

CDM Series™  
PRO Series™

Professional Series  
Two-Way Mobile Radio

Installation Manual



**MOTOROLA**  
*intelligence everywhere™*





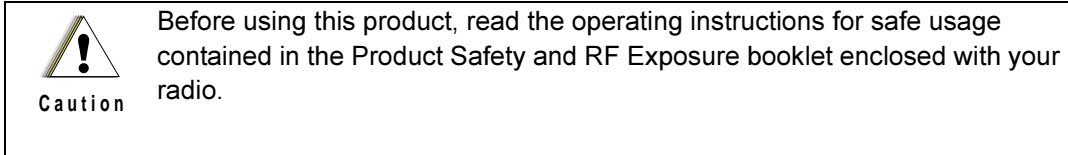


**CDM Series™**  
**PRO Series™**  
**Professional Series**  
**Two-Way Mobile Radio**  
**Installation Manual**

---

# Foreword

## Product Safety and RF Exposure Compliance



### ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81095C99) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: <http://www.motorola.com/cgiss/index.shtml>.

## Manual Revisions

Changes which occur after this manual is printed are described in FMRs (Florida Manual Revisions). These FMRs provide complete replacement pages for all added, changed, and deleted items. To obtain FMRs, contact the Customer Care and Services Division (refer to "Appendix A Replacement Parts Ordering").

## Computer Software Copyrights

The Motorola products described in this manual may include copyrighted Motorola computer programs stored in semiconductor memories or other media. Laws in the United States and other countries preserve for Motorola certain exclusive rights for copyrighted computer programs, including, but not limited to, the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Motorola computer programs contained in the Motorola products described in this manual may not be copied, reproduced, modified, reverse-engineered, or distributed in any manner without the express written permission of Motorola. Furthermore, the purchase of Motorola products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Motorola, except for the normal non-exclusive license to use that arises by operation of law in the sale of a product.

## Document Copyrights

No duplication or distribution of this document or any portion thereof shall take place without the express written permission of Motorola. No part of this manual may be reproduced, distributed, or transmitted in any form or by any means, electronic or mechanical, for any purpose without the express written permission of Motorola.

## Disclaimer

The information in this document is carefully examined, and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, Motorola reserves the right to make changes to any products herein to improve readability, function, or design. Motorola does not assume any liability arising out of the applications or use of any product or circuit described herein; nor does it cover any license under its patent rights nor the rights of others.

## Trademarks

MOTOROLA and the Stylized M logo are registered in the US Patent & Trademark Office. All other product or service names are the property of their respective owners.

© Motorola, Inc. 2002.

# Table of Contents

<b>Foreword</b> .....	<b>ii</b>
Product Safety and RF Exposure Compliance .....	ii
Manual Revisions .....	ii
Computer Software Copyrights .....	ii
Document Copyrights .....	ii
Disclaimer .....	ii
Trademarks .....	ii
<b>List of Figures</b> .....	<b>vi</b>
<b>List of Tables</b> .....	<b>vii</b>
<b>Chapter 1 Introduction</b> .....	<b>1-1</b>
1.1 Notations Used in This Manual .....	1-1
1.2 General Information .....	1-1
1.3 Planning the Installation .....	1-1
<b>Chapter 2 DC Power Cable Installation</b> .....	<b>2-1</b>
2.1 Planning the DC Power Cable Installation .....	2-1
2.2 Installing the DC Power Cable .....	2-1
<b>Chapter 3 Mounting Trunnion Installation</b> .....	<b>3-1</b>
3.1 Planning the Mounting Trunnion Installation .....	3-1
3.1.1 Trunnion (15 W/25 W/40 W/45 W radios) .....	3-1
3.1.2 Trunnion (60 W radios) .....	3-1
3.2 Installing the 15 W/25 W/40 W/45 W Trunnion .....	3-1
3.3 Installing the 60 W Trunnion .....	3-3
3.4 Control Head Mounting Position .....	3-5
<b>Chapter 4 Antenna Installation</b> .....	<b>4-1</b>
4.1 Mobile Radio Operation and EME Exposure .....	4-1
4.2 Selecting an Antenna Site .....	4-1
4.3 Installing the Antenna .....	4-2
4.4 Completing the Installation .....	4-2

---

<b>Chapter 5</b>	<b>Installation Options (15 W/25 W/40 W/45 W only)</b>	<b>5-1</b>
5.1	Radio Mounting in Dashboard	5-1
5.2	Installing the External Speaker	5-2
5.3	Installing the Remote Control Head	5-3
5.3.1	Removing the Front Housing	5-3
5.3.2	Assembling the Remote Front Housing	5-3
5.3.3	Assembling the Remote Back Housing	5-3
5.3.4	Installing the Remote Control Head	5-4
<b>Chapter 6</b>	<b>Accessory Connections</b>	<b>6-1</b>
6.1	Accessory Connector Pin Functions	6-1
6.2	Connection Plan for Accessories	6-2
<b>Chapter 7</b>	<b>Noise Sources</b>	<b>7-1</b>
7.1	Introduction	7-1
7.2	Radiated Noise	7-1
7.3	Conducted Noise	7-2
7.4	Induced Noise	7-2
<b>Chapter 8</b>	<b>Operation of a Conventional Ignition System</b>	<b>8-1</b>
8.1	Introduction	8-1
8.2	Sources of Ignition Interference	8-1
<b>Chapter 9</b>	<b>Detection of Noise Sources</b>	<b>9-1</b>
9.1	Noise Detection Procedure	9-1
9.1.1	Reducing Noise in Alternator-Equipped Vehicles	9-1
9.1.2	Reducing Noise in Generator-Equipped Vehicles	9-2
9.2	Sources of Noise	9-3
<b>Chapter 10</b>	<b>Noise Reduction Techniques</b>	<b>10-1</b>
10.1	General	10-1
10.2	Ignition System Interference	10-1
10.2.1	Engine Maintenance and Tune-Up	10-1
10.2.2	Available Noise Reduction Kits	10-1
10.2.3	Ignition Coil Interference	10-2
10.2.4	Distributor Interference	10-2
10.2.5	Battery Connections	10-2
10.3	Alternator/Generator Whine	10-3
10.4	Voltage Regulator Noise	10-4
10.5	Hood and Trunk Lid Noise	10-4
10.6	Other Electrical Noises	10-5
10.7	Ground Bonding	10-5

---

**Appendix A Replacement Parts Ordering.....A-1**

A.1 Basic Ordering Information .....A-1  
A.2 Motorola Online .....A-1  
A.3 Mail Orders .....A-1  
A.4 Telephone Orders .....A-2  
A.5 Fax Orders .....A-2  
A.6 Parts Identification .....A-2  
A.7 Product Customer Service .....A-2

---

## List of Figures

Figure 2-1. Power Cable Routing into the Engine Compartment.....	2-2
Figure 2-2. Power Cable Assembly .....	2-3
Figure 3-1. 15 W/25 W/40 W/45 W Transmission Hump Mounting (Top) and Below Dash Mounting (Bottom).....	3-2
Figure 3-2. 15 W/25 W/40 W/45 W Radio into Trunnion .....	3-3
Figure 3-3. 60 W Radio Transmission Hump Mounting.....	3-4
Figure 3-4. 60 W Radio Being Placed onto a Trunnion .....	3-4
Figure 4-1. Connections to the Back of Radio .....	4-2
Figure 5-1. Mounting the radio into the dashboard.....	5-1
Figure 5-2. Mounting Frame Detail .....	5-2
Figure 5-3. Mounting the Speaker Under the Dashboard.....	5-2
Figure 5-4. Removing the Front Housing.....	5-3
Figure 6-1. Accessory Connector .....	6-3
Figure 7-1. Noise Sources .....	7-2
Figure 8-1. Typical Vehicular Ignition System, Simplified Schematic Diagram .....	8-1
Figure 9-1. TLN8845 Noise Reduction Kit for Alternator-Equipped Vehicles .....	9-1
Figure 9-2. TLN6252 Noise Reduction Kit for Generator-Equipped Vehicles.....	9-2
Figure 10-1. Ignition Coil Noise Suppression .....	10-2
Figure 10-2. Generator Whine Suppression .....	10-3
Figure 10-3. Alternator Whine Suppression.....	10-3
Figure 10-4. Voltage Regulator Noise Suppression .....	10-4
Figure 10-5. Ground Bonding .....	10-5



---

## ***List of Tables***

Table 2-1. Power Cables .....	2-1
Table 5-1. Associated Components .....	5-4
Table 6-1. Connector Pin Functions .....	6-1
Table 9-1. Parts List for TLN8845 Noise Reduction Kit for Alternator-Equipped Vehicles .....	9-1
Table 9-2. Parts List for TLN6252 Noise Reduction Kit for Generator-Equipped Vehicles .....	9-2

---

**Notes**

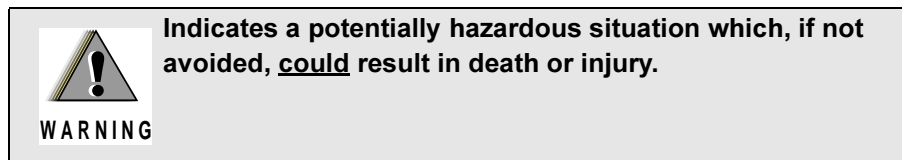
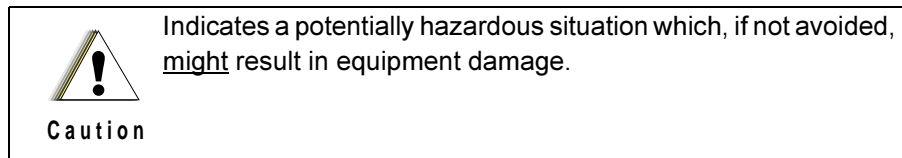
---

# Chapter 1 Introduction

## 1.1 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of note, caution, warning, and danger notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

**NOTE:** An operational procedure, practice, or condition that is essential to emphasize.



## 1.2 General Information

There are two methods of installing your mobile radio:

- Use the standard radio package that contains a direct-mounting trunnion and power cables.
- Use the required RLN4781 mounting kit to install the radio in the car radio cut-out.

An accessory connector on the rear of the radio (see Figure 4-1) enables you to attach different accessories required for the installation.

A ten-pin telephone type connector on the front control head panel (see Figure 3-1) provides for the connection of various types of microphones.

