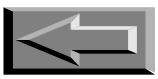
MOTOROLA

GM350

Mobile Radio

Installation Manual

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GM350 Installation Manual

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1.0 Installation

This chapter gives details on planning/procedures for installing the radios. Provides brief detail on the accessory connector and gives details and mechanical explosion view diagrams for the radio accessories.

2.0 Reducing Noise Interference in Mobile Two-Way Radio Installations

Describes ways of reducing noise interference when installing the radios.

Chapter 1

GM350 Installation

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1.0 Safety Information

Every radio, when transmitting, radiates energy into the atmosphere which may, under certain conditions, cause the generation of a spark.

All users of vehicles fitted with radios should be aware of the following warnings:

WARNING: **DO NOT operate the radio near flammable liquids or in the vicinity of explosive devices.**



During normal use, the radio will subject you to radio energy substantially below the level where any kind of harm is reported.

To ensure personal safety, please observe the following simple rules:

- ❑ **DO NOT** transmit when the antenna is very close to, or touching, exposed parts of the body, especially the face and eyes.
- ❑ **DO NOT** hold the transmit (PTT) key in when not desiring to transmit.
- ❑ **DO NOT** operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.
- ❑ **CHECK** the laws and regulations on the use of mobile radios in area of operation. Always obey them. Also, when using your radio while driving, please: give full attention to driving, use hands-free operation, if available, and pull off the road and park before making or answering a call if driving conditions so require.

2.0 Installation Safety Warning

Installation of vehicle communication equipment should be performed by a professional installer/ technician qualified in the requirements for such installations.

Consider the occupants' safety when you choose a location for the radio. Do not mount the radio overhead or on a side wall unless you take special precautions.

Special precautions:

Do not mount the radio overhead or on a wall, unless you give it the added protection of a retaining strap.

If someone were to remove the radio and fail to replace it properly, road shock could bump the radio loose, and the falling radio could, in some circumstances, cause serious injury to the driver or a passenger. In a crash, even when properly installed, the radio could break loose and become a dangerous projectile.

WARNING: **An air bag inflates with great force. DO NOT place objects, including communication equipment, in the area over the air bag or in the air bag deployment area. If the communication equipment is improperly installed and the air bag inflates, this could cause serious injury.**



An air bag's size, shape and deployment area can vary by vehicle make, model and front compartment configuration (e.g., bench seat vs. bucket seats). Contact the vehicle manufacturer's corporate headquarters, if necessary, for specific air bag information for the vehicle make, model and front compartment configuration involved in your communication equipment installation.

WARNING: 

It is mandatory that radios installed in vehicles fuelled by liquefied petroleum gas conform to the National Fire Protection Association standard NFPA 58, which applies to vehicles with a liquid propane (LP) gas container in the trunk or other sealed off space within the interior of the vehicle. The NFPA58 requires the following:
1) Any space containing radio equipment shall be isolated by a seal from the space in which the LP gas container and its fittings are located.
2) Removable (outside) filling connections shall be used.
3) The container space shall be vented to the outside.

3.0 Operational Safety Warnings

WARNING: 

For vehicles equipped with electronic ignition systems, check the vehicle service manual for warnings about the use of two-way radio equipment in the vehicle.

3.1 Radio Care / Handling

CAUTION: 

Avoid physical abuse; do not pound, drop, or throw the radio. It may damage exposed parts such as controls and connectors.

Do not connect any equipment other than Motorola compatible equipment, as it may damage the radio. For a list of available compatible accessories consult the Accessories Guide or check with your local representative.

4.0 Introduction

Your mobile two-way radio offers various methods of installation possibilities. The standard radio package contains a direct mounting trunnion and power cables. Some models of the mobile radios may also be mounted in the car radio cut-out. This requires a mounting kit GLN7320A per ISO7736. In both cases it should be assured that the cables can be routed to the radio cabinet without being exposed to excessive heat or mechanical damage.

On the rear of the radio an accessory connector provides the connection to the different accessories required for the installation. The front control head panel has an eight pin telephone type connector to allow connection of various microphones.

4.1 Control Head Mounting Position

The control head is designed to be reverse mounted on the radio, i.e. rotated through 180°. This useful feature provides multiple mounting options for the radio. For example, the radio may be mounted on either side of the vehicle transmission tunnel with the cooling fins of the radio against the side of the tunnel to facilitate the safest and ergonomically ideal position. The control head is then positioned to provide most convenient user access.

To reverse mount the control head perform the following steps:

1. Remove the control head by inserting a small flat blade screwdriver, or similar, in the recesses between the control head and the radio housing.
2. Press until the control head releases and then repeat the operation on the opposite side of the radio.
3. Pull the control head away, ensuring that the flex connector remains attached to the control head.
4. Rotate the control head through 180° and align the flex to the new position by folding.
5. Replace the control head onto the housing by pushing until the protuding tabs snap into place.

CAUTION: The contact surface of the flex should be facing the printed circuit board.



5.0 Installation Planning and Procedures

5.1 Installation Planning - Mobile Radios

Planning is the key to fast, easy radio installation. Before a hole is drilled or a wire is run, inspect the vehicle and determine how and where you intend to mount the antenna, radio, and accessories. Plan wire and cable runs to provide maximum protection from pinching, crushing and overheating.

5.2 Installation Planning - Antenna Mounting

CAUTION: Installation of antennas with mobile radio equipment with transmitter power in excess of 7 watts.



Note: For low power mobile radios (7 watts or less), there are no antenna type or installation restrictions.

In Non-Metallic Body Vehicles with transmitters at any frequency having a power output in excess of 7 watts, do not install any type of antenna closer than 0,6 meter in distance from any occupant of the vehicle. Failure to follow this procedure may result in the exposure, of the vehicle occupants, to frequency energy levels higher than recommended by the American National Standards Institute (ANSI).

In Metallic Body Vehicles with transmitters at any frequency having a power output in excess of 7 watts, it is mandatory that when using a glass mount antenna the installation instructions covering the location of the antenna at the top of the front or rear window and the cable routing be followed exactly as described. Failure to follow this procedure may result in the exposure of the vehicle occupants to radio frequency energy exposure levels higher than recommended by the American National Standards Institute (ANSI).

For other antenna types follow the existing installation instructions. The best mounting location for the antenna is in the centre of a large, flat conductive surface. In almost all vehicles, these requirements are best satisfied by mounting the antenna at the centre of the roof. A good alternate location is at the centre of the trunk lid. If the trunk lid is used, connect grounding straps between the trunk lid and vehicle chassis to ensure the trunk lid is at chassis ground. See the instruction manual supplied with the antenna for complete installation information.

6.0 Radio Mounting

6.1 Mounting Trunnion

The standard mounting trunnion allows the radio to be mounted to a variety of surfaces. Ensure the mounting surface is able to adequately support the weight of the radio. Allow sufficient space around the radio for free air flow for cooling. Ensure that the unit is close enough to the vehicle operator to permit easy access to operating controls. Although the trunnion can be mounted to a plastic dashboard, it is recommended that the mounting screws be located so they penetrate the supporting metal frame of the dashboard.

6.2 DC Power Cable Installation

This radio must be operated only in negative ground electrical systems. Reverse polarity will cause the cable fuse to blow. Check the vehicle ground polarity before you begin installation to prevent wasted time and effort.

The 3 meter (10 feet) DC power cable shipped with the radio is long enough for installation in most vehicles. Begin the power cable installation in the following manner:

1. Determine a routing plan for the power cable with reference to where the radio is to be mounted.
2. Locate an existing hole with a grommet in the vehicle fire wall, or drill a 10 mm Ø access hole at the location for passing the power cable into the engine compartment. Install a grommet with 5 mm Ø inner diameter in the access hole to avoid damage to the cable.

CAUTION: High degree of care should be exercised not to damage any existing vehicle wires.



3. From inside the vehicle, feed the red and black leads (without lugs attached) through the access hole and into the engine compartment. (see Figure 1-1).

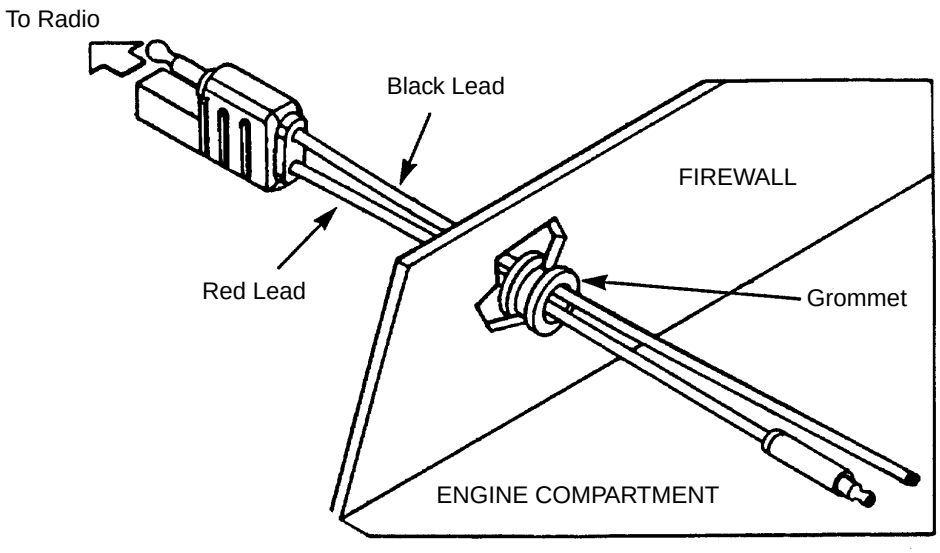
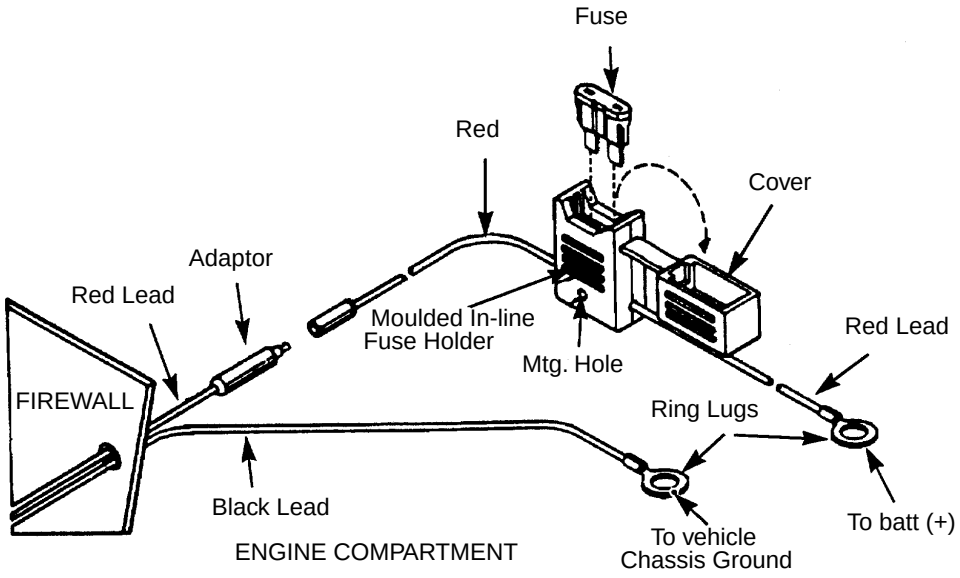


Figure 1-1 Power Cable Routing into Engine Compartment.

