provided in the center of the board for removal of the module and push the module from the board.

Some modules have screws holding them in place. Before attempting to push a module from the board, remove any screws present (K).



TRANSMIT CIRCUIT

ALIGNMENT AND TEST PROCEDURE

TRANSMIT CIRCUIT ALIGNMENT

EQUIPMENT

1. General Electric Test Adapter 4EX12A11.
2. General Electric Audio Generator 4EX6A10.
3. General Electric Battery Pack Eliminator 19C328969G1.
4. Regulated Power Supply, set at 7.5 VDC and capable of 3 amperes, connected to the Battery Pack Eliminator.
5. Ammeter, capable of 3 amperes, in series with the power supply and Battery Eliminator.
6. Deviation meter.
7. 50 ohm terminating watt meter.
8. Frequency Counter.

PRELIMINARY

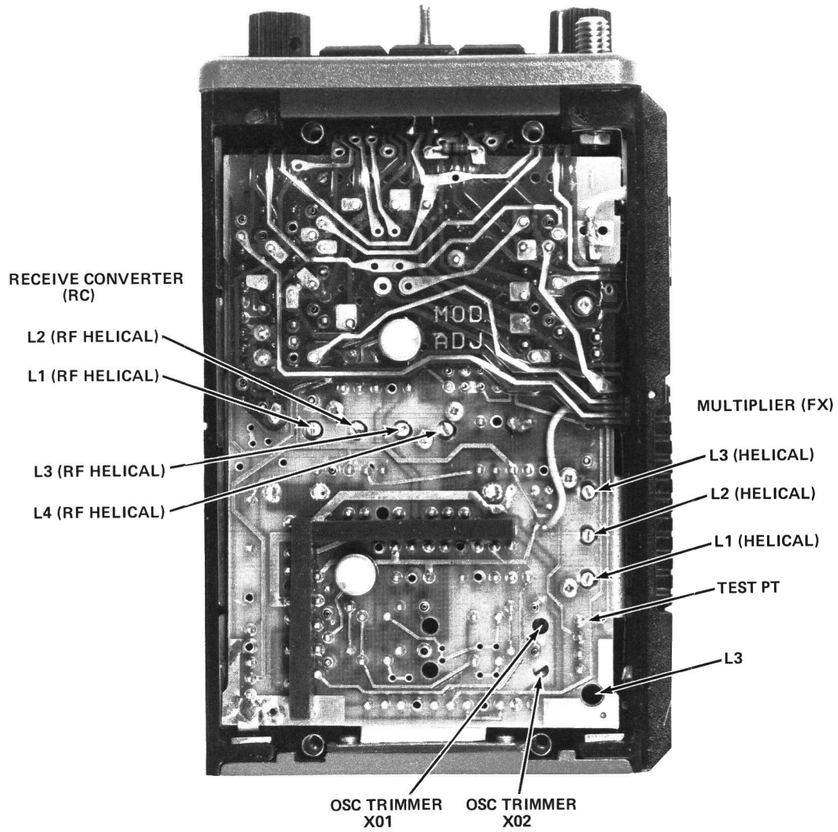
1. Carefully remove the back cover from radio (See Disassembly Procedure).
2. Connect equipment as shown.
3. Set Audio Oscillator for 120 millivolts RMS at 1 kHz.
4. Set HI PWR adjust R902 fully counterclockwise.
5. If present, set LOW POWER ADJ R2101 fully counterclockwise.

NOTE

In units equipped with the HI/LO power option, the HI/LO power may be slaved to the channel select switch. When making power adjustments insure the channel select switch is in a position where HI power is enabled for HI power out. In the case of LO power adjustments, insure the channel select switch is in a position where LO power is enabled for LO power out.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
HIGH POWER ADJUST			
1	R902	Transmit type KT167A - 2.5 Watts at 1.2 amperes or less.	Key transmit circuit and adjust HI PWR ADJUST R902 clockwise for rated current.
2	Multi-frequency switch	Transmit type KT168A - 6.0 Watts at 2.4 amperes or less.	Switch multi-frequency switch and determine which channel has the highest current.
3	R902		Re-adjust R902 until the channel with the highest current has rated current.
LOW POWER ADJUST			
4	R2101	Transmit type KT167A - 1 to 2.5 Watts.	Key transmit circuit and adjust LOW PWR ADJ R2101 clockwise to rated power output.
5	Multi-frequency switch	Transmit type KT168A - 1 to 6 Watts.	Switch multi-frequency switch and determine which channel has the highest current.
6	R2101		Re-adjust R2101 until the channel with the highest current has rated power output.
FREQUENCY ADJUSTMENT			
7	X0-1/X0-2		Key transmit circuit and adjust X0-1/X0-2 oscillator trimmers for proper oscillator frequency.
MODULATION ADJUST			
Voice Only			
8	R904	4.5 kHz deviation	Key the transmit circuit and adjust MOD ADJ R904 until deviation meter indicates 4.5 kHz.
9	Multi-frequency switch		Switch multi-frequency switch and determine which channel has the highest deviation.
10	R904		Re-adjust R904 for 4.5 kHz deviation on the channel with the highest deviation.
Voice and Channel Guard			
11	R904	4.5 kHz deviation	With the multi-frequency switch on a channel guarded channel, key the transmit circuit and adjust R904 until the deviation meter indicates 4.5 kHz.
12	Multi-frequency switch		Switch the multi-frequency switch and determine which channel has the highest deviation.
13	R904		Re-adjust R904 for 4.5 kHz deviation on the channel with the channel with the highest deviation.
14	--	500 Hz to 1 kHz deviation	To check the Channel Guard output, remove the audio oscillator input. The Channel Guard deviation should be between 500 Hz and 1 kHz.
Voice and Compressor			
15	--	35 millivolt RMS at 1 kHz	Set audio oscillator for 35 millivolts RMS at 1 kHz.
16	R904	3.8 kHz deviation	Key transmit circuit and adjust R904 until deviation meter indicates 3.8 kHz.
17	Multi-frequency switch		Switch the multi-frequency switch and determine which channel has the highest deviation.
18	R904		Re-adjust R904 for 3.8 kHz deviation on the channel with the highest deviation.
Voice, Channel Guard and Compressor			
19	--	3.5 millivolt RMS at 1 kHz	Set audio oscillator for 35 millivolts RMS at 1 kHz.
20	R904	3.8 kHz deviation	Key transmit circuit and adjust R904 until deviation meter indicates 3.8 kHz.
21	Multi-frequency switch		Switch multi-frequency switch and determine which channel has the highest deviation.
22	R904		Re-adjust R904 for 3.8 kHz deviation on the channel with the highest deviation.



RECEIVE CIRCUIT ALIGNMENT

EQUIPMENT

1. General Electric Test Adaptor 4EX12A11.
2. A 138-174 MHz signal source.
3. A 21.4 MHz signal source (Used in setting frequency).
4. Volt/Ohmmeter (20,000 ohms/volt DC).
5. RF voltmeter.
6. Distortion Analyzer.

PRELIMINARY

1. Carefully remove back cover from radio (see Disassembly Procedure).
2. Connect test equipment as shown (see Receive Circuit Test Procedures).
3. Set output of 138-174 MHz signal source for approximately 50 millivolts.
4. Turn SQUELCH control fully clockwise.
5. Turn all RF tuning screws out of the casting.
6. If multiple frequency, place the channel select switch in the lowest frequency position.
7. Turn all equipment on.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	PROCEDURE
	FREQUENCY MULTIPLIER (FX)	
1	L3	With volt/ohmmeter between TEST PT and ground, tune L3 for a peak indication (approximately 0.6 VDC).
2	MULTIPLIER HELICALS L1, L2 & L3	With RF voltmeter between Pin 1 of the Fx module and ground, tune MULTIPLIER HELICALS L1, L2 and L3 for maximum injection signal.
	RECEIVE CONVERTER (RC)	
3	RF HELICALS L1, L2, L3 & L4	With an on-frequency signal tune RF HELICALS L1, L2, L3 and L4 for maximum quieting. Reduce the signal level as the quieting increases keeping the receive circuit out of limiting.
	FREQUENCY ADJUSTMENT	
4		While applying an on-frequency signal, loosely couple a 21.4 MHz signal to the converter. Adjust the oscillator trimmer(s) for a zero beat frequency between the two signals.

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating --- but not properly. The problems encountered could be low audio, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized.

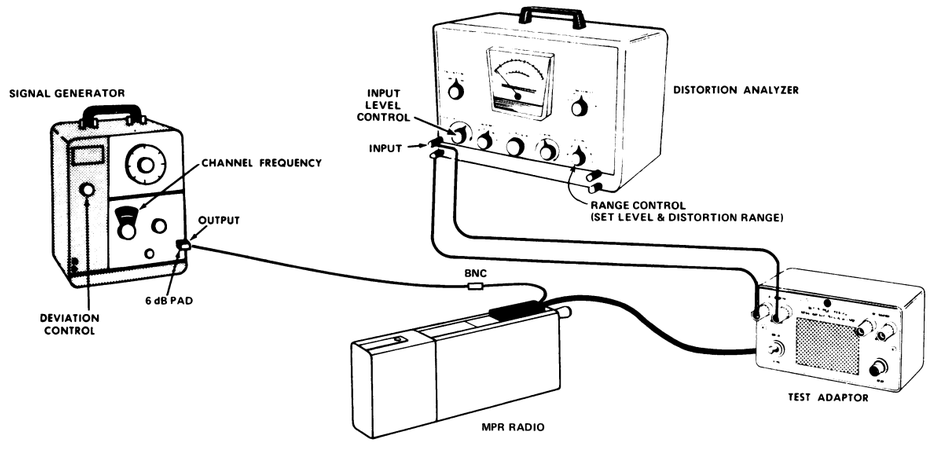
Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad
- Test Adaptor Model 4EX12A11

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



RECEIVE CIRCUIT TEST PROCEDURES

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power output as follows:

A. Connect a 1,000 microvolt test signal modulated by 1,000 hertz ±3.0 kHz deviation.

B. Set the Volume Control for a 500 milliwatt output (2 volts RMS).

C. Make distortion measurements according to manufacturer's instructions. Reading should be less than 10% (5% is typical). 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 0.5 watt, make the following checks:

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

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

STEP 2

USABLE SENSITIVITY (12 dB SINAD)

TEST PROCEDURE

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 3.0 kHz deviation.

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. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range 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 specification with an audio output of at least 250 milliwatts.

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, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWITH (IF BANDWITH)

TEST PROCEDURE

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 ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

THESE INSTRUCTIONS COVER THE FREQ CODING FOR C. G. MODULE 19D429618 USING THE STANDARD C. G. FREQ.

1. INSTALL CONTACT PINS (19B219681), PER FIG. 1, IN POSITIONS INDICATED BY "X" IN CHART 1, WHICH AGREES WITH DESIRED CG FREQ. (NOTE - EXAMPLE SHOWN FOR 127.3Hz).
2. ASSEMBLE SNAP ON COVER (19D429521P1).
3. BREAK OFF CONTACT TABS ABOVE COVER BY BENDING TOWARD EITHER END OF MODULE. (DO NOT BEND TAB TOWARD SIDE OF MODULE).
4. STAMP APPROPRIATE CG FREQ ON LABEL (NP280529) AND ASSEMBLE IN RECESS ON TOP OF COVER. (EXAMPLE 127.3)

CHART 1

FREQ CHART										
C.G. FREQ	CONTACT PIN POSITION									
	9	8	7	6	5	4	3	2	1	0
67	X		X	X	X	X			X	X
71.9	X		X	X		X	X	X	X	X
77	X		X	X			X		X	X
82.5	X		X		X	X		X		X
88.5	X		X			X	X	X		X
94.8	X		X					X		
100	X			X	X		X	X	X	X
103.5	X			X	X					X
107.2	X			X		X			X	
110.9	X			X					X	X
114.8	X				X	X		X		
118.8	X				X			X		
123	X					X			X	X
127.3	X								X	
131.8		X	X	X	X	X				
136.5		X	X	X		X	X	X		X
141.3		X	X	X			X		X	
146.2		X	X		X	X		X	X	
151.4		X	X		X					X
156.7		X	X				X	X		
162.2		X		X	X	X		X	X	
167.9		X		X		X	X	X	X	X
173.8		X		X			X			
179.9		X			X		X	X	X	X
186.2		X				X		X	X	
192.8			X	X	X	X	X	X		
203.5			X	X		X				X
210.7			X		X	X		X		

THESE INSTRUCTIONS COVER THE FREQ CODING FOR CG MODULE 19D429618 USING THE NON STANDARD CG FREQ.