## 1.3 Planning the Installation

1. Mount the radio horizontally near the driver so the driver can easily view, access, and operate the controls and accessories.
2. Ensure that the location is not exposed to dirt and moisture.
3. Verify that there will be sufficient space around the mobile unit for air flow and installation.
4. Check that there is enough routing space for the power cable connector and the antenna coaxial cable.
5. Plan the best place to run connections to minimize chafing, pinching, crushing, and overheating of wires and cables.

**NOTE:** When installing a mobile radio in a vehicle that has airbags installed, make sure that the mounting location of the mobile radio or any radio accessory is not in the deployment path of the air bag.


---

## Notes

---

# Chapter 2 DC Power Cable Installation

## 2.1 Planning the DC Power Cable Installation

 Caution	This radio must be operated only in negative ground electrical systems. Operating the radio on a positive ground system will cause the cable fuse to short-circuit. Check the vehicle ground polarity before you begin installation.
--	--

The 10-foot (3 m) DC power cable shipped with the radio should be long enough to be installed in most vehicles. Take the following precautions before you begin:

- Whenever possible, avoid routing the cable above the catalytic converter.
- Use grommets whenever a cable has to pass through a hole in a metal panel.

The following table lists power cables available for this radio:


Table 2-1. Power Cables

Number	Description	Rating
HKN4137	12 V Low-power cable to battery	1-25W; 15A fuse; 14 AWG 3m
HKN4191	High-Power cable to battery	1-60W; 20A fuse; 12 AWG 3m
HKN4192	12 V Power cable to battery	1-60W; 20A fuse; 10 AWG 6m


## 2.2 Installing the DC Power Cable

Install the power cable as follows:

1. Determine a routing plan, keeping in mind where the radio is to be mounted.

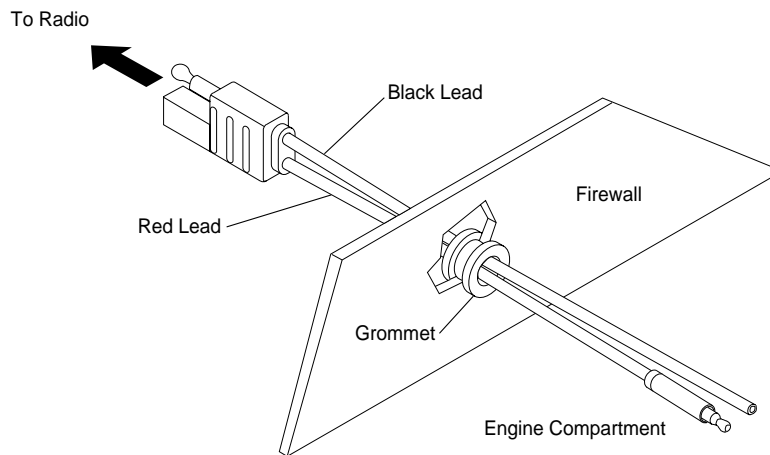
 Caution	Improper handling with the power cable may short to ground. Ensure that the power cable fuse is removed during radio installation.
--	--

2. Locate an existing hole with grommet in the vehicle fire wall, or use a 3/8-inch (9.5 mm) bit to drill an access hole in the fire wall. Install a grommet with a 3/16-inch (4.9 mm) inside diameter into the hole to protect the power cable.

 Caution	Be very careful not to damage existing wires.
--	---

---

- From inside the vehicle, feed the red and black leads (without the lugs attached) through the access hole and into the engine compartment. (See Figure 2-1.)



FL08302460

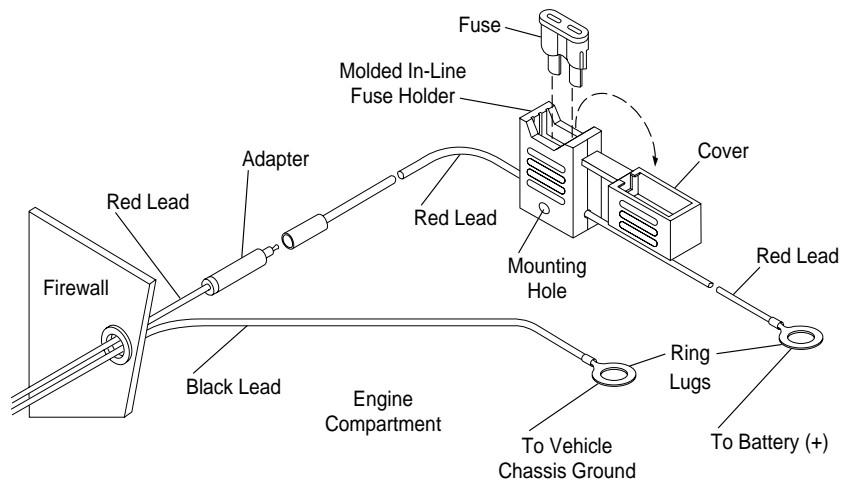
*Figure 2-1. Power Cable Routing into the Engine Compartment*

- Connect the black lead of the power cable to the nearest vehicle chassis ground point, which is usually the central ground point near the battery (using the provided ring lug if necessary). Shorten the black lead to remove any excess cable. (See Figure 2-2.)

**NOTE:** Locate a good vehicle ground point. The vehicle central ground point provides the best ground. If this is not available, the vehicle frame provides the best ground. Optimum radio performance can only be achieved with a very low resistance ground connection. Verify that the connections between the battery's negative terminal, the vehicle chassis, and the engine block have low resistance.

- Place the fuse holder close to the battery. Ensure that it is not near any hot engine component. Mount the fuse holder using its mounting hole and dress the wires as required.
- Insert the stripped end of the red lead of the fuse holder into the ring lug hole and crimp it. Connect the fuse holder red adapter lead plug to the mating receptacle on the red lead of the power cable. (See Figure 2-2.)
- Connect the power cable's black lead directly to the vehicle chassis ground.
- Connect the red lead ring lug from the fuse holder to the positive (+) battery terminal. Make sure the adapter cable is connected to the main power cable red lead.
- Carefully check that all connections are proper. Insert the fuse into the fuse holder and close the cover. (See Figure 2-2.)

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



FL08302470

Figure 2-2. Power Cable Assembly

## Notes



---

## Chapter 3 Mounting Trunnion Installation

### 3.1 Planning the Mounting Trunnion Installation

#### 3.1.1 Trunnion (15 W/25 W/40 W/45 W radios)

The mounting trunnion for a 15 W/25 W/40 W/45 W radio allows the radio to be mounted to a variety of surfaces.

1. Ensure the surface can support the weight of the radio.
2. Although the mounting trunnion can be mounted to a plastic dashboard, it is recommended that the mounting screws be located so they penetrate the dashboard's supporting metal frame.

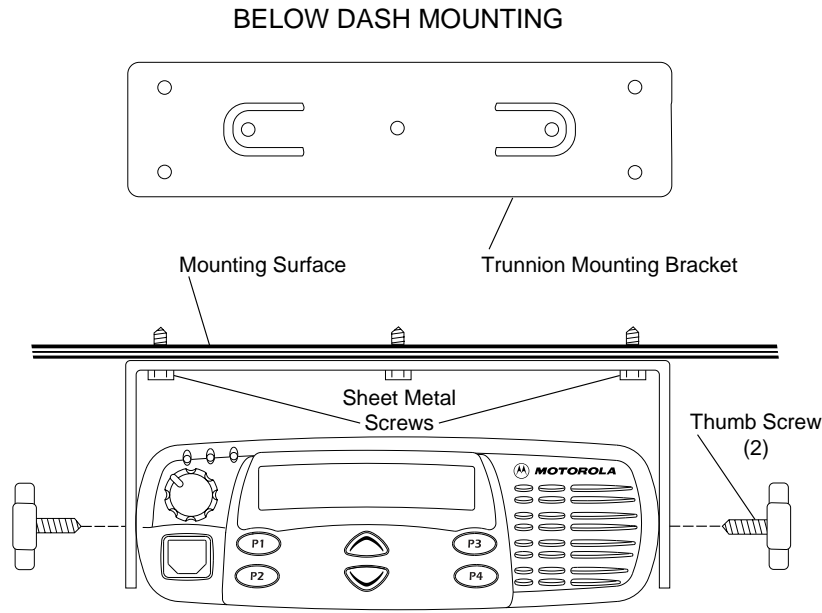
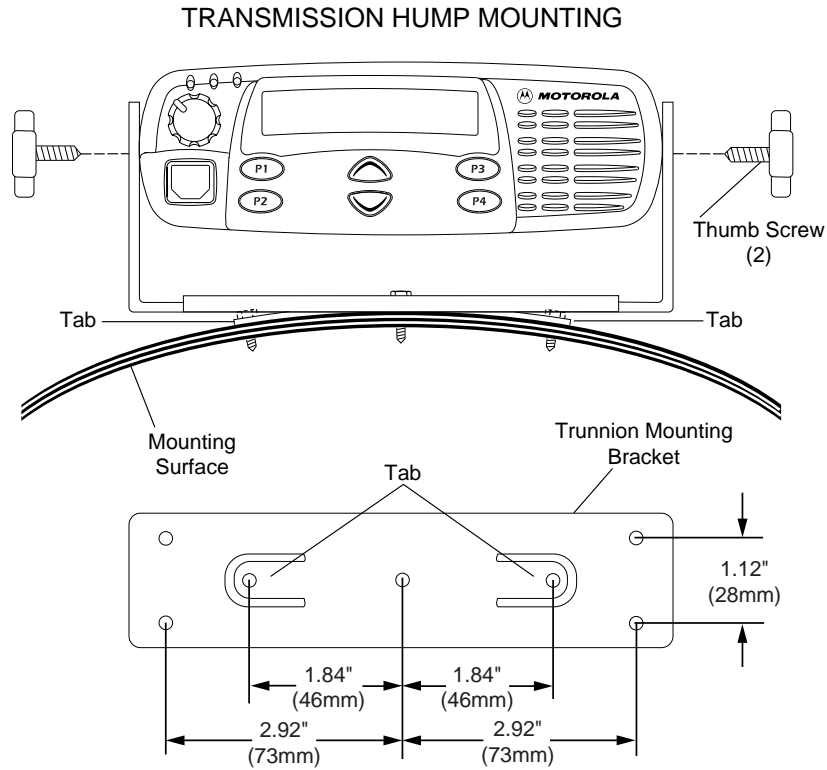
#### 3.1.2 Trunnion (60 W radios)

The mounting trunnion for a 60 W radio allows the radio to be mounted for a transmission hump. It is recommended that a 60 W radio be mounted only on the transmission hump.