4. Locate the nearest available vehicle chassis ground mounting point and shorten the black lead to remove excess cable length.
5. Install ring lugs (supplied) onto stripped end of power cable black lead, and onto stripped end of red lead on fuse holder (see Figure 1-2).
6. Locate the fuse holder as close to the battery as possible and away from any hot engine component. Mount the fuse holder via the mounting hole and dress wires as necessary. Connect the fuse holder red adaptor lead plug to the mating receptacle on the red lead of the power cable (see Figure 1-2).
7. Connect the power cable black lead directly to the vehicle chassis ground.
8. Connect the power cable red lead from the fuse holder to the positive (+) battery terminal. Make sure the adaptor cable is connected to the main power cable red lead.
9. Plug fuse into in-line fuse holder (see Figure 1-2).

Note: Failure to mount the red lead of the power cable kit directly to the battery may result in severe alternator whine interference.



Note: If Black Lead connected to battery (-) terminal an additional 10A fuse in the black lead should be implemented.

Figure 1-2 Power Cable Assembly.

6.3 MOUNTING TRUNNION INSTALLATION

1. Select the location to mount your radio either on the Transmission Hump or Under the Dash (see Figure 1-5). By mounting the trunnion on the transmission hump take care the transmission housing is not affected.
2. Using the trunnion mounting bracket as a template, mark the positions of the holes on the mounting surface. Use the innermost three holes for a curved mounting surface such as the transmission hump and the three outmost holes for a flat surface such as under the dash.
3. Centre-punch the spots you have marked and drill a 4 mm Ø hole at each.
4. Secure the trunnion mounting bracket with the three screws provided. (see Figure 1-5)
5. Slide the radio into the trunnion. Secure the radio with the two thumb screws provided (see Figure 1-3).

6. Mount the antenna using the instructions provided with the antenna kit. Run the coaxial cable to the radio mounting location. If necessary, cut off the excess cable and install the cable connector.

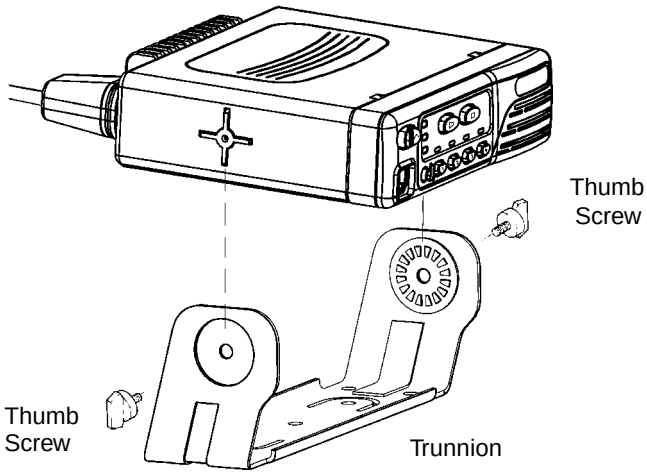


Figure 1-3 Radio into Trunnion .

7. Connect the antenna cable connector to the radio antenna connector on the rear of the radio (see Figure 1-4).

8. Mount the microphone clip to a convenient spot near your radio.

9. Plug the microphone into the control head connector. Your microphone has a telephone type connector at the end of its cord.

10. To complete your radio installation plug the power cable into the radio power connector (see Figure 1-4).

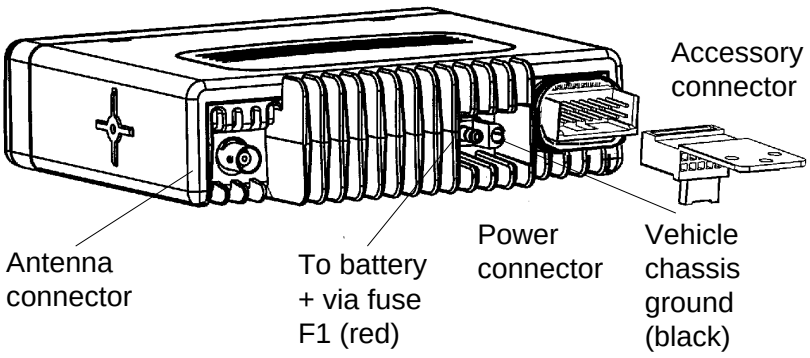


Figure 1-4 Connections to Radio rear.

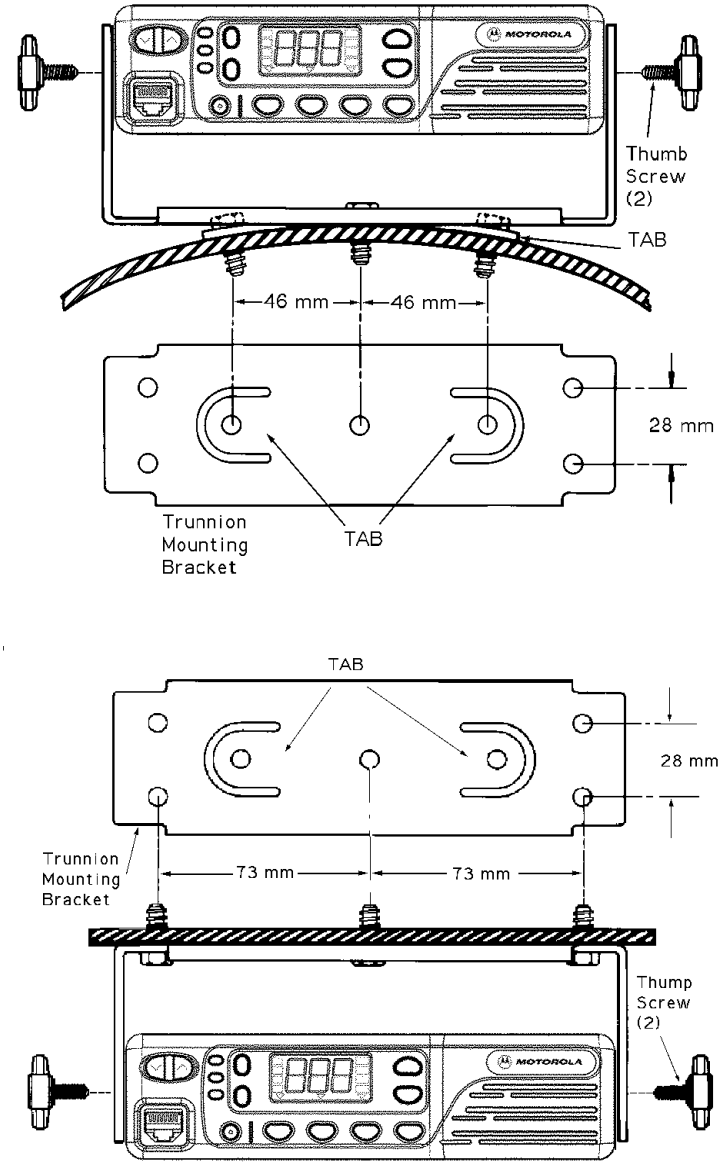


Figure 1-5 Transmission Hump Mounting (top) and Below Dash Mounting (bottom)

6.4 Radio Mounting in an Automotive Dashboard

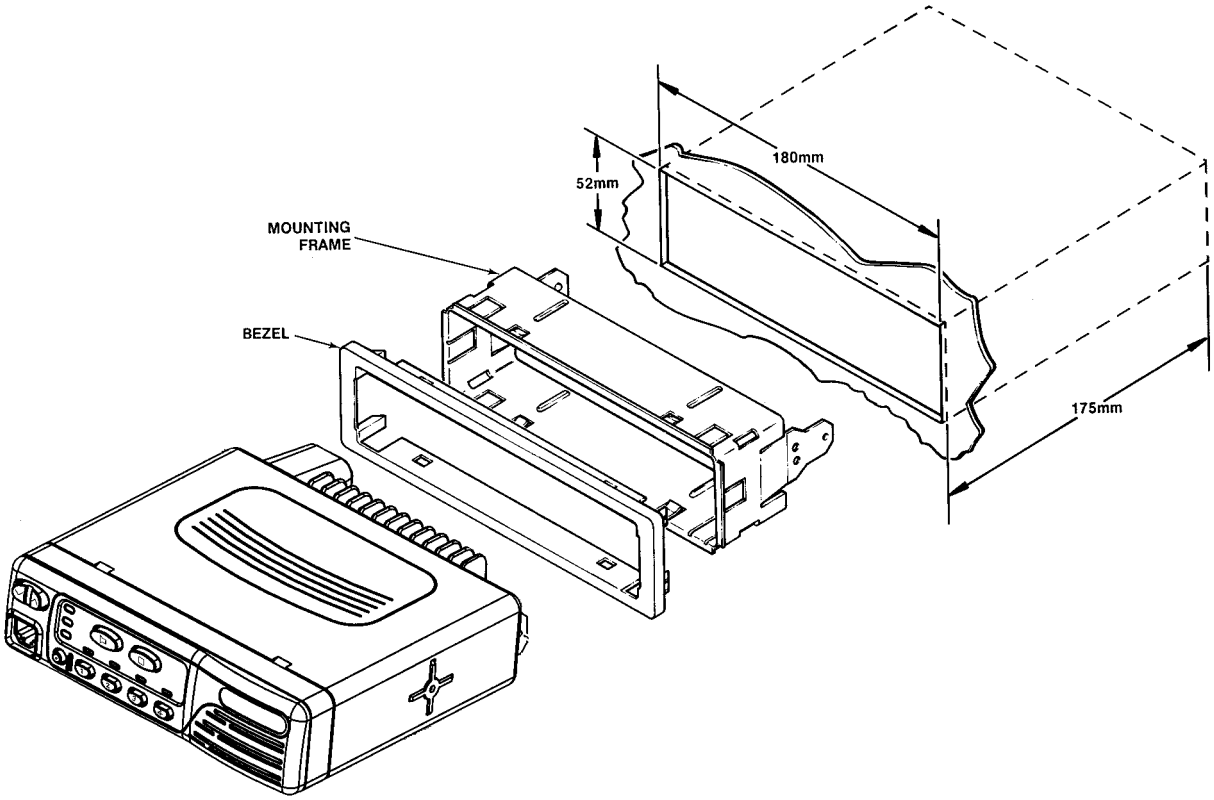


Figure 1-6 Mounting the complete radio in the dashboard.

To install the radio in an automotive dashboard.

1. Open the radio cutout in the dashboard and, if necessary, enlarge it to the dimension shown in Figure 1-6.
2. Insert the mounting frame into the cutout and bend the six tabs (see Figure 1-7) to hold it in place. Press the Bezel onto the mounting frame.
3. Slide the radio into the mounting frame.

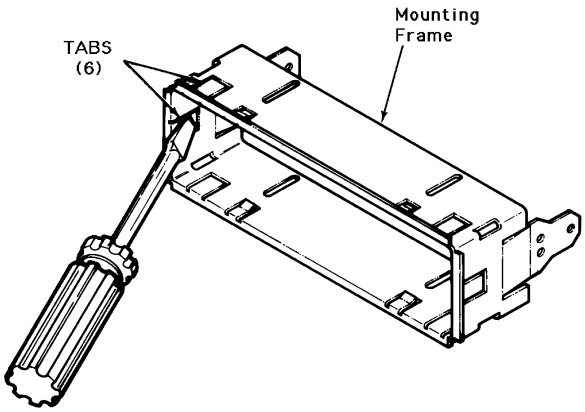


Figure 1-7 Mounting Frame Detail.

4. Make necessary connections to the radio for the power, antenna and accessory connector as shown in Figure 1-4.

6.5 External Speaker Installation

1. Remove the speaker from the trunnion bracket by loosening the two wing screws.
2. Choose a place to mount the speaker.
3. Using the trunnion bracket as a template, mark the locations of the three mounting holes.
4. Centrepunch and drill a 4 mm Ø hole at each location.
5. Mount the trunnion bracket with the screws supplied (Figure 1-8).
6. Insert the speaker into the trunnion bracket and tighten the two wing screws.
7. Insert the external speaker accessory plug into the accessory connector of radio.