1. USE CHART 2 TO CALCULATE THE CG FREQ DESIRED.
2. FIND THE FREQ DESIRED BY ADDING UP THE FREQ IN CHART 2. ABOVE EACH FREQ IS A CONTACT PIN POSITION NUMBER, IF THIS POSITION IS OPEN (THAT IS A PIN IS NOT INSTALLED), THE CG WILL PRODUCE THAT FREQ. IF MORE THAN ONE IS LEFT OPEN, THE OUTPUT FREQ WILL BE THE SUM OF THE OPEN POSITIONS.

   EXAMPLE: CG FREQ 128Hz THEREFORE CONTACT PIN POSITION #9 WILL BE OPEN AND CONTACT PINS WILL BE INSTALLED IN POSITION 0, 1, 2, 3, 4, 5, 6 ,7 AND 8.

   EXAMPLE: CG FREQ 132.75Hz. THEREFORE CONTACT PIN POSITION #9 WHICH IS 128, #4 WHICH IS 4, #1 WHICH IS .5, AND #0 WHICH IS .25 WILL BE OPEN. ADD THE FREQ 128 + 4 + .5 + .25 = 132.75. CONTACT PINS WILL BE INSTALLED IN POSITION #2, 3, 5, 6, 7 AND 8.
3. INSTALL CONTACT PINS, ASSEMBLE COVER AND STAMP LABEL PER INSTRUCTIONS FOR FREQ CODING THE STANDARD CG FREQ.

CHART 2

9	8	7	6	5	4	3	2	1	0	CONTACT PIN POSITION
128	64	32	16	8	4	2	1	.5	.25	FREQ IN Hz

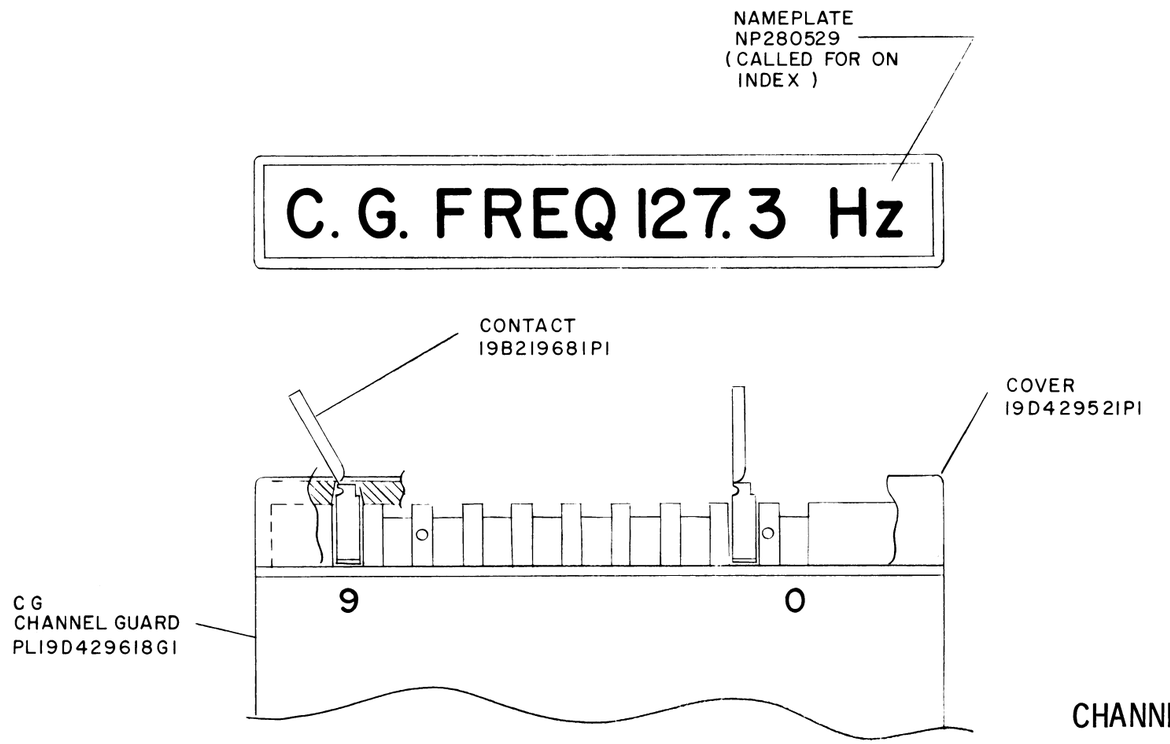
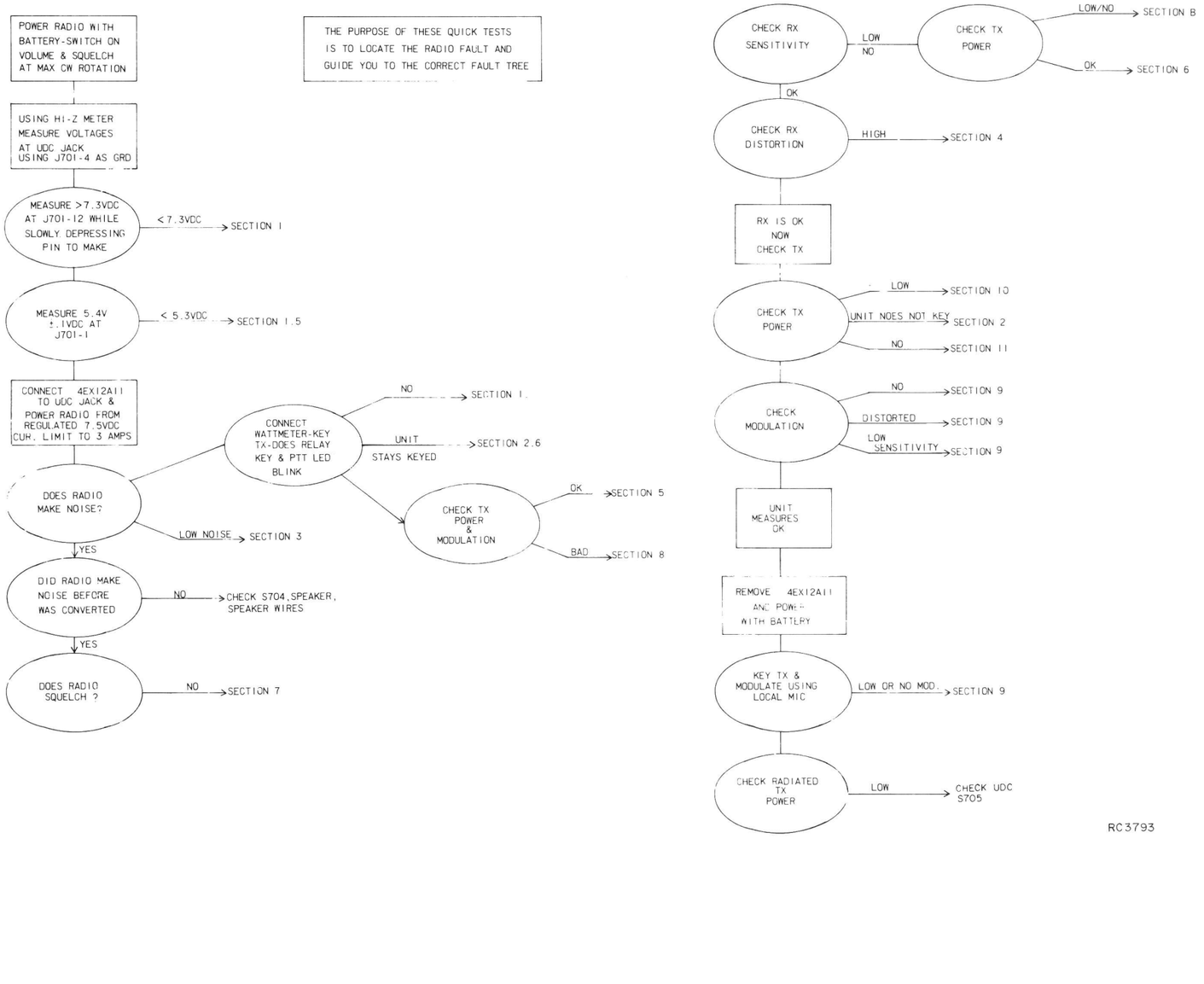


FIG. 1

(19D429867, Sh. 3, Rev. 0)

MPR TROUBLESHOOTING TREE



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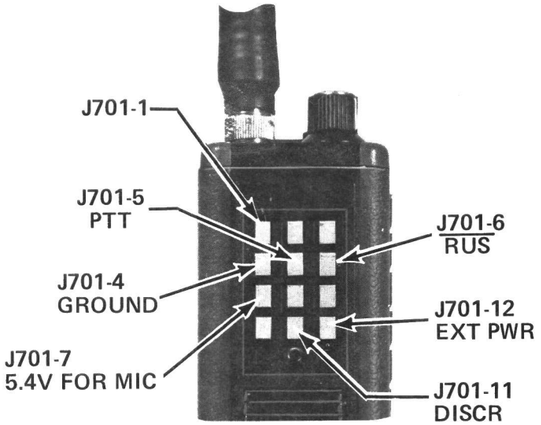
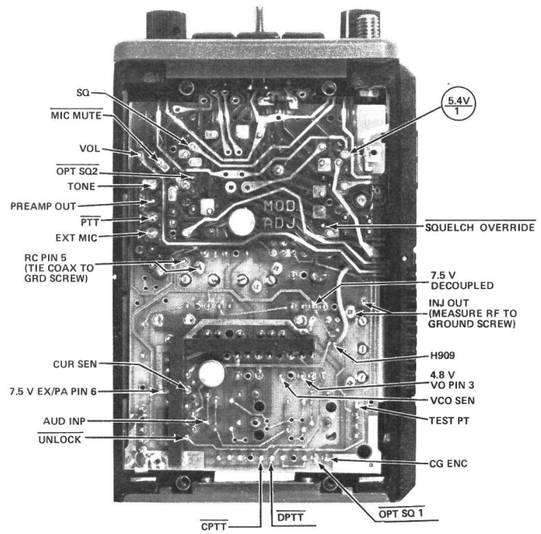
UDC JACK (J701) CONNECTION