### 3.2 Installing the 15 W/25 W/40 W/45 W Trunnion

When mounting the trunnion on the transmission hump, be careful that the transmission housing is not affected.

1. Mount your radio either on the transmission hump or on an open portion underneath the dash. (See Figure 3-1.)
  2. Use the trunnion mounting bracket as a template to mark the hole positions on the mounting surface. Use the innermost three holes for a curved mounting surface such as the transmission hump, and the three outermost holes for a flat surface such as under the dash.
  3. Center-punch the spots you marked and use a 5/32-inch (4 mm) bit to drill a hole at each location.
  4. Secure the trunnion mounting bracket to the mounting surface with the three self-tapping screws provided. (See Figure 3-1.)
  5. Slide the radio into the trunnion. Secure the radio with the two M5 thumb screws provided. (See Figure 3-2.)
-



FL08302500

Figure 3-1. 15 W/25 W/40 W/45 W Transmission Hump Mounting (Top) and Below Dash Mounting (Bottom)

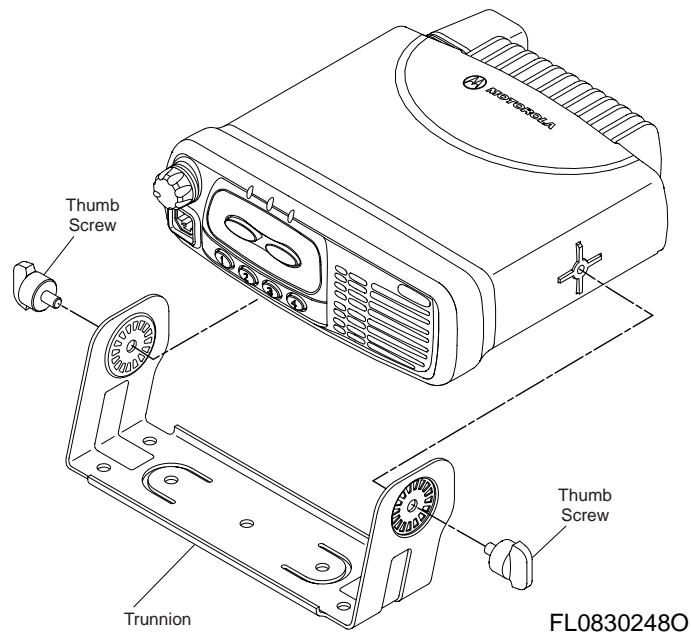


Figure 3-2. 15 W/25 W/40 W/45 W Radio into Trunnion

### 3.3 Installing the 60 W Trunnion

Be careful that the transmission housing is not affected.

1. Mark the hole positions on the mounting surface using the trunnion mounting bracket as a template. Use the five holes for a curved mounting surface. (See Figure 3-3.)
2. Center punch the spots you have marked and drill a  $5/32$ " (4 mm) hole at each location.
3. Secure the trunnion mounting bracket to the surface with the five 10-16x $3/4$ " (20 mm) screws provided.
4. Slide the radio in the trunnion. Secure the radio with the two M5 thumb screws and one TT5 rear screw provided. (See Figure 3-4.)

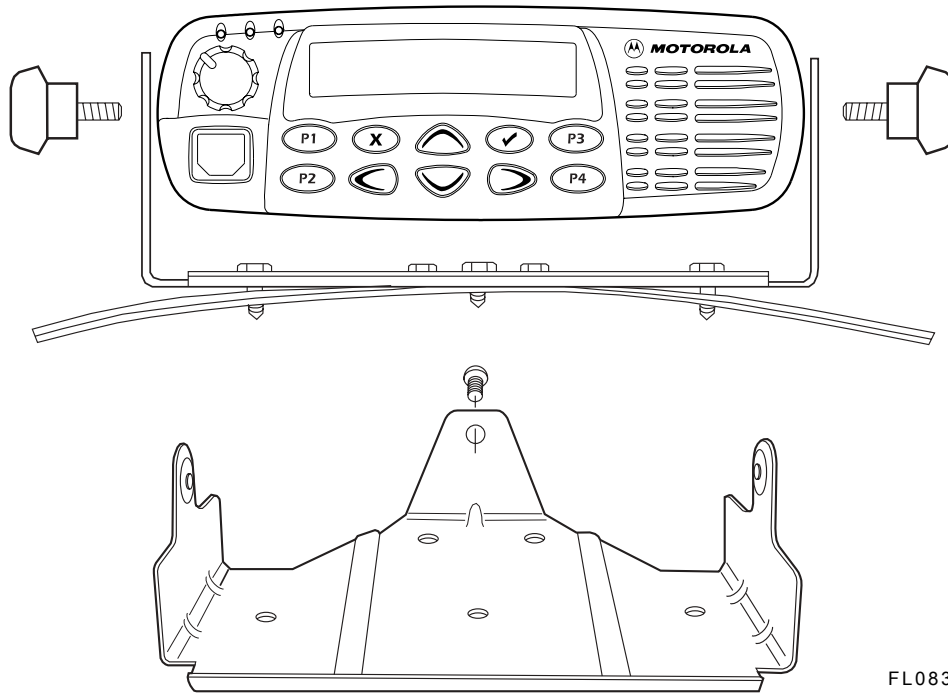


Figure 3-3. 60 W Radio Transmission Hump Mounting

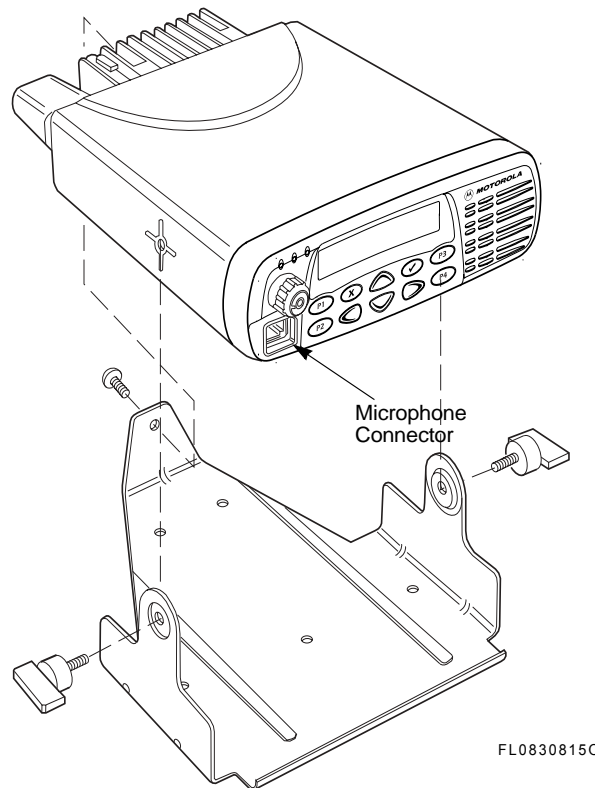


Figure 3-4. 60 W Radio Being Placed onto a Trunnion

### 3.4 Control Head Mounting Position

The control head is designed to be removed from the housing and rotated 180 degrees. This provides multiple mounting options for the radio. For example, the radio can be mounted on either side of the vehicle transmission tunnel to facilitate the safest and most ergonomically ideal position. The control head can then be turned to provide the most convenient access.

To reposition the control head:

1. Insert the control head removal tool (Motorola part number 6686119B01) in the recess between the control head and the radio housing. (See Figure 5-4 on page 5-3.)
2. Press on the removal tool until the control head releases.
3. Pull the control head away while ensuring that the flex connector remains attached.
4. Rotate the control head, and fold the flex circuit to align it to the new position.
5. Push the control head into the housing until the protruding tabs snap into place.



Caution

The contact surface of the flex circuit should face the printed circuit board.


## Notes

---


# Chapter 4 Antenna Installation

## 4.1 Mobile Radio Operation and EME Exposure

Read the following electromagnetic energy exposure (EME) statements and observe the following cautions pertaining to antenna installation.

 Caution	Use caution when installing antennas with mobile radio equipment using 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.

 Caution	Read the Product Safety and RF Exposure booklet enclosed with your radio before proceeding with the installation.
--	---

## 4.2 Selecting an Antenna Site

Follow these guidelines for selecting an antenna site:

- Install the vehicle antenna external to the vehicle in accordance with the requirements of the antenna manufacturer/supplier.
- The best mounting location for the antenna is in the center of a large, flat conductive surface. In almost all vehicles, mounting the antenna in the center of the roof will satisfy these requirements. A good alternate location is in the center of the trunk lid. (Check the requirements of the antenna manufacturer/supplier before mounting the antenna to the trunk lid.) If you use the trunk lid, ensure that the trunk lid is grounded by connecting grounding straps between the trunk lid and the vehicle chassis.
- Ensure the antenna cable can be easily routed to the radio. Ensure that the antenna cable is routed separately and not in parallel to any other vehicle wiring or mobile radio cable wiring.
- Check the antenna location for any electrical interference.

**NOTE:** Severe receiver interferences may be caused by any two metal pieces rubbing against each other (for example, seat springs, shift levers, trunk and hood lids, or exhaust pipes) in close proximity to the antenna.

- If the vehicle is equipped with an electronic anti-lock braking system (ABS), and the antenna will be trunk-mounted, install the antenna on the side opposite to the braking modulator box. This minimizes radio interference to the modulator box from the radio.
  - Make sure the mobile radio antenna is installed at least one foot (30.48 cm) away from any other antenna on the vehicle. This minimizes signal interference.
-

### 4.3 Installing the Antenna

Use the instructions provided with the antenna kit to mount the antenna.

1. Run the coaxial cable to the radio mounting location. If necessary, cut off the excess cable and install the cable connector.
2. Connect the antenna cable connector to the radio antenna connector on the rear of the radio. (See Figure 4-1.)