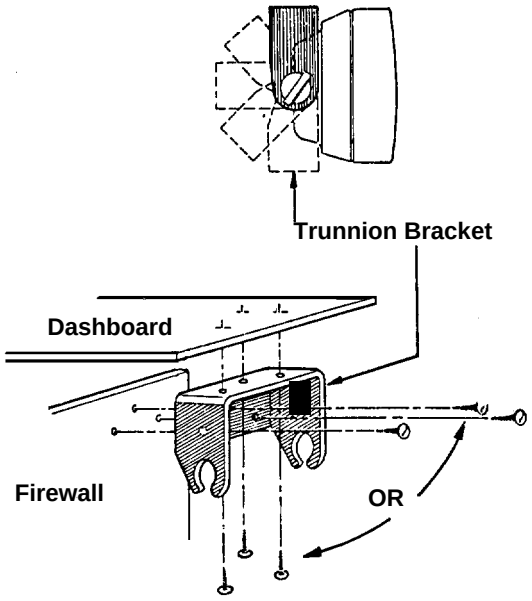


Figure 1-8 Mounting Speaker under the Dashboard.

7.0 Accessory Connector Pin Functions

This section gives a brief description of the accessory connector pin functions. Please refer to the Service Manual, Appendix B, for a more detailed description on the accessory pin functions.

CAUTION:



1. The accessory connections shown are not compatible to some other models of Motorola radios. Check the appropriate accessory or technical manual for further information.

2. The output of this pin may be configured by a solder link within the radio. Switched B+ is the default. The current limiting resistor (R0455) default is 0Ω, therefore extreme care must be taken to avoid short circuiting this output to ground, which will damage the radio. The maximum continuous current allowed is 300mA. A suitable external fuse must be installed into the lead to pin 13 to avoid damage to the radio.

Pin	Function	4 ch	128 ch	Description
1	External Speaker -	✓	✓	Speaker - and Speaker + (Pin 16) are used to connect an external speaker. The audio PA is a bridge amplifier with a minimum load resistance of 3.2 ohms. The internal speaker can be disabled by removing the control head. Disconnect the internal speaker and assemble the control head back to the radio.
2	External Mic Audio	✓	✓	This mic input is parallel to the mic input of the control head micro-phone connector.
3	Programmable Input	✓	✓	This function depends on dealer programming.
4	Programmable Output	✗	✓	This function depends on dealer programming.
5	Flat_TX_Audio	✗	✓	This input is intended for injecting signals into the transmit path that should not be filtered, e.g. the digital output of a modem.
6	Bus+	✓	✓	This pin is connected to the radio‘s SCI serial bus for programming.
7	Ground	✓	✓	Used as ground for both analogue and digital signals
8	Programmable Input/Output	✗	✓	This function depends on dealer programming.
9	Programmable Input	✗	✓	This function depends on dealer programming.
10	Ignition	✓	✓	Connecting this line with the ignition line of the car will automati-cally turn the radio on when the ignition of the car is turned on.
11	RX_Audio	✗	✓	There are two possible outputs: (i) Discriminator Audio and (ii) Continuous filtered RX audio output of AFIC. The output is dependent on dealer programming.
12	Programmable Input/Output	✗	✓	This function depends on dealer programming.
13	SW_B+/Analogue Gnd	✗	✓	This voltage is available when the radio is switched on.
14	Programmable Input/Output	✗	✓	This function depends on dealer programming.
15	RSSI	✗	✓	This is an analog output which indicates the strength of the received signal.
16	External Speaker +	✓	✓	Refer to PIN1

8.0 Installation Diagrams

CAUTION: The accessory connections shown are not compatible to some other models of Motorola radios. Check the appropriate accessory or technical manual for further information.



Connection Plan for GM350 Accessories 1-13

Positioning of Accessory Connector 1-13

5.5" Speaker GSN6059 1-14

Handset HMN3141 1-15

Enhanced Compact Microphone GMN6146 1-17

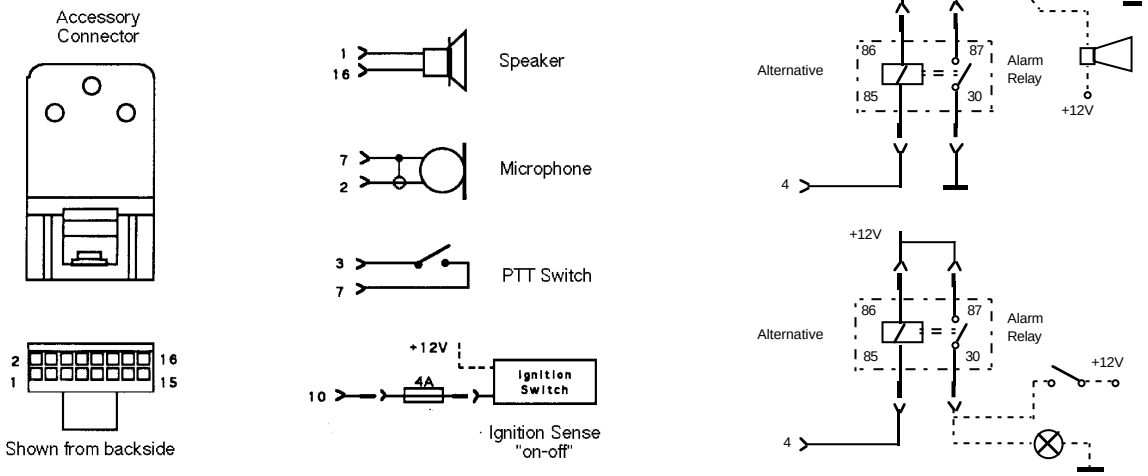
DTMF Microphone GMN6148 1-18

Base Tray GLN7318 1-19

Power Supply GPN6133 1-20

List of Accessories 1-21

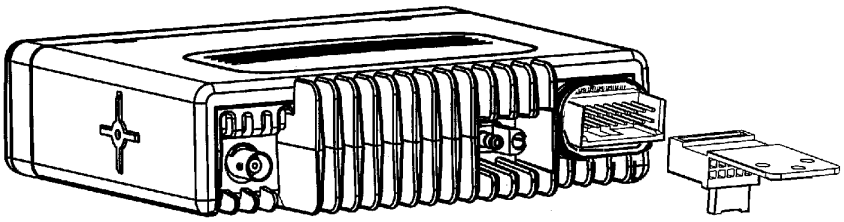
8.1 Connection Plan for GM350 Accessories



CAUTION:

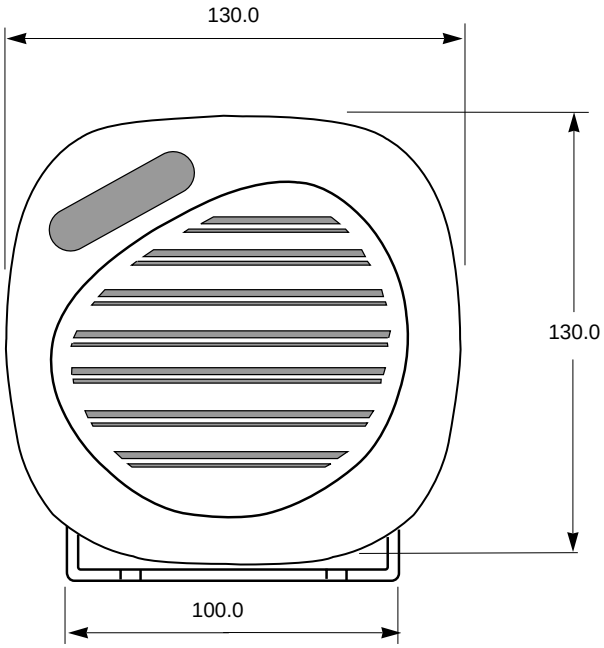
1. DO NOT short pin 16 or 1 on the accessory connector to ground, this may damage the radio.

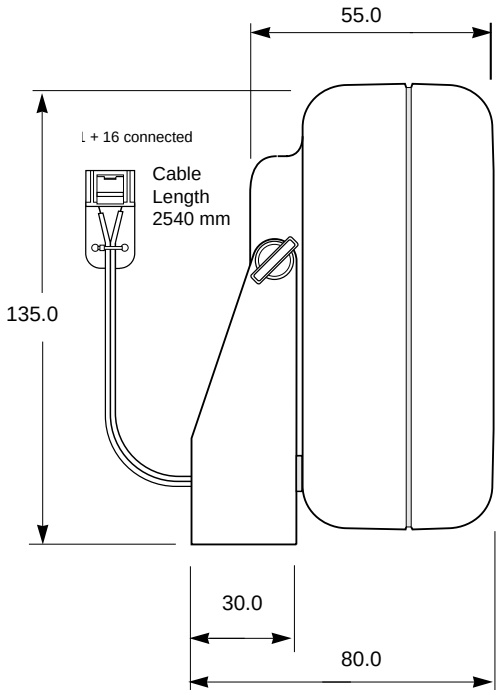
2. A suitable external fuse **MUST BE** installed into the lead to pin 13 to avoid damage to the radio.



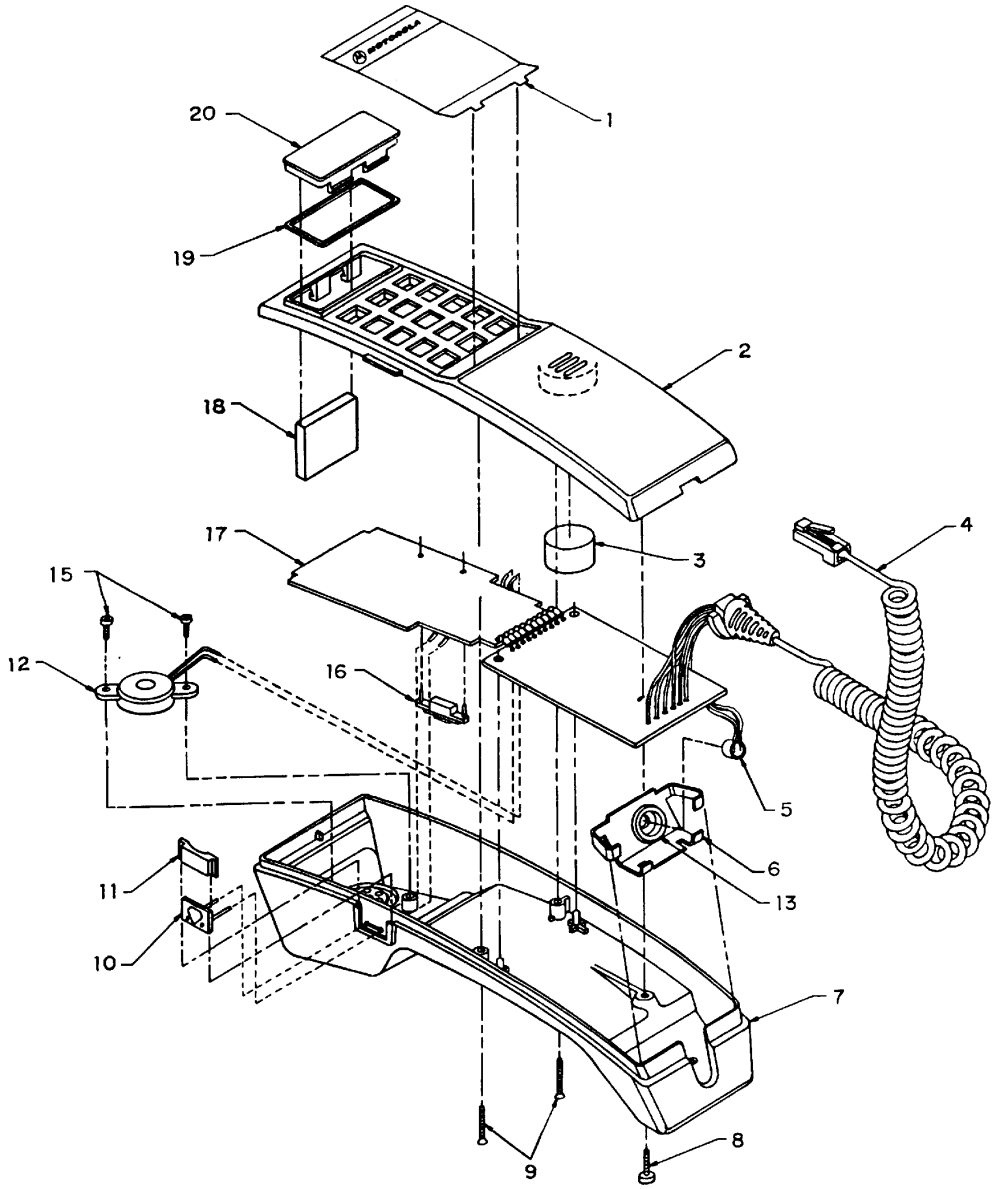
CAUTION: Ensure correct position of the accessory connector.