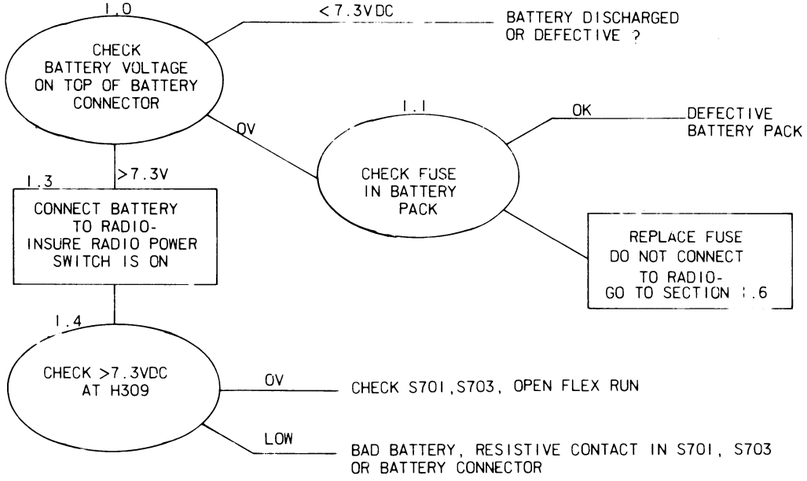
MPR SERVICE TEST POINTS



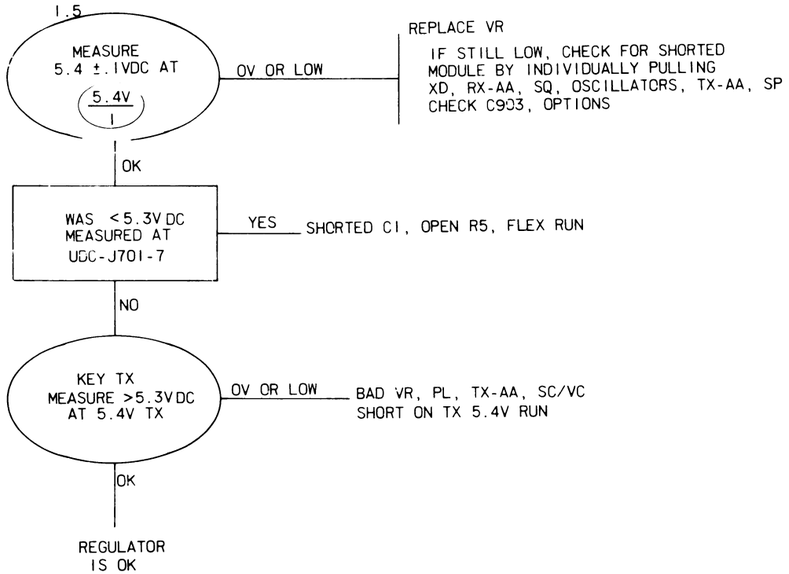
MPR TROUBLESHOOTING PROCEDURE

Sheet 1

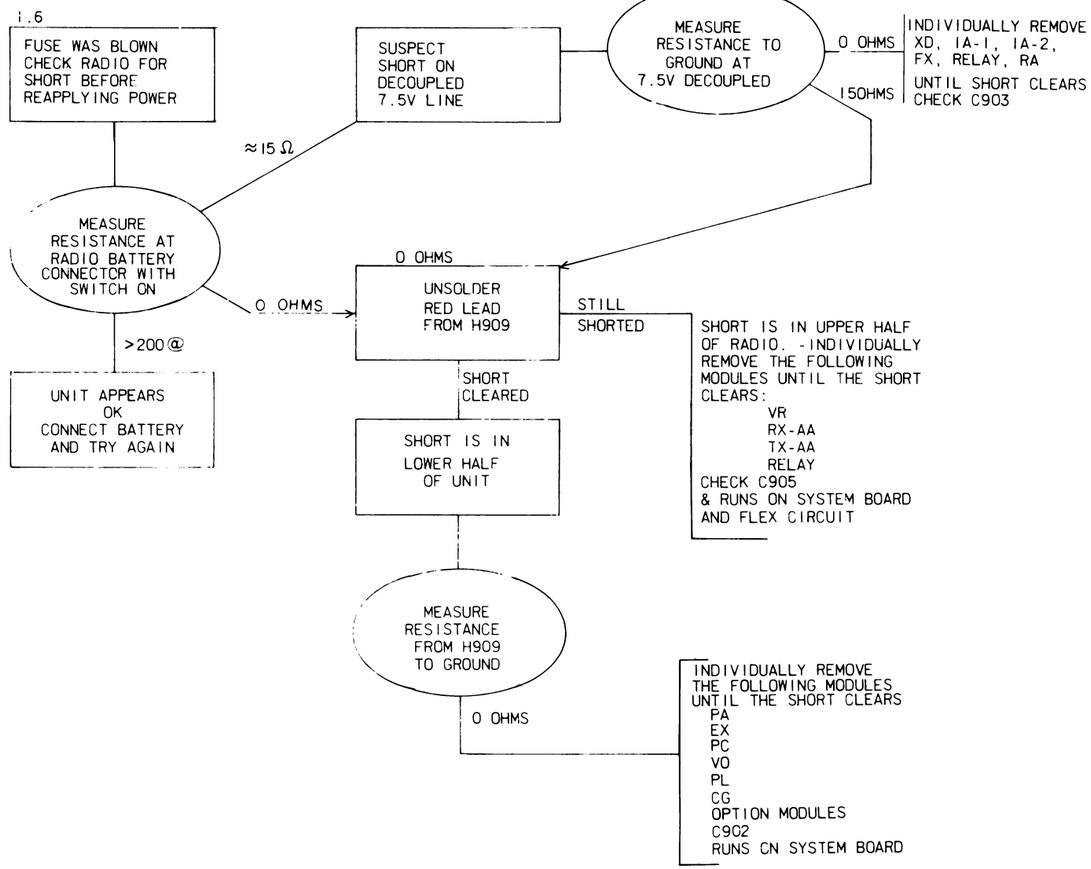
SECTION #1
POWER DISTRIBUTION FAULT



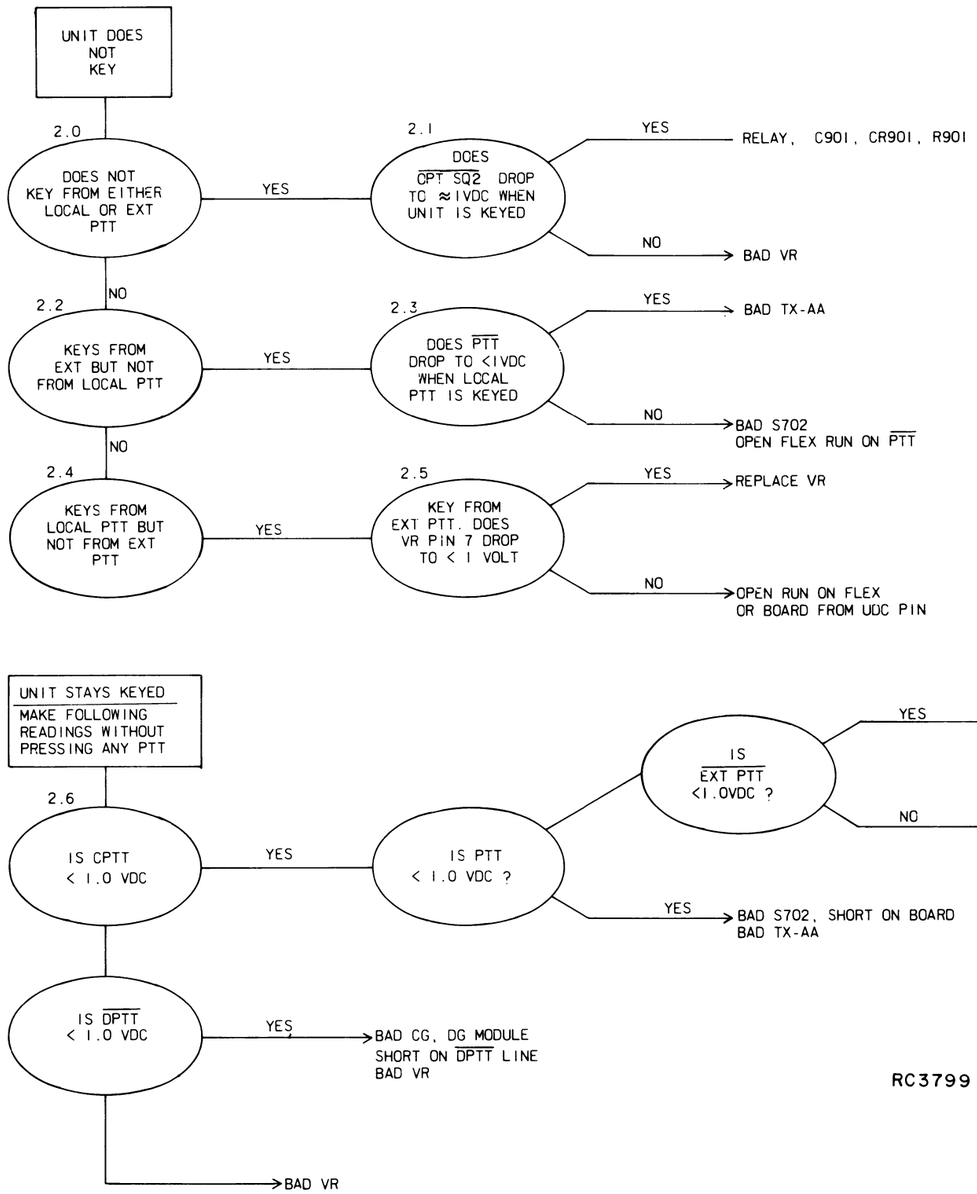
REGULATOR FAULT
SECTION 1.5



LOCATING A SHORT
SECTION 1.6



SECTION 2
TRANSMITTER KEYING FAILURE



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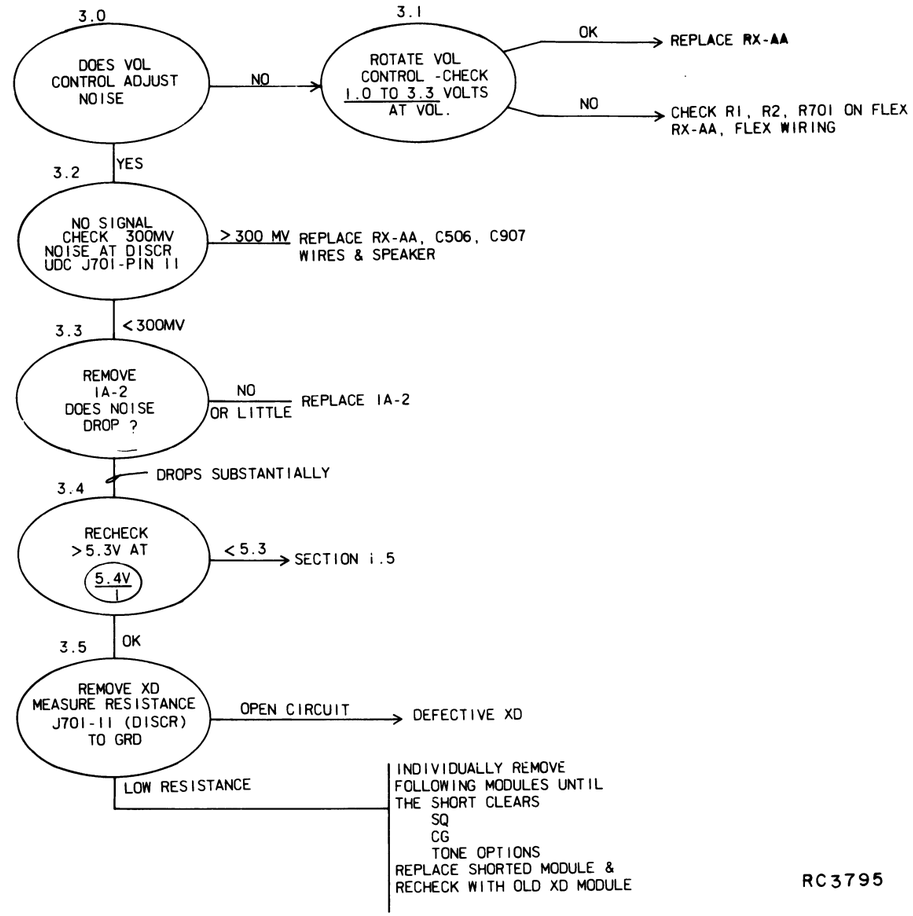
SECTION 3
RX AUDIO NOISE LOW