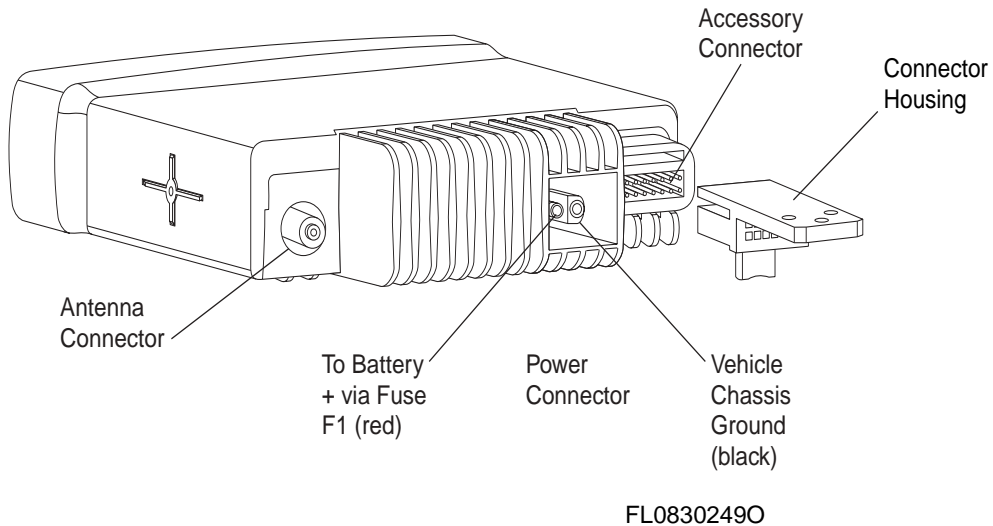


Figure 4-1. Connections to the Back of Radio

### 4.4 Completing the Installation

To complete your radio installation:

1. Mount the microphone clip to a convenient spot near your radio.
2. Your microphone has a telephone-type connector at the end of its cord. Plug this connector into the control head connector.
3. Plug the power cable into the radio power connector. (See Figure 4-1.)



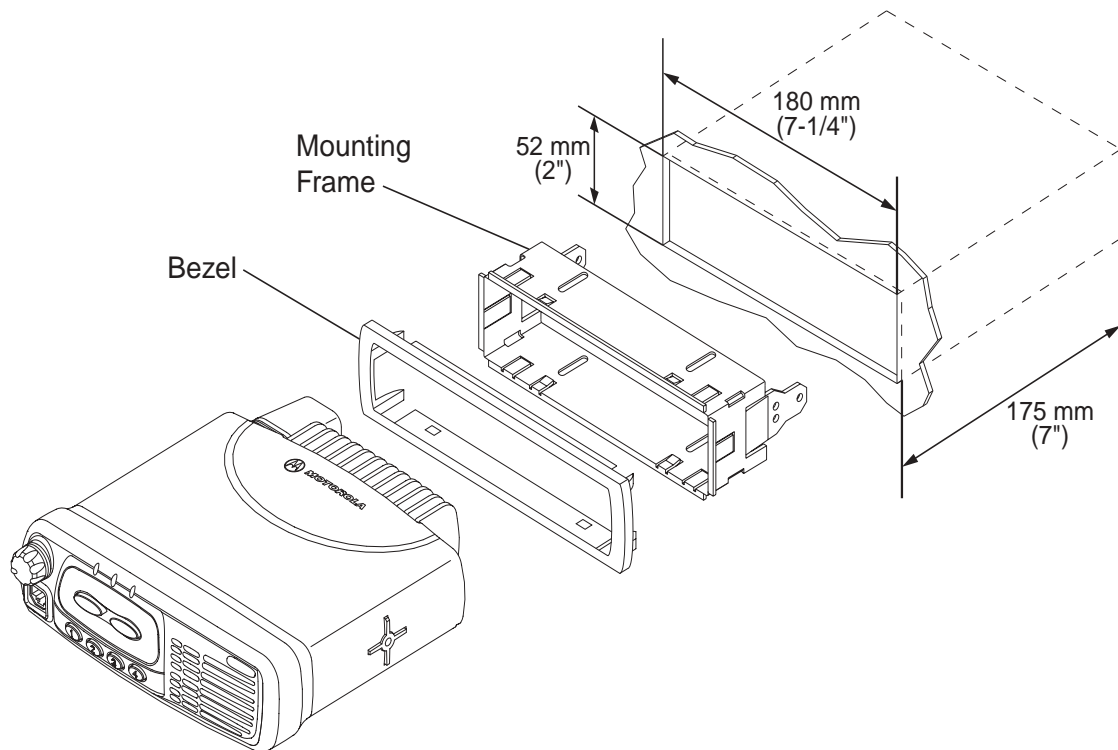
---

## Chapter 5 Installation Options (15 W/25 W/40 W/45 W only)

### 5.1 Radio Mounting in Dashboard

To install the radio in an automotive dashboard:

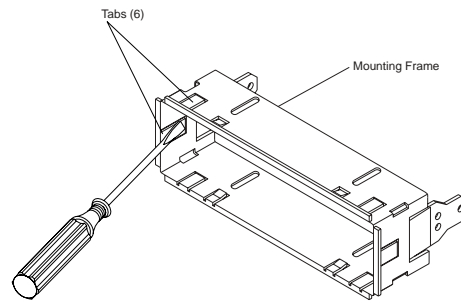
1. Open the radio cutout in the dashboard and, if necessary, enlarge it to the dimensions shown in Figure 5-1.
2. Insert the mounting frame into the cutout and bend the six tabs to hold it in place. (See Figure 5-2.) Press the bezel onto the mounting frame.
3. Slide the radio into the mounting frame.
4. Make the necessary connections to the radio for power, antenna, and accessory connector as shown in Figure 4-1.



FL0830251-A

Figure 5-1. Mounting the radio into the dashboard

---



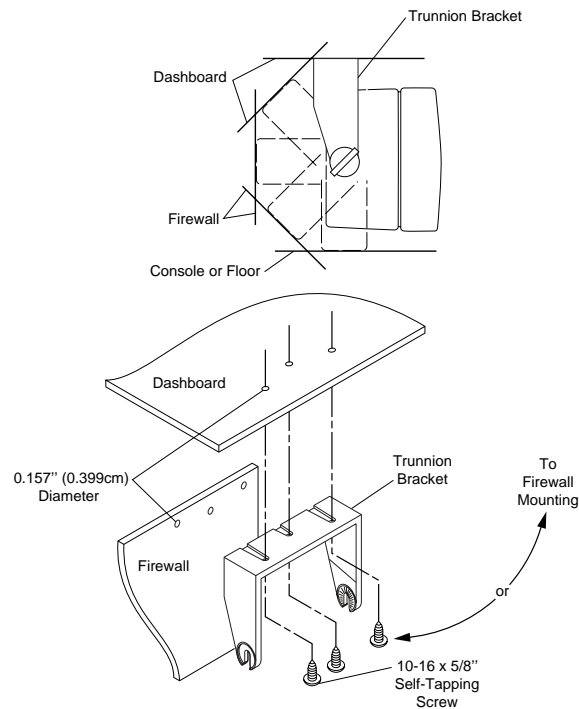
FL08302520

Figure 5-2. Mounting Frame Detail

## 5.2 Installing the External Speaker

Choose a place to mount the speaker.

1. Remove the speaker from the trunnion bracket by loosening the two wing screws.
2. Use the trunnion bracket as a template to mark the locations of the three mounting holes.
3. Center-punch and drill a 5/32-inch (4 mm) diameter hole at each location.
4. Mount the trunnion bracket with the screws supplied. (See Figure 5-3.)
5. Insert the speaker into the trunnion bracket and tighten the two wing screws.
6. Insert the external speaker accessory plug into the accessory connector of the radio.



FL08302530

Figure 5-3. Mounting the Speaker Under the Dashboard

## 5.3 Installing the Remote Control Head

### 5.3.1 Removing the Front Housing

Remove the Control Head from the Transceiver as follows:

1. Insert the control head removal tool (Motorola part number 6686119B01) in the recess between the Control Head and the Transceiver. (See Figure 5-4.)
2. Split the Control Head into Front and Back housings by inserting the control head removal tool in the recess between them.

**NOTE:** Disassemble from the bottom or label side to minimize cosmetic damage. The Control Head Back Housing is not required for remote mounting.

3. Remove the flex from the Control Head PCB only.

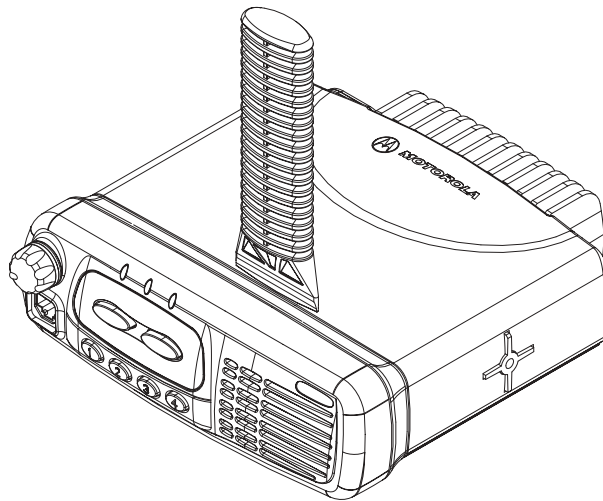


Figure 5-4. Removing the Front Housing

### 5.3.2 Assembling the Remote Front Housing

Assemble the Remote Front Housing as follows:

1. Connect the flex from the Transceiver to the Remote Front PCB.

**NOTE:** For correct orientation of the flex, align the 'O' on the flex with the 'O' on the PCB.

2. Press the Remote Front Housing onto the Transceiver chassis until the four chassis tabs snap into place.

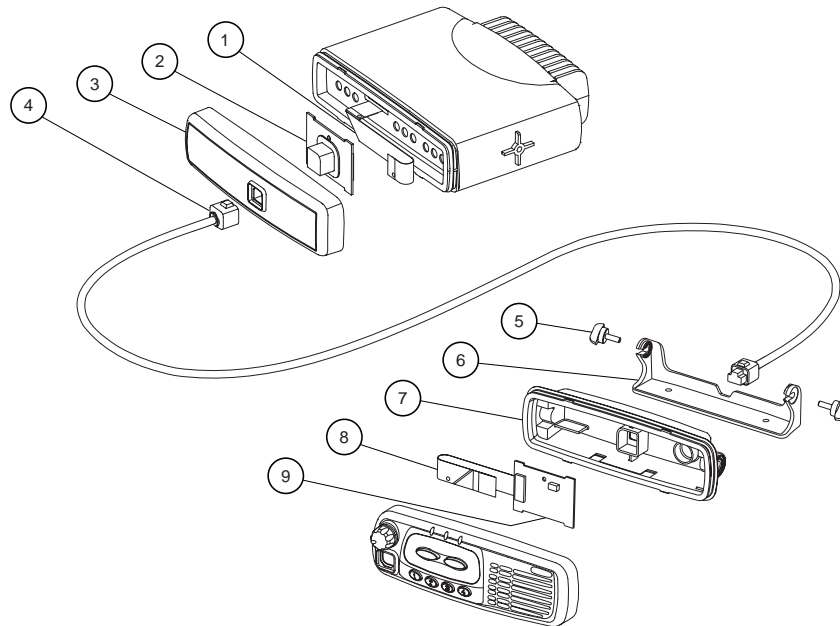
### 5.3.3 Assembling the Remote Back Housing

Be sure the speaker and the speaker support are aligned and proceed as follows:

1. Connect the flex from the Remote Back to the Control Head PCB connector (the connector flex was removed above in Step 3 of Section 5.3.1 "Removing the Front Housing").
2. Press the Control Head onto the Remote Back Housing until **ALL** the tabs snap into place (four tabs on the RLN4801, and six on the RLN4802).