8.2 Speaker GSN6059 5.5ins/130mm, 13 Watts





8.3 Handset HMN9416 (P/O HMN3141) Mechanical Exploded View



Ref No.	*Motorola Part No.*	*Description*
1	13-80928W01	Escutcheon
2	15-82281R01	Top Housing
3	75-80927W01	Top Housing Pad
4	30-06418T01	Coil Cord Cable
5		Mic Cartridge (MK101)
6	07-80148G02	Mic Gasket Bracket
7	15-84795P04	Bottom Housing
8	03-10908A91	Machine Screw
9	03-10913B37	Tapping Screw
10		PTT Dome Switch (S11)

Ref No.	*Motorola Part No.*	*Description*
11	38-84658P01	PTT Button
12		Speaker (LS10)
13	32-80272F16	Microphone Gasket
14		Not used
15	03-10944A03	Tapping Screw
16	43-84312N01	Reed Switch Spacer
17	01-80701Y77	Circuit Board Assembly
18	75-80926W01	Circuit Board Pad
19	32-80282F02	Lens Gasket
20	61-80266F10	Display Lens

8.3.1 Description

The HMN3141 Handset and hang-up cup is a slimline telephone handset with push to talk (PTT) button. It is used in place of, and operates similar to, the standard mobile microphone.

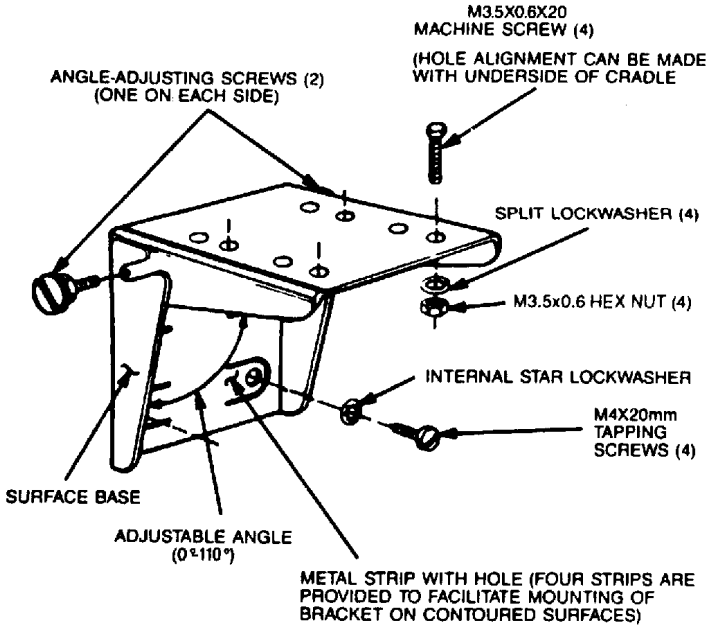
8.3.2 Installation

General

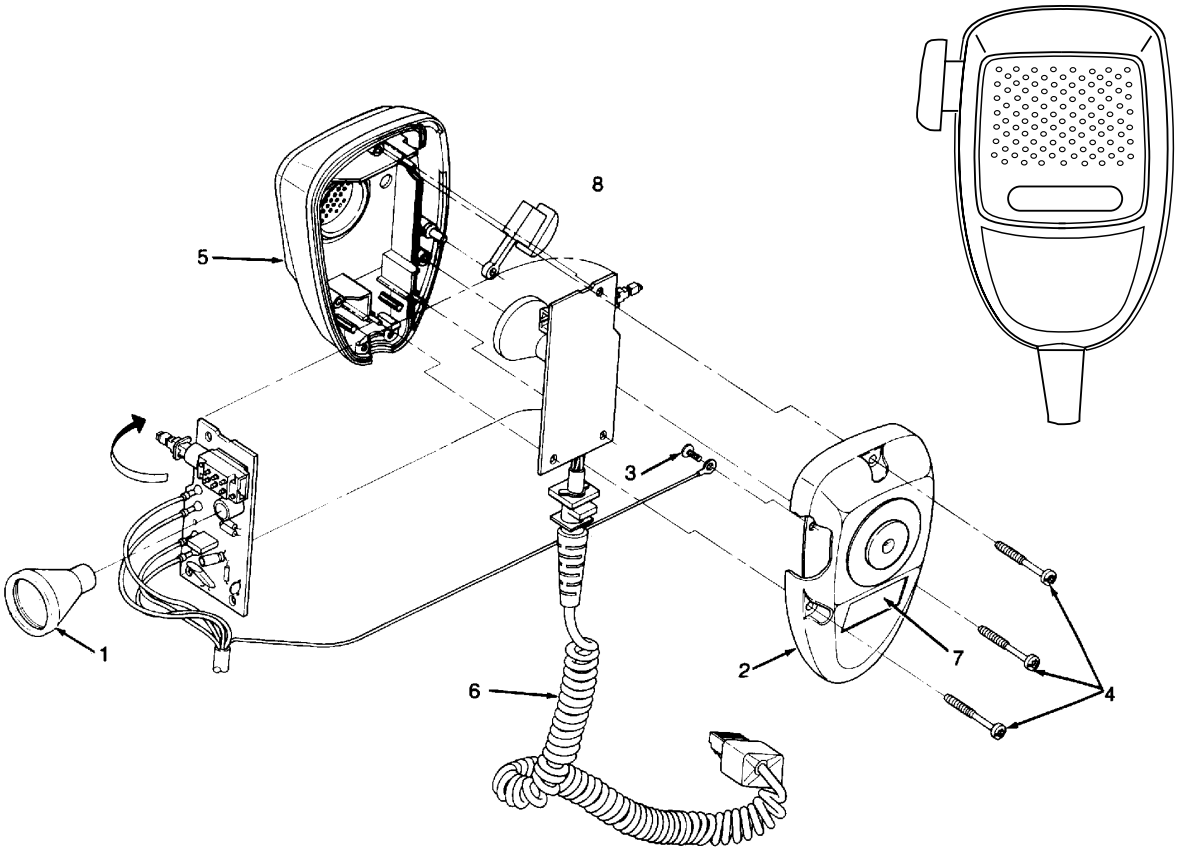
When planning the installation of your handset, it is important that it does not interfere with the operation of the vehicle or its accessories, nor disturb passenger seating or leg space. The handset must be within convenient reach to the user. In general terms, the location of the handset should be similar to the standard mobile microphone.

Adjustable Angle Bracket

1. Verify that the selected mounting surface is strong enough to support the mounting hardware.
2. Use the base of the adjustable angle bracket as a template, then centre punch and drill four 3.4mm diameter holes. Be careful not to damage any wires or other vital vehicle components when drilling the holes.
3. Use the four M4x20mm tapping screws and the internal star lockwashers to mount and secure the bracket.
4. Place the hang-up cup on top of the mounting surface of the mounting bracket and secure it using the four M3.5x0.6x20mm machine screws, lockwashers, and hex nuts provided.
5. Select the angle between the two bases of the adjustable angle bracket (from 0 to 110 degrees) and tighten the two adjusting screws.

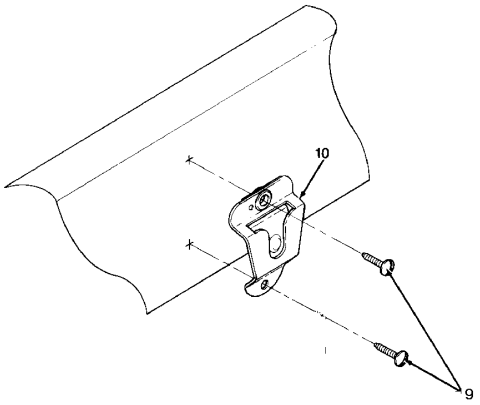


8.4 Enhanced Compact Microphone GMN6146 Mechanical Exploded View



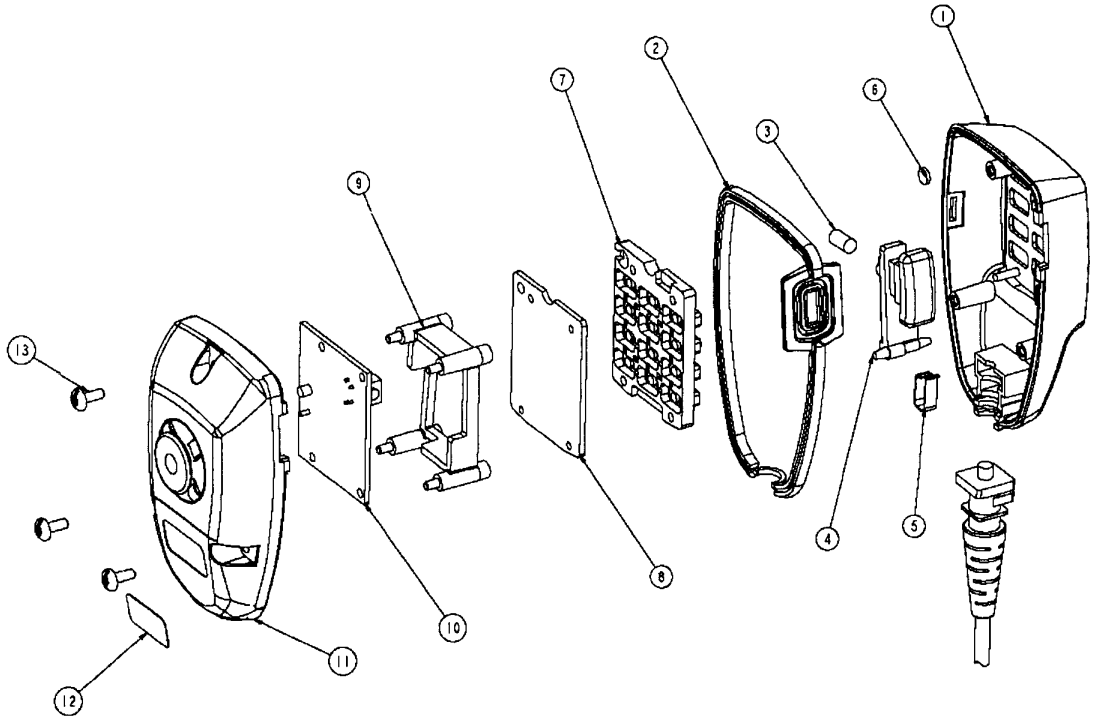
Ref No.	*Motorola Part No.*	*Description*
1	05-80148D01	Grommet
	14-84360C01	Insulator switch
2	01-80743T71	Microphone rear Housing
3	03-10943M09	Screw, M3x.5x6
4	03-80076E04	Screw, metric hi-lo (3 used)
5	15-80137D05	Microphone front housing
6	30-80152H05	Coiled cord
7		Name plate (GMN6146)
8	38-80144D03	Button, push to talk

