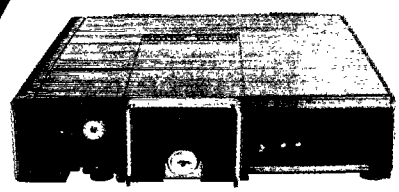
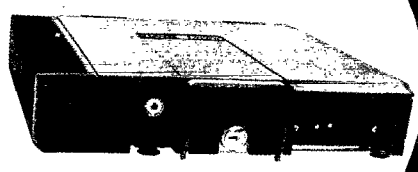
MOBILE RADIO

DELTA-S

(SYNTHESIZED)
TWO-WAY MOBILE COMMUNICATIONS
MAINTENANCE MANUAL LBI-31563
(NEGATIVE GROUND ONLY)

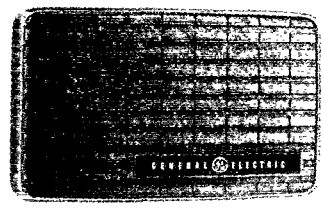


60 WATT
MOBILE RADIO



110 WATT
MOBILE RADIO

29.7-50 MHZ
TWO-WAY FM
MOBILE
COMBINATIONS



SPEAKER

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

FCC FILING NUMBER

RECEIVER	TRANSMITTER	POWER OUTPUT	FREQUENCY
ER-137-A	KT-211-A	60-WATTS	29.7-36 MHz
ER-137-B	KT-211-B	60-WATTS	36-42 MHz
ER-137-C	KT-211-C	60-WATTS	42-50 MHz
ER-137-A	KT-212-A	110-WATTS	29.7-36 MHz
ER-137-B	KT-212-B	110-WATTS	36-42 MHz
ER-137-C	KT-212-C	110-WATTS	42-50 MHz

UNDER U.S. LAW, OPERATION OF AN UNLICENSED RADIO TRANSMITTER WITHIN THE JURISDICTION OF THE UNITED STATES MAY BE PUNISHABLE BY A FINE UP TO $10,000, IMPRISONMENT UP TO TWO YEARS, OR BOTH!

WARNING

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

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

SYSTEM SPECIFICATIONS*

FREQUENCY RANGE	29.7-50 MHz
BATTERY DRAIN (Maximum)	
Receive	
Squelched	0.7 Amperes at 13.8 volts
Unsquelched	2.2 Amperes at 13.8 volts
Transmit	
60 Watts	13.0 Amperes at 13.6 Volts
110 Watts	22.0 Amperes at 13.4 Volts
FREQUENCY STABILITY	0.0005%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSION, LESS ACCESSORIES (H X W X D)	
60 Watts	65 mm X 260 mm X 325 mm (2.5 X 10.2 X 12.7 inches)
110 Watts	65 mm X 290 mm X 325 mm (2.5 X 11.4 X 12.7 inches)
WEIGHT, LESS ACCESSORIES	
60 Watts	5.9 kg (13.0 pounds)
110 Watts	6.5 kg (14.5 pounds)

TRANSMITTER

CONDUCTED SPURIOUS	-85 dB
MODULATION	±4.5 kHz
AUDIO SENSITIVITY	65 to 120 Millivolts
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -4.5 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA
DISTORTION	Less than 2% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.5 kHz maximum
MAXIMUM FREQUENCY SEPARATION	2 MHz
MICROPHONE LOAD IMPEDANCE	600 ohms
POWER ADJUST RANGE	2:1 of rated power
RF OUTPUT IMPEDANCE	50 ohms
FM NOISE	-65 dB
CARRIER ATTACK TIME	25 milliseconds
AUDIO ATTACK TIME	25 milliseconds
CHANNEL GUARD TX TONE DISTORTION	<5%

