MOBILE RADIO

MASTR® II

MAINTENANCE MANUAL LBI 30621

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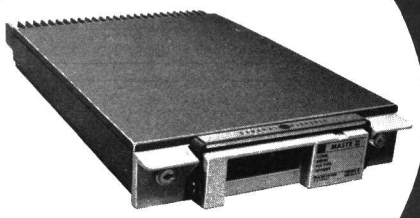

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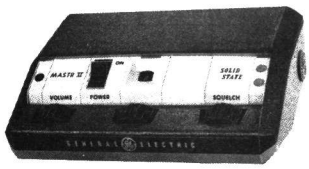

CONTROL UNIT

66 - 88 MHz, 25 WATT

TWO - WAY FM MOBILE COMBINATIONS

SPEAKER

GENERAL ELECTRIC

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WARNING

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

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

EQUIPMENT INDEX

EQUIPMENT	MODEL OR TYPE NUMBER
Transmitter and Receiver	Refer to Applicable Maintenance Manual
Exciter/PA Cable	5491689P86
Receiver Antenna Cable	5491689P83
Control Unit	Refer to Applicable Control Unit Maintenance Manual
Microphone	Refer to Applicable Control Unit Maintenance Manual
Speaker	Refer to Applicable Control Unit Maintenance Manual
Antenna	Refer to Applicable Control Unit Maintenance Manual
Power/Control Cable	Refer to Applicable Control Unit Maintenance Manual
12-Volt Fuse Assembly	Refer to Applicable Control Unit Maintenance Manual
Ignition Switch Cable Assembly	Refer to Applicable Control Unit Maintenance Manual
Microphone Bracket	7141414G4
Channel Guard Microphone Hookswitch	19C320318G3
Extractor Tool Kit	19B227456G1
Mounting Hardware	19A129474G1
Key (BF10A)	5491682P4
Alignment Tools	19B219676G1 19B219678P1
OPTIONS	
Power/Control Cables 9-Foot, 18-Conductor 9-Foot, 30-Conductor 9-Foot, 38-Conductor 27-Foot, 18-Conductor 27-Foot, 30 Conductor 27-Foot, 38-Conductor	 19D423424G1 19D423424G7 19D423424G13 19D423424G3 19D423424G9 19D423424G15
Handset Hookswitch	19C320478G1 19B219846G1
12-Volt 3-wire Ignition Switch Cable Assembly	19B219537G1

SYSTEM SPECIFICATIONS*

FREQUENCY RANGE	66-88 MHz
BATTERY DRAIN	
Receiver	
Squelched	0.250 Amperes
Unsquelched	2.40 Amperes
Transmitter	6.0 Amperes at 13.6 VDC
DIMENSIONS (H X W X D)	
Two-Way Radio	2-1/2" x 11-3/4" x 18-3/4"
Control Unit (less bracket)	2-1/4" x 6-1/4" x 5"
Speaker (less bracket)	5-1/8" x 5-1/4" x 2-3/16"
WEIGHT	
Two-Way Radio (includes mounting plate)	26 pounds
Control Unit	1-1/4 pounds
Speaker	1-1/2 pounds
TEMPERATURE RANGE	-40°C to +70°C (-40°F to +158°F)
DUTY CAPABILITY	
Intermittent	20% Transmit, 100% Receive
Continuous	100% Transmit at reduced power

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

COMBINATION NOMENCLATURE

1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th & 9th Digits	10th Digit
Mechanical Package	System Voltage	Power Output	Channel Spacing	Frequency Capability	Number of Freq.	Options	Frequency Range	Oscillator Stability
M Standard	**C** 12-VDC Neg. GND.	**5** 25 Watts	**4** 20 kHz	**A** 1-Freq.	**A** 1-Freq.Xmit 1-Freq.Rec.	**S** Standard	**44** 66-78 MHz	**A** ±5 PPM (±.0005%)
	X ±12-VDC Less Accessories			**C** 2-Freq.	**B** 2-Freq.Xmit 1-Freq.Rec.	**U** Channel Guard	**45** 77-88 MHz	**B** ±2 PPM (±.0002%)
				K 8-Freq.	**C** 2-Freq.Xmit 2-Freq.Rec.			
					D 1-Freq.Xmit 2-Freq.Rec.			
					E 3-Freq.Xmit 3-Freq. Rec.			
					F 4-Freq.Xmit 4-Freq.Rec.			
					G 5-Freq.Xmit 5-Freq.Rec.			
					H 6-Freq.Xmit 6-Freq.Rec.			
					J 7-Freq.Xmit 7-Freq.Rec.			
					K 8-Freq.Xmit 8-Freq.Rec.			