Hang-Up Clip

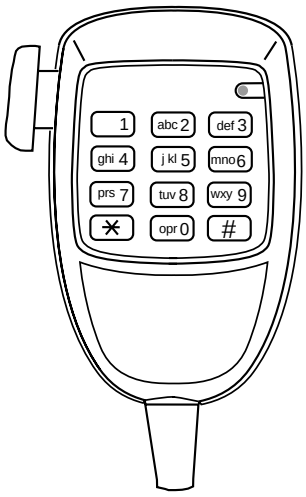


Ref No.	*Motorola Part No.*	*Description*
9	03-00139913	Screw, 8-18x1/2 (3 used)
10	01-80743T91	Hang-up clip

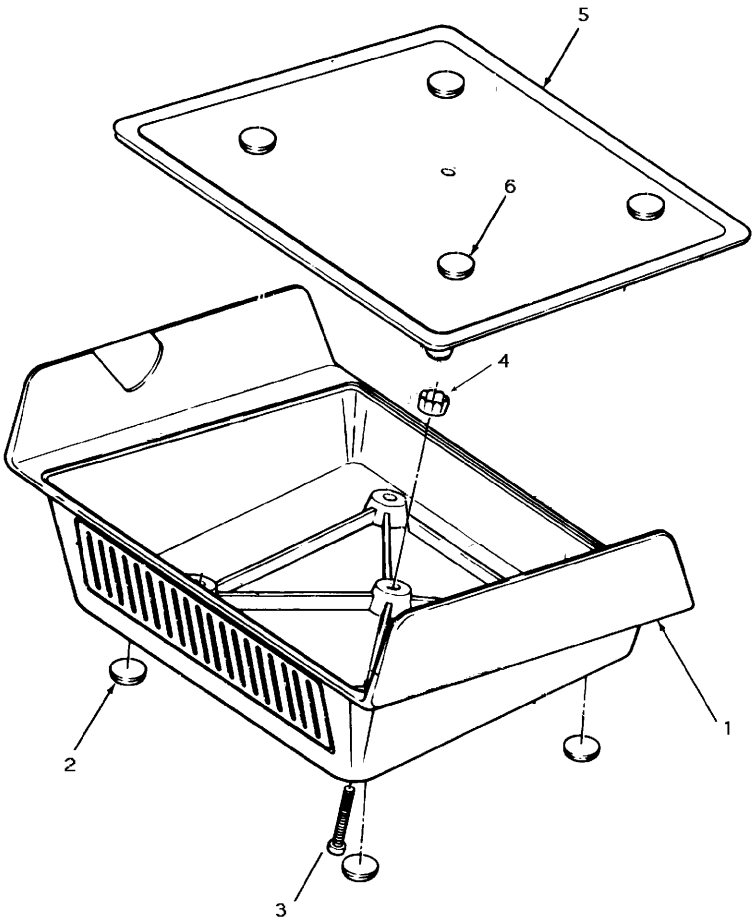
8.5 DTMF Microphone GMN6148 Mechanical Exploded View



Ref No.	*Motorola Part No.*	*Description*
1	15-80652D01	Microphone front housing
2	32-80565B01	Microphone gasket
3	75-80983Z01	Rubber Spacer, Switch
4	38-80654D01	Button, push to talk
5	41-80658D01	Spring, PTT
6	35-80089D02	Felt baffle
7	75-80655D01	Keypad
8	01-80707Y77	DTMF Encoder board assy
9	42-80656D01	Spacer
10	01-80707Y78	Switch/Sidetone board assy
11	01-80669D01	Microphone rear Housing
12	54-80104R..	Mic label
13	03-139959	Screw, thread forming



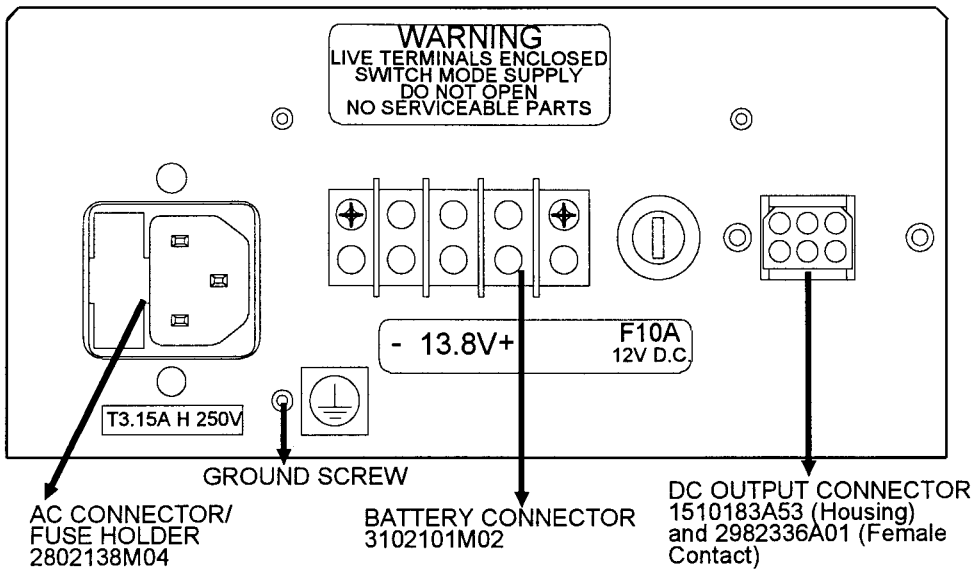
8.6 Base Tray GLN7318



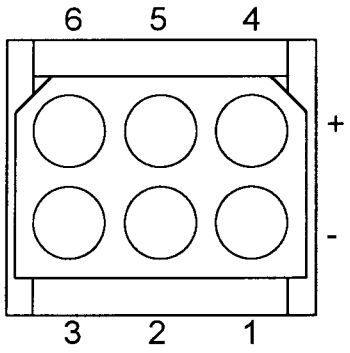
Ref No.	*Motorola Part No.*	*Description*
1	1580155J02	Base housing
2	7510606A06	Bumper RBR black
3	0384725C09	Screw 4.2x16
4	4205722C02	Clamp fastener
5	1580154J02	Cover base housing
6	7510606A13	Bumper black

8.7 Power Supply GPN6133

REAR VIEW



PIN DESCRIPTION OF THE DC OUTPUT MOLEX CONNECTOR:



Pin 1 - 0 VDC
Pin 2 - On Battery
Pin 3 - Not used
Pin 4 - 13.8 VDC
Pin 5 - Low Battery
Pin 6 - Not used

9.0 List of Accessories

Mechanical Hardware Kits:

GLN7324	Low Profile Trunnion Kit (Standard)
GLN7317	High Profile Trunnion Kit
GLN7320	In-Dash Mount, DIN install. Kit
GLN7325	IP54 seal, accessory connector
HLN9457	Accessory Connector Facility Kit

Microphones:

GMN6146	Enhanced Compact Microphone (Standard)
GMN6148	DTMF Microphone
HMN3141	Handset with Hang-up cup
HMN3000	Desk Microphone

Speakers:

Speaker connecting cables are provided with a 16-pin accessory connector plug.

GSN6059	13 W External Speaker, square

Cables:

GKN6270	Battery power cable 3m, 10A fuse (Standard)
GKN6271	Ignition switch cable

Other

GKN6272	Alarm, Relay and Cable Kit
GLN7323	External PTT
GLN7318	Base Tray
GPN6126	24/12V DC Converter, 6A
GPN6127	24/12V DC Converter, 15A
GPN6133	EMC approved Power Supply
HPN4002	Non-EMC approved Power Supply
HPN8393	Non-EMC approved Power Supply

Chapter 2

Reducing Noise Interference in Mobile Two-Way Radio Installations

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1.0 Introduction

Electrical noise generated by the electrical system of a vehicle, as well as local ambient noise, can interfere with normal operation of mobile radios. Satisfactory operation of a mobile radio in a given vehicle may require slight or heavy noise reduction, depending both upon the relative signal strength of the desired radio signal and upon the ability of the radio to reject the undesired noise. These requirements vary from vehicle to another, depending upon the vehicle type and required coverage area. When operating in a strong signal area, a certain amount of noise interference can be tolerated. In weak signal areas, however, noise reduction becomes very important. As a rule of thumb, noise levels create greatest interference in the 25-50MHz band and reduce with increasing frequency.

Before attempting any noise reduction procedures, determine the noise source(s). Then, follow a logical, systematic method of elimination until the interference is eliminated or reduced to an acceptable level.

CAUTION:



Do not add interference elimination equipment to vehicles equipped with electronic ignition systems before obtaining advice from the vehicle manufacturer. Addition of some noise suppression components may interfere with proper operation of electronic ignition systems and could seriously damage them.

Care and patience must be exercised in locating and eliminating noise sources. There may be several sources of noise, each slightly stronger or weaker than the other. Elimination of one source may seem ineffective because another noise source remains active at a barely discernible difference in level. It is suggested that a service manual for the vehicle in question be consulted to determine what noise reduction provisions the manufacturer applies when AM, AM/FM, or CB radios are installed as original equipment. These radios are also subject to electrical noise interference and the manufacturer may install noise suppression components only upon those vehicles which require radio equipment at the time of manufacture. These noise suppression components should be added in any first attempt to suppress noise.

2.0 Noise Sources

The three major noise sources affecting mobile radio systems are 1) radiated noise, 2) conducted noise, and 3) induced noise. (See Figure 2-1 for typical vehicular noise sources.)

2.1 Radiated Noise

Radiated noise enters the radio through the antenna along with the desired signal and can block or degrade desired communication. It can be generated by power lines, fluorescent lights, or by electrical discharges from static build-up, ignition systems, or electrical motors. Radiated noise is the most common cause of mobile radio interference.

When a spark discharge or arc takes place through air, energy is radiated at frequencies from a few kilohertz to hundreds of megahertz. This spurious radiation may have some energy radiated at a frequency near or even identical to the desired radio signal. The standard receiver may be unable to distinguish between the two signals (desired and noise) and so they both enter the receiver with a resulting degradation of the desired signal.

It is impractical to prevent all arcing in the standard vehicle electrical system. In an 8-cylinder engine running at 2,000 RPM, arcing occurs across the spark plugs at a rate of 8,000 sparks per minute or 133 sparks per second. Electrical motors and generators also produce arcs.