RECEIVER

AUDIO OUTPUT (to 4.0 ohm speaker)	12 Watts with less than 3% distortion		
SENSITIVITY	Standard		
12 dB SINAD (EIA Method)	0.25 uV		
20 dB Quieting Method	0.35 uV		
Squelch <6 dB SINAD	0.25 uV		
Channel Guard 8 dB SINAD			
SELECTIVITY EIA Two-Signal Method (@ 20 kHz channels)	-100 dB		
SPURIOUS RESPONSE	-100 dB		
INTERMODULATION	-85 dB		
MODULATION ACCEPTANCE	±6.5 kHz		
MAXIMUM FREQUENCY SEPARATION	No Center Tuning	Center Tuning	3 dB degradation with Center Tuning
29.7-36 MHz	0.5 MHz	1.0 MHz	1.75 MHz
36-42 MHz	0.625 MHz	1.25 MHz	2.00 MHz
42-50 MHz	0.75 MHz	1.5 MHz	2.50 MHz
FREQUENCY RESPONSE	Within +2 and -8 dB of a standard *6 dB per octave de-emphasis curve* from 300 to 3000 Hz (1000 Hz reference)		
RF INPUT IMPEDANCE	50 ohms		
HUM/NOISE RATIO			
UNSQUELCHED	-50 dB		
SQUELCHED	-70 dB		
RECEIVER RECOVERY TIME	200 milliseconds		
RECEIVER ATTACK TIME	150 milliseconds		
CHANNEL SPACING	20 kHz		

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

COMBINATION NOMENCLATURE

DIGITS 1 & 2	DIGIT 3	DIGIT 4	DIGIT 5	DIGIT 6	DIGITS 7-9	DIGIT 10	DIGIT 11
Product Code	Transmit Frequency Range	Receive Frequency Range	Channel Spacing	Type	RF Power Output	Model/ Channel Capacity	Oscillator Stability
N3 DELTA S	**B** 29.7-36 MHz	**B** 29.7-36 MHz	**3** 20 kHz	**N** Narrowband	**060** 60 Watts	**T** A Mode 16 Channel	**B** ±5 PPM
	C 36-42 MHz	**C** 36-42 MHz			**110** 110-Watts	**Z** A/B Mode 32 Channel	
	D 42-50 MHz	**D** 42-50 MHz					

STRUCTURED OPTIONS

DIGIT A	DIGIT D	DIGIT M	DIGIT N	DIGIT R
Program-ming	Channel Guard	Mounting	Antenna	Receiver Type
0 Test Program	**0** None	**0** Std. Frame & Mtg Hdwe	**0** None	**0** None
1 Custom Program	**B** Tone/ Digital	**N** None	**A** Whip	**B** Noise Blanker
2 S950 Down Load				

DESCRIPTION

General Electric synthesized DELTA-S 29.7-50 MHz 60 and 110 watt mobile radio combinations are completely solid state utilizing microcomputer technology and integrated circuits to provide high quality - high reliability radios. The DELTA-S is designed to military specification MIL-STD-810C. Standard combinations may be equipped with:

- Microcomputer Controlled Frequency Synthesizer
- Up to 32 channels
- .0005% frequency stability
- Noise Blanker
- Tone and Digital Channel Guard, optional
- Other structured options

The radio set is housed in a weather resistant case only 2 1/2 inches high. The radio is secured to the vehicle by a bottom mounting plate, and is tamperproof when locked into the 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 pulled down, the handle can be used to carry the radio.

The basic radio consists of two printed wiring boards mounted in a cast aluminum frame. The two boards are the transmitter-receiver-system (TRS) board and the power amplifier board (See Figure 1).

The PA board is inserted into the radio from the top of the frame, while the TRS board is inserted from the bottom. *There are no wires used in the* basic radio. Interconnections are provided by pins on the TRS board that mate with connectors on the PA assembly.

The TRS Board is connected to chassis ground allowing it to used in vehicles with a negative ground battery system only.

The radio is of single-layer construction with all major modules and tuning adjustments easily accessible from the top of the radio.