DESCRIPTION

MASTR® II mobile radio combinations are compact, highly reliable and ruggedly-constructed units that are designed to meet the most stringent requirements in the two-way radio field.

The radios are fully transistorized -- utilizing both discrete components and Integrated Circuits (IC's) for highest reliability. Since no tubes are used, the radio is ready to use the instant it is turned on. The standard combination may be equipped with the following:

- One through eight frequencies
- Plug-in oscillators for ±0.0002% or ±0.0005% oscillator stability
- Channel Guard (tone squelch)

The radio set is housed in a drip-proof case only 2-1/2 inches high. The radio mounts to the vehicle by a bottom mounting plate, and is tamper-proof when locked into the mounting plate. When unlocked, the handle can be pulled down and the radio pulled out of the mounting plate or the top cover removed for servicing. When the handle is pulled down 90 degrees, the radio can be locked to hold the handle in the carrying position.

No power supply is required since the highest supply voltage used in the radio is supplied by the vehicle battery.

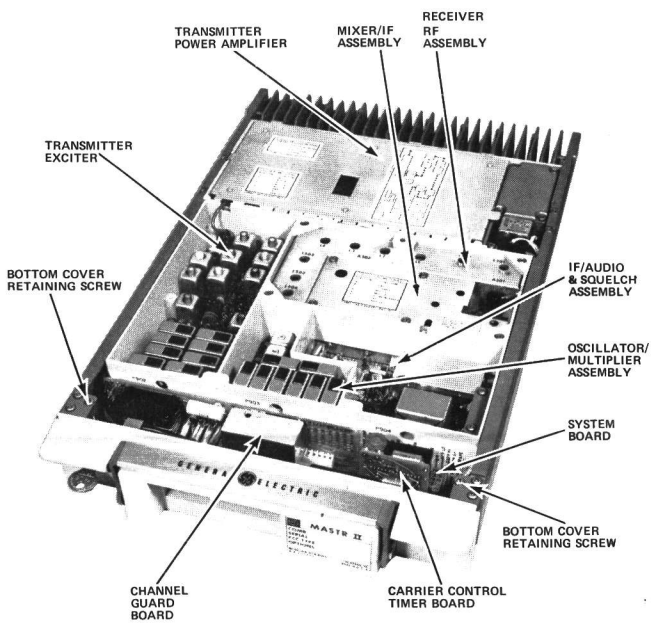


Figure 1 - Module Layout

The radio is of single-layer, modular construction with all major modules and tuning adjustments easily accessible from the top of the radio (see Figure 1).

Centralized metering jacks for the transmitter, receiver and system board are provided for simplified alignment and troubleshooting.

Both the transmitter and receiver are electrically isolated from the radio chassis to permit operation in 12-Volt, positive or negative ground vehicles without the use of a polarity converter. The transmitter exciter and receiver modules are mounted in a Lexan® frame for isolation. Simply changing four leads to the control unit and reversing the power leads at the fuse block allows the radio to be used in negative or positive ground vehicles. No changes are required in the radio.

TRANSMITTER

The transmitter consists of an exciter board located in the mounting frame, and a power amplifier assembly. The PA assembly consists of a PA board mounted on a PA casting at the rear of the radio. A hermetically sealed antenna switch is also mounted on the PA assembly.

Only two RF power transistors are used in the 25-Watt PA.

RECEIVER

The receiver consists of an oscillator/multiplier assembly (Osc/Mult), RF assembly, mixer/IF assembly (MIF), and IF-audio and squelch assembly (IFAS).