### 5.3.4 Installing the Remote Control Head

1. Position the Remote Mount Bracket in the desired location and mark the positions of the mounting holes.
2. Center-punch the marked spots and drill 4 mm holes at each spot.
3. Fix the Remote Mount Bracket in position using the supplied screws.
4. Route the Remote Cable (Table 5-1) as required, feeding it through the bracket (a 20 mm hole is required for the cable plug).
5. Push the cable plug into the Remote Front and Back Housing until it snaps into place.
6. Snap the assembly into the bracket.
7. Adjust the assembly as required and fix it in position with the wing screws supplied.



FL08302540

Table 5-1. Associated Components

Item	Description	Part Number
1,8	Flex (two per kit)	8486127B01
2,9	Remote PCB (two per kit)	8464278B02
3	Transceiver Front Housing	1564270B01
4	Cable Kit 3M Cable Kit 5M Cable Kit 7M	RKN4077 RKN4078 RKN4079
5	Wing screws	0305760W02
6	Remote Bracket	0764275B01
7	Remote Back Housing Plain	1564268B01
	Remote Back Housing Popular/Preferred	1564269B01
	O-Ring Controlhead	3202620Y01

---

# Chapter 6 Accessory Connections

## 6.1 Accessory Connector Pin Functions

This section gives a description of the accessory connector pin functions.


 <b>Caution</b>	The accessory connections shown are not compatible with some other models of Motorola radios. Check the appropriate accessory or technical manual for further information.
---	--

Table 6-1. Connector Pin Functions

Pin	Function	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 ( $\frac{3}{4}$ ). 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	External or Emergency Mic depends on dealer programming. This microphone signal is independent of the microphone signal on the microphone connector. The nominal input level is 80mV for 60% deviation. The DC impedance is 660 ohms and the AC impedance is 560.
3	Digital In 1	This is a digital input only and the primary use for this pin is external PTT. If Fast Data PTT is required, this pin must be used. (See Note 1 on page 6-2).
4	Digital Out 2	This is a digital output only and the primary use for this pin is as an external alarm output (See Note 3 on page 6-2).
5	Flat_TX_Audio (NPD Data Out)	This input is intended for injecting signals into the transmit path that should not be filtered; for example, the analog output of a modem. The nominal input level is 150mV rms for 60% deviation. The impedance is greater than 25k ohms.
6	Digital In 3	This is a digital input only. Function depends on dealer programming. (See Note 4 on page 6-2).
7	Ground	Used as ground for both analog and digital signals.
8	Digital In/Out 4	This is a digital input/output depending on dealer programming. (See Note 1, 2 on page 6-2).
9	Digital In 5 with Wakeup Emergency	This is a digital input only. Emergency can be enabled via the Customer Programming Software (CPS). To activate, this line must be connected to ground; this will turn on the radio. The CPS details which functions may be assigned to this pin by the codeplug.
10	Ignition Detect	Connecting this line to the ignition line of the vehicle will automatically turn the radio on when the ignition of the vehicle is turned on.

---

Table 6-1. Connector Pin Functions (Continued)

Pin	Function	Description
11	Receiver Audio	There are two possible outputs: (1) Discriminator Audio; and (2) Continuous filtered RX audio. The nominal output level for Discriminator Audio is 330mV rms at 60% deviation and for Filtered Audio 600mV rms at 60% deviation at 1kHz. Function depends on dealer programming.
12	Digital In/Out 7	This digital input/output function depends on dealer programming.
13	Switched Battery Voltage	This voltage is available when the radio is switched on. The maximum current is 1A.
14	Digital In/Out 8	This is a digital input/output depending on dealer programming. (See Note 1, 2 below).
15	RSSI	This is an analog output which indicates the strength of the received signal.
16	External Speaker +	Positive output of radio's audio PA (see Pin 1).
17	Bus +	This pin is used for flashing and programming the radio.
18	Boot Control	To enter Boot Mode, this line must be connected to ground when the radio is switched on.
19	Reserved	Reserved.
20	Reserved	Reserved.

**Note 1: Digital Input**

4.7k ohms Internal Pull Up Resistor to +5V.  
 Maximum Input Voltage accepted as Low = 0.6V  
 Minimum Input Voltage accepted as High = 3.0V

**Note 2: Digital Output**

4.7k ohms Internal Pull Up Resistor to +5V  
 Maximum Current when Output Low = 10mA  
 Maximum Voltage when Output Low = 0.5V @ 10mA


**Note 3: High Current Digital Output**

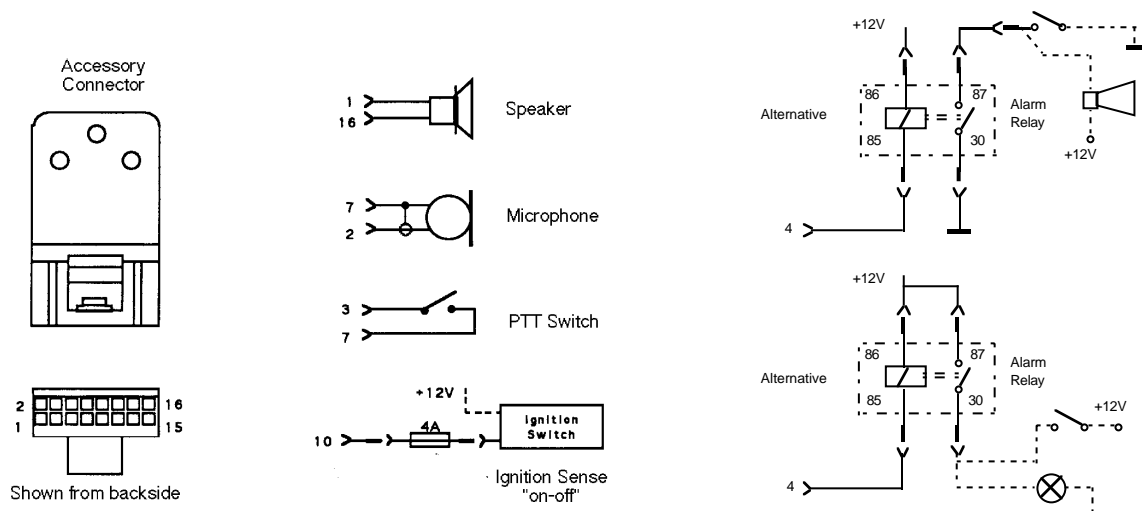
4.7k ohms Internal Pull Up Resistor to continuous B+  
 Maximum Current when Output Low = 200mA  
 Maximum Voltage when Output Low = 1.7V @200mA


**Note 4: Digital Input**

10k ohms Internal Pull Up Resistor to +5V  
 Maximum Input Voltage accepted as Low = 0.6V  
 Minimum Input Voltage accepted as High = 3V

## 6.2 Connection Plan for Accessories

 <b>Caution</b>	<p>The accessory connections shown are not compatible with some other models of Motorola radios. Check the appropriate accessory or technical manual for further information.</p>
---	---



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

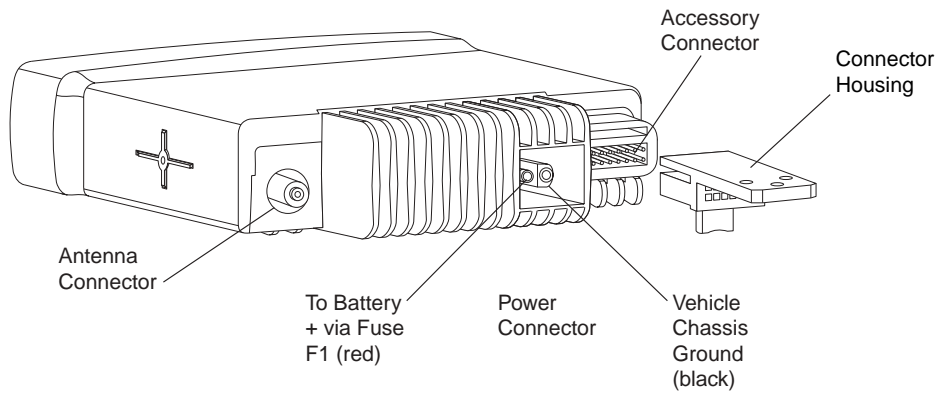



Figure 6-1. Accessory Connector

 Ensure the correct position of the connector housing. Plug the 16-pin connector housing into the center of the 20-pin accessory connector. The outer two pins on either side are not used.  
**Caution**

**Notes**




---

# Chapter 7 Noise Sources

## 7.1 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 may require slight or heavy noise reduction, depending upon the relative strength of the radio signal and the ability of the radio to reject undesired noise. These requirements vary from one 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.

 <b>Caution</b>	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.

Consult a service manual for the vehicle 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.

The three major noise sources affecting mobile radio systems are: radiated noise, conducted noise, and induced noise. (See Figure 7-1 for typical vehicular noise sources.)