Centralized metering jacks for the transmitter, receiver and system functions are provided to facilitate alignment and troubleshooting.

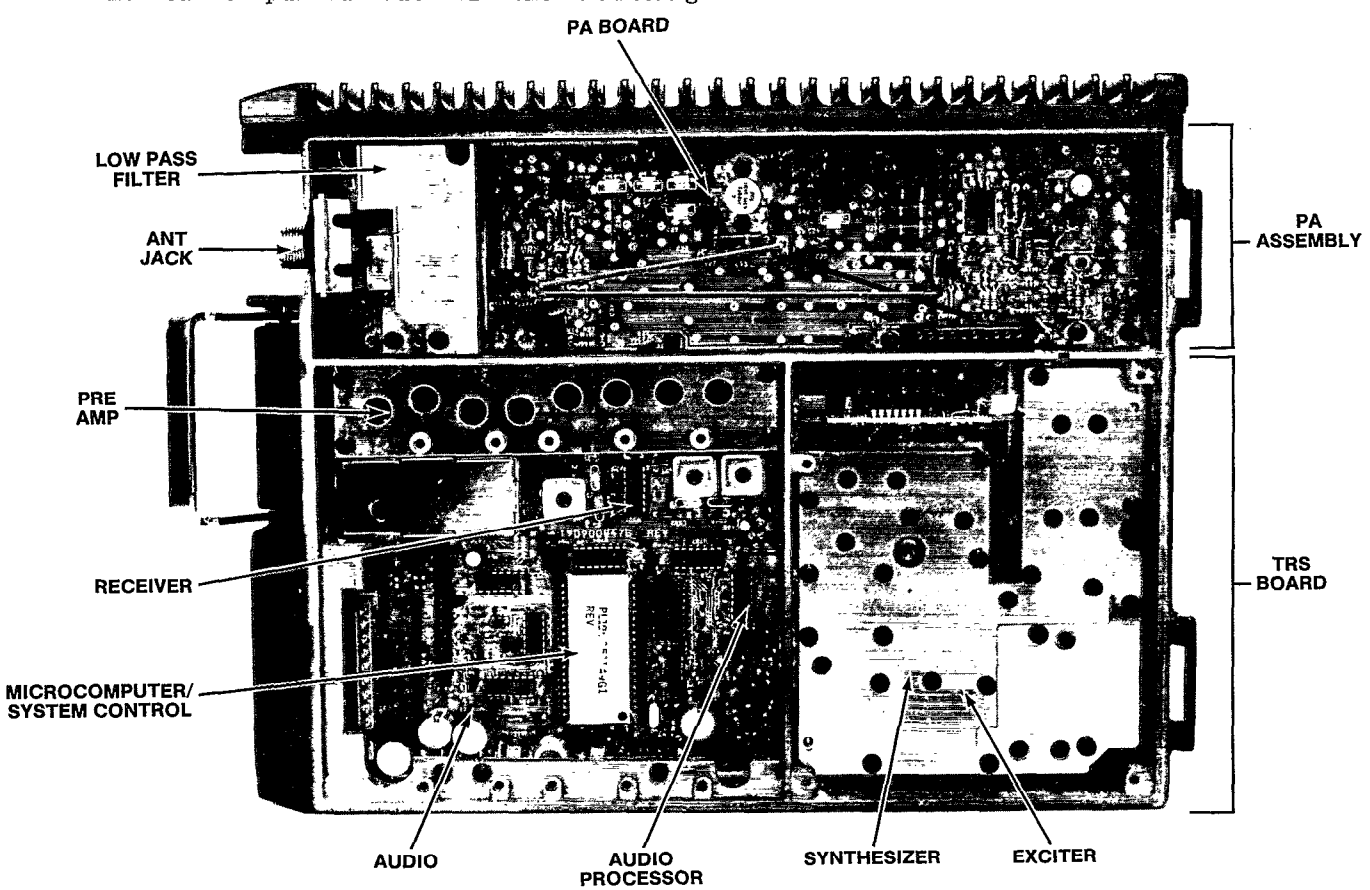


Figure 1 - Typical Module Layout

Simply changing power leads to the control unit and reversing the power leads in the main connector allows the radio to be used in negative or positive ground vehicles. No changes are required in the radio. Refer to the Installation Manual for details.