CONTROL UNIT

The control unit contains the power on-off rocker switch, volume and squelch controls, channel selector switch in multi-frequency models, a red transmit indicator light and a power on/frequency indicator light. Space is provided for an optional rocker switch, and two optional indicator lights.

The control unit is enclosed in a two piece molded LEXAN® housing, and is supplied with a LEXAN® mounting bracket and Safety Release assembly. The Safety Release assembly breaks away under impact for passenger safety. This mounting assembly also permits the control unit to be swiveled as desired for the convenience of the operator.

Three connectors are located on the rear of the control unit. Two of the connectors are for the control cable(s), and

one (Vehicle Systems Jack J701) is for power, accessories and external options.

MICROPHONE AND HANDSET

MASTR II mobile combinations use a dynamic microphone with a built-in transistorized microphone pre-amplifier. The microphone is housed in a sturdy Lexan® case, and the extendable coiled cord plugs into the microphone jack on the bottom of the control unit. The plug is secured to the jack by a retaining screw.

An optional telephone-type handset is available for use with the radio. The handset uses a dynamic microphone with a built-in microphone pre-amplifier. The extendable coiled cord plugs into the microphone jack on the bottom of the control unit, and is secured to the jack by a retaining screw.

HOOKSWITCHES

In Channel Guard applications, a microphone or handset hookswitch is supplied with the radio. The hookswitches are equipped with a Channel Guard disable switch.

Placing the switch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the Channel Guard is disabled when the microphone or handset is removed from the hookswitch.

SPEAKER

A five-inch speaker contained in a Lexan® housing provides an audio output of 12 Watts. The speaker impedance is eight ohms. The speaker leads are terminated in Vehicle Systems Plug P701 which connects to J701 on the rear of the control unit.

The speaker is supplied with a Lexan® mounting bracket and Safety Release assembly. The Safety Release assembly breaks away under impact for passenger safety, and permits the speaker to be swiveled as desired to direct sound to the operator.

PRE—INSTALLATION CHECK

MASTR II radios are shipped from the factory completely connected to permit the serviceman to perform system checks on the transmitter and receiver without removing the radio from its shipping container. Simply removing the lid on the internal packing case provides access to the battery cables, ignition switch cables, microphone, control unit and radio antenna jack. The radio is shipped connected for 12-Volt, negative ground operation.

CAUTION

Before bench testing the MASTR II Mobile Radio, be sure of the output voltage characteristics of your bench power supply.

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

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

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

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.6 VDC for loads of 6 to 16 amperes; 13.4 VDC for loads of 16 to 36 amperes). Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lapp Model 73) may be usable when operated in parallel with a 12-Volt automotive storage battery.

INITIAL ADJUSTMENT

After the MASTR II Radio has been installed (as described in the INSTALLATION Manual), the following adjustments should be made by an electronics technician who holds a 1st or 2nd Class FCC Radio-telephone license.

Make sure that a RADIO TRANSMITTER IDENTIFICATION form (FCC Form 452-C or General Electric Form NP270303) has been filled out and attached to the transmitter.

TRANSMITTER ADJUSTMENT

The adjustment for the transmitter includes measuring the Forward and Reflected Power and adjusting the antenna length for optimum ratio, then setting the transmitter to rated power output (or to the specific output or input which may be required by the FCC station authorization). Next, measuring the frequency and modulation and

entering these measurements on the FCC-required Station records. For the complete transmitter adjustment, refer to the ALIGNMENT PROCEDURE in the MAINTENANCE MANUAL for the transmitter.

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. For the Receiver Initial Adjustment Procedure, refer to the FRONT END ALIGNMENT PROCEDURES in the MAINTENANCE MANUAL for the receiver.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the separate OPERATOR's MANUAL. The basic procedures for receiving and transmitting measages follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by pressing the POWER-ON rocker switch to the ON position.
2. Turn the SQUELCH control clockwise (to the right) as far as possible.
3. Adjust the VOLUME control until the noise is easily heard, but is not annoyingly loud.
4. Now, slowly turn the SQUELCH control counterclockwise (to the left) until the noise just fades out.