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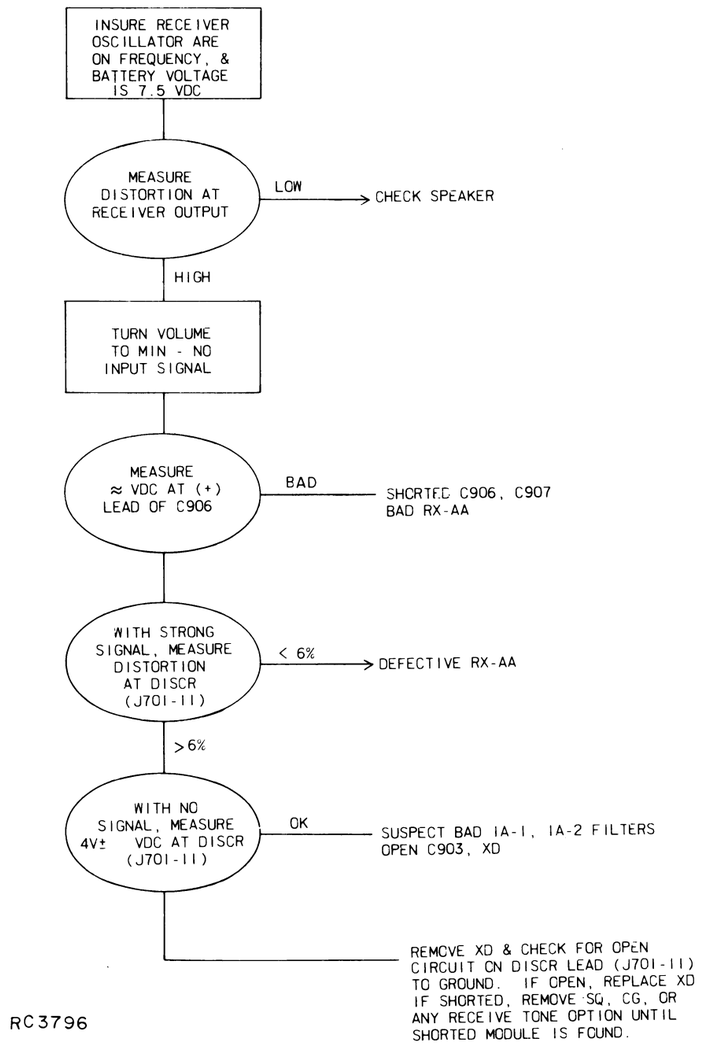
TROUBLESHOOTING PROCEDURE

SECTION 4
RECEIVER AUDIO DISTORTED



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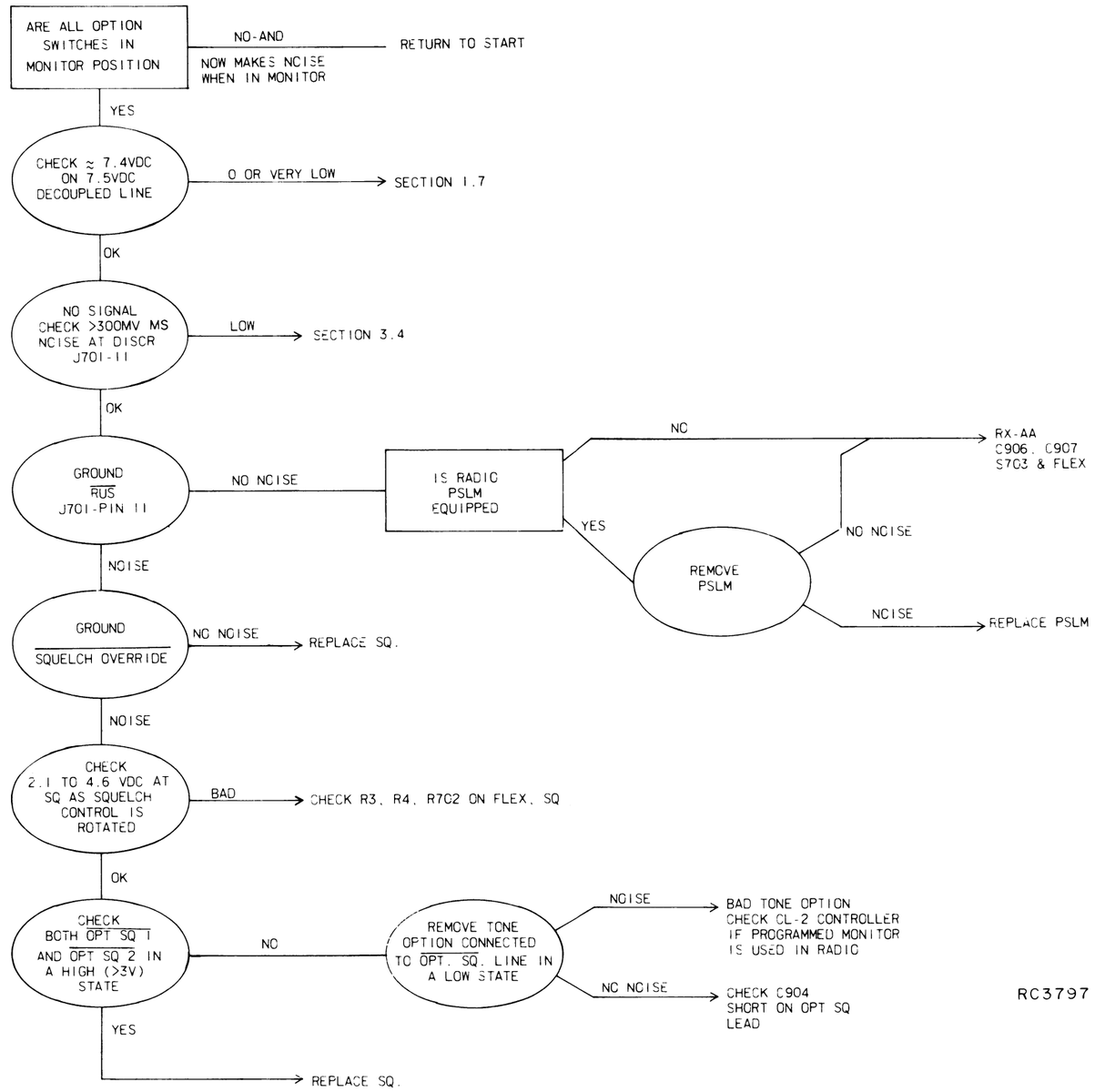
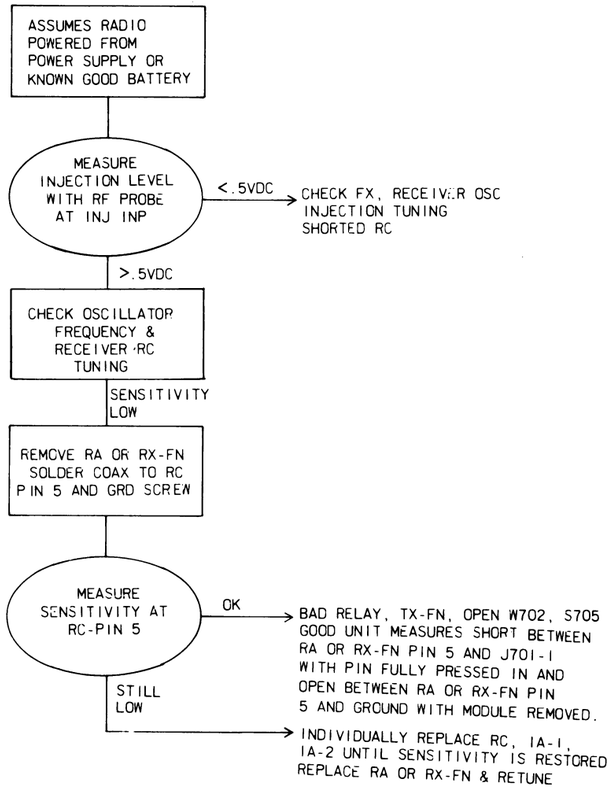
SECTION 5
NO RECEIVER AUDIO