SYNTHESIZER/INTERCONNECT

The synthesizer consists of a microcomputer, electrically erasable PROM(S) (EEPROM), a frequency synthesizer IC, transmit and receive VCO's, and associated circuitry. The frequency synthesizer under control of the microcomputer generates all transmit and receive RF frequencies.

The EEPROM stores binary data for all RF frequencies, Channel Guard tones/digital codes, and the timing function of the carrier control timer (CCT). The microcomputer accesses the EEPROM and provides the correct WALSH bits to the Channel Guard board to generate the correct Channel Guard tone or digital code on a per channel basis.

Depending on the configuration of the radio, one or two EEPROMS may be provided. Radios not equipped with a MODE A/B switch will have one EEPROM. Radios with more than 16 channels and those with the MODE switch will have two EEPROMS.

PROGRAMMING

The EEPROM allows the radio to be programmed or reprogrammed as needed to adapt to changing system requirements. RF frequencies, Channel Guard tones and digital codes, and the CCT function can be reprogrammed.

The EEPROMS can be reprogrammed through the radio front connector using the General Electric Universal PROM Programmer Model TQ2310. This programmer allows all information to be loaded simultaneously.

NOTE

When programming, remember that all RF frequencies must be divisable by 5 kHz.

Alternatively, a single channel Programmer Model 4EX22A10 allows the user to reprogram the radio on a per channel basis. Use of this programmer requires that the radio top cover and any option boards present be removed. A special programming jack, J711, is provided in the radio for interconnections.

Programming instructions are provided in the respective Programmer Maintenance Manuals.

TRANSMITTER

The transmitter consists of the exciter, frequency synthesizer, transmit VCO, and a power amplifier assembly. The PA assembly consists of a PA board mounted along the side of the radio next to the heat sink assembly. The PA board also contains a hermetically sealed antenna relay and a low pass filter. The broad band PA requires no tuning.

RECEIVER

The single conversion receiver consists of the frequency synthesizer, RX VCO, injection amplifiers, front end, IF and limiter detector. In radios equipped with the optional noise blanker, a noise blanker board is plugged into J406 on the TRS board. Audio and squelch circuitry for the receiver is located in the system section of the TRS board. Jacks for the Channel Guard and other structured options are also located in the system area.

CONTROL UNITS

Two "S" series control units, the S500 and the S600, may be used directly with DELTA-S radio combinations.

The S500 control unit contains an on-off volume control switch, a rotary channel selector switch for 1, 8, or 16 channels, a MODE A/B switch (optional) to expand the channel select capability to 32, seven segment channel indicator(s), a red transmit indicator, channel busy indicator (optional), and a tone option jack. Options that may be used with this control unit include Type 90 and 99 tone, squelch operated relay SOR, GE-STAR encoder, and public address. An interface board is required in the radio. The S500 control unit uses the same power/control cables as the C500 control unit.

The S600 control unit contains an on-off volume control switch, squelch disable switch, red transmit indicator, and a 7 segment channel indicator. A rotary channel select switch permits selection of up to eight channels. A white power on indicator is used for back lighting the front panel. Space is provided for two optional pushbutton switches and two optional indicators. The S600 control unit uses the same power/control cables as the C600 control unit.

CHANNEL SELECTION

Depending on the control unit used, a single rotary or pushbutton selector

switch will select up to 16 channels. In radios equipped with more than 16 channels, the control unit will contain a MODE A/B switch. The MODE switch allows the user to select a second set of 16 channels (17-32).