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

TO TRANSMIT A MESSAGE

1. Turn the radio on as directed in the "To Receive A Message" section.
2. Press the push-to-talk button on the microphone and speak across the face of the microphone in a normal voice. Release the button as soon as the message has been given. The red indicator light on the control unit will glow each time the microphone button is pressed, indicating that the transmitter is on the air. The receiver is muted whenever the transmitter is keyed.

MAINTENANCE

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

An alternate method is to use a special soldering tip that heats all of the pins simultaneously.

PREVENTIVE MAINTENANCE

To insure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks as listed in the table of Maintenance Checks.

TEST AND TROUBLESHOOTING PROCEDURES

The individual Maintenance Manual for the transmitter and receiver describe standard test procedures which the serviceman can use to compare the actual performance of the transmitter or receiver against the specifications of the unit when shipped from the factory. In addition, specific troubleshooting procedures are available to assist the serviceman in troubleshooting the transmitter and receiver.

NOTE

In positive ground operation only, A- is "hot" with respect to vehicle ground. Shorting the receiver front end casting or any printed wiring board ground patterns to the radio case may cause one of the in-line fuses to blow.

MECHANICAL PARTS BREAKDOWN

A mechanical parts breakdown diagram of the two-way radio is provided in this manual. The diagram shows the placement and GE Part Number of mechanical items on the Two-Way radio set (see Table of Contents).

RE-INSTALLATION

If the radio is ever moved to a different vehicle, always check the battery polarity and voltage of the new system before using the radio.

MAINTENANCE CHECKS	INTERVAL	
	6 Months	As Required
CONNECTIONS - Ground connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and parts to make sure that nothing is working loose.	X	
ANTENNA - The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antenna or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to the applicable ALIGNMENT PROCEDURE and troubleshooting sheet for typical voltage readings.		X
FREQUENCY CHECK - Check transmitter frequency and deviation as required by FCC. Normally, these checks are made when the unit is first put into operation, after the first six months, and once a year thereafter.		

NOISE SUPPRESSION

After completing the initial adjustment of the transmitter and receiver, the serviceman should determine whether additional noise suppression is required. The following information should assist the serviceman in identifying and elminating undersirable noise interference.

Ignition Noise

Ignition noise sounds like a "popping" sound in the speaker, whose frequency varies with engine speed while a weak signal is being received. This type of interference is generated by the spark plugs, distributor and any poor connections in the high-voltage system which might cause arching. Ignition noise may be identified by noting that the noise disappears as soon as the ignition switch is turned off.

1. If the vehicle does not have a resistance lead from the coil to the center of the distributor cap, disconnect the lead so that a Cable-Type Suppressor may be inserted in it close to the distributor. Screw the cut ends of the lead into the suppressor.

> NOTE
>
> A resistance lead operates as a very effective noise suppressor as long as there are no breaks anywhere along its length. Never cut a resistance lead to insert a suppressor. A loose knot is often tied in the lead to prevent excess flexing, which might break the conductor.

2. Check to see that:

   -- the distributor points and condenser are in good condition.

   -- the high-voltage leads from the distributor are not broken and are making good contact at each end.

   -- the spark plugs have clean, dry insulators and their electrodes are clean and properly adjusted.

   -- the timing has been properly adjusted.