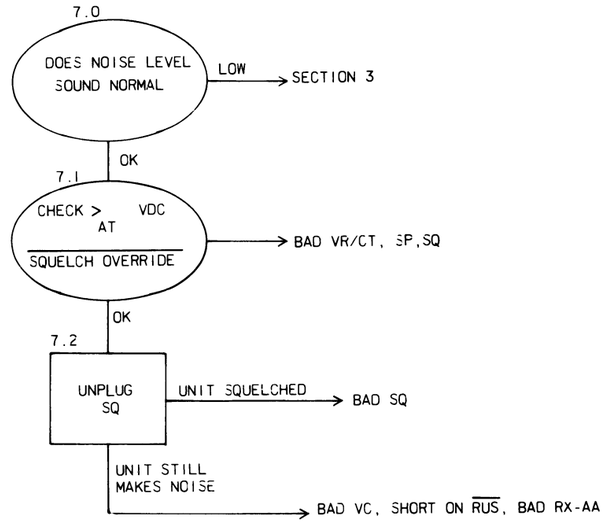
RC3797

SECTION 6
LOW OR NO RECEIVER SENSITIVITY



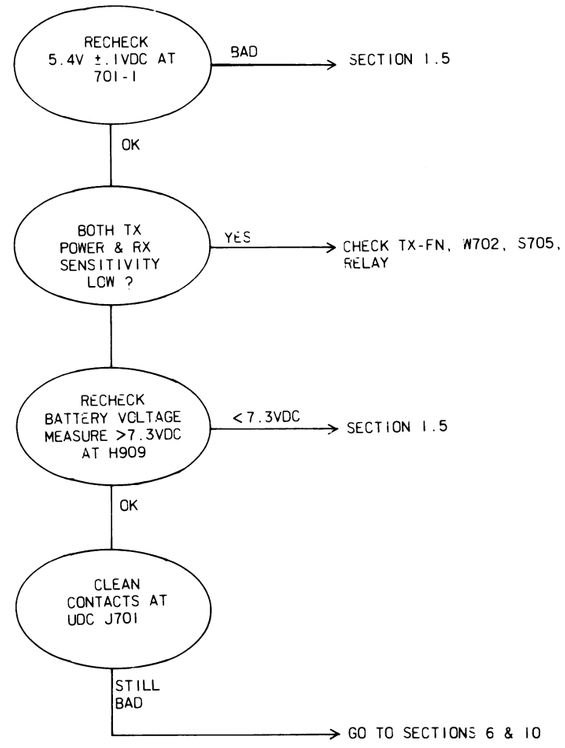
RC3798

SECTION 7
UNIT DOES NOT SQUELCH



RC3800

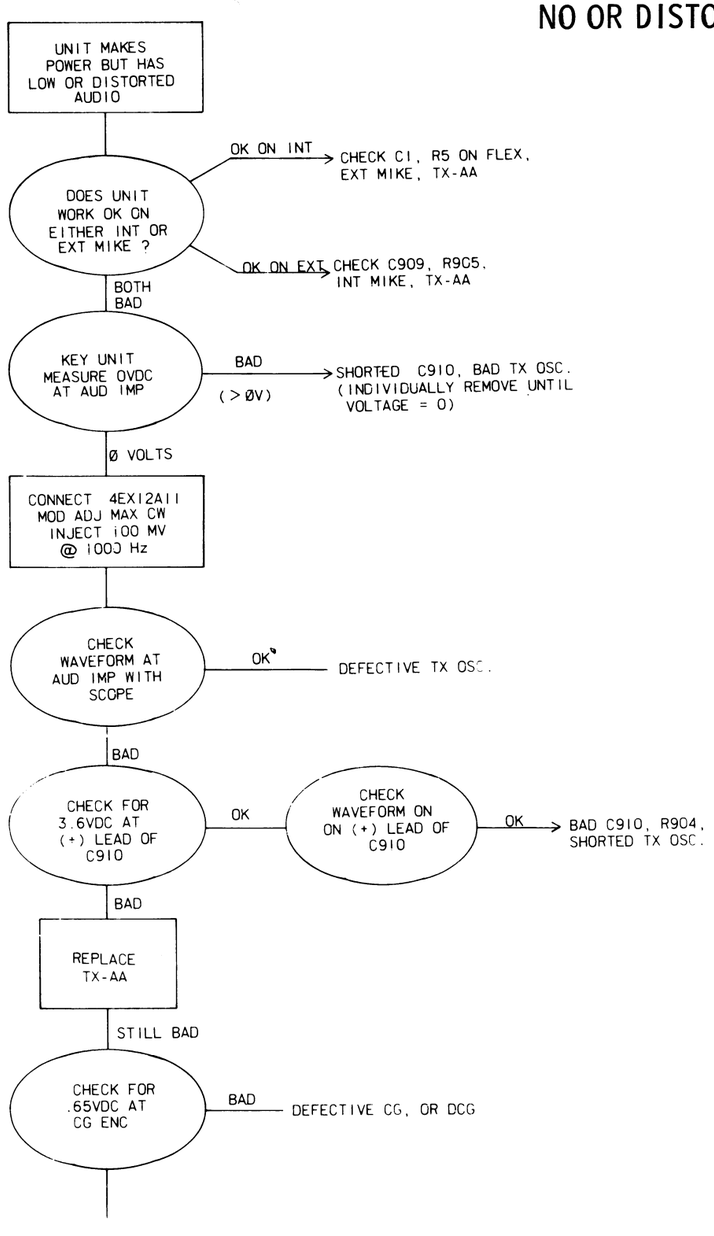
SECTION 8
BOTH RX & TX MALFUNCTION

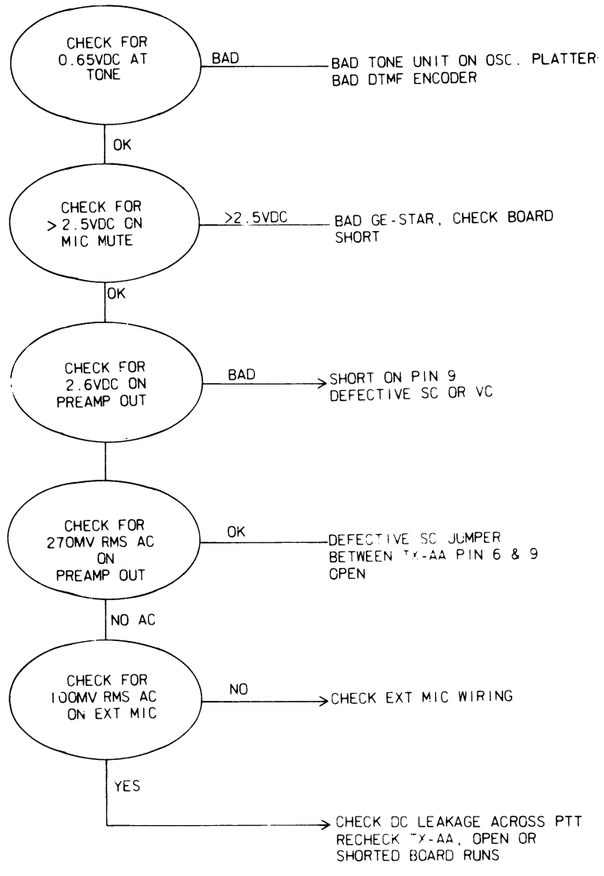


RC3803

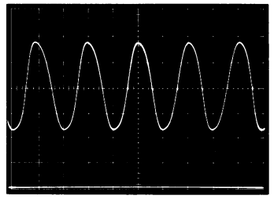
TROUBLESHOOTING PROCEDURE

SECTION 9
NO OR DISTORTED TX AUDIO

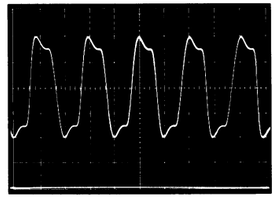




RC3802

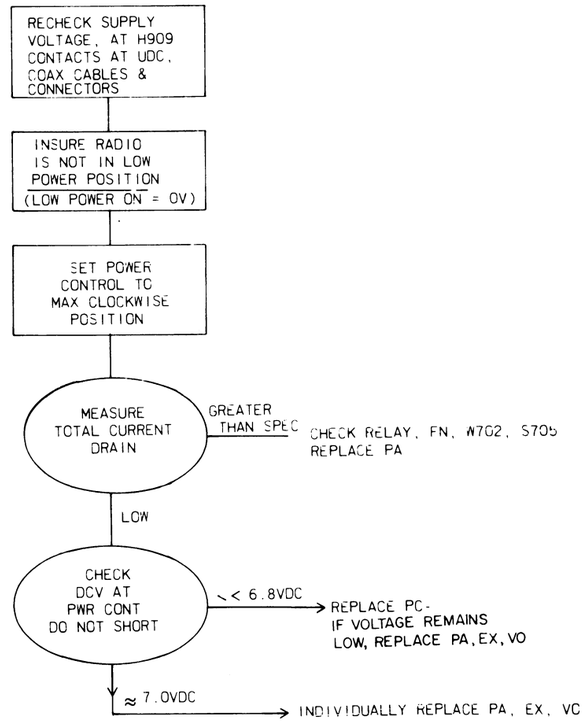


WAVEFORM WITH COMPRESSOR



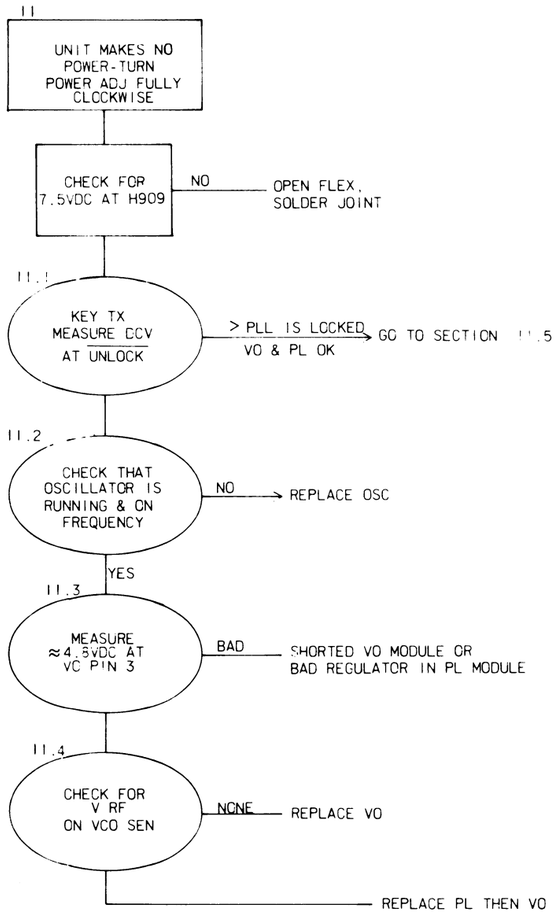
WAVEFORM WITHOUT COMPRESSOR

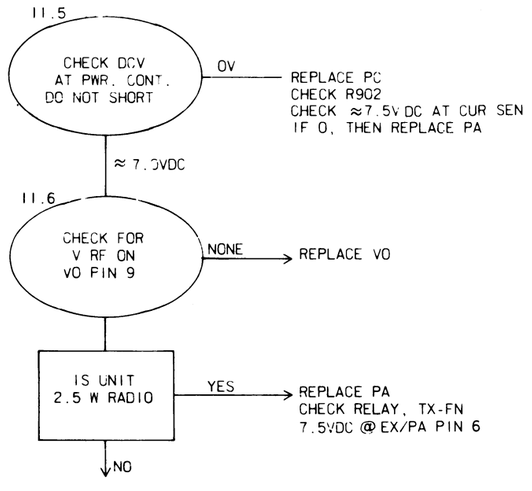
SECTION 10
LOW POWER

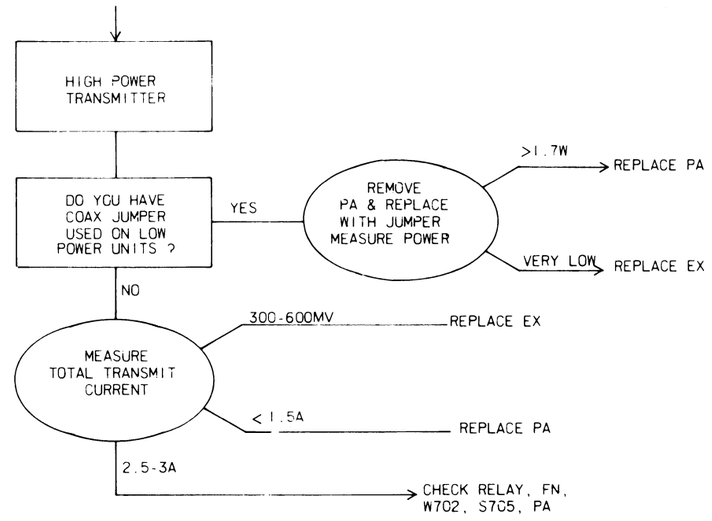


RC3804

SECTION 11
NO TRANSMIT POWER





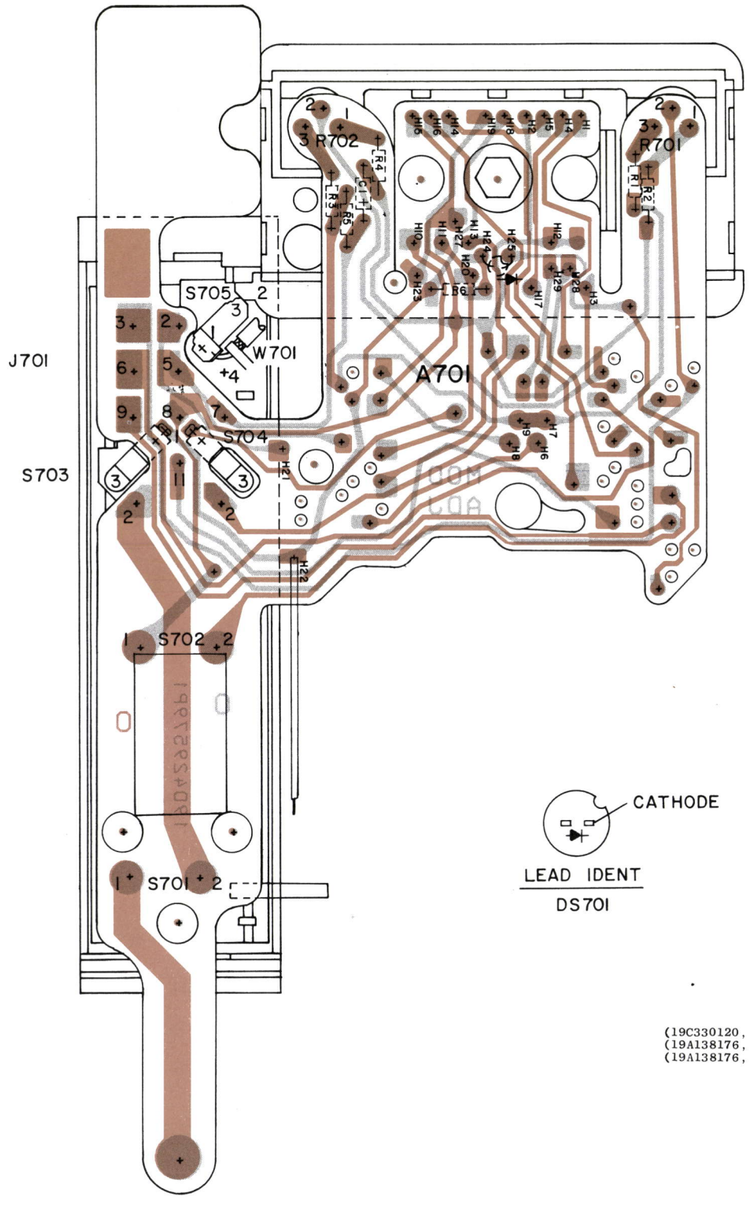


RC3801

TROUBLESHOOTING PROCEDURE

Sheet 7