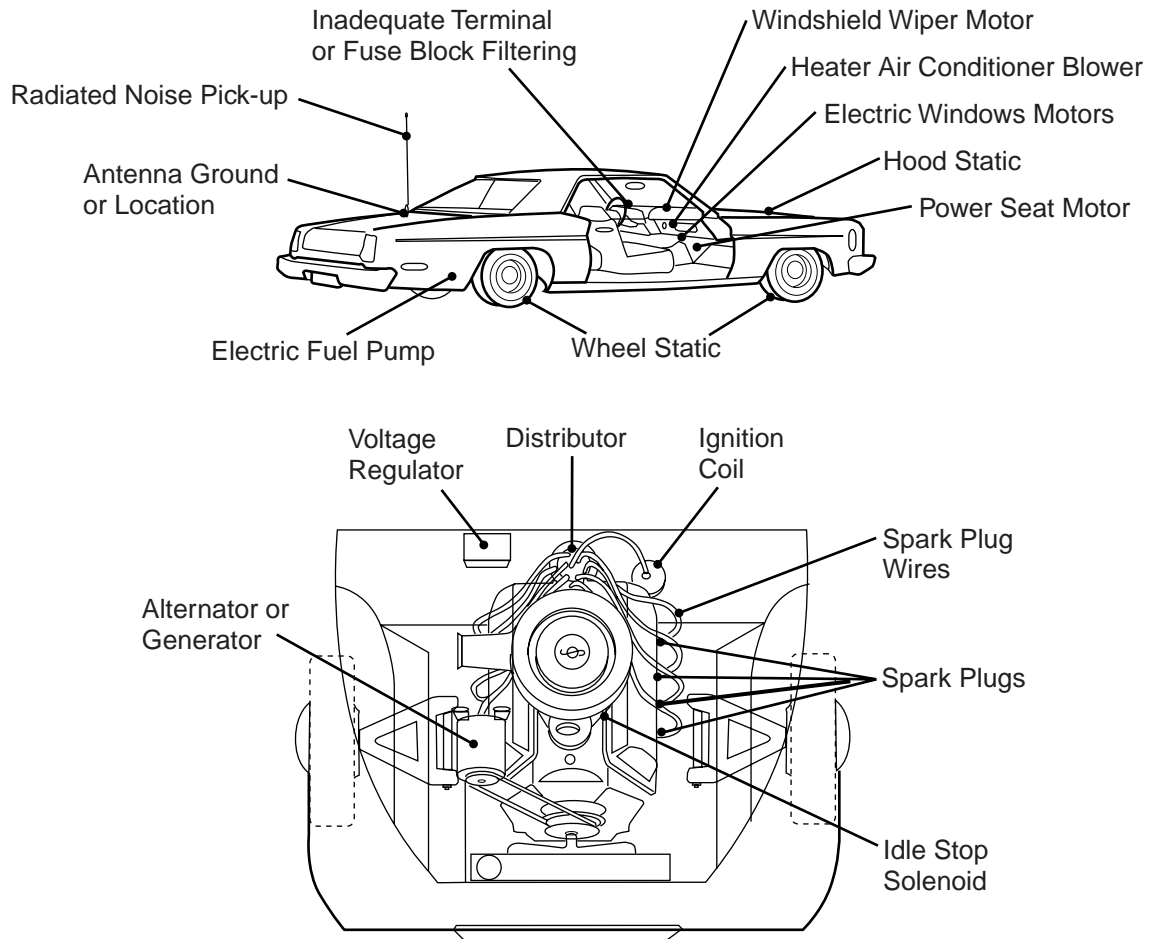
## 7.2 Radiated Noise

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). Therefore they both enter the receiver, resulting in degradation of the desired signal.

---

It is impractical to prevent all arcing in the standard vehicle electrical system. In an eight-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.



FL0830260-O

Figure 7-1. Noise Sources

### 7.3 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.

### 7.4 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. Communication is degraded 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.

---

# Chapter 8 Operation of a Conventional Ignition System

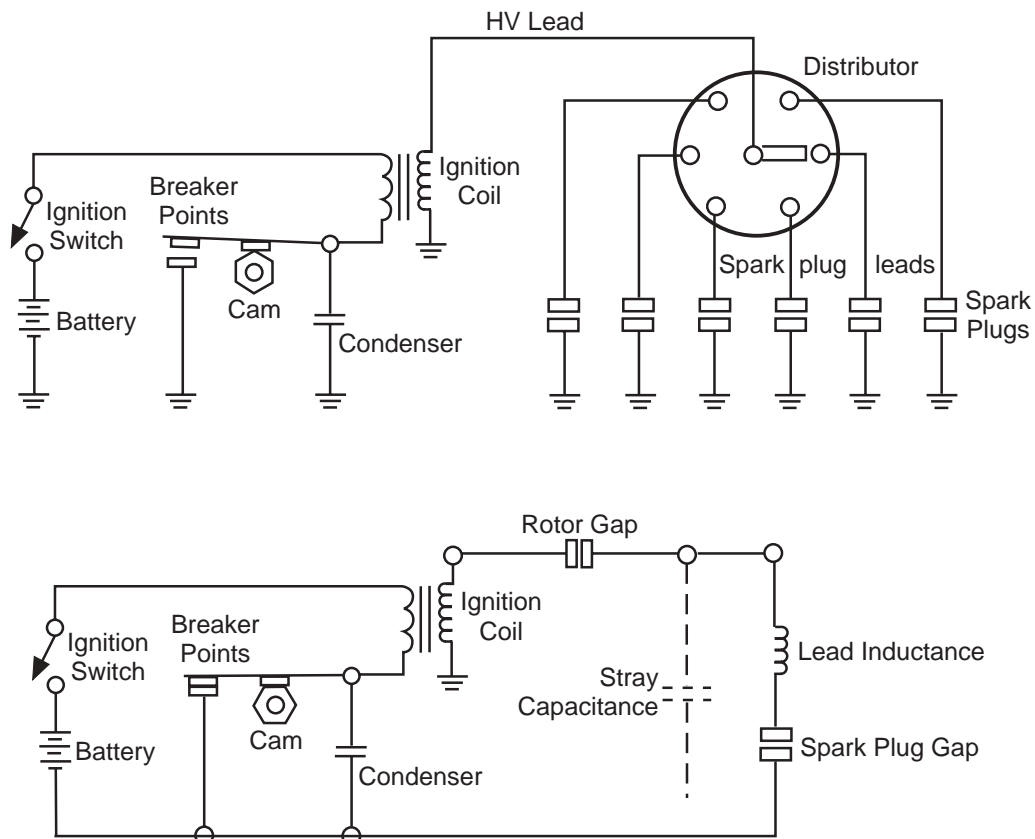
## 8.1 Introduction

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

Ignition is necessary in a gasoline engine to ignite the gasoline vapor 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.

## 8.2 Sources of Ignition Interference

In the conventional ignition system (Figure 8-1), 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.



FL0830261-O

Figure 8-1. 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 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 synchronization 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 (ionized spark gap), the circuit tends to oscillate. The frequency and amplitude of oscillation vary as current changes in the spark gap.

# Chapter 9 Detection of Noise Sources

## 9.1 Noise Detection Procedure

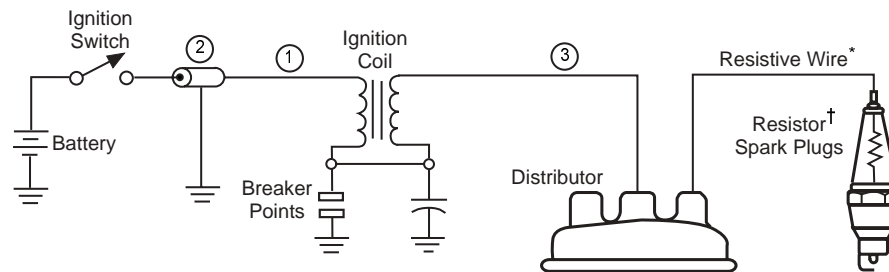
Detection of offending noise sources is the heart of noise suppression because, after the noise source is identified, the solution becomes obvious. A logical step-by-step procedure is basic to effective noise suppression.

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-polarized 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 Figure 9-1 and Figure 9-2 for part numbers.)

### 9.1.1 Reducing Noise in Alternator-Equipped Vehicles

Use Motorola Noise Reduction Kit number TLN8845. (See Figure 9-1.)



\*Noise reduction can only be achieved if components are grounded properly.

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

FL0830262-A

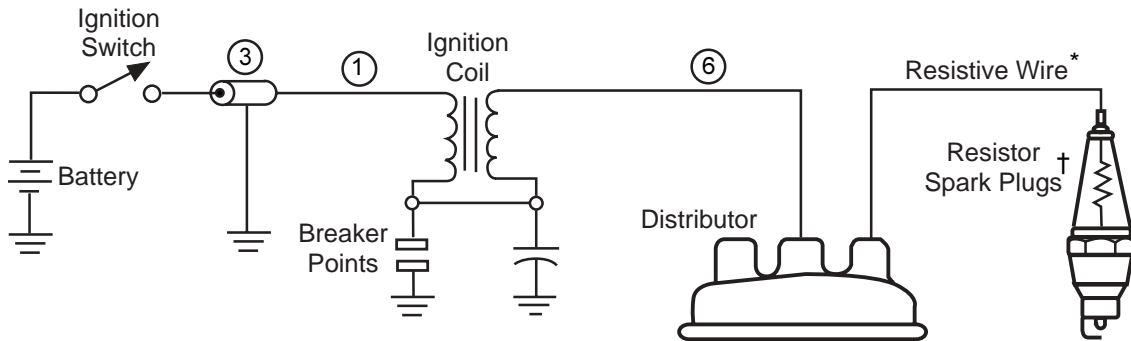
Figure 9-1. TLN8845 Noise Reduction Kit for Alternator-Equipped Vehicles

Table 9-1. Parts List for TLN8845 Noise Reduction Kit for Alternator-Equipped Vehicles

Reference Number	Quantity	Motorola Part Number	Description
1	1	0100839913	Lead and Lug Assembly
2	1	0882571B02	Capacitor, Coaxial (0.1 uF, 100 V)
3	1	0180782852	Ignition Coil Suppressor Cable
	1	1V80782A52	Hood Wipers (2) and Mounting Hardware Kit (not shown).

### 9.1.2 Reducing Noise in Generator-Equipped Vehicles

Use Motorola Noise Reduction Kit number TLN6252. (See Figure 9-2.)



\*Noise reduction can only be achieved if components are grounded properly. Be sure that all the capacitors and generator field suppressor assembly are grounded properly. This may require bonding straps for proper bypass capacitor effectiveness.  
 †Items not supplied in kit. See auto parts dealer.