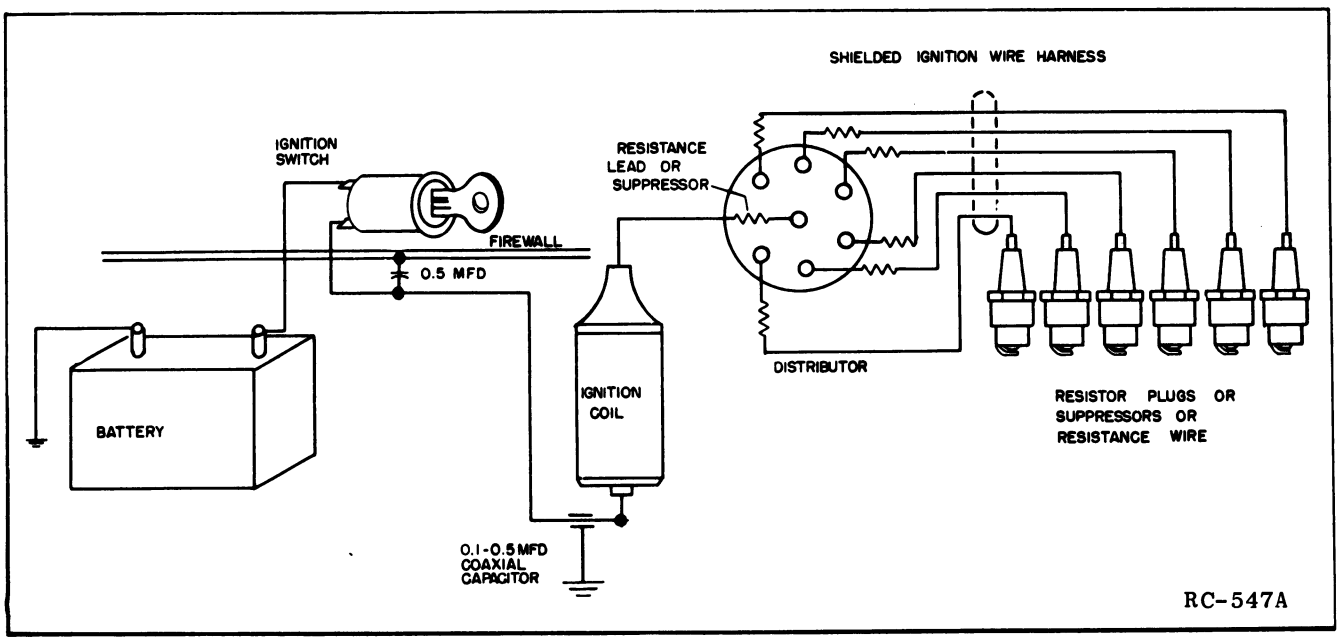


Figure 2 - Ignition Circuit with Noise Suppression Components

3. Use a 0.5-mFd by-pass capacitor to by-pass the battery lead to the ignition coil. Mount the capacitor under a screw which will provide a good ground and connect the capacitor lead to the terminal of the coil which is connected to the ignition.

4. Remove the ignition coil and its mounting bracket. Clean paint from coil (where the bracket mounts), from the bracket and from the engine block. Remount the coil so as to obtain a good ground for the coil case.

5. If the vehicle has been driven 30,000 or 40,000 miles or more, the cap and rotor of the distributor will probably need replacing. This will not only reduce ignition noise, but also improve the overall performance of the engine.

6. High-voltage ignition wires can become capacitively coupled to the low-voltage systems, causing ignition noise to appear in the low-voltage system. This coupling can be minimized by separating the high-and low-voltage leads, or if necessary, separately shielding the leads.

7. If one of the ignition leads happens to have the critical length for radiating at the receiver's frequency, the noise can be reduced by changing the length of the lead. A noise source of this type is not common and can only be found by using a noise meter or by trial and error.

8. If the preceding steps fail to reduce ignition noise to a satisfactory level, it may be necessary to install resistance-type spark plugs, individual suppressors on each spark plug, or a shielded ignition wire harness.

Alternator Noise

Alternator noise shows up as a high-pitched "whine", whose pitch varies with engine speed. To check for this type of noise, run the engine at a moderate speed and then shut off the engine, while listening to the noise on the receiver. Alternator noise will continue as long as the engine turns, lowering in pitch as the engine slows down.

It may be necessary to install a coaxial type, 0.5 mFd filter capacitor from the ungrounded alternator terminal to ground.

CAUTION

Do not install this capacitor on alternators that are equipped with a factory-supplied capacitor for protecting the rectifiers and suppressing noise.