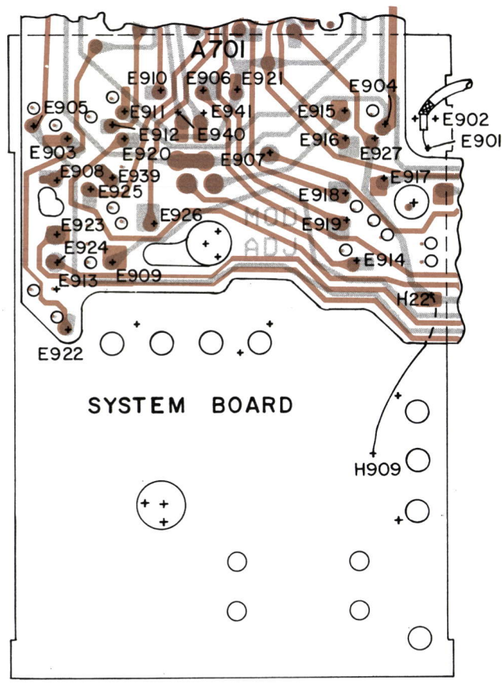
CONTROL ASSEMBLY

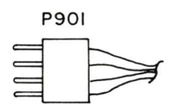


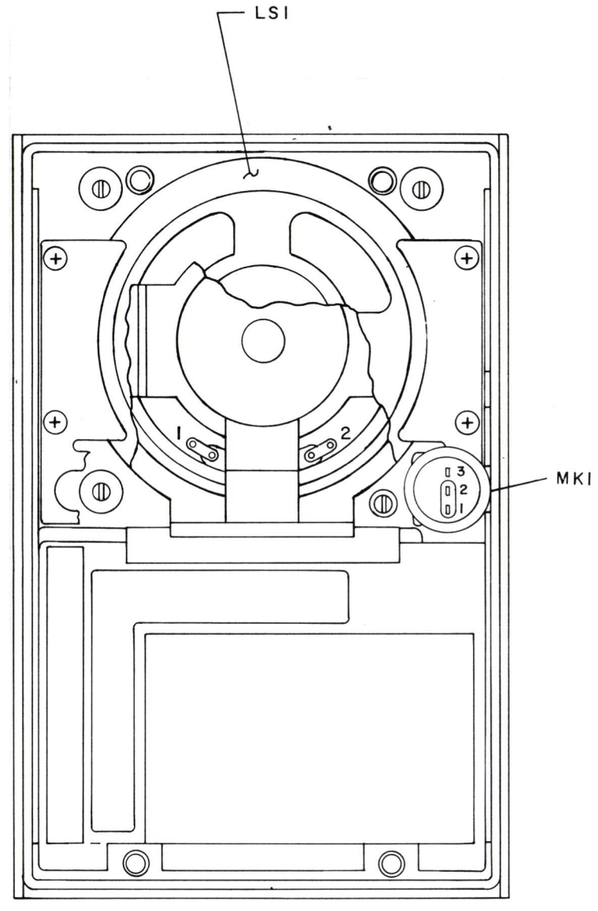
(19C330120, Rev. 1)
(19A138176, Sh, 1, Rev. 0)
(19A138176, Sh. 2, Rev. 0)

FRONT COVER

CONNECTION CHART		
FROM	TO	WIRE
P901	LSI - 1	W
	MKI - 2	O
	MKI - 1	R
	LSI - 2	BK
LSI - 2	MKI - 3	T28 - BK







(19C330141, Rev. 0)

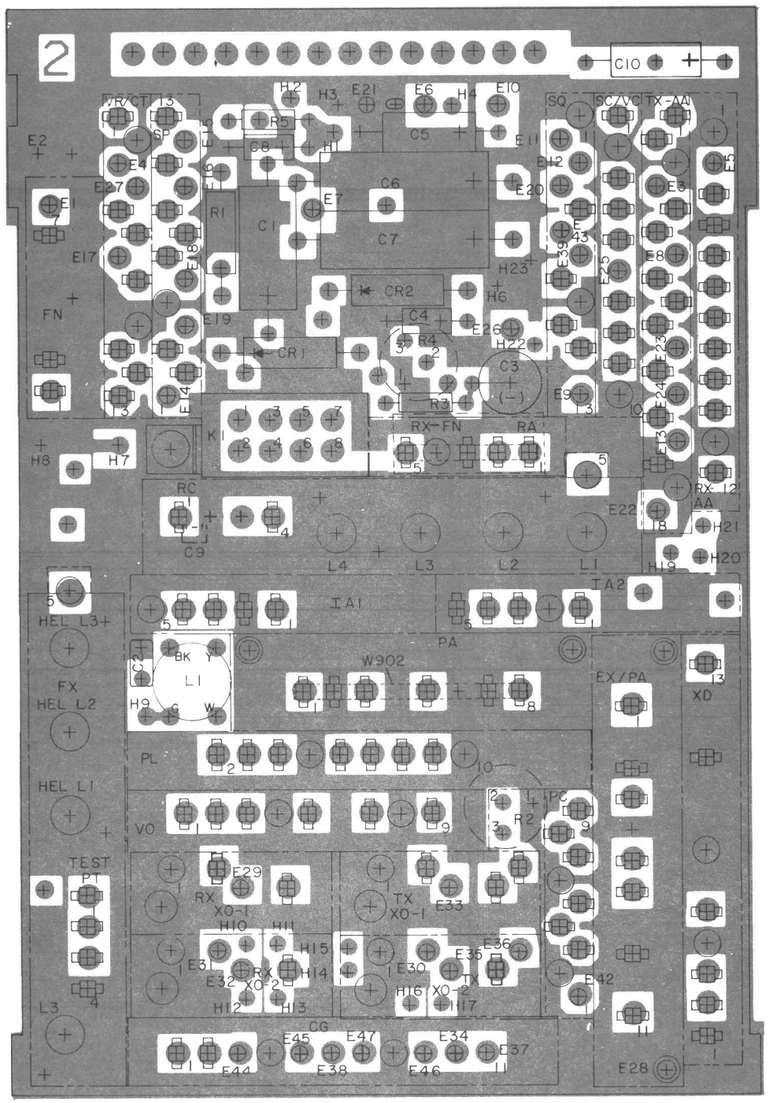
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

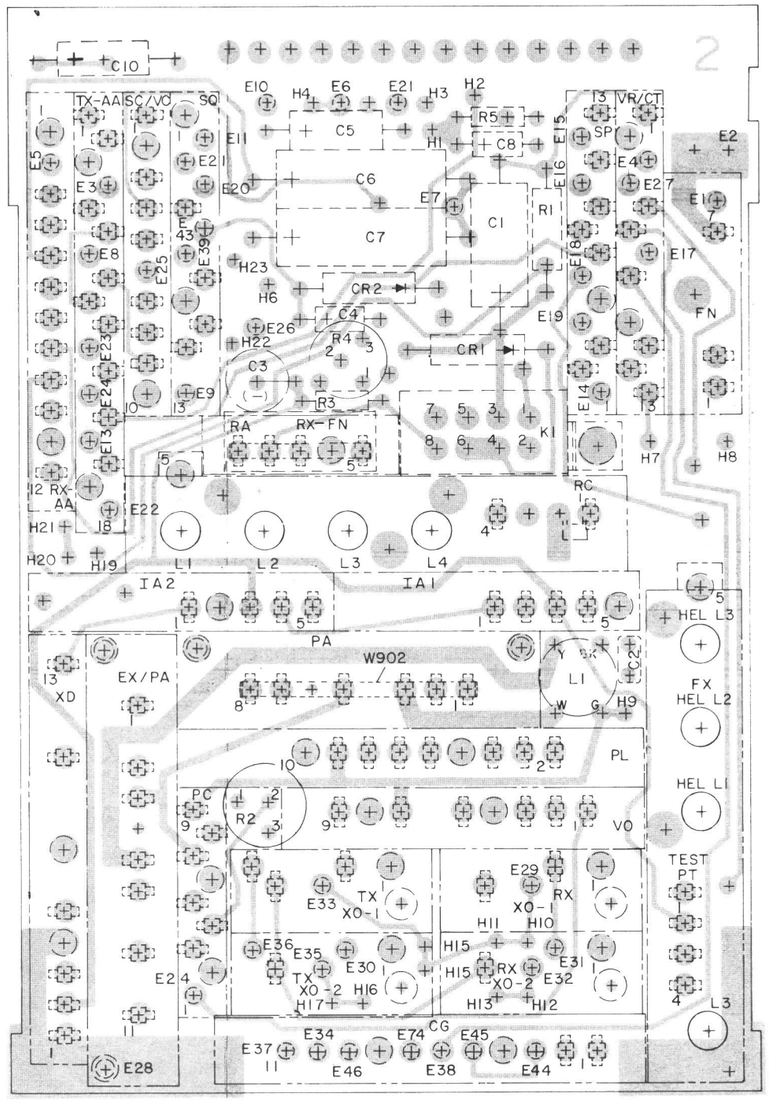
CONTROL ASSEMBLY FRONT COVER (Sheet 1)

SYSTEM BOARD

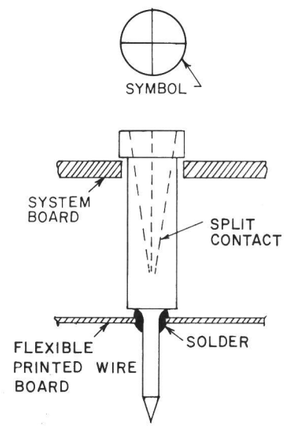
PARTIAL REFERENCE DESIGNATIONS ARE SHOWN ALL DESIGNATIONS ARE 900 SERIES, EXAMPLE C1- C901.

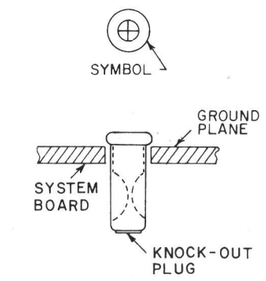


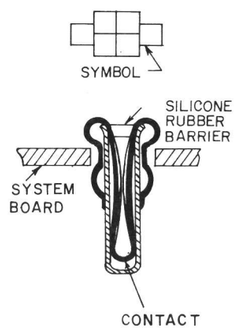
FRONT SIDE (19B232313, First Layer, Rev. 2)



BACK SIDE (19B232313, Fourth Layer, Rev. 2)