The MODE A/B switch may be used to provide mobile-to-mobile communications through an intermediate repeater (repeated path) or direct mobile-to-mobile communications. For example: channel 1 Mode A may be programmed for the repeater frequency (repeated path) while channel 1 Mode B would be programmed for the mobile receive frequency (direct path). Judicious programming will allow selection of repeated or direct communications paths on selected channels.

MICROPHONE AND HANDSET

A hand held microphone with a built-in transistorized microphone preamplifier is available for use with the radio. The microphone is housed in a sturdy two piece case, and the extendable coiled cord plugs into the microphone jack at the back of the control unit. The plug is secured to the jack by a retaining screw.

An optional telephone-type handset is also available. The handset uses a dynamic microphone with a built-in microphone preamplifier. The extendable coiled cord plugs into the microphone jack on the back of the control unit, and is secured to the jack by a retaining screw.

HOOKSWITCHES

In Channel Guard or other tone 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 Channel Guard decoder. With the switch in the "down" position, the Channel Guard is disabled when the microphone or handset is removed from the hookswitch.

SPEAKER

A three by five-inch speaker contained in a molded plastic housing provides an audio output of 12 watts with a speaker impedance of four ohms. The speaker leads are terminated in Vehicle Systems Plug P3 which connects to J1-A on the rear of the control unit.

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by a certified electronics technician.

TRANSMITTER ADJUSTMENT

The transmitter adjustments include measuring the forward and reflected power and optimizing the antenna length, then setting the transmitter to rated power output. Next, measure the frequency and modulation and record these measurements for future reference. For the complete transmitter adjustment, refer to the Alignment Procedure in the Service Manual.

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. Refer to the front end alignment procedures in the service section of this manual.

There are no initial adjustments for the receiver.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the Operator's Manual. The basic procedures for receiving and transmitting messages in mobile combinations are as follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by turning the OFF-VOLUME control halfway to the right.
2. Turn the SQUELCH control clockwise (to the right) as far as possible. A noise will be heard from the speaker.
3. Adjust the VOLUME control until the noise is easily heard, but is not annoyingly loud.
4. Turn the SQUELCH control counterclockwise (to the left).
5. In multi-frequency radios, select the proper frequency.

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

TO TRANSMIT A MESSAGE

1. Turn the radio on and select the proper channel.
2. If a lengthy message (or several messages) are to be sent, the vehicle engine should be running to maintain the battery charge.
3. Pick up the microphone and listen briefly to the speaker to make sure that no one else is using the channel.
4. Press the Push-to-Talk (PTT) switch on the microphone and send the message. The red transmit light on the control unit will glow each time the PTT switch is pressed.

MAINTENANCE

The use of microcomputer technology allows self diagnostic maintenance routines to be incorporated in the microcomputer software. These routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation.

The service section of this manual contains the diagnostic routines, and other maintenance information to service this radio. The service section includes:

- System interconnections
- Mechanical layout
- Disassembly procedures
- Replacement of IC's, chip capacitors, and resistors
- Service tips
- Microcomputer self diagnostics
- Alignment procedures for the transmitter and receiver
- Troubleshooting Procedure and waveforms

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 eliminating undesirable noise interference (See Figure 2).

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 arcing. 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 at the distributor and cut 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.
3. Use a 0.5-mFd by-pass capacitor to bypass 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.