Generator Noise

Generator noise shows up as a high-pitched "whine", whose pitch varies with engine speed. To check for this type of noise, run the engine at a moderate speed and then shut off the engine, while listening to the noise on the receiver. Generator

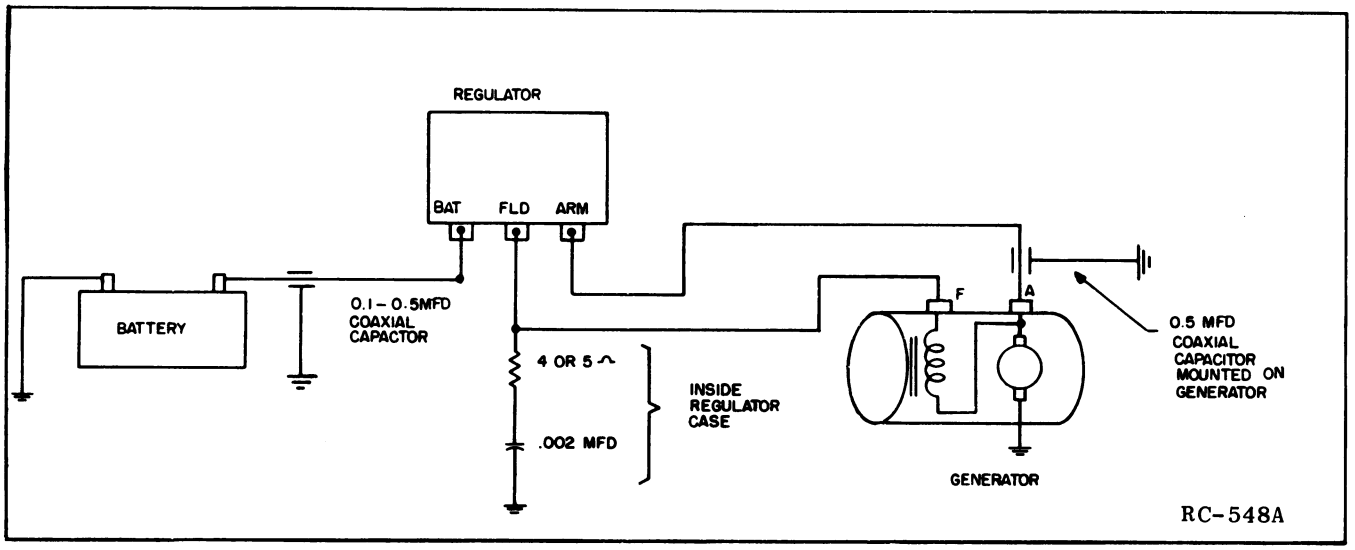


Figure 3 - Generator Circuit with Noise Suppression Components

noise will continue as long as the engine turns, lowering in pitch as the engine slows down.

By-pass the armature terminal on the generator to ground with a 0.5-mFd, 40 or 50-amp coaxial capacitor. Be sure to scrape the area where the capacitor is to be mounted, so that its case will be well grounded.

CAUTION

Do not by-pass the field terminal (F), as this will damage the voltage regulator contacts.

Generator Regulator Noise

Generator regulator noise shows up as a "raspy" sound which is generated by the contacts in the regulator and radiated by the leads coming out to the regulator. If suppression of regulator noise is necessary, connect a 5-ohm resistor in series with a .002-mFd capacitor from the field, terminal (F) of the regulator to ground. If possible, these components should be mounted inside regulator case. The battery terminal (BAT) and armature terminal (ARM) can be by-passed to ground with 0.5-mFd capacitors.

CAUTION

If the regulator is opened to install the capacitor or resistor, remember that one wrong connection or shorted wire can damage the regulator or generator.

Gauge noise produces a "hissing" or "crackling" sound. Tapping the face of each gauge while the engine is running usually shows up which gauge is at fault. By-pass the gauge lead to ground with a 0.5-mFd capacitor, connected close to the sensing element.