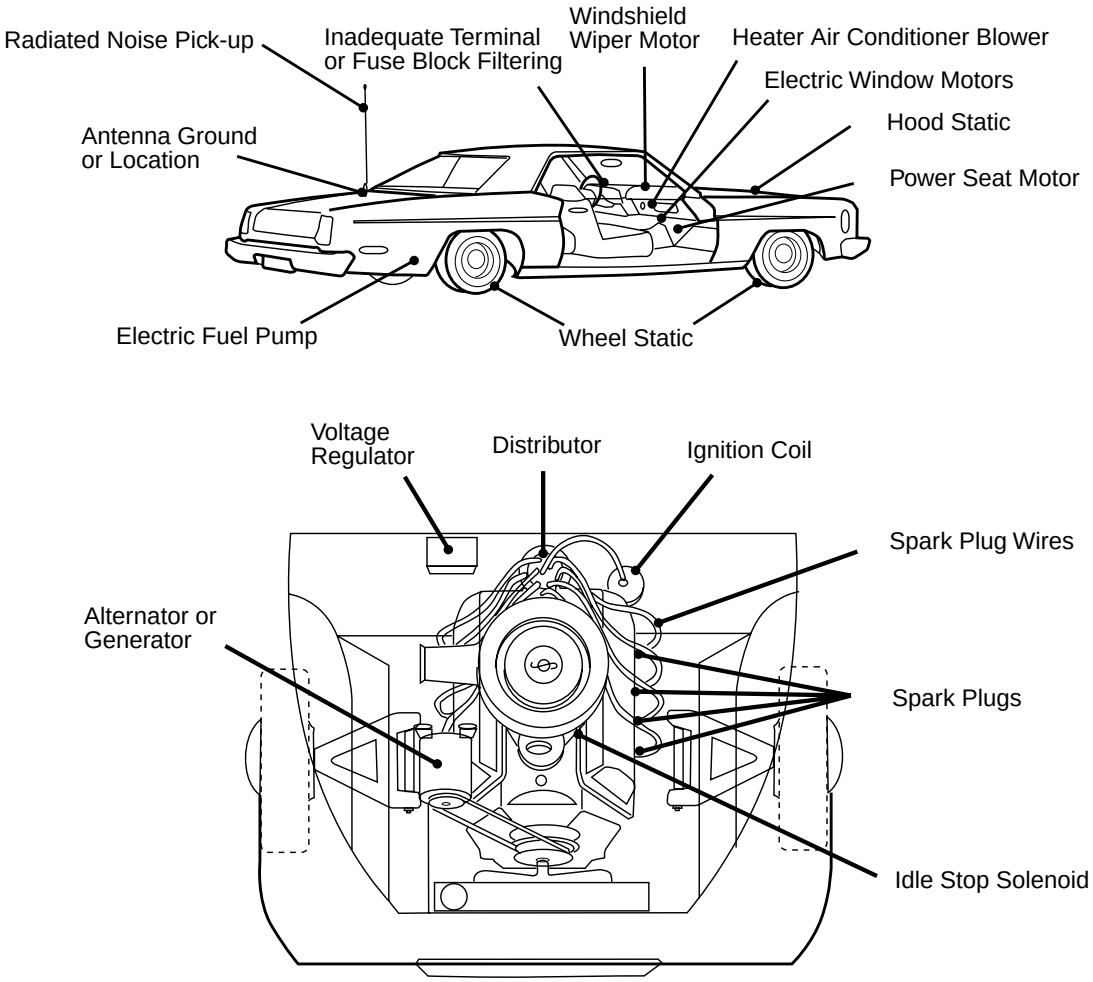


Figure 2-1 Noise Sources.

2.2 Conducted Noise

Conducted noise enters the radio through the points where the radio is attached to the vehicle's electrical system such as battery cables, ignition switch, chassis ground etc. It can be generated by electrical transients, electrical motors, poor grounding points, or inadequate electrical system filtering (from alternators, generators, voltage regulators, or weak batteries). Conducted noise can degrade both transmit and receive performance of a mobile radio.

2.3 Induced Noise

Induced noise enters the radio through the proximity of radio wiring to other wiring in the vehicle. Electrical currents through the standard vehicular wiring can induce undesirable noise signals into the radio cabling (and degrade communication) simply because the wiring provides a transformer-type coupling action without any actual physical connection. Induced noise can degrade both transmit and receive performance of a mobile radio.

3.0 Operation of a Conventional Ignition System

To effectively reduce ignition interference in a vehicle, it is well to understand the operation of an automobile ignition system.

Ignition is necessary in a gasoline engine to ignite the gasoline vapour and the air mixture in its cylinders. The system is made up of the battery, distributor, breaker points, coil, condenser, and spark plugs. The battery is the only electrical source of power in an automobile, so the lower battery voltage must be stepped up to the high voltage necessary to arc across the spark plug electrodes. This arc ignites the gas mixture.

In the conventional ignition system (Figures 2-2) a mechanical circuit breaker (the cam and points in the distributor) opens the primary circuit of the ignition coil, and high voltage is developed at the secondary. This high voltage is synchronized and applied to each spark plug by the distributor.

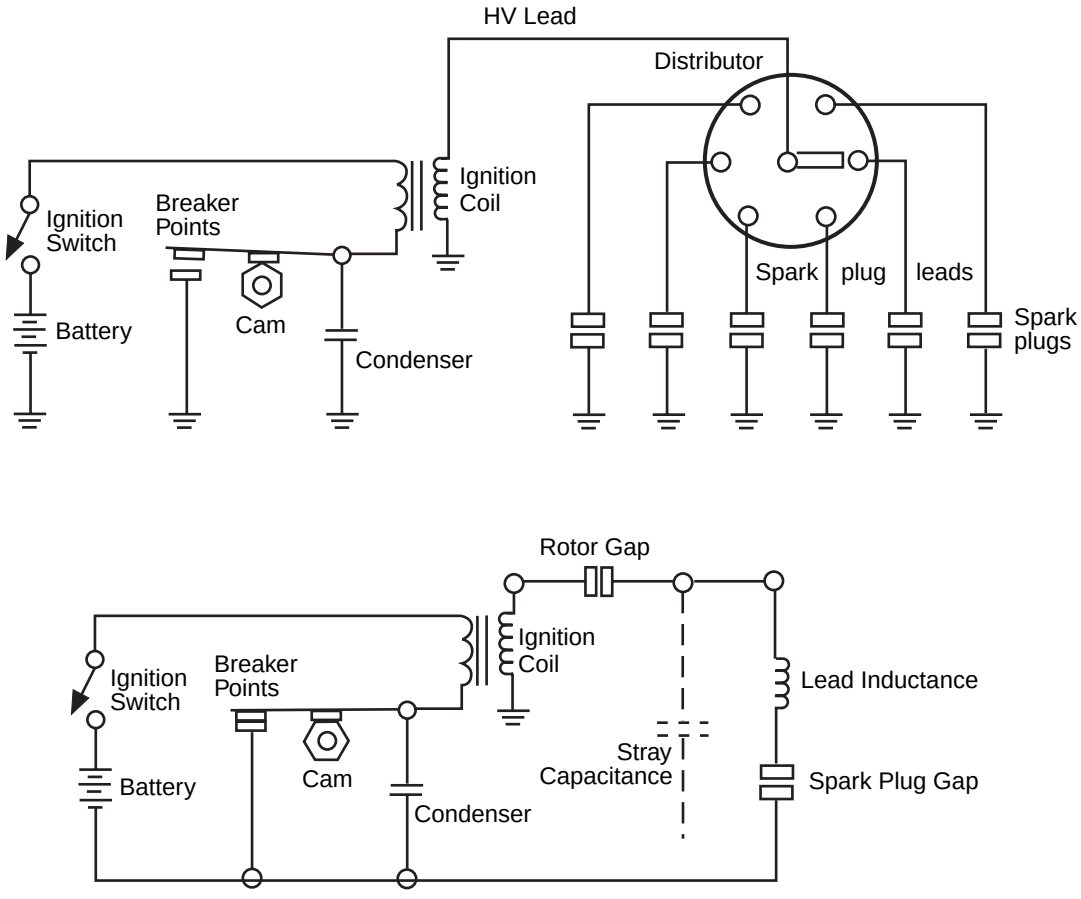


Figure 2-2 Typical Vehicular Ignition System, Simplified Schematic Diagram.

The battery is connected to the primary winding of the coil through the ignition switch. The primary circuit is returned to the battery through the breaker points, which are bypassed by the condenser. The points are normally closed. As the cam shaft is rotated by the engine, its lobes or corners open and close the points in proper synchronisation with the piston in each cylinder.

With the ignition switch on and the breaker points closed, coil primary current builds up at a rate determined by the coil inductance.

When the breaker points open, primary current decreases and, by self-induction, an electromotive force is induced in the primary which is many times greater than the battery voltage. The high voltage inducted in the coil secondary causes a spark across the distributor rotor-to-spark plug wire gap and then across the spark plug gap for a short interval of time when the breaker points open. The condenser reduces arcing of the points.

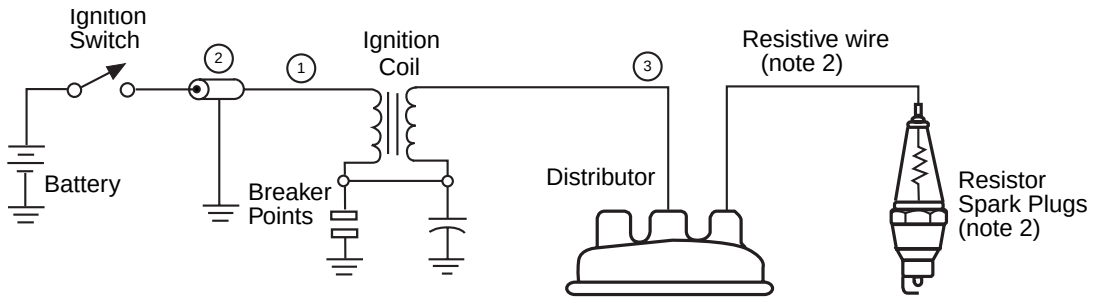
The secondary circuit of the ignition coil, including the distributor rotor gap and the spark gap, is the main source of ignition interference. The lead inductance and stray capacitance provide a tuned circuit. Because the discharge of the circuit is through a low resistance (ionised spark gap), the circuit tends to oscillate. The frequency and amplitude of oscillation vary as current changes in the spark gap.

4.0 Detection of Noise Sources

Detection of offending noise sources is the heart of noise suppression because, after the noise source is identified, the solution becomes obvious. A logical methodical procedure is basic to the effective noise suppression.

Use your available equipment to best advantage. A pick-up loop, about one inch in diameter, can be connected to a portable CB radio or a mobile radio being operated at a frequency similar to the installed radio frequency but from an isolated supply voltage. The pick-up loop can be moved throughout the vehicle with the radio used as a radiated noise detector. Be sure the pick-up loop has sufficient insulation to prevent the input of the radio from coming into direct contact with high voltage points in the vehicle ignition system.

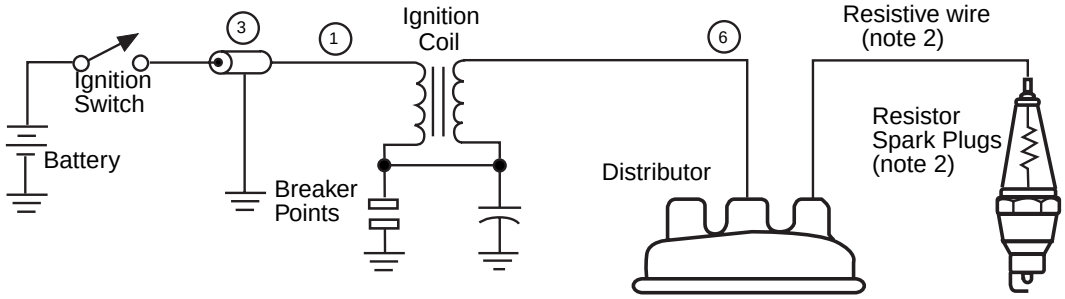
A non-polarised bypass capacitor, which has alligator clips firmly attached, can be used on a trial-and-error basis to locate wiring which needs additional filtering. Keep capacitor lead lengths short for best suppression. Ceramic disc capacitors are not as suitable or effective as automotive coaxial capacitors. (See figures 2-3 and 2-4 for part numbers.)



Notes:
1. Noise reduction can only be achieved if components are properly grounded.
2. Items not supplied in kit. See auto parts dealer.