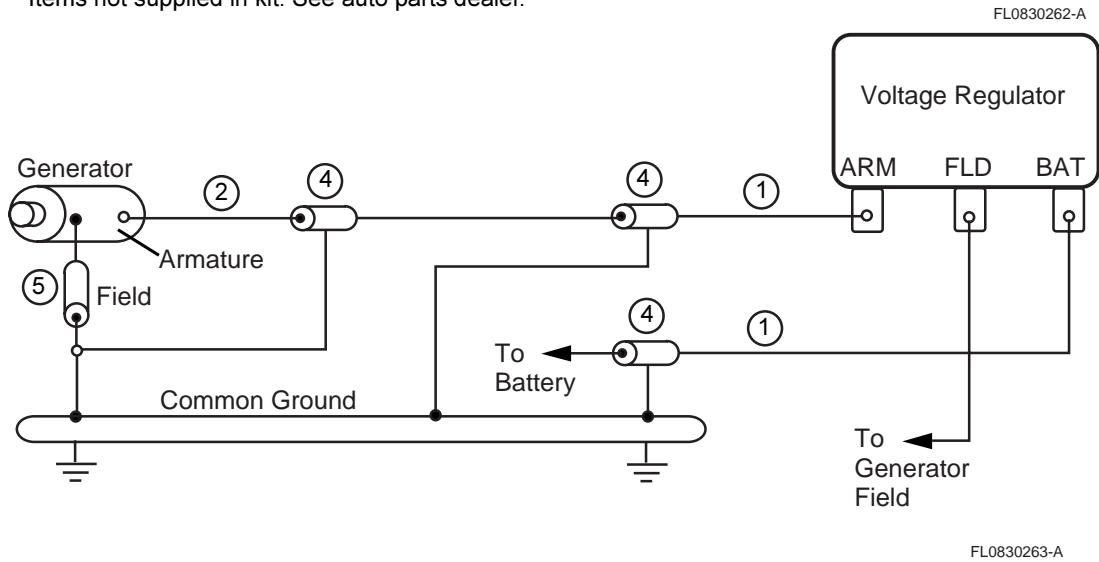


Figure 9-2. TLN6252 Noise Reduction Kit for Generator-Equipped Vehicles

Table 9-2. Parts List for TLN6252 Noise Reduction Kit for Generator-Equipped Vehicles

Reference Number	Quantity	Motorola Part Number	Description
1	3	0100839913	Lead and Lug Assembly
2	1	0180700A88	Lead and Lug Assembly
3	1	0882571B02	Capacitor, Coaxial (0.1 uF, 100 V)
4	3	0882571B01	Capacitor, Coaxial (0.5 uF, 100 V)
5	1	0180700A89	Generator Field Suppressor Assembly
6	1	30A502396	Ignition Coil Suppressor Cable
	1	0180700A91	Hood Wipers (2) and Mounting Hardware Kit (not shown).

## 9.2 Sources of Noise

Some interference is due to geographic location. This interference does not need to be eliminated 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 depend upon location. Make sure you are not attempting to suppress noise in 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, more quiet 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, and other electrical accessories. 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, and other possible sources. 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 will probably be generated only when the vehicle is in motion.

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

## Notes



---

# Chapter 10 Noise Reduction Techniques

## 10.1 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.

**NOTE:** The vehicle manufacturer's service manual may also provide noise suppression information which is valuable in any first attempt at noise suppression.

## 10.2 Ignition System Interference

### 10.2.1 Engine Maintenance and Tune-Up

The most important step in reducing ignition noise is ensuring 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. Make sure the spark plugs distributor points and condenser are in good condition.
2. Make sure ignition timing is properly adjusted.
3. Make sure the distributor cap and rotor are in good condition. They should be replaced at least every 30,000 miles.
4. Make 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.

### 10.2.2 Available Noise Reduction Kits

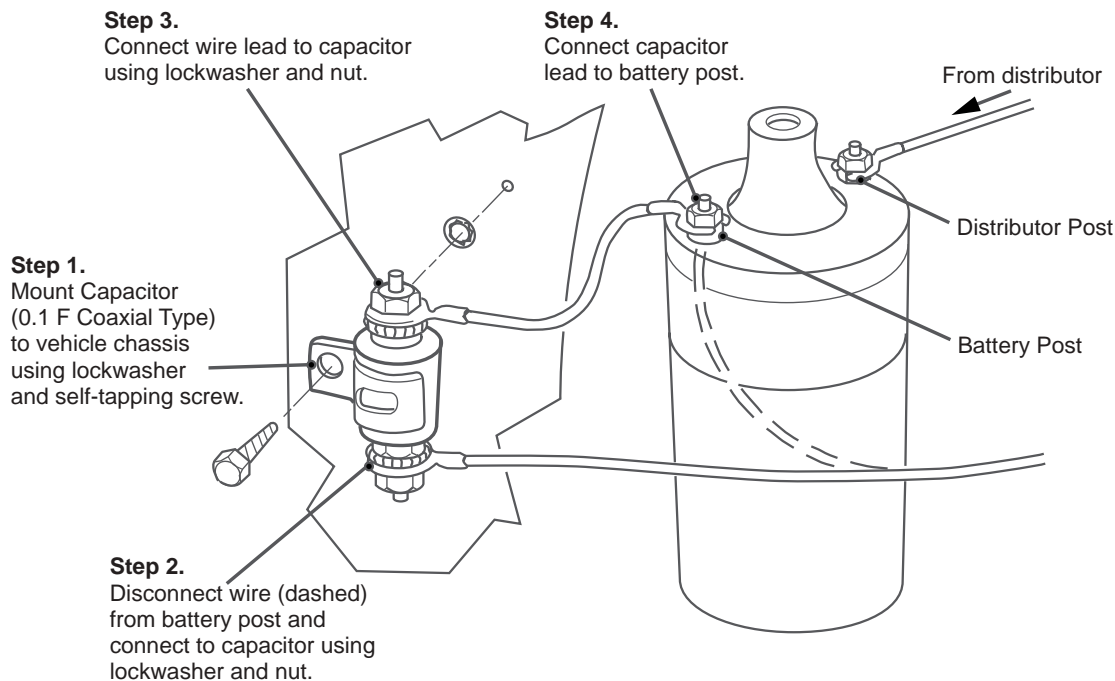
Motorola offers two noise reduction kits: Model TLN8845 for alternator-equipped vehicles; Model TLN6252 for generator-equipped vehicles. These kits are for suppression of noise in the primary and secondary of the ignition coil and for bleeding of static charges on the hood. The TLN6252 is also used to suppress noise from the generator and voltage regulator. Figure 9-1 on page 9-1 and Figure 9-1 on page 9-1, illustrate the contents of the kits and their usage.

Most auto parts dealers can supply 0.05 uF 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.

---

### 10.2.3 Ignition Coil Interference

This type of interference is characterized by a popping sound which is most noticeable *when the engine is running slowly*. To suppress the noise, connect a 0.1 uF coaxial capacitor (Motorola Part No. 0882571B02) from the battery side of the ignition coil to vehicle ground. (See Figure 10-1.) 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; proper operation of the ignition system can be impaired if the "input" terminal is bypassed.



FL0830264-O

Figure 10-1. Ignition Coil Noise Suppression

### 10.2.4 Distributor Interference

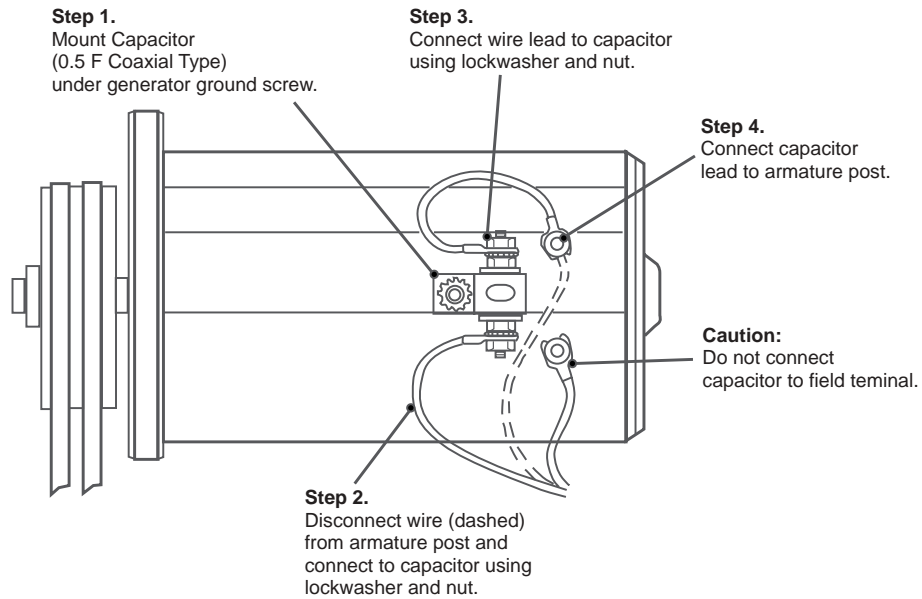
This type of interference is characterized by popping sounds which are present *at all engine speeds*. It is caused by sparking between the rotor and the distributor cap inserts as the rotor turns. To suppress this noise, use resistance ignition wire to connect the ignition coil to the distributor cap.

### 10.2.5 Battery Connections

The radio set power cable can pick up noise generated in the vehicle. This noise can be minimized 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/hour battery) which bypasses induced noise. The battery ground lead should be securely bonded to the vehicle frame. Undesirable parallel ground currents can be minimized by using the vehicle frame as a common ground point. To implement ignition switch control of the radio, the radio power leads can be connected to the battery through a relay controlled by the ignition switch.