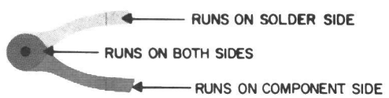
RC3776

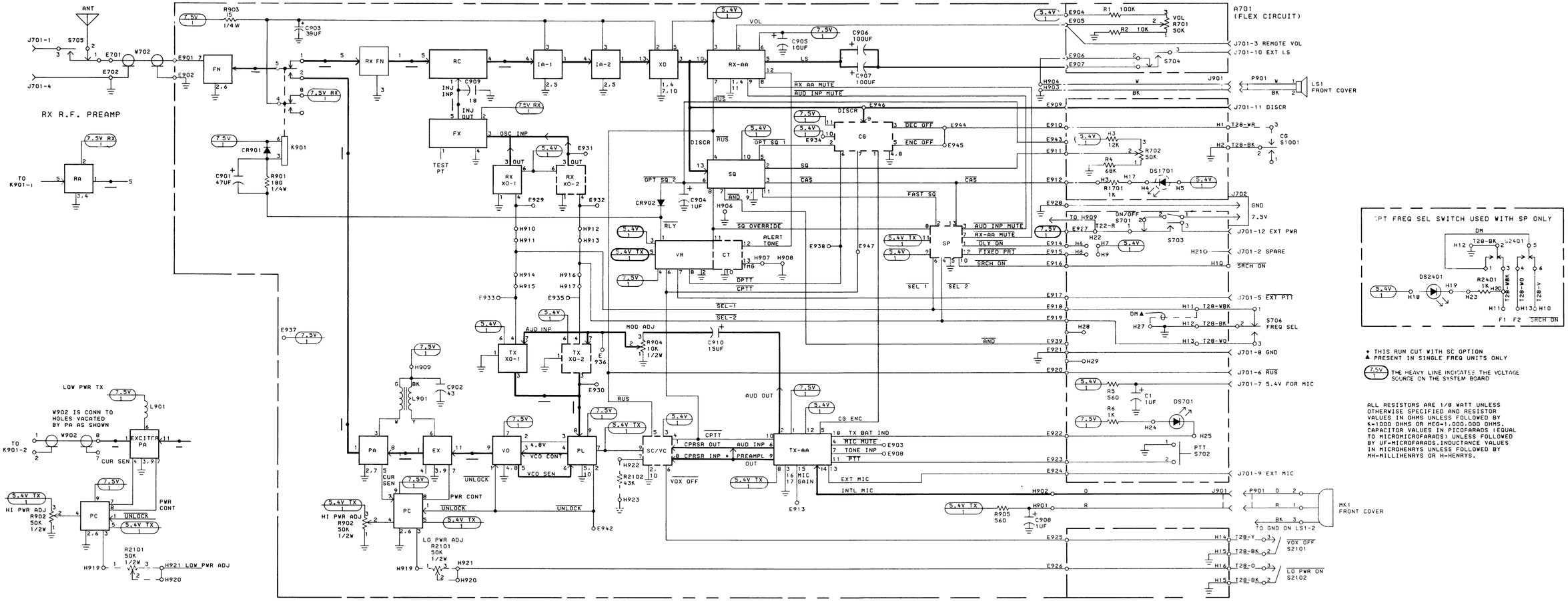
CONTACT IDENTIFICATION

OUTLINE DIAGRAM

(19D429555, Rev. 5)

SYSTEM BOARD
(Sheet 2)





(19R622350, Rev. 8)

* THIS RUN CUT WITH SC OPTION
▲ PRESENT IN SINGLE FREQ UNITS ONLY

(7.5V) THE HEAVY LINE INDICATES THE VOLTAGE SOURCE ON THE SYSTEM BOARD

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS.INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

138-174 MHz MPR TWO-WAY FM RADIO

PARTS LIST

POIA COMBINATION
MPR MODULE LIST
19B232660
(138-174 MHz)

SYMBOL	GE PART NO.	DESCRIPTION
CG	19D429618G1	Channel Guard.
CT	19D429505G2	Carrier Controlled Timer (Includes Voltage Regulator).
EX	19D429471G1	(138-150.8 MHz) Exciter for 3.8 to 6.4 watt transmit.
	19D429471G2	(150.8-174 MHz) Exciter for 3.8 to 6.4 watt transmit.
EX/PA	19D429471G3	(138-150.8 MHz) Exciter and Power Amplifier for 1.8 to 3.8 watt transmit.
	19D429471G4	(150.8-174 MHz) Exciter and Power Amplifier for 1.8 to 3.8 Watt transmit.
FN	19D429438G1	Low Pass Filter.
FX	19D429429G1	(138-162 MHz) Injection Frequency Multiplier.
	19D429429G2	(162-174 MHz) Injection Frequency Multiplier.
IA-1	19D429542G1	IF preamplifier.
IA-2	19D429482G1	IF Amplifier.
PA	19D429414G1	(138-150.8 MHz) RF Power Amplifier.
	19D429414G2	(150.8-174 MHz) RF Power Amplifier.
PC	19D429538G1	Power Control.
PL	19D429540G1	(138-150.8 MHz) Phase Lock Loop.
	19D429540G2	(150.8-174 MHz) Phase Lock Loop.
RA	19D429533G1	Receive RF preamplifier.
RC	19D429508G1	(138-150.8 MHz) Receive Front End.
	19D429508G2	(150.8-162 MHz) Receive Front End.
	19D429508G3	(162-174 MHz) Receive Front End.
RX-AA	19D429420G1	Receive Audio Amplifier.
Rx-FN	19B233143G1	Passive Filter.
Rx-XO	19A137645G1	Receive Oscillator.
SC	19D429546G1	Speech Compressor.
SC/VC	19D429546G3	Speech Compressor and Voice Control.
SP	19D429525G1	Priority Search Lock Monitor.
SQ	19D429426G1	Squelch.
TX-AA	19D429486G1	Transmit Audio Processor.
TX-XO	19A137646G1	Transmit Oscillator.
VC	19D429546G2	Voice Control.
VO	19D429548G1	(138-150.8 MHz) Voltage Controlled Oscillator.
	19D429548G2	(150.8-174 MHz) Voltage Controlled Oscillator.
VR	19D429505G1	Voltage Regulator. (Does not include CT).
XD	19D429422G1	Receiver Discriminator.

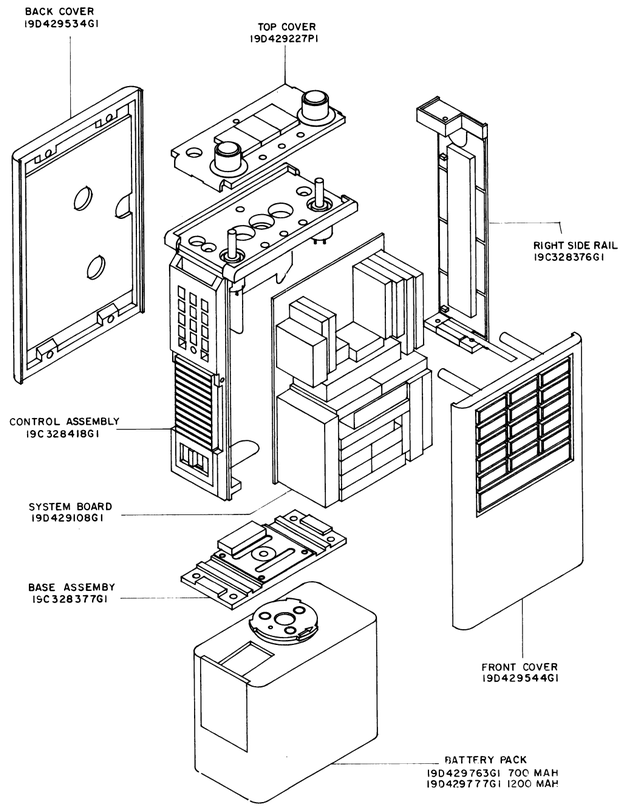
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

SYSTEM BOARD
19D429108G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C901	5491674P42	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C902	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
C903	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C904	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C905	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C906 and C907	19B200240P19	Tantalum: 100 µf ±20%, 6 VDCW.
C908	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR901 and CR902	5494922P1	Silicon; sim to Type 1N456.
		- - - - - - - - - - TERMINALS - - - - - - - - -
E1	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E3 thru E27	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E28	4033513P23	Contact, electrical: sim to Bead Chain R62-11A.
E29 thru E39	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
E42	19A134591P1	Contact, electrical: sim to Augat LSG-1AG14-14.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J901	19A134584P1	Plug: 3 amp max rating, wire No. 28 AWG stranded.
		- - - - - - - - - - RELAYS - - - - - - - - -
K901	19B209666P1	Sensitive, hermetic sealed: 90 ohms ±10%, 5.75 to 9.0 VDC nominal v, 2 form C contact; sim to C.P. Clare MF1401G03.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L901	19B232664G1	Coil.
		- - - - - - - - - RESISTORS - - - - - - - - - -
R901	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R902	19A134512P8	Variable, cermet: 50K ohms ±10%, 0.5 w; sim to A-B A2A503.
R903	19A134564P1	Metal film: 15 ohms ±5%; sim to Corning Glass Style FP 1/4.
R904	19A134512P7	Variable, cermet: 10K ohms ±10%, 0.5 w; sim to A-B A2A103.
R905	3R151P561J	Composition: 560 ohms ±5%, 1/8 w.
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B232662P1	Support. (K901).
	19A115834P5	Contact, electrical: sim to AMP 3-331272-5. (Used with K901).
	19B200525P2	Rivet, tubular. (Secures K901 support).
	19A115834P9	Contact, electrical: sim to AMP 2-332070-4. (Quantity 30).
	19B209648P1	Contact, electrical. (Quantity 120).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