Reference Number	*Quantity*	*Motorola Part Number*	*Description*
1	1	1V839913	Lead & Lug Assembly
2	1	8C82571B02	Capacitor, Coaxial (0.1µF, 100V)
3	1	30A502396	Ignition Coil Suppressor Cable
-	1	1V80782A52	Hood Wipers (2) and Mounting Hardware Kit (not illustrated).

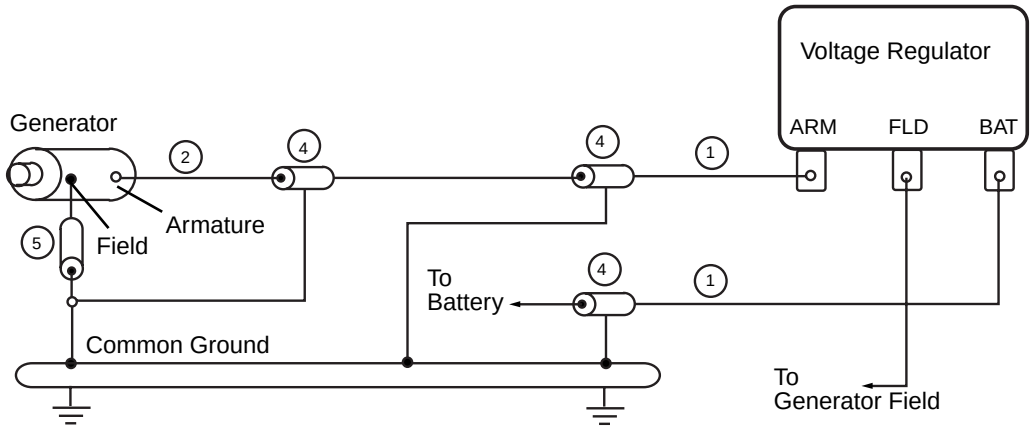
Figure 2-3 TLN8845A Noise Reduction Kit for Alternator-Equipped Vehicles.



Notes:

1. Noise reduction can only be achieved if components are grounded properly. Be sure that all the capacitors and the generator filed suppressor assembly are grounded properly. This may require bonding straps for proper bypass capacitor effectiveness.

2. Items not supplied in kit. See auto parts dealer.



Reference Number	*Quantity*	*Motorola Part Number*	*Description*
1	3	1V839913	Lead & Lug Assembly
2	1	1V80700A88	Lead & Lug Assembly
3	1	8C82571B02	Capacitor, Coaxial (0.1µF, 100V)
4	3	8C82571B01	Capacitor, Coaxial (0.5µF, 100V)
5	1	1V80700A89	Generator Field Suppressor Assembly
6	1	30A502396	Ignition Coil Suppressor Cable
-	1	1V80700A91	Hood Wipers (2) and Mounting Hardware Kit (not illustrated).

Figure 2-4 TLN6252A Noise Reduction Kit for Generator-Equipped Vehicles.

Some interference is due to geographic location and need not be eliminated with mobile radios since it is possible for the vehicle to be moved away from the interfering noise source. Noise from power lines, fluorescent lights, and other vehicles (emitting high levels of radiated noise) are examples of noise which depends upon location. Make certain that you are not attempting to noise suppress a vehicle while it is in a noisy location. If you suspect that your location is noisy, simply turn off everything in the vehicle except the radio and listen to the remaining ambient noise. If the noise level is objectionable, you may have to noise suppress the vehicle during a less noisy time of day or in a different, quieter location.

Check the installed radio for conducted and inducted noise by using an unmodulated signal generator to supply a clean RF signal through a coaxial cable directly to the antenna connector on the radio set. This should prevent radiated noise from entering the receiver and masking conducted and induced noise. Make certain that the signal generator is not microphonic and is placed away from the noise of the engine and exhaust.

Operate the controls for fans, blowers, power windows, headlamps, turn signals, windshield wipers, etc. and listen for the presence of noise in the received radio signal. This will allow the source of the interference to be determined. Some noise sources cannot be turned on and off at will. These sources will need to be attacked piecemeal on a trial and error basis. . . alternator whine, voltage regulators, electric fuel pump etc. Remember that induced noise can result from radio wiring being too close to other vehicle wiring. This problem is most easily solved by proper cable routing at the time of installation.

Radiated noise must be attacked after conducted and induced noise has been satisfactorily suppressed. The vehicle ignition system is usually the primary source of this interference. Antenna placement can be critical in some installations. Remember that static discharge generates static or radiated noise and probably will only be generated when the vehicle is in motion.

Since radiated noise interference is most noticeable in weak signal areas, it is suggested that suppression be finalised while listening to a weak “on frequency” signal. (The squelch should be “open” so that even marginal signals can be heard.)

5.0 Noise Reduction Techniques

5.1 General

There are three basic ways to suppress noise. The first is the addition of resistance in circuits subject to ringing. This method is used for the ignition coil HV cable, spark plug wires, and spark plugs. The second is to filter noise from low voltage wiring using coaxial bypass capacitors. The third is to control static charge build-up using wipers for movable parts such as automobile hoods and trunk lids, or flexible bonding leads for fixed members. Static in wheels may also be controlled using collector rings. Applications of each of these techniques are discussed below.

The vehicle manufacturer's service manual also may provide noise suppression information which is valuable in any 1st attempt at noise suppression.

5.2 Ignition System Interference

5.2.1 Engine Maintenance and Tune-Up

The most important step in reducing ignition noise is insuring that the engine is in proper tune. Pay particular attention to the following points if the noise interference from the ignition system is severe:

1. Be sure the spark plugs distributor points, and condenser are in good condition.
2. Be sure ignition timing is properly adjusted.
3. Be sure the distributor cap and rotor are in good condition. They should be replaced at least every 30,000 miles.
4. Be sure that spark plug wires make good, solid contact at each end and are routed as far as possible from low voltage leads.
5. Many late-model automobiles are equipped with a shield over the distributor points. Check to see that this shield is properly positioned and securely attached.

5.2.2 Available Noise Reduction Kits

Motorola offers two noise reduction kits; Model TLN8845A for alternator-equipped vehicles and Model TLN6252A for generator-equipped vehicles. These kits are for suppression of noise in the primary and secondary of the ignition coil and for bleeding of static charges on the hood. The TLN6252A also is used to suppress noise from the generator and voltage regulator. Figures 2-3 and 2-4 show the contents of the kits and their usage.

Motorola also offers wheel static collectors (Motorola Part No. 1K534254-regular type and 1K563173-small type. Use of these items are described in section 5.8.

Most auto parts dealers can supply 0.05 μF bypass capacitors (condensers), resistive ignition wires, and resistor spark plugs. The type of spark suppression used in noise reduction should always be in accordance with the recommendations of the vehicle manufacturer, that is, if spark plugs are to be replaced with built-in suppressor types, they should be in the proper heat ranges and thread sizes for the particular engine. In each ignition system, there is a maximum amount of resistance that may be connected between the distributor and a spark plug. If resistance-type ignition wire is used, the length of each wire must be limited so that its resistance does not exceed the allowable maximum.

5.2.3 Ignition Coil Interference

This type of interference is characterised by a popping sound which is most noticeable when the engine is running slowly. To suppress the noise, connect a 0.1 μF coaxial capacitor (Motorola Part No. 8C82571B02) from the battery side of the ignition coil to vehicle ground (see Figure 2-5). This keeps the distributor noise from being conducted through the battery lead into the electrical system of the vehicle. Note that some electronic ignition systems do not route the battery lead to the ignition coil and can have proper operation impaired if the ”input” terminal is bypassed.

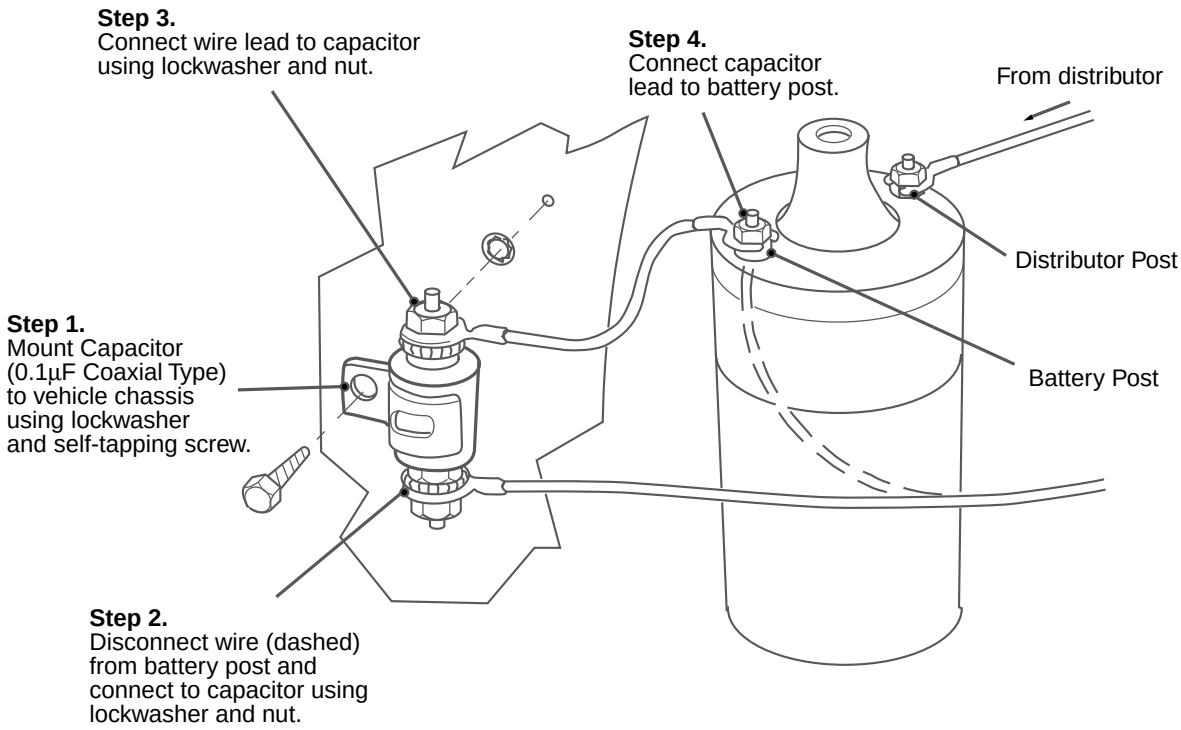


Figure 2-5 Ignition Coil Noise Suppression.

5.2.4 Distributor Interference

This type of interference is characterised by popping sounds which are present at all engine speeds. It is caused by sparking between the rotor and the distributor cap inserts as the rotor turns. To suppress this noise, use resistance ignition wire to connect the ignition coil to the distributor cap.

5.3 Battery Connections

The radio set power cable can pick up noise generated in the vehicle. This can be minimised by connecting the power cable directly to the battery instead of the fuse block. The battery acts like a large capacitor (about one Farad for a 50 amp/hr. battery), which bypasses induced noise. The battery ground lead should be securely bonded to the vehicle frame. Undesirable parallel ground currents can be minimised by using the vehicle frame as a common ground point. If ignition switch control of the radio is desired, the radio power leads may be connected to the battery through a relay which is controlled by the ignition switch.

5.4 Alternator/Generator Whine

This type of interference is characterised by a high-pitched whine which varies with engine speed. A 0.5 µF coaxial capacitor (Motorola Part No. 8C82571B01) can be used to bypass the whine. For generators, the capacitors is connected in the armature lead. Never use a capacitor in the field lead. Use the field suppressor assembly supplied in the TLN6252A Noise Reduction Kit. For alternators, the capacitor is connected in the lead to the battery post (see figure 2-6 and 2-7).