Static and Arcing Noise

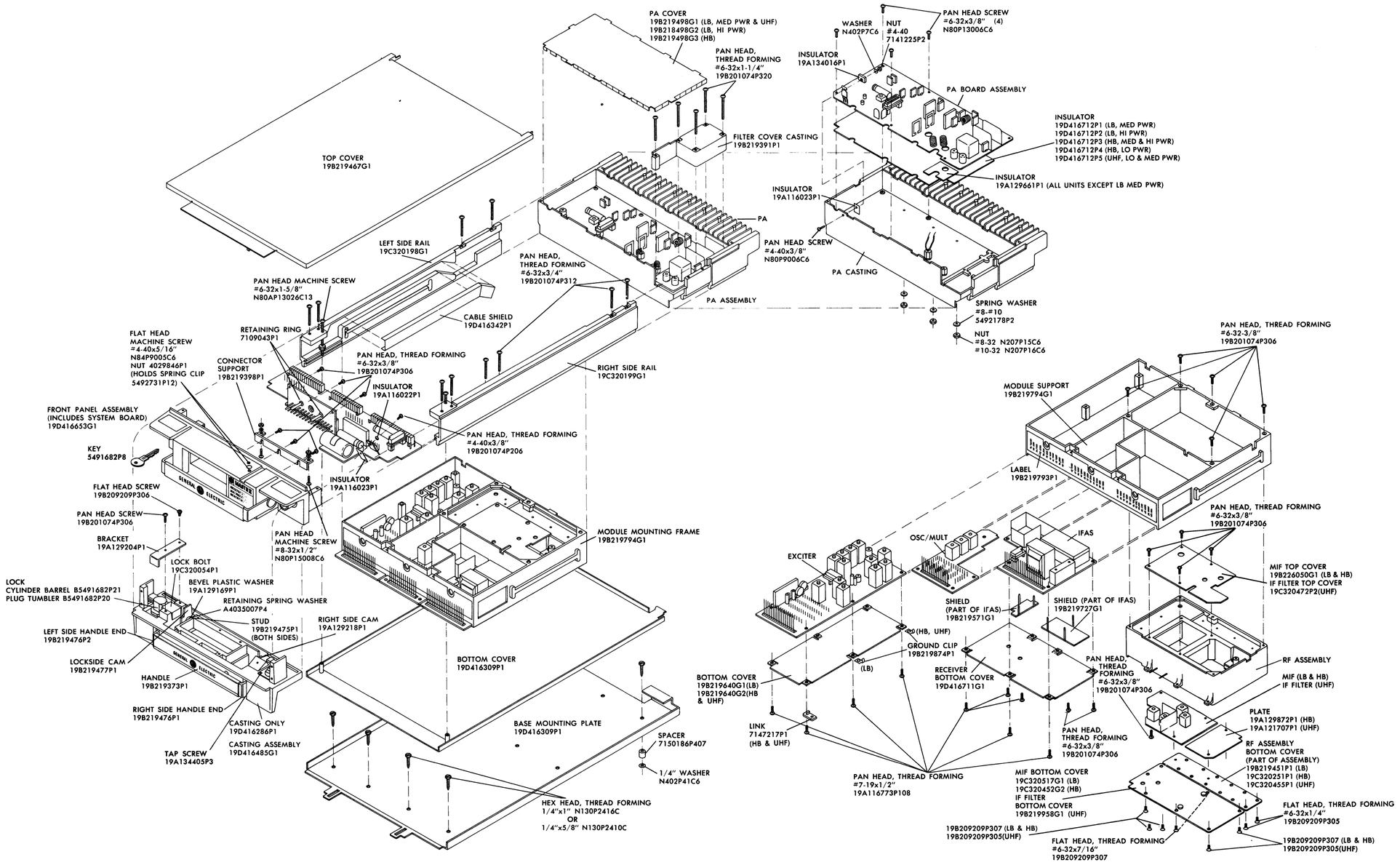
The following suggestions may help to cure other unusual types of interference:

1. Use bonding braid to electrically bond the hood and each corner of the engine block to the vehicle's frame. Scrape paint and dirt from bonding points to obtain a good ground.

2. Treat noisy tires with anti-static power.

3. Use front-wheel static collectors for irregulator "popping" noise which disappears when the brakes are applied.

4. Use heavily graphited penetrating oil on the exhaust pipe and muffler supports if they are producing noise.



MECHANICAL PARTS BREAKDOWN

MASTR II STANDARD COMBINATIONS