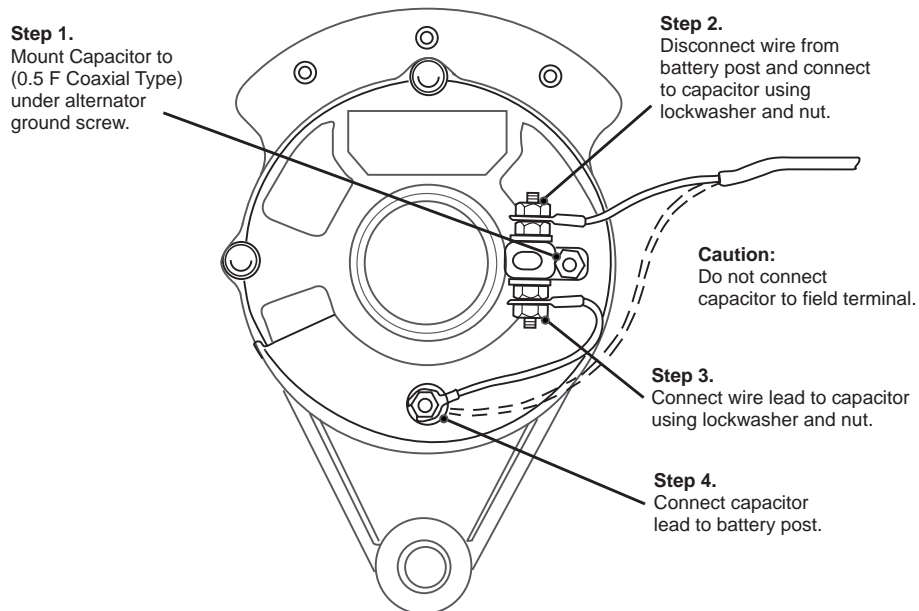
### 10.3 Alternator/Generator Whine

This type of interference is characterized by a high-pitched whine which *varies with engine speed*. A 0.5 uF coaxial capacitor (Motorola Part No. 0882571B01) can be used to bypass the whine. For generators, the capacitor is connected in the armature lead. Never use a capacitor in the field lead. Use the field suppressor assembly supplied in the TLN6252 Noise Reduction Kit. For alternators, the capacitor is connected in the lead to the battery post. (See Figure 10-2 and Figure 10-3.



FL0830310-O

Figure 10-2. Generator Whine Suppression

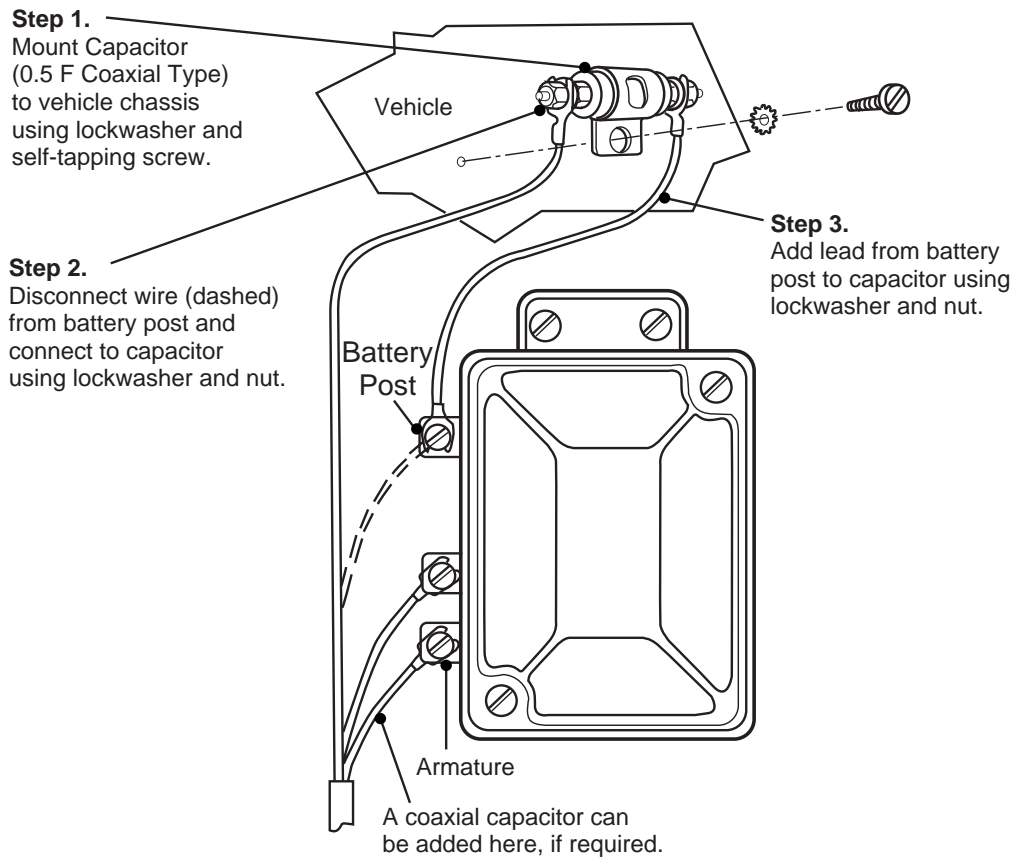
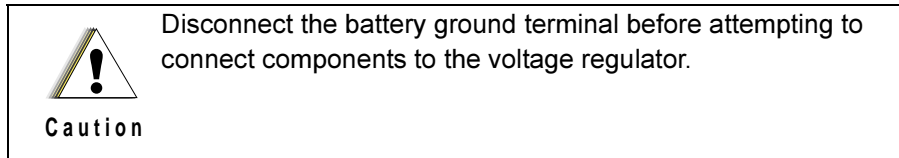


FL0830311-O

Figure 10-3. Alternator Whine Suppression

## 10.4 Voltage Regulator Noise

This type of interference is characterized 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  $\mu$ F coaxial capacitor (Motorola Part No. 0882571B01) in the battery and armature leads of the voltage regulator. (See Figure 10-4.)



FL0830265-O

Figure 10-4. Voltage Regulator Noise Suppression

## 10.5 Hood and Trunk Lid Noise

This type of noise is characterized by irregular popping sounds. It is caused by friction in poorly bonded automobile hoods or trunk lids. This friction 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 TLN8845 or TLN6252 Noise Reduction Kits) which provides electrical bonding of the hood or trunk to the vehicle body while permitting them to be opened.

## 10.6 Other Electrical Noises

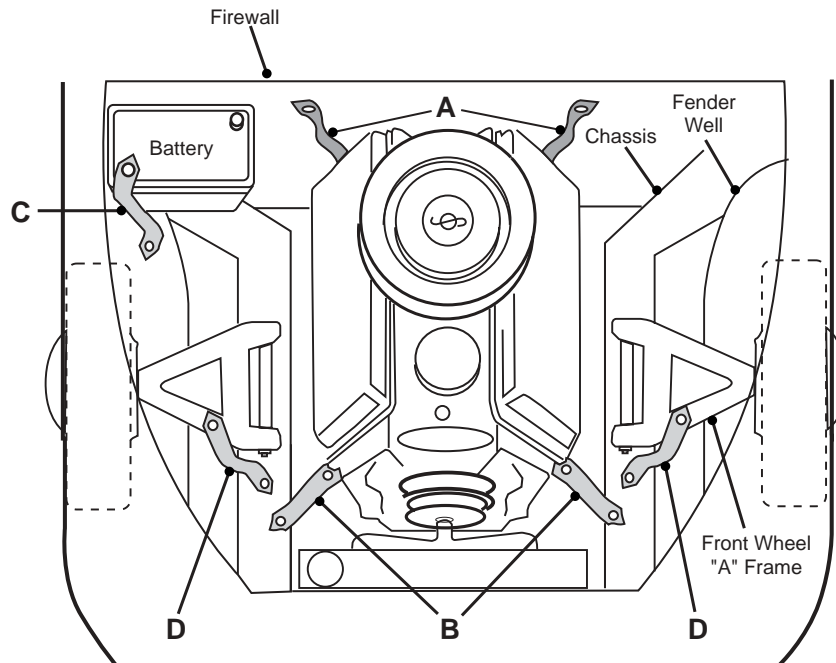
Other elements of the electrical system which can generate noise are listed below. These can be suppressed by connecting a 0.5  $\mu\text{F}$  bypass capacitor between the noise source and ground.

1. Ammeter-to-battery lead
2. Gauges (oil, fuel, and 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.)

## 10.7 Ground Bonding

If a vehicle is not properly bonded to ground, static charges can increase. This increase can cause noise from electrical 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 (see Figure 10-5) may be helpful are listed below.

- 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.



FL0830266-O

Figure 10-5. Ground Bonding

## Notes

---

# Appendix A Replacement Parts Ordering

## A.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

## A.2 Motorola Online

Motorola Online users can access our online catalog at

<https://www.motorola.com/businessonline>

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only).

## A.3 Mail Orders

Send written orders to the following addresses:

**Replacement Parts/  
Test Equipment/Manuals/  
Crystal Service Items:**

Motorola Inc.  
Customer Care and Services  
Division\*  
Attention: Order Processing  
1307 E. Algonquin Road  
Schaumburg, IL 60196  
U.S.A.

**Federal Government Orders:**

Motorola Inc.  
U.S. Federal Government  
Markets Division  
Attention: Order Processing  
7230 Parkway Drive  
Landover, MD 21076  
U.S.A.

**International Orders:**

Motorola Inc.  
Customer Care and Services  
Division\*  
Attention: Order Processing  
1307 E. Algonquin Road  
Schaumburg, IL 60196  
U.S.A.

\*The Customer Care and Services Division (CCSD) was formerly known as the Accessories and Aftermarket Division (AAD).

---

## **A.4 Telephone Orders**

Customer Care and Services Division\*  
(United States and Canada)  
7:00 AM to 7:00 PM (Central Standard Time)  
Monday through Friday (Chicago, U.S.A.)  
1-800-422-4210  
1-847-538-8023 (International Orders)

U.S. Federal Government Markets Division (USFGMD)  
1-800-826-1913 Federal Government Parts - Credit Cards Only  
8:30 AM to 5:00 PM (Eastern Standard Time)

## **A.5 Fax Orders**

Customer Care and Services Division\*  
(United States and Canada)  
1-800-622-6210  
847-576-3023 (International)

USFGMD  
(Federal Government Orders)  
1-800-526-8641 (For Parts and Equipment Purchase Orders)

## **A.6 Parts Identification**

Customer Care and Services Division\*  
(United States and Canada)  
1-800-422-4210, menu 3

## **A.7 Product Customer Service**

Customer Response Center  
(Non-technical Issues)  
1-800-247-2346  
FAX:1-800-247-2347

\*The Customer Care and Services Division (CCSD) was formerly known as the Accessories and Aftermarket Division (AAD).







MOTOROLA, the Stylized M Logo are registered in the U.S. Patent and Trademark Office. All other product or service names are the property of their respective owners.  
© Motorola, Inc. 2002



**6881092C58-C**