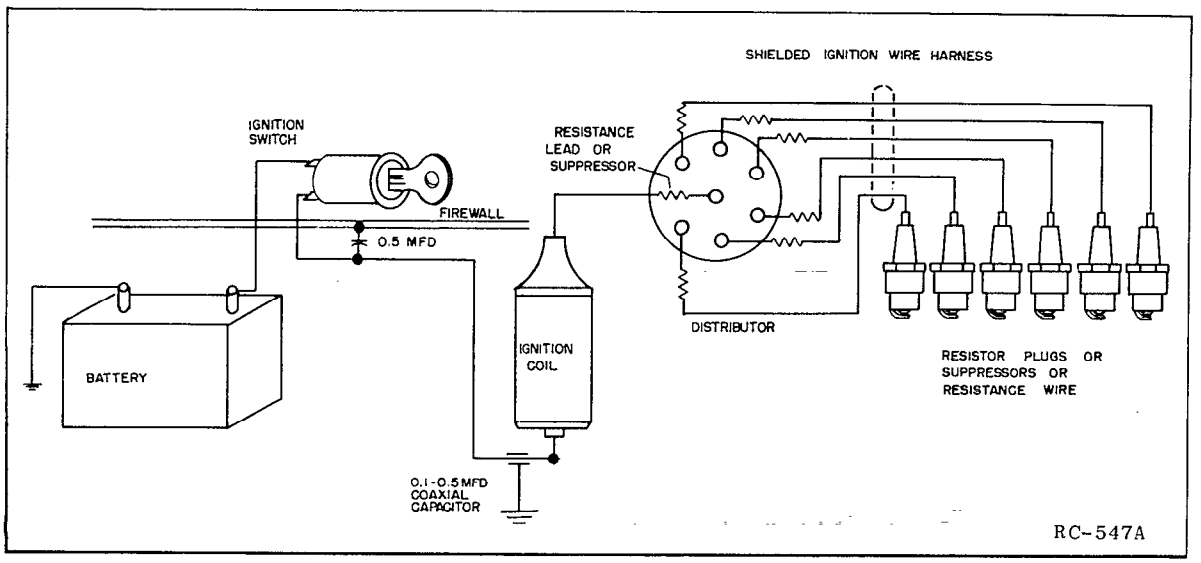


Figure 2 - Ignition Circuit with Noise Suppression Components

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 noise will continue as long as the engine turns, lowering in pitch as the engine slows down (See Figure 3).

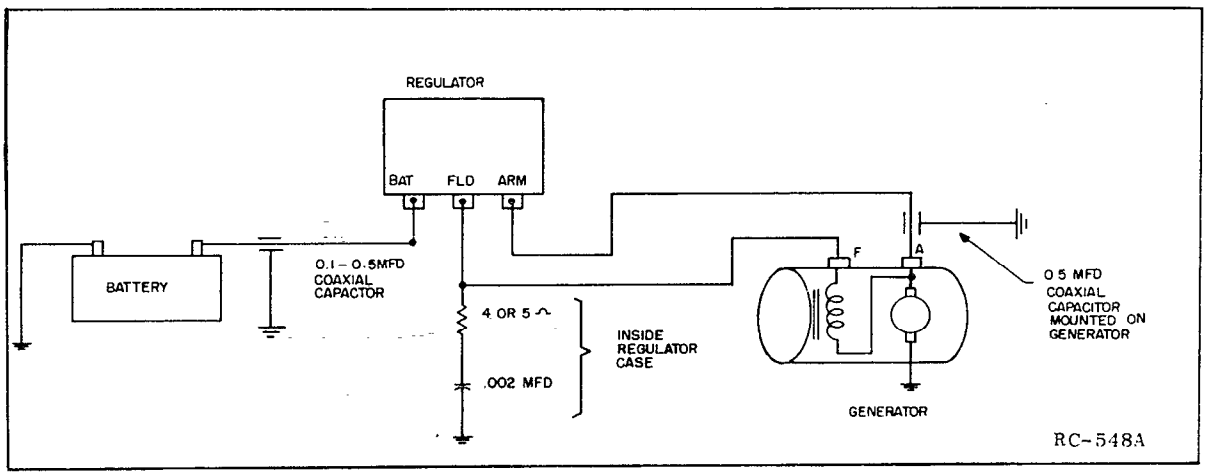


Figure 3 - Generator Circuit with Noise Suppression Components

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 powder.
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.

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