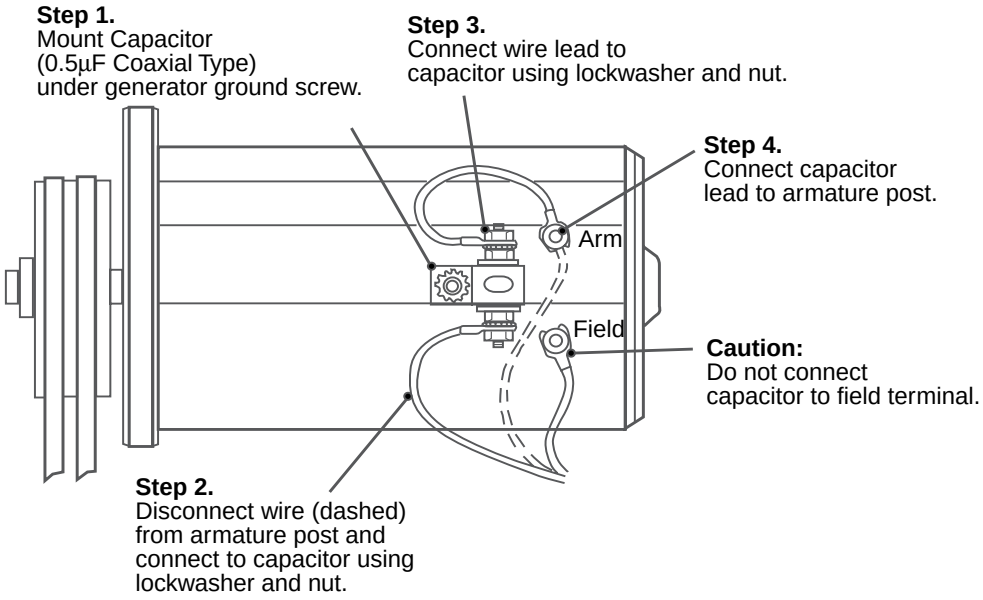


Figure 2-6 Generator Whine Suppression.

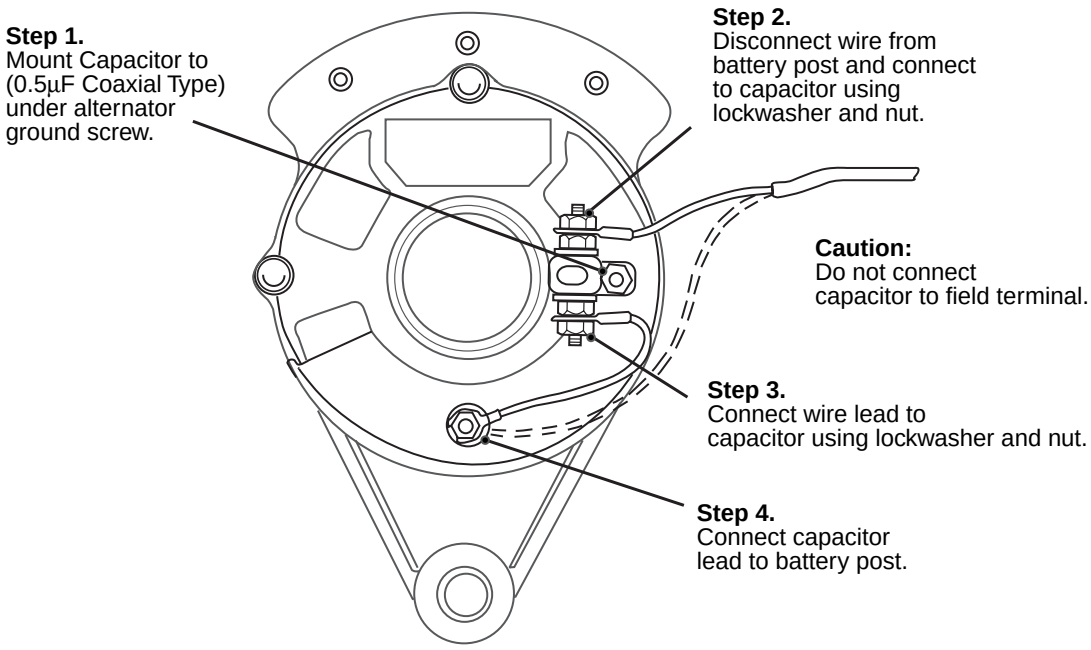


Figure 2-7 Alternator Whine Suppression.

5.5 Voltage Regulator Noise

This type of interference is characterised by erratic popping noises which change only slightly with changes in engine speed. The noise is generated by arcing in the vibrating breaker contacts of the voltage regulator. It can be suppressed by connecting a 0.5 µF coaxial capacitor (Motorola Part No. 8C82571B01) in the battery and armature leads of the voltage regulator (see figure 2-8).

CAUTION: Disconnect the battery ground terminal before attempting to connect components to the voltage regulator.

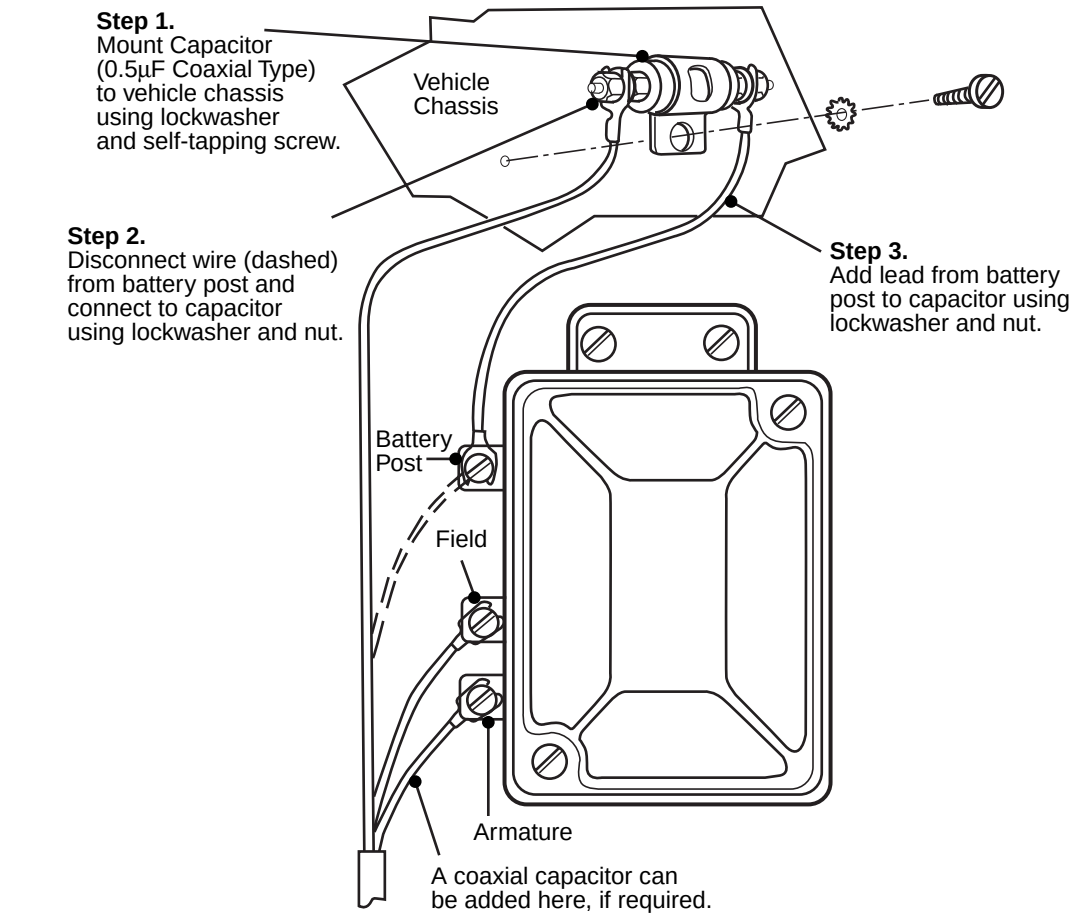


Figure 2-8 Voltage Regulator Noise Suppression.

5.6 Hood and Trunk Lid Noise

This type of noise is characterised by irregular popping sounds. It is caused by friction in poorly bonded automobile hoods or trunk lids, which causes static electricity to build up until arcing occurs. This type of noise is suppressed using a Motorola Hood Wipers and Mounting Hardware Kit (part of TLN8845A or TLN6252A Noise Reduction Kits) which provides electrical bonding of the hood or trunk to the vehicle body while permitting them to be opened.

5.7 Other Electrical Noises

Other elements of the electrical system which can generate noise are listed below. These can be suppressed by connecting a 0.5 μF bypass capacitor between the noises source and ground.

1. Ammeter-to-battery lead
2. Gauges (oil, fuel, temperature)
3. Ignition Switch
4. Lamp bulbs (headlamps, tail lamps, dome lamps, etc.)
5. Accessory wiring (electrical fuel pump, electric windshield wipers, heater fan motor, window openers, etc.)

5.8 Wheel Static

Road friction can cause static build-up on the front wheels. Suppress noise from this source using wheel static collector rings (Motorola Part No. 1K534254 regular type - 1K653173 small type).

5.9 Ground Bonding

Static charges can build up on various parts of a vehicle if not properly bonded and cause noise through arcing. This type of noise is suppressed by bonding the part using one-inch wide ground straps (keep them as short as possible). Some common points where bonding may be helpful are listed below, see Figure 2-9.

A. From engine block to the firewall.

B. From engine block to vehicle frame at points where the engine is shock-mounted.

C. From the battery ground terminal to the vehicle body.

D. From top of front wheel “A” frames to chassis, particularly in cases where rubber-mounted members are used.

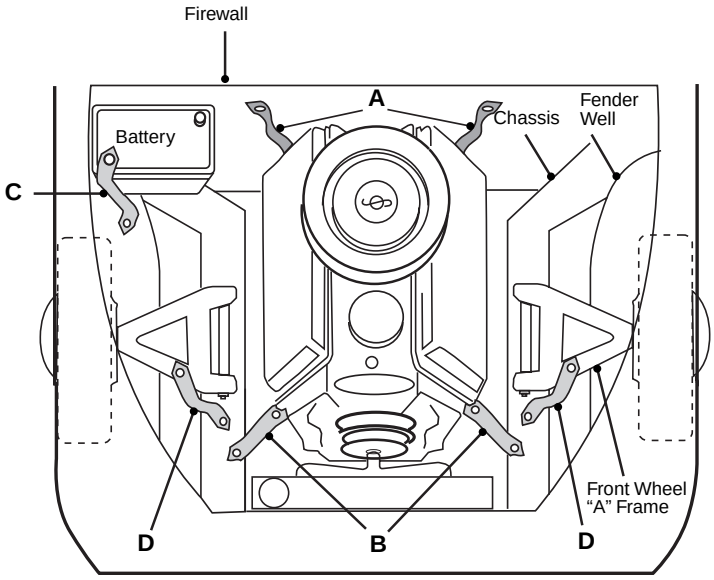


Figure 2-9 Ground Bonding.

5.10 Extender Radios

Impulse noise (principally ignition noise) is heard as annoying “pops” along with a received message. Each noise impulse excites the highly selective receiver tuned circuits which “ring” after the noise impulse disappears. This “ringing” effectively extends the duration of the noise impulse as it passes through the receiver. Motorola radios with the “Extender” feature have additional circuitry which “blanks” the receiver for the duration of the undesired noise pulse so that annoying “pops” are not heard. The “Extender” receiver effectively chops out the small portion of the message which contains “pops”. This type of receiver is effective in areas where other noisy vehicle ignition systems interfere with received messages. However, even “Extender” receivers cannot cope with extremely noisy environments because too much chopping can also destroy message intelligibility.