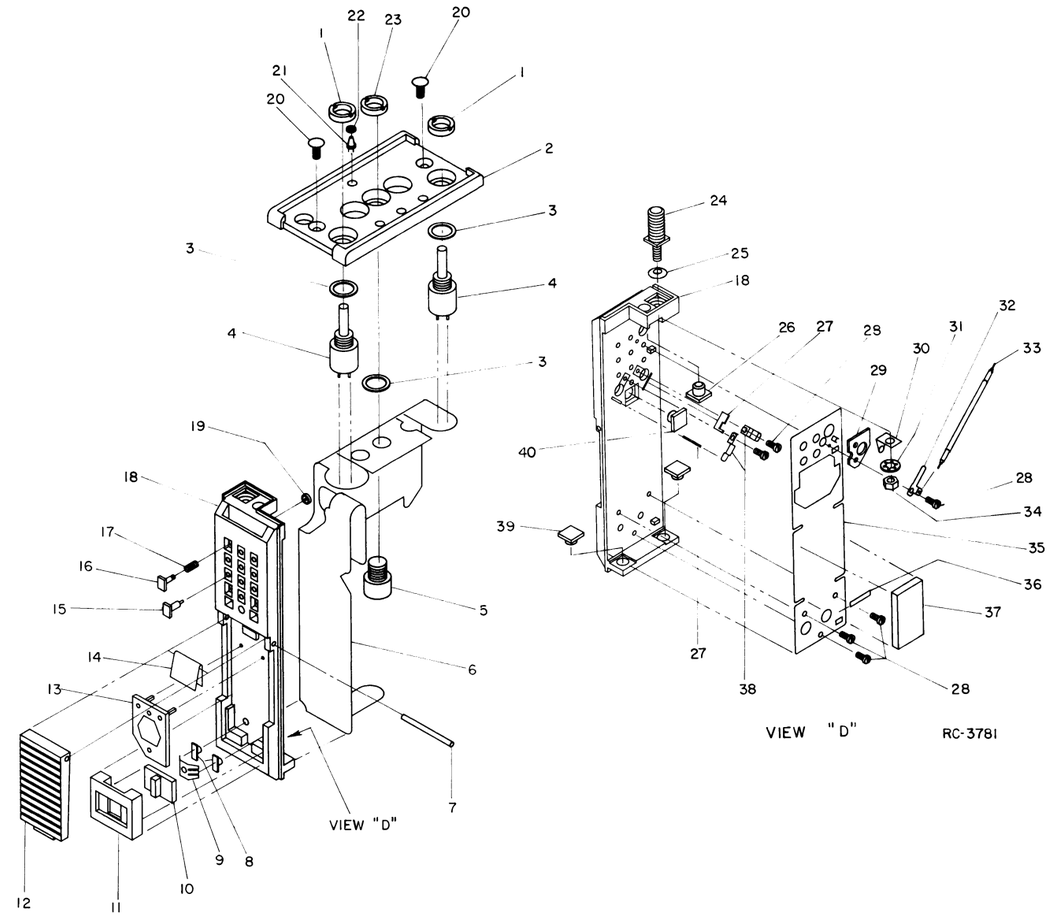
RC-3784

PARTS LIST

CONTROL ASSEMBLY
19C328418G1

SYMBOL	GE PART NO.	DESCRIPTION
A701		"A" SYSTEM FLEX BOARD 19D429580G1
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCw; sim to Sprague Type 162D.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P104J	Composition: 100K ohms ±5%, 1/8 w.
R2	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
R3	3R151P123J	Composition: 12K ohms ±5%, 1/8 w.
R4	3R151P683J	Composition: 68K ohms ±5%, 1/8 w.
R5	3R151P561J	Composition: 560 ohms ±5%, 1/8 w.
R6	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
		SIDE RAIL 19D429564G1
		- - - - - - - - INDICATING DEVICES - - - - - - - -
DS701	19A134323P1	Diode, optoelectronic: red light emitting.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J701		(See items 15-17 & 19 on RC3781).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S701		(See items 8-11 on RC3781).
S702		(See items 7, 12-14 on RC3781).
S703		(See items 16, 17, 19, 27, 28 & 38 on RC3781).
S704		(See items 16, 17, 19, 27, 28 & 38 on RC3781).
S705		(See items 16, 17, 19, 28-30, & 32 on RC3781).
		TOP PLATE 19C328388G1
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R701 and R702	19A134528P1	Variable, cermet: 50K ohms ±10%, 1 watt. (Part of Mechanical Parts RC3781, item 4).
		MECHANICAL PARTS (SEE RC3781)
1	19A127319P1	Nut: 1/4-32. (Used with R701 & R702- Volume & Squelch).
2	19D429207P1	Top plate.
3	4037064P14	Washer, non-metallic. (Used with R701 & R702- Volume & Squelch, & dummy plug).
4	19A134528P1	Resistor, variable: 50K ohms ±10%, 1 w. (R701 & R702).
5	N170P21004C6	Cap screw: No. 1/4-20 x 1/4.
6	19D429580P1	Printed Board. (A701).
7	19A134585P1	Pin, spring. (Part of S702).
8	19B232651P1	Contact. (Part of S701).
9	19B232560P1	Spring. (Part of S701).
10	19A137826G1	Slide. (Part of S701).
11	19C328373P1	Plate. (Part of S701).
12	19C328176P1	Button. (Part of S702).
13	19B209643P2	Switch, push: 200 milliohms res max; sim to Bowmar KB Series. (Part of S702).
14	19A137414P1	Spring. (Part of S702).
15	19B232413P1	Contact. (J701-2 thru J701-9, J701-11).
16	19B232416P1	Contact. (Part of S703-S705).
17	4035235P13	Spring. (Part of S703-S705).
18	19D429241P1	Left side rail.
19	19A137413P1	Seal. (Part of S703-S705).
20	19A134586P2506E	Machine screw: 2.5- 0.45 x 6MM. (Secures top plate & Base assembly to side rails).
21	19A134323P1	Diode, optoelectric: red; sim to Opcoa LLL-7A. (DS701).
22	19A134582P1	Washer, non-metallic.
23	19A127319P7	Nut: 1/4-20. (Used with dummy plug).
24	19A137411P1	Antenna stud.
25	19C307091P1	Packing.
26	19B232415P2	Bushing. (Secures top plate to left side rail).
27	19B232414P1	Contact. (Part of S703 & S704).
28	19A134588P1	Drive screw. (Part of S703-S705).
29	19B232672P1	Insulator. (Part of S705).
30	19B232671P1	Contact. (Part of S705).
31	19A134657P2	Lockwasher, internal tooth: Metric, M2.2.
32	19B232670P1	Contact. (Part of S705).
33	19A137417G3	Cable. (W702).
34	19A134590P4	Hex nut, Metric: 2.5 x 0.45.
35	19C328385P1	Shield.
36	4C39064P34	Strap.
37	19B232682P4	Pad.
38	19B232417P1	Contact. (Part of S703 & S704).
39	19A137410P1	Bushing. (Secures base assembly to side rails).
40	19B232415P1	Bushing.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

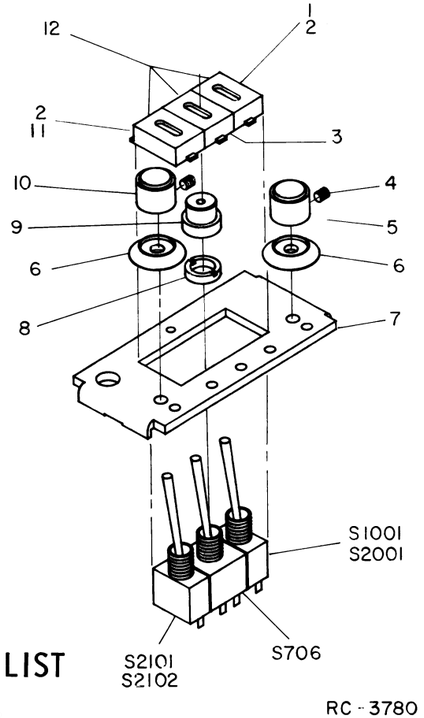


PARTS LIST

TOP COVER ASSEMBLY
(Can not be ordered as an assembly)
(SEE RC3780)

SYMBOL	GE PART NO.	DESCRIPTION
1	19B232996G3	Decorative cap. (Channel Guard).
2	19B232996G5	Decorative cap. (VOX).
3	19B232996G1	Decorative cap. (2 Frequency).
4	19A134642P2503	Set screw, Metric: 2.5- .45 x 3MM.
5	19C328108P1	Knob. (Volume).
6	19C328193P2	Dial, scale. (min - max).
7	19D429227P1	Top plate.
8	19A127319P6	Nut: 1/4-40. (Used with 2 frequency switch S706).
9	19B232508P1	Seal. (Used with S706, S1001, S2101, S2102 switches).
10	19C328108P2	Knob. (Squelch).
11	19B232996G4	Decorative cap. (Hi-Lo).
12	19B232517P1	Dummy cap.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



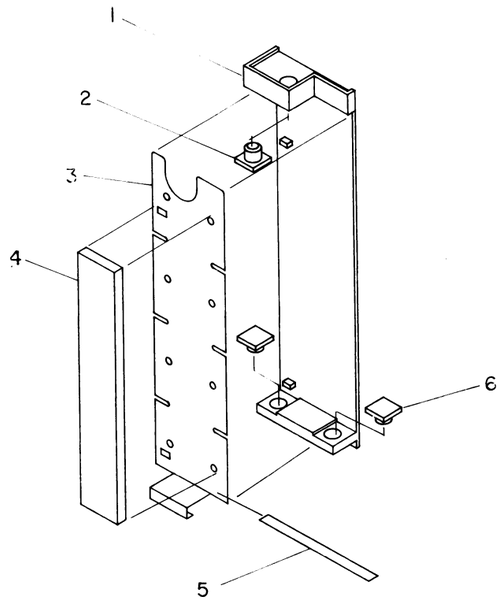
RC-3780

PARTS LIST

RIGHT SIDE RAIL
19C328376G1
(SEE RC3782)

SYMBOL	GE PART NO.	DESCRIPTION
1	19D429242P1	Side rail.
2	19B232415P2	Bushing. (Secures top plate to side rail).
3	19C328322P1	Shield.
4	19B232682P3	Pad.
5	4039064P3	Strap.
6	19A137410P1	Bushing. (Secures base assembly to right side rail).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



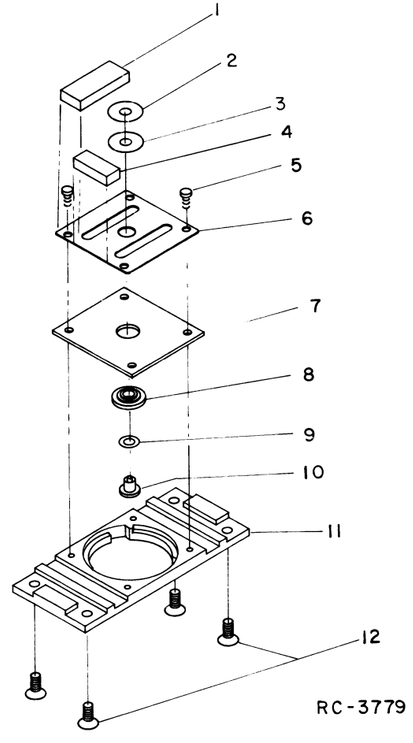
RC-3782

PARTS LIST

BASE ASSEMBLY
19C328377G1
(SEE RC3779)

SYMBOL	GE PART NO.	DESCRIPTION
1	19B232682P5	Pad.
2	19A137529P1	Washer.
3	19A137529P2	Washer.
4	19B232682P11	Pad.
5	19A134793P1804	Tap screw, thd. forming (Metric).
6	19B232497P1	Spring.
7	19B237706P1	Pad.
8	19A137490P1	Insulator.
9	4035306P70	washer, non-metallic.
10	19A137531P1	Contact.
11	19D429248P1	Base.
12	19A134586P2506	Machine screw: 2.5 with 0.45 thd. pitch, 6MM long (Metric).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



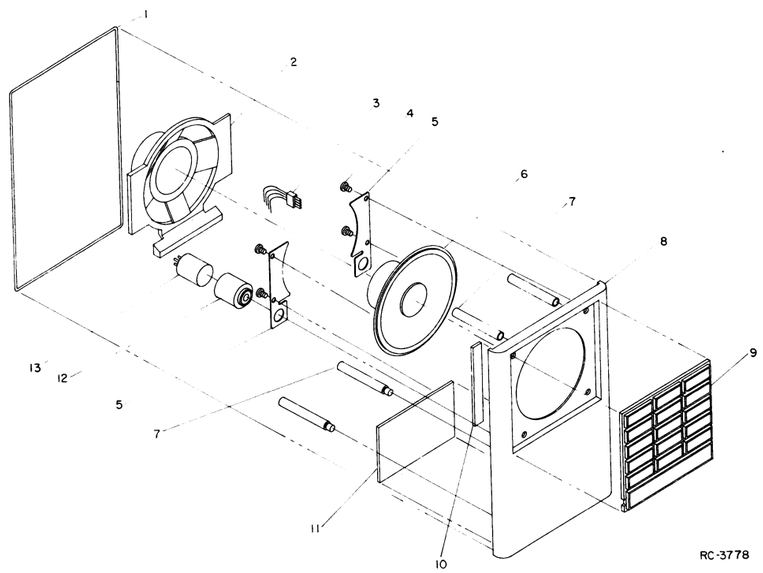
RC-3779

PARTS LIST

REAR COVER
19D429534G1
(SEE RC3777)

SYMBOL	GE PART NO.	DESCRIPTION
1	4035249P10	Washer, non metallic.
2	19C328374P1	Rear cover.
3	19B232524P1	Pad.
4	19A134583P1	Seal, rubber.
5	19A137412P1	Machine screw: 2.5 - .45 x 3MM.
6	19B232524P2	Pad.
7	19B233216P1	Option, receptacle.
8	N327P9010E	Rivet, tubular.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



PARTS LIST

FRONT COVER ASSEMBLY
19D429544G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS1	19A134460P1	Permanent magnet: 2 inch, 8 ohms ±10% voice coil imp, 400 to 3000 Hz freq range; sim to Pioneer A50AP1301F.
		- - - - - - - - MICROPHONES - - - - - - - - -
MK1	19A134461P1	Cartridge, electret: 200 to 1000 ohms imp at 1 KHz; sim to Primo EM-60.
		- - - - - - - - - - - PLUGS - - - - - - - - -
P901	19A134584P2	Connector, plug: stranded wire No. 28 AWG, 3 amps max.
		MECHANICAL PARTS (SEE RC3778)
1	19A134583P1	Seal, rubber.
2	19D429314P1	Speaker boot.
3	19A134584P2	Connector, plug. (P901).
4	19A134793P1804	Tap screw, thd. forming (Metric).
5	19B232496P1	Speaker retaining plate.
6	19A134460P1	Speaker, permanent magnet. (LS1).
7	19A137409P1	Spacer.
8	19C328382G1	RF Cover.
9	19D429300P1	Grille.
10	19B232682P1	Pad.
11	19B232682P2	Pad.
12	19B232498P1	Mike boot.
13	19A134461P1	Microphone. (MK1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES