

future
The Future *of* Mobile Radio



M7200 Series Mobile Radio

Trunk-Mount Full-Duplex
Mobile Radio with Control Head
for OpenSky Radio Networks

MANUAL REVISION HISTORY

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1 SAFETY INFORMATION

1.1 SYMBOLS USED IN THIS MANUAL

The following symbols are used throughout this manual:



The **WARNING** symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** symbol until the conditions identified are fully understood or met.



The **CAUTION** symbol calls attention to an operating procedure, practice, or the like, which, if not performed correctly or adhered to, could result in damage to the equipment or severely degrade equipment performance.



The **NOTE** symbol calls attention to supplemental information, which may improve system performance or clarify a process or procedure.

1.2 RF ENERGY EXPOSURE AWARENESS AND CONTROL INFORMATION FOR FCC OCCUPATIONAL USE REQUIREMENTS

Before using the mobile two-way radio, read this important RF energy awareness and control information and operational instructions to ensure compliance with RF exposure guidelines.



This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to remain below RF exposure limits. This radio is NOT authorized for general population, consumer, or any other use.



Changes or modifications not expressly approved by M/A-COM, Inc. could void the user's authority to operate the equipment.

This two-way radio uses electromagnetic energy in the radio frequency (RF) spectrum to provide communications between two or more users over a distance. It uses RF energy or radio waves to send and receive calls. RF energy is one form of electromagnetic energy. Other forms include, but are not limited to, electric power, sunlight, and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which, when used improperly, can cause biological damage. Very high levels of x-rays, for example, can damage tissues and genetic material.

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection. All two-way radios marketed in North America are designed, manufactured, and tested to ensure they meet government-established RF exposure levels. In addition, manufacturers also recommend

specific operating instructions to users of two-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it. Please refer to the following websites for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits:

<http://www.fcc.gov/oet/rfsafety/rf-faqs.html>

<http://www.osha.gov/SLTC/radiofrequencyradiation/index.html>

1.2.1 Federal Communications Commission Regulations

The M7200 two-way mobile radio is designed and tested to comply with the FCC RF energy exposure limits for mobile two-way radios before it can be marketed in the United States. When two-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a label directing users to specific user awareness information. The radio has an RF exposure product label. Also, this Installation Manual and the applicable Operator's Manual include information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

1.3 COMPLIANCE WITH RF EXPOSURE STANDARDS

The M7200 two-way mobile radio is designed and tested to comply with a number of national and international standards and guidelines regarding human exposure to RF electromagnetic energy. This radio complies with the IEEE and ICNIRP exposure limits for occupational/controlled RF exposure environment at duty-cycle times of up to 50% (50% transmit, 50% receive), and it is authorized by the FCC for occupational use. In terms of measuring RF energy for compliance with the FCC exposure guidelines, the radio's antenna radiates measurable RF energy only while it is transmitting (talking), not when it is receiving (listening) or in standby mode.

The M7200 mobile two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission (FCC), Code of Federal Regulations; 47 CFR § 2 sub-part J.
- American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE) C95.1-1992.
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999.



Table 1-1 lists the recommended minimum safe lateral distances for a controlled environment and for unaware bystanders in an uncontrolled environment, from transmitting antennas (i.e., monopoles over a ground plane, or dipoles) at rated radio power for mobile radios installed in a vehicle. Transmit only when unaware bystanders are at least the uncontrolled recommended minimum safe lateral distance away from the transmitting antenna.

Table 1-1: Recommended Minimum Safe Lateral Distance from Transmitting Antenna

ANTENNA PART NUMBERS (All are 700 & 800 MHz Dual-Band Antennas)	RATED POWER OF VEHICLE INSTALLED MOBILE RADIO	RECOMMENDED MINIMUM LATERAL DISTANCE FROM TRANSMITTING ANTENNA	
		CONTROLLED	UNCONTROLLED
MAMV-AN3J (3 dBd Gain); MAMV-AN3K (3 dBd Gain, Elev. Feed); MAMV-AN3V (3 dBd Gain with GPS Rx)	15 watts	12.6 inches (32 centimeters)	27.6 inches (70 centimeters)

1.3.1 Mobile Antennas

The antenna(s) for the radio must be installed in accordance with section 7 in this manual. Refer to Table 1-1 above and/or Figure 7-1 for applicable antenna part numbers. Installation guidelines presented in section 7 are limited to metal-body motor vehicles or vehicles with appropriate ground planes.

Use only the M/A-COM approved/supplied antenna(s) or an approved replacement antenna. Unauthorized antennas, modifications, or attachments can cause the FCC RF exposure limits to be exceeded.

1.3.2 Approved Accessories

The radio has been tested and meets FCC RF guidelines when used with M/A-COM accessories supplied or designated for use with it. Use of other accessories may not ensure compliance with the FCC's RF exposure guidelines, and may violate FCC regulations. For a list of approved accessories refer to section 4 in this manual (begins on page 14) and/or M/A-COM's Products and Services Catalog.

1.3.3 Contact Information

For additional information on RF exposure and other information, contact M/A-COM using one of the contact links listed in section 3.3 on page 13.

1.4 OCCUPATIONAL SAFETY GUIDELINES AND SAFETY TRAINING INFORMATION

To ensure bodily exposure to RF electromagnetic energy is within the FCC allowable limits for occupational use, always adhere to the following basic guidelines:

1. The push-to-talk button should only be depressed when intending to send a voice message.
2. The radio should only be used for necessary work-related communications.
3. The radio should only be used by authorized and trained personnel. It should never be operated by children.
4. Do not attempt any unauthorized modification to the radio. Changes or modifications to the radio may cause harmful interference and/or cause it to exceed FCC RF exposure limits. Only qualified personnel should service the radio.
5. Always use M/A-COM authorized accessories (antennas, control heads, speakers/mics, etc.). Use of unauthorized accessories can cause the FCC RF exposure compliance requirements to be exceeded.

The information listed above provides the user with information needed to make him or her aware of a RF exposure, and what to do to assure that this radio operates within the FCC exposure limits of this radio.

1.5 COMMON HAZARDS

The operator of any mobile radio should be aware of certain hazards common to the operation of vehicular radio transmissions. Possible hazards include but are not limited to:

1. Explosive Atmospheres

Just as it is dangerous to fuel a vehicle with its motor running, be sure to turn the radio **OFF** while fueling the vehicle. If the radio is mounted in the trunk of the vehicle, **DO NOT** carry containers of fuel in the trunk.

2. Interference To Vehicular Electronic Systems

Electronic fuel injection systems, electronic anti-skid braking systems, electronic cruise control systems, etc., are typical of the types of electronic devices that can malfunction due to the lack of protection from radio frequency (RF) energy present when transmitting. If the vehicle contains such equipment, consult the dealer for the make of vehicle and enlist his aid in determining if such electronic circuits perform normally when the radio is transmitting.

3. Electric Blasting Caps

To prevent accidental detonation of electric blasting caps, **DO NOT** use two-way radio within 1000 feet (305 meters) of blasting operations. Always obey the "Turn Off Two-Way Radios" signs posted where electric blasting caps are being used. (OSHA Standard: 1926.900)

4. Radio Frequency Energy

To prevent burns or related physical injury from radio frequency energy, do not operate the transmitter when anyone outside of the vehicle is within the minimum safe distance from the antenna as specified in Table 1-1.

5. Vehicles Powered By Liquefied Petroleum (LP) Gas

Radio installation in vehicles powered by liquefied petroleum gas, where the LP gas container is located in the trunk or other sealed-off space within the interior of the vehicle, must conform to the National Fire Protection Association Standard NFPA 58. This requires:

- a. The space containing radio equipment is isolated by a seal from the space containing the LP gas container and its fittings.
- b. Outside filling connections are used for the LP gas container.
- c. The LP gas container space is vented to the outside of the vehicle.

6. Vehicles Equipped With Airbags

For driver and passenger safety, avoid mounting the Control Head (or any other component) above or near airbag deployment areas. In addition to driver-side and passenger-side front-impact airbags, some vehicles may also be equipped with side-impact airbags. For occupant safety, verify the location of all airbags within the vehicle before installing the radio equipment.

2 SPECIFICATIONS¹

2.1 GENERAL

Dimensions, Mobile Radio: (Height x Width x Depth)	2.8 x 8.8 x 9.3 inches (7.1 x 22.4 x 23.6 centimeters) (Includes bracket but not cables)
Dimensions, Control Head:	2.4 x 7.1 x 2.1 inches (6.10 x 18.03 x 5.33 centimeters)
Weight, Mobile Radio:	8.0 pounds (3.63 kilograms)
Weight, Control Head:	1.5 pounds (0.7 kilograms)
Operating Ambient Temperature Range:	-22 to +140° Fahrenheit (-30 to +60° Celsius)
Storage Temperature Range:	-40 to +185° Fahrenheit (-40 to +85° Celsius)
DC Supply Voltage Operating Range:	+13.6 Vdc ±10% (Normal range per TIA-603)
DC Supply Current Requirements	
Receive:	1.5 amps maximum at 0.5-watt speaker audio output power (includes CH-103/CH-103PA Control Head)
Transmit:	8 amps maximum, 6 amps typical at 15 watts transmit RF output power (includes CH-103/CH-103PA Control Head)
Quiescent/Off Current	
Mobile Radio:	100 microamps maximum
CH-103/CH-103PA Control Head:	50 milliamps maximum

2.2 TRANSCEIVER

Frequency Ranges

Receive	
700 MHz Narrow Bands:	764 to 767 MHz and 773 to 776 MHz
800 MHz Band:	851 to 869 MHz
Transmit	
700 MHz Narrow Bands:	794 to 797 MHz and 803 to 806 MHz
800 MHz Band:	806 to 824 MHz
Transmit Output Power	
700 MHz Channels in Half-Duplex Mode:	1 watt to 15 watts (excluding interoperability channels)
700 MHz Interoperability Channels:	300 milliwatts maximum
800 MHz Channels in Full-Duplex Mode:	1 watt to 10 watts (programmable range)
800 MHz Channels in Half-Duplex Mode:	1 watt to 15 watts (programmable range)
Channel Spacing:	12.5 kHz or 25 kHz (mode dependent)
Data Communications Mode:	Full-Duplex
Voice Communications Mode:	Half-Duplex
Oscillator Stability:	±1.5 ppm with AFC disabled; ±0.5 ppm with AFC

¹ These specifications are primarily intended for the use of the installation technician. See the appropriate Specifications Sheet for the complete specifications.

Receiver Sensitivity

700 MHz OTP Mode:	-111 dBm minimum, -113 dBm typical for 5% BLER
800 MHz OTP Mode:	-111 dBm minimum, -112 dBm typical for 5% BLER
700 MHz P25 Mode (TIA-102 Method):	-116 dBm minimum, -121 dBm typical for 5% BLER
800 MHz P25 Mode (TIA-102 Method):	-116 dBm minimum, -121 dBm typical for 5% BLER
800 MHz OCF Mode (TIA-603 Method):	-118 dBm minimum for 12 dB SINAD
700 MHz EDACS Mode:	-118 dBm minimum, for 12 dB SINAD
800 MHz EDACS Mode:	-118 dBm minimum, for 12 dB SINAD

Receiver Intermodulation Rejection:

ACPR Mask

P25 Mode (TIA-102 Method):	67 dBc (minimum)
OCF, OTP and EDACS Modes:	FCC Mask G and H compliant

Audio Frequency Response:

Audio Output Power (Control Head):

Voice-Coding Method:

OpenSky Data Rate:

70 dB minimum for OCF, P25, and EDACS modes

300 to 3000 Hz (with <3% audio distortion)

10 watts RMS maximum into 4-ohm external speaker;
1 watt into 4-ohm headset

Adaptive Multi-Band Excitation (AMBE™)

19.2 kbps

2.3 REGULATORY

FCC Type Acceptance:

BV8M7200

Applicable FCC Rules:

Part 15 and Part 90 (for 700 and 800 MHz)

Industry Canada Certification:

3670A-M7200

Applicable Industry Canada Rules:

RSS-119

3 INTRODUCTION

3.1 GENERAL DESCRIPTION

The M7200 series mobile radios are high-performance full-duplex dual-band digital mobile radios. These radios can operate on 700 MHz and 800 MHz OpenSky trunked radio networks using the OpenSky Trunking Protocol (OTP). In the future, the radio will also operate on 800 MHz Enhanced Digital Access Communications System (EDACS) trunked radio networks, and 800 MHz APCO Project 25 phase I compliant Common Air Interface (P25 CAI) trunked radio networks. Other future operating modes include talk-around communications in accordance the APCO Project 25 phase I standard, and conventional FM repeater-based and FM talk-around voice communications in accordance with the TIA/EIA-603 conventional land-mobile radio standard.



NOTE

The initial release of this radio only supports operations on 700 MHz and 800 MHz OpenSky trunked radio networks. Later releases of the radio will add other modes to support other trunked radio networks, and conventional FM repeater-based and FM talk-around voice communication modes.

The radio has two models:

- M7250 — Trunk-Mount Full-Duplex Mobile Radio with CH-103 or CH-103PA Control Head
- M7270 — Trunk-Mount Full-Duplex Mobile Radio with CH-721 Control Head. As of the publication of this manual, this combination is not available.

This manual only covers the installation of the M7250 model mobile radio.

The M7250 model mobile radio is designed to operate in a mobile environment, typically within a motor vehicle. It must be connected to an external transmit/receive antenna such as one mounted to the vehicle's rooftop or trunk lid. In high-power half-duplex mode, the radio's 800 MHz RF transmit output power is rated at 15 watts minimum. The high-power limit for 700 MHz interoperability channels operations is 300 milliwatts maximum. This high-power limit guarantees that the 2-watt ERP (effective radiated power) limit of the 700 MHz interoperability narrowband channels is not exceeded when the radio is connected to a 6 dB gain antenna. Several different types of external-mount antennas are approved and available for use with the radio, as listed in Table 1-1 and Table 4-2.

The radio is designed for remote mounting in a motor vehicle's trunk, or some other preferably unoccupied section in a vehicle, such as a fire truck's equipment shelf. It is remotely controlled by one or more control heads connected to it via a 3-wire Controller Area Network (CAN) link cable. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio, controlling data such as button presses and radio messages, and user data such as that for a mobile data terminal connected to serial port of the radio or control head. For proper operation, the CAN link must be terminated appropriately on each end.

Control heads which may be utilized with the radio include the standard CH-103 and the siren/public address CH-103PA control head. The CH-103PA can interface to an optional Federal Signal Electronic siren/light control system for broadcasting via a public address (PA) speaker. In multiple control head installations, control heads are interconnected to the mobile radio in a series (daisy-chain) fashion via CAN link cables. Other control head models are planned in the future.

The radio must be powered by an external +13.6-volt (nominal) DC power source. In mobile applications, the motor vehicle's electrical system is the source of DC power. The control head(s) connected to the radio is also powered by the same DC power source, but separately fused. When the control head is powered-up by the operator, it "wakes up" the radio by transmitting data to the radio via the CAN link.

The radio provides half-duplex voice communications, and both half- and full-duplex data communications. Voice communication is accomplished via a “push-to-talk” (PTT) type microphone and a speaker connected to the mobile radio’s control head.

For data communications, the radio has an industry-standard TIA/EIA/RS-232 serial interface port for connecting optional data-type equipment, such a Mobile Data Terminal (MDT), a laptop PC, a third-party display, or a key-entry device. This port works seamlessly with equipment from popular manufacturers and off-the-shelf applications. OpenSky employs User Datagram Protocol over Internet Protocol (UDP/IP) data packet transfers, providing “plug and play” connectivity for data-type devices.

700 MHz operating bands of the radio include the two 3 MHz wide repeater output bands from 764 to 767 MHz and 773 to 776 MHz, and the two 3 MHz wide repeater input bands from 794 to 797 MHz and 803 to 806 MHz. The mobile can operate only on the narrowband channels within these bands and, as previously stated, transmit output power is limited to 300 milliwatts.

800 MHz operating bands of the radio include the Specialized Mobile Radio (SMR) and the National Public Safety Planning Advisory Committee (NPSPAC) radio frequency channels. This includes the 806 to 825 MHz repeater input band and the 851 to 870 MHz band used for repeater output and talk-around communications. These bands provide a total of over 830 possible channels spread over the 806 - 824 MHz mobile transmission and 851 - 869 MHz mobile reception bands.

The radio has a built-in Global Positioning System (GPS) tracking receiver. GPS provides quick and accurate unit location information to dispatchers via the radio network. The GPS receiver determines the unit’s location and the radio transmits it to the radio network. The GPS antenna may be integrated into the mobile transmit/receive antenna (a “combination” antenna) or it may be separate from the mobile transmit/receive antenna.

The radio meets or exceeds many tough environmental specifications included within military standard MIL-STD-810F, automotive industry standard SAE-J1455, the radio industry standard TIA/EIA-603, and the radio standard established by the U.S. Forest Service.

OpenSky employs Adaptive Multi-Band Excitation (AMBE™) voice-coding technology developed by Digital Voice Systems, Inc. AMBE allows the radio to deliver exceptional voice quality, even in weak received signal areas (i.e., “fringe” areas).

OpenSky radio network also uses Time-Division Multiple-Access (TDMA) modulation technology. This technology allows multiple radio users to share a single RF channel. In addition, a single RF channel can support simultaneous digital voice and data communications.

This manual contains installation procedures for the mobile radio, and the CH-103 and CH-103PA control heads. These procedures cover the mounting and cabling of the equipment as well as the testing of the radio and control head. Interconnect wiring diagrams are included at the rear of this manual.



M/A-COM recommends the buyer use only a M/A-COM authorized representative to install and service this product. The warranties provided to the buyer under the terms of sale shall be null and void if this product is installed or serviced improperly, and M/A-COM shall have no further obligation to the buyer for any damage caused to the product or to any person or personal property.

3.2 RELATED DOCUMENTS

The following documents contain additional information:

- Operator's Manual: MM23016
- Maintenance Manual: MM20117

3.3 CONTACTING M/A-COM FOR TECHNICAL ASSISTANCE

Should the mobile radio or control head require repair, or if there are questions or concerns about the installation of this equipment, contact M/A-COM's Technical Assistance Center (TAC) using the following telephone numbers or email address:

- U.S. and Canada: 1-800-528-7711 (toll free)
- International: 434-385-2400
- Fax: 434-455-6712
- Email: tac@tycoelectronics.com

4 UNPACKING AND CHECKING EQUIPMENT

4.1 MATERIALS

An M7250 mobile radio installation consists of two (2) main components:

- Trunk-Mount Full-Duplex 700/800 MHz Mobile Radio Unit (MRU), part number RU25011-0001
- CH-103 Control Head, part number MACDOS0003 or
CH-103PA Control Head, part number MACDOS0009

Installation Kit MAMV-ZN6X can be used to install the mobile radio, or individual components can be purchased separately as needed. Table 4-1 lists the parts included in the kit. Table 4-2 lists part numbers for radio options and accessories. Table 4-3 lists the parts included in CH-103 Installation Kit MAMV-ZN6Y. Table 4-4 includes optional parts available for CH-103 and CH-103PA installations.

Table 4-1: Installation Kit MAMV-ZN6X

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	1000003678	Bracket, Base
2	1	FS23057	Kit, Fuse Distribution Rail. Includes (1) Fuse Distribution Rail Assembly, (1) ATC Fuse Holder, (1) 15-Amp ATC Fuse, (1) 30-Amp ATC Fuse, 20 Feet of 10-AWG Red Wire, 1 Foot of 10-AWG Black Wire, (1) Moisture-Resistant Butt Splice, and (2) 3/8-Inch Ring Terminals.
3	1	MAMROS0075-N1210	Cable, DC Power: 12-AWG, 10-Foot, Straight Connector
4	1	MACDOS0010	Terminator, CAN; 3-pin
5	2	AD00006	Screws: #8-32 Pan-Head (Package of 4)

Table 4-2: Additional Options and Accessories

PART NUMBER	DESCRIPTION
MACDOS0003	CH-103 Control Head
MACDOS0009	CH-103PA Control Head. Includes Siren/PA functionality.
MAMV-ZN7P	Kit, Accessory; Remote-Mount for Data-Only Radio. Includes (1) Base Bracket 1000003678, (1) 10-foot DC Power Cable, (2) CAN Terminators (1) Fuse Distribution Rail Kit FS23057 and (1) Vehicle Fuse Tap FS24473.
MAMROS0044	Kit, Trunk Mounting. Includes base bracket, screws.
MACDOS0010	Terminator, CAN; 3-pin
MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10 Feet, Straight Connector
MAMROS0075-N1220	Cable, DC Power; 12-AWG, 20 Feet, Straight Connector
MAMROS0075-R1210	Cable, DC Power; 12-AWG, 10 Feet, Right-Angle Connector
MAMROS0075-R1220	Cable, DC Power; 12-AWG, 20 Feet, Right-Angle Connector
1000022242-0001	Cable, Full-Data I/O Option
1000022242-0002	Cable, Programming Option
MAMV-AN3J	Antenna, 700/800 MHz; 3 dB Gain, Rooftop-Mount
MAMV-AN3K	Antenna, 700/800 MHz; 3 dB Gain, Elevated-Feed, Rooftop-Mount
MAMV-AN3L	Antenna, GPS; Magnetic/Roof-Mount
MAMV-AN3V	Antenna, Combo GPS/700/800 MHz; 3 dB Gain, Rooftop-Mount
MAMROS0055	TIA/EIA-232 Serial Computer Cable (6 feet)

Table 4-3: CH-103/CH-103PA Installation Kit MAMV-ZN6Y

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	AJ03067	Bracket, Control Head
2	1	AD00150	Thumbscrews, Black (Package of 2)
3	1	MACDOS0010	Terminator, CAN; 3-Pin
4	1	MACDOS0006-RR030	Cable, CAN; 30 feet, Right-Angle-Right Angle Connectors
5	1	MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10 feet, Straight Connector
6	1	FS23058	Kit, Fuse Distribution Accessory. Includes (1) Fuse Block, (1) Protective Marker, (1) Adjacent Jumper, (1) 5-Amp ATC Fuse, (1) 15-Amp ATC Fuse.
7	1	FS24473	Kit, Vehicle Fuse and T-Tap. Includes (1) ATM Fuse Holder, (1) 2-Amp ATM Fuse, (2) T-Tab Disconnects and (1) 1/4-Inch Crimp Tab.
8	1	LS102824V10	Speaker, External Mobile; 20-Watt
9	1	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector

Table 4-4: Additional Accessories for CH-103 and CH-103PA Control Heads

PART NUMBER	DESCRIPTION
MAMV-CL6R	Kit, Cable; CH-103PA Public Address. Includes (1) 50-Foot Speaker Y-Cable MACDOS0015-NN050, (1) 50-Foot Common Mic Interface Cable MACDOS0014-RN050 and (1) 10-Inch CAN Y-Cable MACDOS0017-BR010.
MAMV-SU5B	Kit, Power-Off Time Delay Relay. Includes (1) Relay MAMROS0088, (1) 22 to 18-AWG Moisture-Resistant Splice, (1) 12 to 10-AWG Moisture-Resistant Butt Splice, and (1) 3/8-Inch Ring Terminal.
MACDOS0006-NN030	Cable, CAN; 30-Foot, Straight-to-Straight Connectors
MACDOS0006-NN090	Cable, CAN; 90-Foot, Straight-to-Straight Connectors
MACDOS0006-NR030	Cable, CAN; 30-Foot, Straight-to-Right Angle Connectors
MACDOS0006-NR090	Cable, CAN; 90-Foot, Straight-to-Right Angle Connectors
MACDOS0006-RR030	Cable, CAN; 30-Foot, Right-Angle-to-Right-Angle Connectors
MACDOS0006-RR090	Cable, CAN; 90-Foot, Right-Angle-to-Right-Angle Connectors
MACDOS0010	Terminator, CAN; 3-Pin
MACDOS0011	Kit, Control Head Dash Bracket. Includes bracket and thumbscrews.
MACDOS0012	Kit, Control Head Pedestal Mounting. Includes pedestal mount and screws.
MACDOS0013-CN004	Kit, Speaker; 20-Watt, CH-103, Straight Connector
MACDOS0013-CR004	Kit, Speaker; 20-Watt, CH-103, Right-Angle Connector
MACDOS0013-PN004	Kit, Speaker; 20-Watt, CH-103PA, Straight Connector
MACDOS0013-PR004	Kit, Speaker; 20-Watt, CH-103PA, Right-Angle Connector
MACDOS0014-NN050	Cable, Common Microphone Interface; 50 feet, Straight Connector
MACDOS0014-RN050	Cable, Common Microphone Interface; 50 feet, Right Angle Connector
MACDOS0015-NN050	Cable, Speaker; 50-Foot Y-Cable, Straight Connectors
MACDOS0015-RN050	Cable, Speaker; 50-Foot Y-Cable, Right-Angle Connectors
MACDOS0017-BN010	Cable, CAN; Y-Cable, Black, Straight Connectors
MACDOS0017-BR010	Cable, CAN; Y-Cable, Black, Right-Angle Connectors
MAMV-MC7W	Microphone, Noise-Canceling; Alden Straight Connector (Includes Microphone MC103334V20 and Mic Hanger 344A4678P1)
MAMV-(TBD1)	Microphone, Noise-Canceling; Alden Right-Angle Connector (Includes Microphone MC103334V21 and Mic Hanger 344A4678P1)
MAMV-MC7X	Microphone, with DTMF Keypad; Alden Straight Connector (Includes DTMF Mic MC103334V1 and Mic Hanger 344A4678P1)
MAMV-(TBD2)	Microphone, with DTMF Keypad; Alden Right-Angle Connector (Includes Microphone MC103334V2 and Mic Hanger 344A4678P1)
MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10-Foot, Straight Connector
MAMROS0075-N1220	Cable, DC Power; 12-AWG, 20-Foot, Straight Connector
MAMROS0075-R1210	Cable, DC Power; 12-AWG, 10-Foot, Right-Angle Connector
MAMROS0075-R1220	Cable, DC Power; 12-AWG, 20-Foot, Right-Angle Connector
MAMROS0091	Module, Siren and Light Control (SS2000SM-SC)
1020	Speaker, External Mobile; 100-Watt

4.2 MATERIAL INSPECTION



After removal from the carton, examine the radio, control head and other components for broken, damaged, loose or missing parts. If any are noted, contact M/A-COM's Technical Assistance Center (see page 13) immediately to discuss and arrange the return of the equipment to M/A-COM for replacement. Any unauthorized attempts to repair or modify this equipment will void the warranty and could create a safety hazard.

Upon removing items from the carton and verifying that all equipment is accounted for, proceed with the installation.



Mounting of the radio, control head, and/or antenna in ways other than those described in this manual may adversely affect performance, violate FCC rules on RF exposure, and even damage the unit, posing a potential safety hazard.

5 PLANNING THE INSTALLATION

5.1 GENERAL INFORMATION

Before starting, plan the installation carefully so it will meet the following requirements:

- The installation is safe for the operator and passengers within the vehicle.
- The equipment is installed away from the airbag deployment areas.
- The installation allows for convenient access by the operator.
- The equipment is protected from water damage.
- The installation is neat and allows easy service access.
- The equipment is mounted in a location assuring the vehicle occupant's safety and out of the way of passengers and auto mechanics.



A professional radio installer should perform the installation!

5.2 TOOLS REQUIRED

The following list of equipment is recommended for the installation. Equivalents may be used unless otherwise specified.



NOTE

A separate list of test equipment is included in section 16.2.

- Non-Insulated Crimp Tool: Thomas & Betts WT-111-M
- Insulated Terminal Crimp Tool: Klein 1005
- Ratcheting Coaxial Crimp Tool: Cambridge 24-9960P
- Non-Metallic Fish Tape, 25-Foot: Klein-Lite 50156
- Two Pairs of Slip-Jaw Pliers
- Various Socket and Driver Sets
- Various Fasteners
- Phillips-Head Screwdrivers, #1 and #2
- Flat-Head Screwdrivers, #1 and #2
- $\frac{3}{4}$ -Inch Hole Saw with Depth Protection: Ripley HSK 19 or Antenex HS34, No substitutes
- Clutch-Type Screw Cordless Gun/Drill with Driver Bits: Makita #6096DWE
- Cordless Electric Drill with Bits
- Deburring Tool (for $\frac{1}{4}$ -inch and smaller holes)
- Flush-Cut and Large Wire Cutters

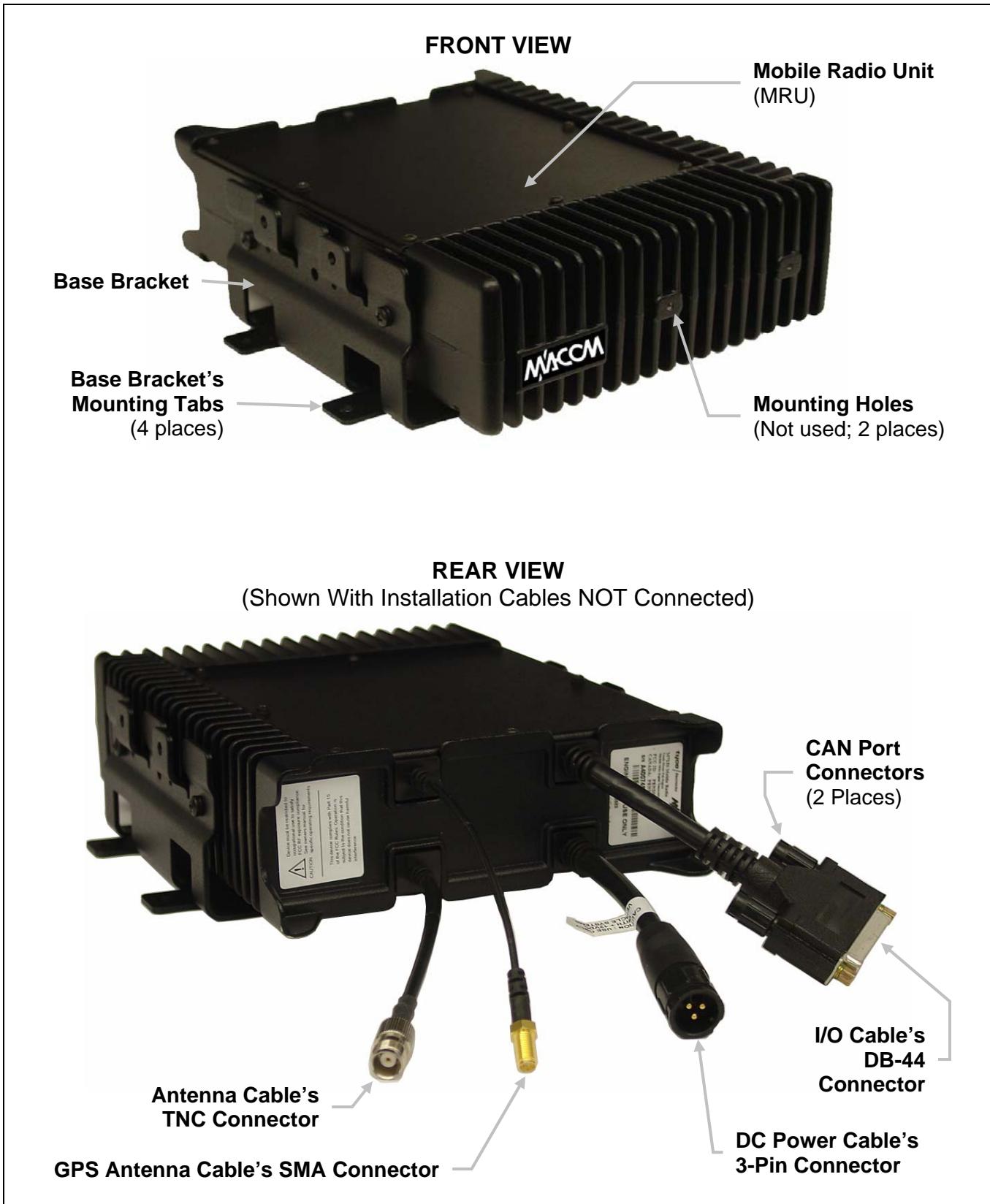


Figure 5-1: Mobile Radio Unit Front and Rear Views

5.3 LOCATING COMPONENTS

Plan the mounting locations of all components (radio, control head, antenna, and cables) and determine the routes for all wiring and cables. Particularly consider the connection of the control head for planning purposes.

- Determine the customer's preferences, if any, for location of components. Comply with these preferences as long as they are consistent with safety recommendations and guidelines presented in this manual, and other generally accepted professional radio installation practices.
- Nominal dimensions for the radio are 2.8 x 8.8 x 9.3 inches (7.1 x 22.4 x 23.6 centimeters; height x width x depth). This includes the base bracket and its mounting tabs, but it does not include any clearance space required for cabling, air circulation, access to mounting hardware, etc.
- Verify sufficient clearance behind the units is provided so cables will not be stressed, crushed, twisted, or bent at severe angles. Also, the front and sides must have clearance for air circulation, access to mounting hardware, etc.
- Connections on the radio are made through "pigtail" type cables exiting the rear of the radio. This design minimizes the stresses associated with mating connections and it allows for easy connector mating. However, stresses can still be induced if adequate service looping is not employed. Connections to the CH-103 and CH-103PA Control Heads are made with connectors mounted on the rear panel of each head instead of "pigtail" type cables.



All cables should have a service loop near each connector end. Do not bend the cables at severe angles near the connector end. Above all, after all components are installed, verify no cable is under any tension. Failure to do so may lead to damaged cables, causing intermittent radio operation or complete radio failure.

6 MOUNTING THE MOBILE RADIO IN THE TRUNK

This section provides details on mounting the mobile radio in the trunk of the vehicle. See Figure 5-1 and refer to the respective wiring diagram at the end of this manual as necessary. See section 9 (page 33) for control head installation procedures.

As an assembled unit, the radio weighs approximately 8 pounds (3.63 kilograms). The preferred mounting of the radio is on top of a firm, flat surface.



NOTE

Installation Kit MAMV-ZN6X (detailed in Table 4-1 on page 14) contains the most complete set of materials for installing the radio. Therefore, the following instructions make repeated reference to this kit. Item numbers given in parenthesis refer to items in the Installation Kit.



NOTE

Prior to beginning the installation, verify the radio has the proper version of software installed and it has been configured for customer usage (i.e., channels, personality, etc.).



CAUTION

Though generally mounted in a trunk or remote location, the radio must be kept away from heat sources. Mounting it in a location which is out of direct sunlight is recommended but not required. Adequate ventilation space must be provided to the rear and side fins. The radio reduces its RF output power when its ambient temperature exceeds approximately +140 ° Fahrenheit (+60° Celsius).



WARNING

At a minimum, the mounting surface should be 16-gauge (approximately 1/16-inch thick) steel sheet metal. Mounting to plastic or other material with low tensile and shear strength could lead to an unsafe and/or failed mounting condition, turning the radio and its base bracket into a projectile during a high-shock incident such as a motor vehicle accident. If the selected mounting surface does not meet the minimum 16-gauge steel sheet metal requirement, the surface should be reinforced with a metal backing plate (not supplied) or it should be reinforced using some other approved mounting method.



CAUTION

Before drilling holes and/or installing mounting screws, verify these operations will not damage or interfere with any existing vehicle component (fuel tank, fuel line, transmission housing, existing vehicle wiring, etc.). Always check to see how far the mounting screws will extend below the mounting surface prior to installation. Always deburr drilled holes before installing screws.

6.1 BRACKET INSTALLATION

Typically, the radio's Base Bracket (Item 1 in Table 4-1) is mounted in the vehicle's trunk, on the top surface of the trunk tray or the trunk floor. However, it can be suspended from the trunk's rear deck if the surface is completely flat, does not require any shimming and the gauge of deck's sheet metal is high (16-gauge minimum).

Since the radio protrudes several inches from the bracket's front and back edges, maintain sufficient distance at the front and back for this and additional clearance. A minimum distance of three (3) inches is required from the rear edge of the bracket; however four (4) inches or more is recommended to improve

radio installation and removal ease. A minimum distance of two (2) inches is recommended from the front edge of the bracket. The bracket is front/back symmetrical, and left/right symmetrical.

As all installations differ, bracket-to-vehicle mounting screws are not included. Steel #10 self-threading screws are recommended. Sheet metal screws are not recommended. The bracket has ten (10) available mounting holes; six (6) are underneath the radio when it is attached to the bracket. The following mounting procedure is recommended:

1. Using the Base Bracket (Item 1) as a template and/or the dimensional information shown in Figure 6-1, mark and drill mounting holes into the mounting surface as required. At least six (6) screws are recommended for proper installation: Four (4) in the screw holes of the bracket's side tabs and two (2) in its center-most screw holes. If the installation prevents the installation of six screws, a minimum of four screws installed in the side tabs' holes is required.

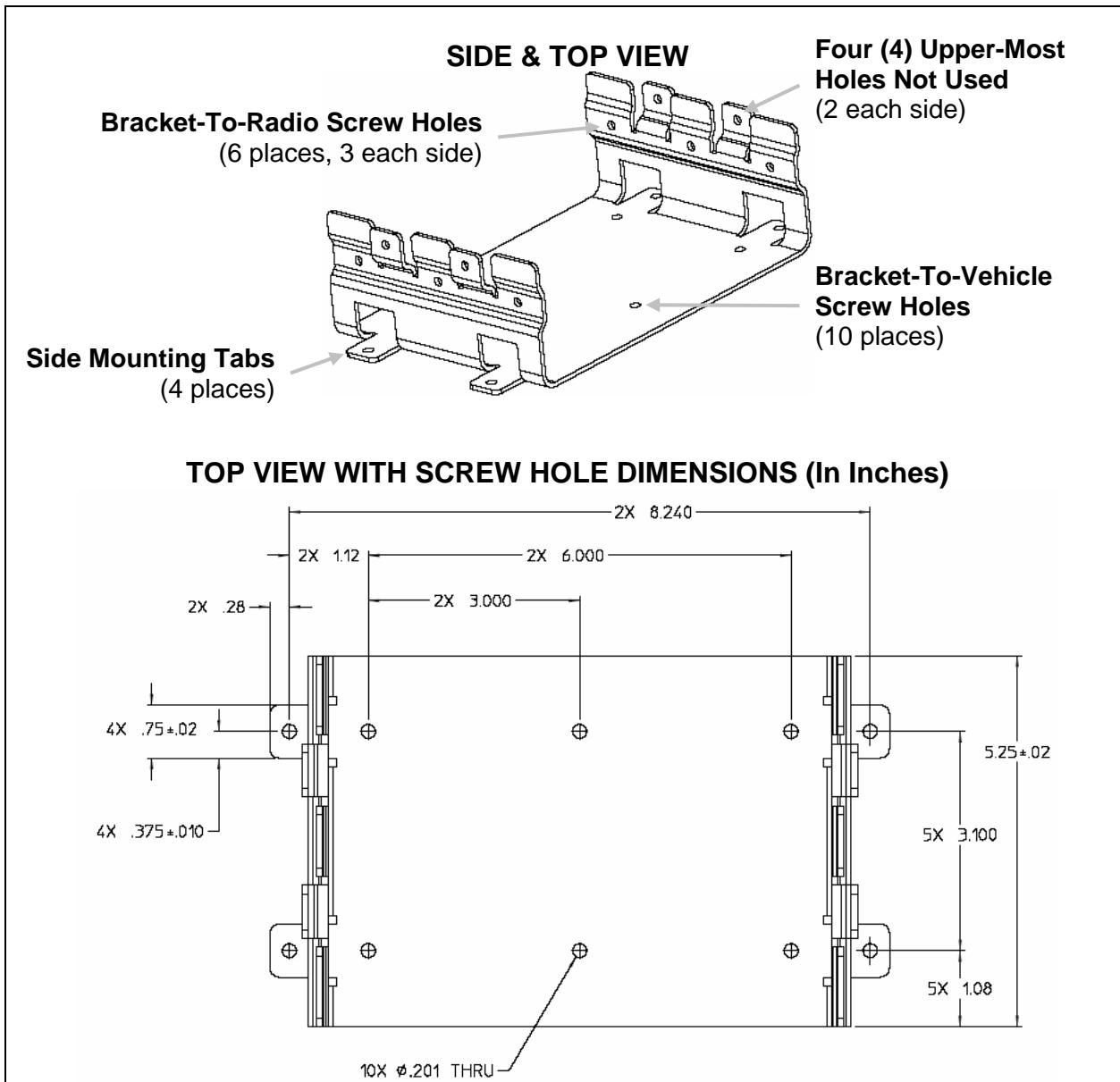


Figure 6-1: Base Bracket (Radio Not Shown)

2. Deburr all newly drilled mounting holes.
3. Set the bracket in place, and install and tighten the mounting screws.
4. Verify the bracket is firmly secured to the mounting surface. A secure mount prevents unreasonable vibration, which could damage the radio and/or cause its cable connections to loosen.

6.2 MOUNT THE RADIO INTO THE BRACKET

The radio should now be mounted into the bracket according to this procedure:

1. Attach the radio into the Base Bracket using three #8-32 pan-head screws (Item 5 in Table 4-1) per side. Tighten all six screws with a screwdriver until the lock washer on the screws are fully compressed and the radio is firm and flush in between the brackets.
2. Check the mounting area for proper clearance for cable service looping and for air circulation, plus an area to secure and rest the excess cable lengths.



NOTE

Proper mounting is one factor that ensures optimal radio performance. An improperly mounted radio may experience degradation in the quality of voice and data communications.

7 ANTENNA INSTALLATION

7.1 ANTENNA MOUNTING LOCATIONS



At this time, review all information presented in the **SAFETY INFORMATION** section of this manual (begins on page 5). A transmitting antenna must be installed in accordance with the guidelines presented in the **SAFETY INFORMATION** section. Use Table 1-1 as a guide for determining the best possible mounting configuration/location in order to reduce human exposure to radio frequency (RF) electromagnetic energy during transmit mode.

Antennas can be mounted in one of three possible locations on the vehicle as described in the following subsections. Figure 7-1 shows the recommended locations and antenna part numbers for each location. Also, see Table 4-2 for additional information. Always follow manufacturer's instructions when mounting an antenna.

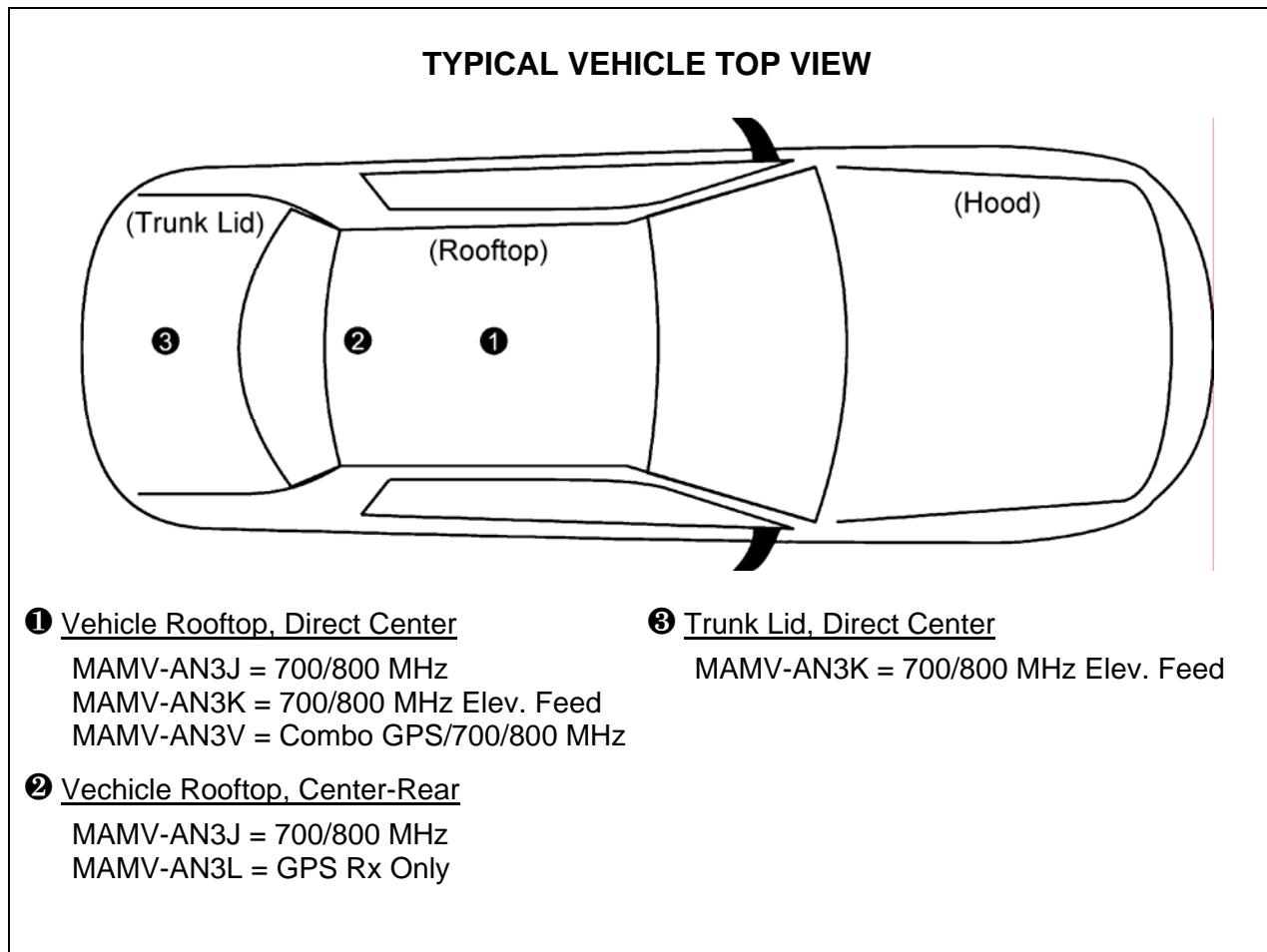


Figure 7-1: Recommended Antenna Mounting Locations (With Antenna Part Numbers)

7.1.1 Direct Center or Center-Rear of Rooftop

The center of the vehicle's roof is the best location for the rooftop antenna (❶ in Figure 7-1). For optimal performance, the mounting area under the antenna must be a flat with a minimum radius of six (6) inches of metallized ground plane. It must be located directly in the center of the roof for RF safety. Other obstructions such as a light bar or another antenna may prevent the antenna from being mounted in the direct center of the roof. In this case, the antenna should be mounted a minimum of one foot away from and behind the obstruction but in the middle of the roof with respect to the left and right sides of the vehicle (❷ in Figure 7-1).

7.1.2 Center of Trunk Lid

Certain vehicles do not allow for the antenna to be placed in the center or center-rear of the roof. In this case, the next best location for the antenna is in the direct center of the trunk lid (❸ in Figure 7-1). In this case, an elevated-feed-point antenna is recommended. Although this type of antenna does not require a metallized ground plane, it must be located directly in the center of the trunk lid for RF safety.



The antenna cable of M/A-COM approved antennas should **never** be cut to a shorter length. Instead, excess cable must be tied and stowed. This not only prevents the antenna from radiating above its intended or configured power, but it also allows for future installation considerations. Installations requiring longer cables are to be treated as custom and separately specified.

7.2 ANTENNA INSTALLATION PROCEDURE



An antenna **must** be installed before completing the radio installation.

7.2.1 Install and Connect Mobile Radio Antenna

Table 4-2 lists several types of mobile radio antennas available for use with the radio. As presented in the previous section, various mounting locations exist. Optimal performance is achieved via a rooftop antenna mounted in the direct center of the motor vehicle's roof:

1. Once the mounting location is selected, refer to the antenna manufacturer's mounting and testing instructions included with the antenna kit for installation guidance. If necessary, contact M/A-COM's Technical Assistance Center (see page 13 for contact information).
2. Route the cable from the antenna to the rear of the radio. The cable should be kept out of casual contact from persons within the vehicle. Tie and stow as necessary.
3. Connect the antenna cable's TNC plug-type (male) connector to the radio's TNC receptacle-type (female) "pigtail" type RF connector at the rear of the radio. Mate the two connectors and turn the plug clockwise until finger-tight.

This will be a temporary connection until the radio and antenna can be tested after the installation is complete. The antenna needs to be connected in case of accidental RF transmission.

7.2.2 Install and Connect GPS Antenna

The radio is equipped with a GPS receiver which requires connection to an externally-mounted GPS antenna if the GPS functions will be utilized.

The SMR/GPS combo antenna kit includes a GPS antenna built into the base of the mobile antenna. No extra holes are required for the GPS cable when using this antenna. The antenna must be kept at least six (6) inches away from any other antenna mounted on the vehicle and have at least six inches of surface ground plane beneath it.

1. Once the mounting location is selected, refer to the antenna manufacturer's mounting and testing instructions for installation guidance. If necessary, contact M/A-COM's Technical Assistance Center (see page 13 for contact information).
2. Route the cable from the GPS antenna to the rear of the radio. The cable should be kept out of casual contact from persons within the vehicle.
3. Connect the GPS antenna cable's SMA plug-type (male) connector to the radio's SMA receptacle-type (female) "pigtail" type RF connector at the rear of the radio. Mate the two connectors and turn the plug clockwise. Tighten with a pair of slip-jaw pliers.



Do not attempt to alter the length of cable from the GPS antenna. The SMA connector on the end of the antenna cable is not field-replaceable. Tie and stow excess cable as necessary.

8 RADIO DC POWER INSTALLATION

Refer to the wiring diagrams at the end of this manual. The diagram in section 19 (page 61) includes mobile radio with the CH-103 Control Head. The diagram in section 20 (page 63) is nearly the same with the exception of the three cables designed for use with the CH-103PA Control Heads. Power connections to either head are exactly the same.

8.1 ON/OFF POWER WIRING CONFIGURATIONS

The mobile radio can be wired in a motor vehicle in various ways to accommodate the user's preferences. In all cases, its red power wire must be connected through an in-line fuse to raw battery power (positive battery terminal). The white ignition wire of the radio's DC Power Cable is only used for the Data-Only (i.e., no Control Head) radio and it is the only means for turning its power on. An in-line switch for switched battery power to the radio must never be considered unless the user has the discipline to turn off the radio through the Control Head's on/off button or through a separate switch wired to the ignition sense wire. Failure to wait for the radio to completely power down before disconnecting battery power will not damage the radio; however, it **will** result in the loss of settings that have changed (e.g., channel number, volume setting, etc.) during the operating session.

Integral to the power management system of the CH-103 and CH-103PA Control Heads is a 60-second power-off Time-Delay Relay (part number MAMROS0088). The addition of this relay is required to remove the relatively high standby (off-state) quiescent-current (30 mA) consumed by the Control Head that would otherwise reduce the charge state of the vehicle's battery. The radio by itself does not require the relay, as its standby quiescent-current is typically below 1 mA. This is especially true in the case of the Data-Only radio configuration since it has no control head. However, because the CH-103 and CH-103PA do require the relay, it is advisable to connect the relay so both the radio and Control Head are shut down together. This relay reduces quiescent-current for the radio/control head pair below 2 mA and, if installed correctly, will work in conjunction with all on/off power configurations described below.

On/Off power functions for the radio are controlled by the Control Head or, in the case of a Data-Only radio, within the radio itself. The following power wiring configurations are supported:

- **Radio turns on automatically with vehicle's ignition switch/key** — The white sense wire of the Control Head's (or Data-Only radio's) DC Power Cable is connected to a fused switched power source, typically identified as "Accessory" power. This source must switch on (up to + battery voltage potential) when the vehicle's ignition switch/key turns on, and it must switch off (to near zero volts) when the ignition switch/key turns off. The required fuse rating is 2 amperes. An ATM fuse holder and fuse are included with the applicable fuse kit.
- **Radio turns on with a manual switch** — The white sense wire of the Control Head's (or Data-Only radio's) DC Power Cable is connected to one side of a manual toggle switch and the other side of this switch is connected to a fused vehicle power source. This configuration is used when, for example, the radio must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. The required fuse rating is 2 amperes if no other devices share the switch. If other devices share the switch, the 2-ampere ATM fuse must be spliced in the white wire on the load/switched power side of the switch.
- **Radio turns on with Control Head's on/off button ("hot wired")** — Standard software configurations allow turning on the radio with the Control Head's on/off button. This configuration may be desired if, for example, the radio must remain on even when the ignition key must be removed from the vehicle. In this case, the white sense wire of the Control Head's DC Power Cable is connected to vehicle chassis ground and the Time-Delay Relay's white wire is connected to the relay's red (power input) wire. In fact, the Time-Delay Relay's function is rendered useless, so the

relay could be completely bypassed in this configuration. Similarly, the 2-ampere ATM fuse and fuse holder included in the fuse kit are not needed.



CAUTION

Because the “hot wired” configuration renders the function of the Time Delay Relay useless, the Control Head will draw substantial quiescent current continuously from the battery when turned off. For this reason, the “hot wired” configuration should only be used in highly-controlled or temporary situations.



NOTE

A software configuration parameter can be set to disable the function of the Control Head’s on/off power button. This may be desired, for example, where frequent contact with the button is unavoidable and detrimental to usage.

8.2 POWER INSTALLATION PROCEDURE

Prepare to connect battery power to the radio through the vehicle’s engine firewall. Plan the wire route carefully, using an existing access hole through the firewall if possible. Alternately, drill a new hole approximately 3/8-inch in diameter and install a small rubber grommet to protect the wire from chafing on the hole’s sharp metal edge. To prevent fumes from entering the passenger compartment, this hole/grommet/wire combination must also be sealed with a silicon-based sealer before completing the installation.

8.2.1 Install Main Fuse Holder, Time-Delay Relay, and Fuse Block

Refer to Figure 8-1 and Figure 8-2 for parts included the radio’s fuse kit. Follow the steps below for connecting the radio to the vehicle’s positive battery power. Also refer to the respective wiring diagram at the end of this manual.



CAUTION

Do **not** install the fuse holder, wire, and relay over or in the near vicinity of the engine. Excessive engine heat can cause permanent damage to these components and can lead to intermittent electrical connection to the battery.



WARNING

Before making connections to the battery’s positive post, carefully disconnect the battery’s negative (ground) cable. This will prevent tools or other metallic objects which come in contact with the battery’s positive terminal from shorting to vehicle chassis ground, causing sparks or even a fire or an explosion! When disconnecting the negative cable, cover/insulate the positive post if it is not already so a tool cannot short between the posts.

A fuse must not be installed in the main fuse holder until all wiring is complete. This will prevent the unit from powering up prematurely and/or causing an in-rush of current that could lead to shorting of the battery, sparks, or even fire.

1. The installation’s main ATC Fuse Holder is a part of the Fuse Distribution Rail Kit (part of Item 2 in Table 4-1). Strip one of the ATC Fuse Holder’s wires and crimp a 3/8-inch ring terminal to it. Ring terminals are also included with the kit.
2. **Verify the fuse is NOT in the Fuse Holder.**

3. Connect the ring terminal directly to the battery's positive post (or if present, to a stud on the battery's main/non-switched power distribution terminal block).
4. Mount the Time-Delay Relay firmly onto a flat surface within the vehicle's engine compartment and near the battery but away from sources of excessive heat. Use the various mounting holes in the relay case as necessary and self-threading screws (not supplied).
5. Strip the Fuse Holder's other wire and strip the relay's 10-AWG red wire. Connect these two wires together using the 10-AWG moisture-resistant insulated butt splice included in the Fuse Distribution Rail Kit.
6. Strip the relay's 10-AWG yellow wire. This is its output lead.
7. Strip one end of the 20-foot long 10-AWG red wire supplied in the Fuse Distribution Rail Kit and connect it to the relay's yellow wire using a 10-AWG moisture-resistant butt splice.
8. Route the other end of the 20-foot long red wire through a wire-loom then through the grommet in the firewall. This end of the red wire will later be connected to the Fuse Block clipped on the Fuse Distribution Rail Assembly (both parts of the Fuse Distribution Rail Kit). The Fuse Distribution Rail Assembly will be located near the radio in the trunk.
9. Connect the relay's white wire to a switched power source such as "Accessory" power at the vehicle's fuse box. Use an 18-AWG moisture-resistant insulated butt splice and 18-AWG wire. Route the wire through a wire-loom then through the grommet in the firewall to the fuse box. This must be the same switched power source (that is later) connected to the Control Head's white wire; see section 9.5.3 on page 37 for additional information.
10. Continue routing the 20-foot red wire through channels in the vehicle to the location of the radio. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing as necessary.
11. Mount the Fuse Distribution Rail Assembly (included in the Fuse Distribution Rail Kit; see Figure 8-2) in the vicinity of the radio's mounting location, but where casual contact is not likely. Use self-threading screws (not supplied) and any available mounting slots in the DIN rail to mount the block.

**NOTE**

The Fuse Distribution Rail Assembly has a DIN-type rail allowing additional Fuse Blocks to be added to it if fuse expansion is necessary in the future, such as for multiple Control Head installations. The rail may be cut to decrease its length if necessary, but enough room for at least one Control Head and any additional future expansion should be considered first.

12. Apply the sticker included in the Fuse Distribution Rail Kit in the vicinity of the Fuse Block as future reference for service personnel.
13. At the Fuse Block, cut and discard excess length from the 20-foot red wire, strip the end, and connect it to the Fuse Block according to the instructions included with the block.

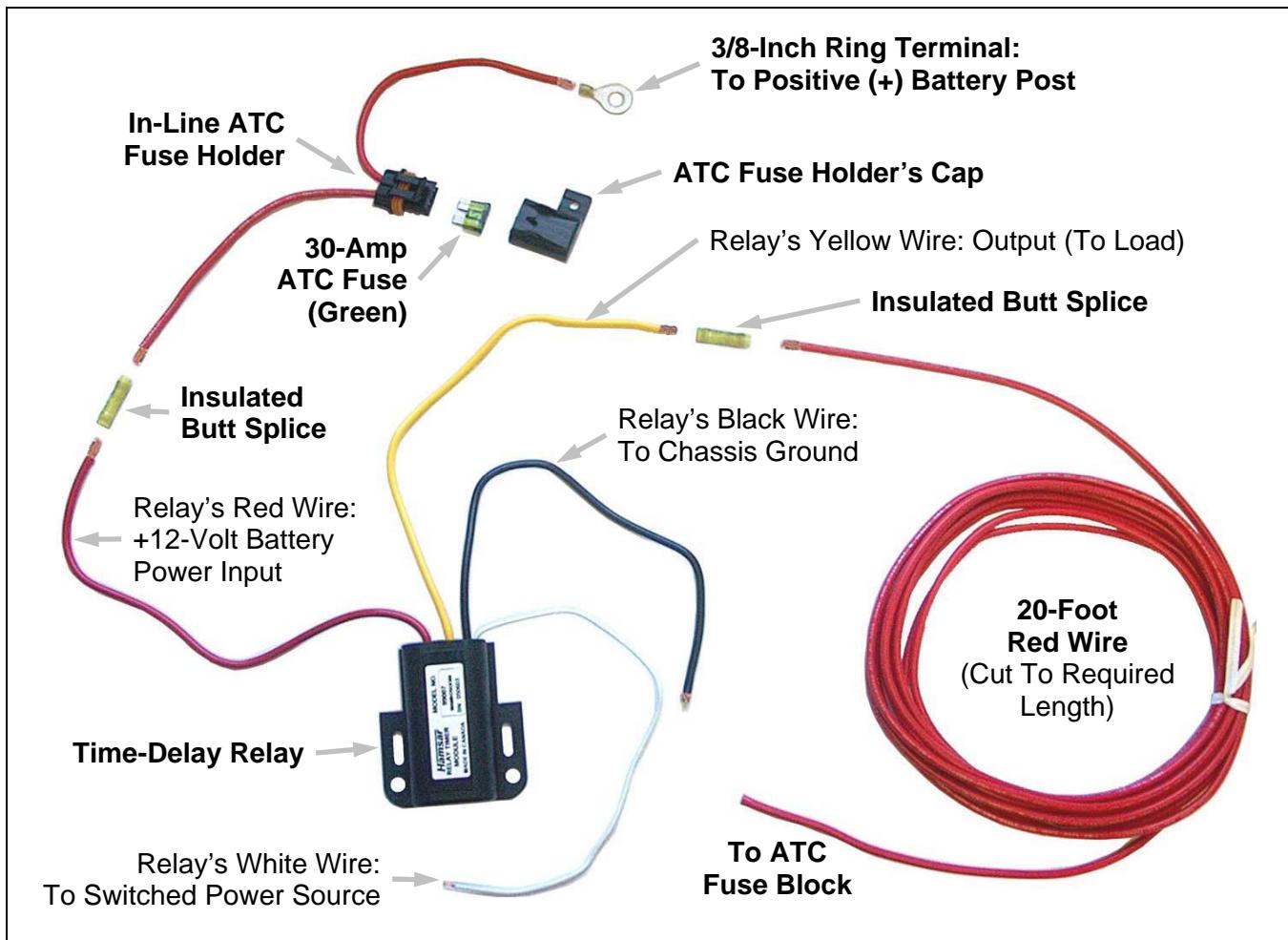


Figure 8-1: Fuse and Power-Off Time Delay Relay Wiring at Battery (Exploded View)

8.2.2 Make Ground Connections at Fuse Block and Time-Delay Relay

1. Strip one end of the 10-AWG black wire (included with the Fuse Distribution Rail Kit) and crimp a 3/8-inch ring terminal to it.
2. Near the Fuse Distribution Rail Assembly, locate an area of vehicle chassis ground within one foot of the assembly and strip the area of any paint or dirt to expose a bare metal surface.
3. Drill a hole as necessary and connect the ring terminal to chassis ground. Use a self-threading screw or other appropriate hardware to ensure a reliable metal-to-metal contact. Tighten securely.
4. Cut the black wire to a length long enough to reach a green-yellow Grounding Block on the Fuse Distribution Rail Assembly, plus length for a service loop. Strip the end and connect it to a Grounding Block in accordance with the instructions provided with the kit. Adjacent Grounding Blocks are electrically connected together, so the black wire will ground both blocks.
5. Obtain the radio's DC Power Cable (Item 3 in Table 4-1) and temporarily connect it to the radio. Next, cut its black (negative) wire to a length long enough to reach a Grounding Block, plus length for a service loop. Strip the end of the wire and connect it to a Grounding Block in accordance with the instructions provided with the kit.

(Image Not Currently Available)

Figure 8-2: Wiring to the Fuse Distribution Rail Assembly (Exploded View)

6. Label and route the DC Power Cable's white wire to the vehicle's fuse box. Tie and stow as necessary so the wire remains out of the way of casual contact and wire chafe is avoided.



NOTE

The Control Head wakes up the radio via the CAN port when power is applied. However, connection of the white sense wire may be needed in future configurations that do not use the Control Head (e.g., Data-Only applications). Therefore, it is recommended that the white wire be labeled, routed up to the vehicle's fuse box, coiled, and stowed for possible future use rather than be cut from the DC Power Cable.

7. In the engine compartment, strip the Time-Delay Relay's black wire and crimp a 3/8-inch ring terminal to the wire.
8. Locate a nearby section of vehicle chassis ground and strip the area of any paint or dirt to expose a bare metal surface.
9. Drill a hole as necessary and connect the relay's black wire to chassis ground using a self-threading screw.



CAUTION
Do NOT connect the relay's black wire directly onto the negative terminal of the battery!

8.2.3 Complete Fuse Block and DC Power Cable Connections

1. Cut the red (positive) wire of the DC Power Cable to a length long enough to reach the Fuse Block plus length for a service loop.

2. Strip the end and connect it to the output power distribution side of the Fuse Block in accordance with the instructions included with the block.
3. Mate the DC Power Cable's connector to the radio's 3-pin power connector as follows: Visually align the key and firmly push and turn the outer locking ring clockwise until it stops. A click will be sensed to confirm proper mating.



Upon connection, verify the DC power cable is not under any stress, a service loop is maintained, and the cable can be properly tied and stowed.

4. Install the 15-Amp ATC fuse included in the Fuse Distribution Rail Kit into the Fuse Block's fuse slot.



Installing a fuse with the wrong amperage rating could cause an unsafe condition and/or a prematurely blown fuse. Verify the correct fuse value for the radio is installed. The color of the 15-amp fuse is blue.

5. Tie and stow all cables/wires as necessary so they remain out of the way of casual contact, and so wire chafe is avoided.



When servicing the radio and/or control head, always manually turn the units off and then pull the main power fuse in the engine compartment.

9 CONTROL HEAD INSTALLATION

9.1 GENERAL INFORMATION

Figure 9-1 below illustrates CH-103 and CH-103PA Control Head interfaces.

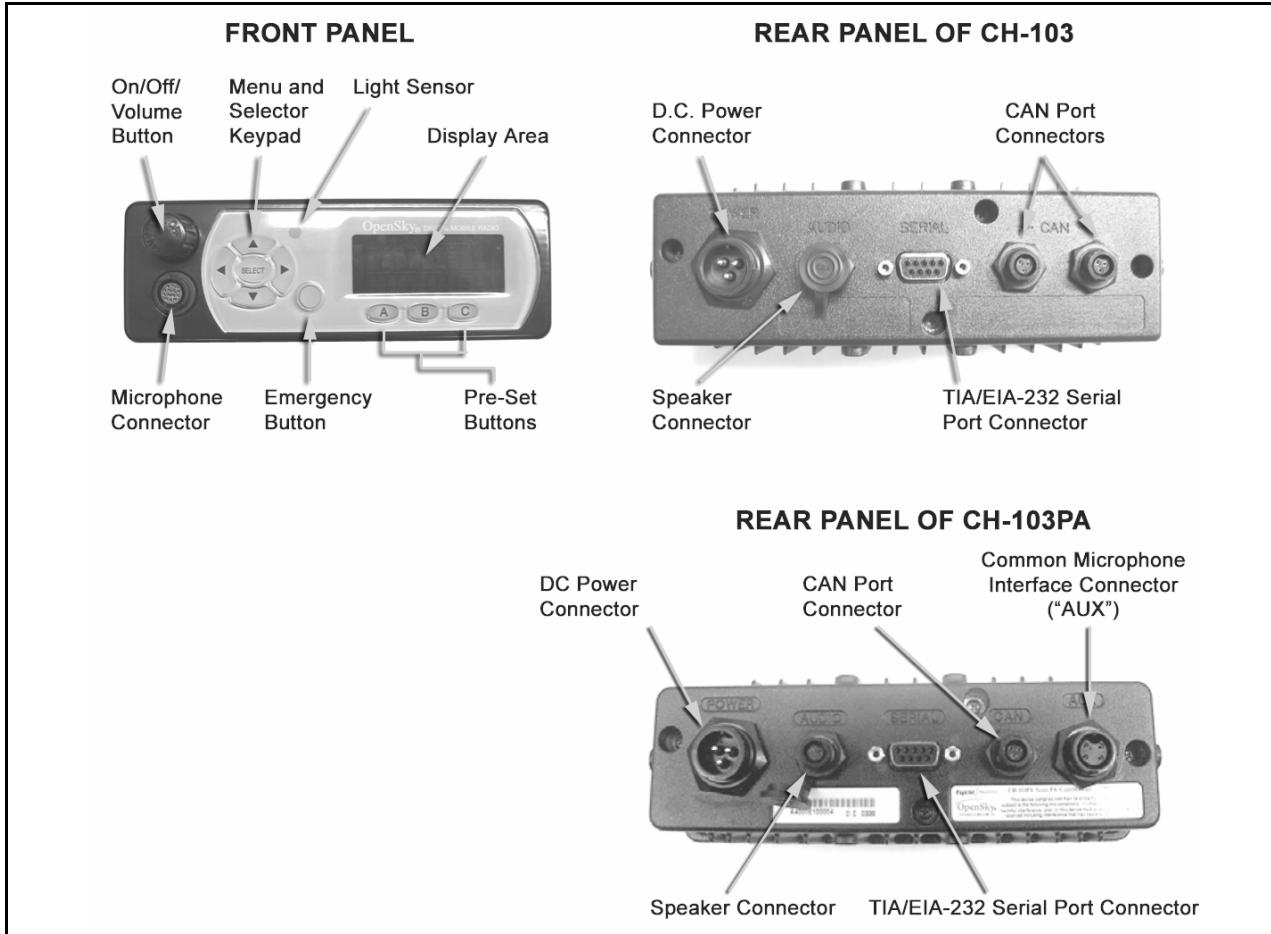


Figure 9-1: CH-103 and CH-103PA Control Head Front and Rear Panels



NOTE Prior to installation, verify the Control Head has the proper software version installed and verify it has been configured for customer usage (i.e., channels, personality, etc.)

NOTE Because the MAMV-ZN6Y Installation Kit (see Table 4-3 on page 15 for complete contents) contains the most complete set of materials for installing the CH-103/CH-103PA Control Head, the following instructions make repeated reference to this kit. Item numbers given in parenthesis below refer to items in the Installation Kit.

NOTE For the CH-103PA Control Head, in addition to the items listed in Table 4-3, other optional accessories are also required to complete the installation. These optional accessories are discussed in the following pages.

9.2 BRACKET INSTALLATION



When drilling holes, be careful to avoid damaging some vital part of the vehicle (fuel tank, transmission housing, etc.). Always check to see how far the mounting screws will extend below the mounting surface prior to installation. After drilling pilot holes, remove all metal shavings from them (debur) before installing mounting screws.

9.2.1 Standard U-Shaped Bracket

1. Using the U-shaped bracket (Item 1 in Table 4-3) as a template, mark and drill mounting holes into the mounting surface as required. It can be mounted under or on top of the dash as required and as space permits. Screws for mounting the bracket are not included, as all installations differ. Self-threading screws are recommended.
2. Install and tighten the mounting screws.
3. Verify the bracket is held firmly to the mounting surface. Firm mounting prevents unreasonable vibration, which could damage the Control Head and/or cause its cable connections to loosen.

9.2.2 Mounting Pedestal (Optional)

An optional mounting pedestal, part number MACDOS0012, may be purchased separately to replace the standard U-shaped mounting bracket. See Figure 9-2.

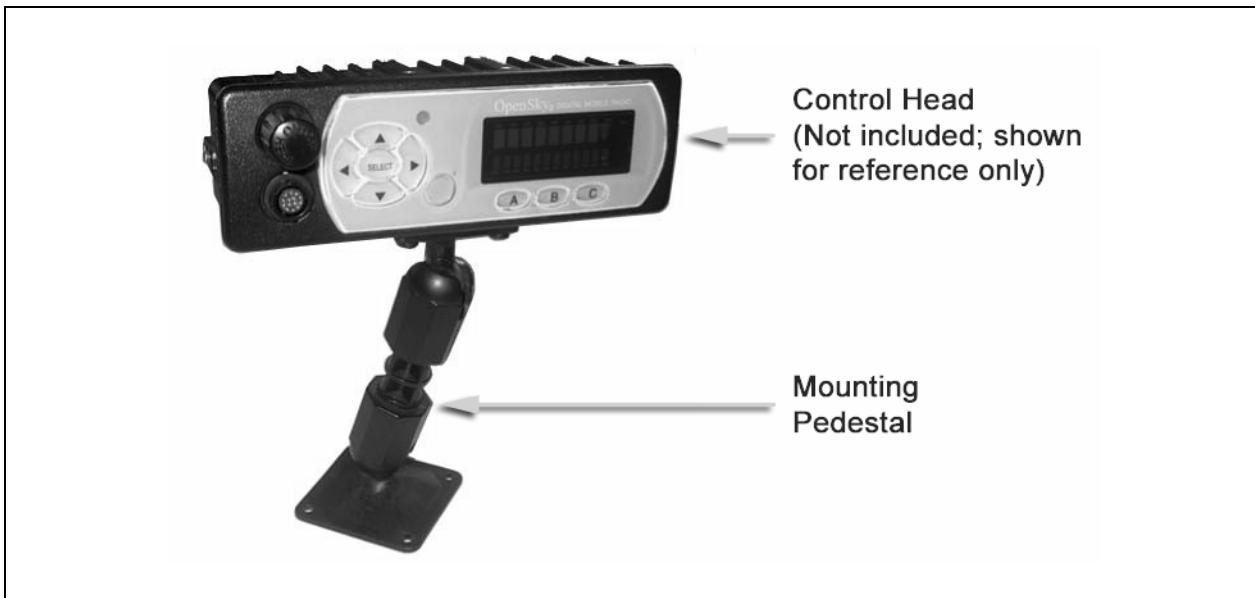


Figure 9-2: Optional Control Head Mounting Pedestal (Part Number MACDOS0012)

9.3 ATTACH CONTROL HEAD TO BRACKET

The following procedure applies to the standard U-shaped mounting bracket:

1. Slide the Control Head into the bracket then start a thumbscrew (Item 2 in Table 4-3) in each side by inserting it through the hole in the bracket and then into the threaded hole in the side of the Control Head. Turn each thumbscrew clockwise as observed from the head of the screw.

2. The Control Head can be positioned at various angles for best display viewing. As necessary, turn it on the thumbscrews to a good position (typically, as viewed from the driver's seat) and then tighten both thumbscrews until the Control Head is held firmly in place.

9.4 CAN CONNECTIONS

9.4.1 General Information

Because CAN devices do not provide their own termination, the CAN bus needs to be terminated at both ends for proper operation.

The CH-103 Control Head has two ports on the rear panel to support “daisy-chaining” of multiple Control Heads or other CAN devices. When a CH-103 is in the middle of a chain (e.g., radio on one end and another Control Head on the other), two separate CAN cables connect to the two ports. When the CH-103 is at the end of a chain of devices, one CAN port connects to the previous CAN device and the other port needs to be terminated with a CAN Terminator (part number MACDOS0010).

The CH-103PA Control Head has only one CAN port. A CAN Y-cable (part number MACDOS0017-BR010 for right-angle connector or MACDOS0017-BN010 for straight connector; listed in Table 4-4) needs to be connected to the rear of the CH-103PA to properly terminate the CAN chain. If the CH-103PA is in the middle of a chain of CAN devices, one CAN cable will connect to one leg of the Y-cable and another CAN cable will connect to the other. When the CH-103PA is the only CAN device or is at the end of a chain of devices, one leg of the Y-cable goes to the previous CAN device and the other needs to be terminated with the CAN Terminator provided in the Control Head Installation Kit.

The radio has two CAN port connections on its I/O pigtail cable. Like the Control Head, it can be connected either at an end or in the middle of a CAN chain. However, for logistical purposes, it typically is an end point and provides a termination when a CAN Terminator is connected to one of the two CAN connectors. The CAN cable from a Control Head then connects to the other connector.

9.4.2 Make CAN Termination

When mating any CAN connection (terminators and cables), visually align the $\frac{3}{4}$ -moon-shaped keys of the connectors, and then gently push and turn the outer locking ring of the plug (male) connector clockwise until it stops. A mild click will be sensed to confirm proper mating. Per the specific Control Head being installed, follow the respective procedure in one of the following subsections.



NOTE

Without visual alignment as a guide, it is possible with excessive force to mate the CAN connectors improperly. Damage to the connector(s) may result. Therefore, visual alignment is recommended when mating CAN connectors.

9.4.2.1 CH-103 Control Head CAN Termination

Connect the CAN Terminator (Item 3 in Table 4-3) onto one of the two smaller 3-pin connectors on the rear of the CH-103. This makes the CAN termination at the Control Head end of the CAN chain. Continue with section 9.4.3.

9.4.2.2 CH-103PA Control Head CAN Termination

Connect the plug (male) connector of the CAN Y-cable to the rear of the CH-103PA and connect the CAN Terminator (Item 3 in Table 4-3) to one leg of the Y-cable. See Figure 9-3. See Table 4-4 for CAN Y-cable part numbers.

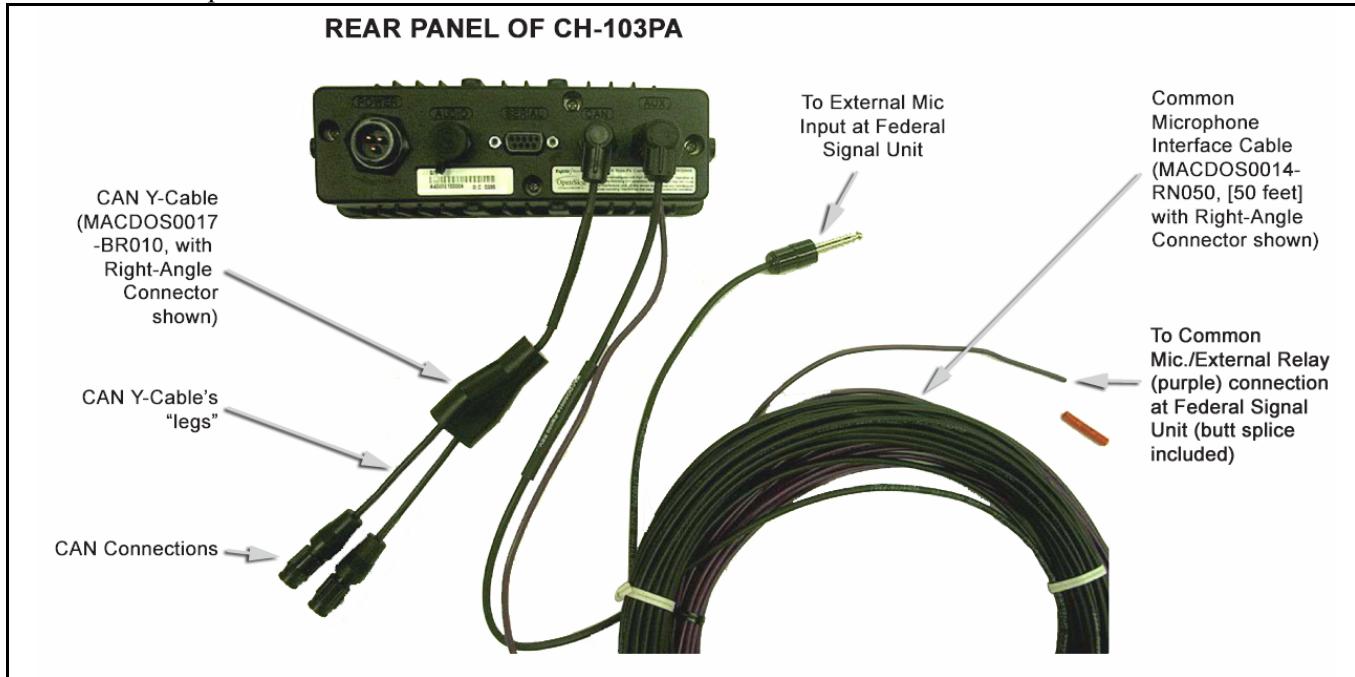


Figure 9-3: CH-103PA CAN Y-Cable and Common Microphone Interface Connections

9.4.3 Connect Control Head to Radio Via CAN Cable

1. Route the CAN Cable (Item 4 in Table 4-3) through the vehicle's channeling to the radio. Remove interior panels, door kick panels, etc., as necessary. Protect the cable from possible chafing as necessary.
2. Attach the CAN Cable's connector to one of the two CAN port connectors on the radio's I/O cable.
3. **CH-103 Control Head:** Connect the other end of the CAN Cable to the open CAN port connector at the rear of the Control Head.
4. **CH-103PA Control Head:** Connect the other end of the CAN Cable to the open leg of the CAN Y-cable.

4. Loop, tie and stow the excess cable as necessary.

9.5 CONTROL HEAD POWER CABLE INSTALLATION

Plan the cable's route carefully. For the red wire, ensure a route that will not crush or damage the wire in any way.

9.5.1 Install Fuse Holder and DC Power Cable and Make Power Connection

The Control Head has a moderately high quiescent-current drain so red wire power connection to the output/load side of the Time-Delay Relay (relay's yellow wire) through the Fuse Block is highly recommended. Refer to the respective wiring diagram at the end of this manual.



NOTE

Do not share the Control Head's fuse with any other device. Doing so can cause excess current to flow through the fuse, causing it to blow unnecessarily.

1. Connect the Control Head's DC Power Cable (Item 5 in Table 4-3) to the large 3-pin connector at the rear of the Control Head. Visually align the key and gently push and turn the outer locking ring clockwise until it stops. A click will be sensed to confirm proper mating.
2. At the back of the Control Head, form a cable service loop of at least six (6) inches, and tie and stow the cable as necessary.
3. Route the cable's red (positive power) wire through channels in the vehicle to the location of the Fuse Distribution Rail Assembly. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing as necessary.
4. Remove the end stop on the fuse side of the Fuse Distribution Rail Assembly, clip the Fuse Block included in the Fuse Distribution Accessory Kit (Item 6 in Table 4-3) onto the DIN rail next to the radio's block, and snap the end stop back onto the DIN rail so both blocks are firmly fixed to the rail. Refer to the instructions included with the kit as necessary.
5. Strip and connect the red wire to the load-side of the newly installed Fuse Block.
6. Install the 5-amp ATC fuse included in the kit into the Fuse Block's fuse slot.



CAUTION

The fuse for the Control Head is rated at 5 amperes. Installing the wrong fuse value could lead to damage. Verify the Control Head has the correctly rated fuse! The color of a 5-amp ATC fuse is tan. The 15-amp (blue) ATC fuse included in the kit should **not** be used for CH-103/CH-103PA Control Head power; it can be returned to stock or stored as a spare for the radio.

9.5.2 Make Ground Connection

1. At the back of the Control Head, locate a nearby section of vehicle chassis ground and strip this area of any paint or dirt to expose a bare metal surface.
2. Cut the black wire of the Control Head's DC Power Cable as short as possible, but long enough for a service loop, then strip it and crimp a 3/8-inch ring terminal (included in the fuse kit) to it.
3. Drill a hole as necessary and screw this ring terminal to chassis ground. Use a self-threading screw or other appropriate hardware to ensure a reliable metal-to-metal contact.

9.5.3 Connect DC Power Cable's White Wire

A review of the information presented in Section 8.1 may be beneficial at this time. As required per the chosen power-up configuration, follow one of the three procedures presented in the sub-sections

below. The Control Head's DC Power Cable and associated fuse and wire terminal devices are shown in Figure 9-4.



NOTE

Only the Control Head's white wire and the Time-Delay Relay's white wire must be connected to the ignition or switched power sense. When this vehicle line is asserted (i.e., power switched on), the Control Head automatically powers-up the radio via the CAN connection.

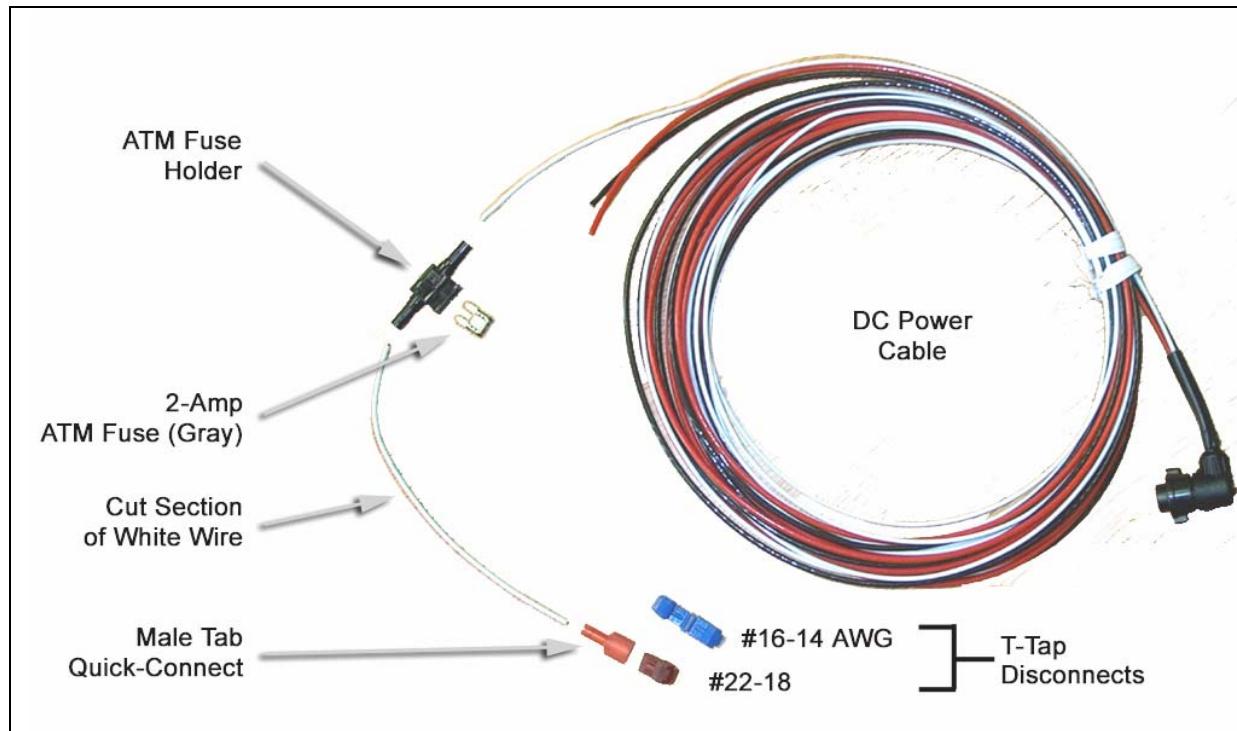


Figure 9-4: Connection of White Ignition Sense Wire

9.5.3.1 Control Head and Radio Turn on with Vehicle's Ignition Switch/Key

With this wiring configuration, the Control Head and radio automatically turn on and off with the vehicle's ignition switch/key. The white wire of the Control Head's DC Power Cable is typically identified as the "white ignition switch wire" or the "ignition sense wire." In this configuration, the white wire connects to a switched power source, typically identified as "Accessory" power, that switches on and off with the vehicle's ignition switch/key.



NOTE

The white ignition sense wire must be connected to a fused power source that switches from approximately zero volts to approximately +13.6 volts when the vehicle's ignition switch/key is turned from the OFF position to the ACCESSORY and RUN positions. Use of a switched power source that is subject to voltage changes as a result of other actions, such as opening a vehicle door, may result in undesirable radio operation and/or a degradation of radio performance.

1. Locate the switched ignition or "Accessory" power wire (typically at or near the vehicle's fuse block or in a vehicle wiring harness) that will be used for the switched ignition power source. It may be necessary to consult the vehicle manufacturer's wiring diagram.

2. Route the white wire of the Control Head's DC Power Cable from the back of the head to an area near the switched ignition power source. At the back of the head, be sure to maintain a cable service loop of at least six (6) inches.
3. Cut a short section (6 to 8 inches) off the end of the white wire and strip each end of this short wire.
4. Extend the length of the Time-Delay Relay's white wire so that it reaches the white wire of the Control Head's DC Power Cable. Use the 18-AWG moisture-resistant butt-splice included in the fuse kit and extra white wire. Extra wire is not included, but in most cases there will be enough extra white wire from the DC power cable to accommodate this wire extension. Cut excess length from this wire.
5. Crimp the male-tab quick-connect terminal to one end of both the short wire and the extended wire from the relay. Refer to the respective wiring diagram at the end of this manual.
6. Crimp the ATM fuse holder to the other end of the short wire. The holder has built-in crimpable joints.
7. Cut the excess length from the white wire of the Control Head's power cable, strip it, and crimp it to the other side of the ATM fuse holder.
8. Pull enough of the switched ignition source wire out of its harness so one of the T-tap quick-disconnect terminals may be attached to it.
9. Two T-tap quick-disconnect terminals are included in the kit. Based on the gauge of wire, select the proper terminal size: Red is for 22 to 18-AWG wire and blue is for 18 to 14-AWG wire.
10. Attach the selected T-tap quick-disconnect terminal by fitting the wire into its wire groove and snapping the two halves together with a pair of pliers as shown in Figure 9-5.

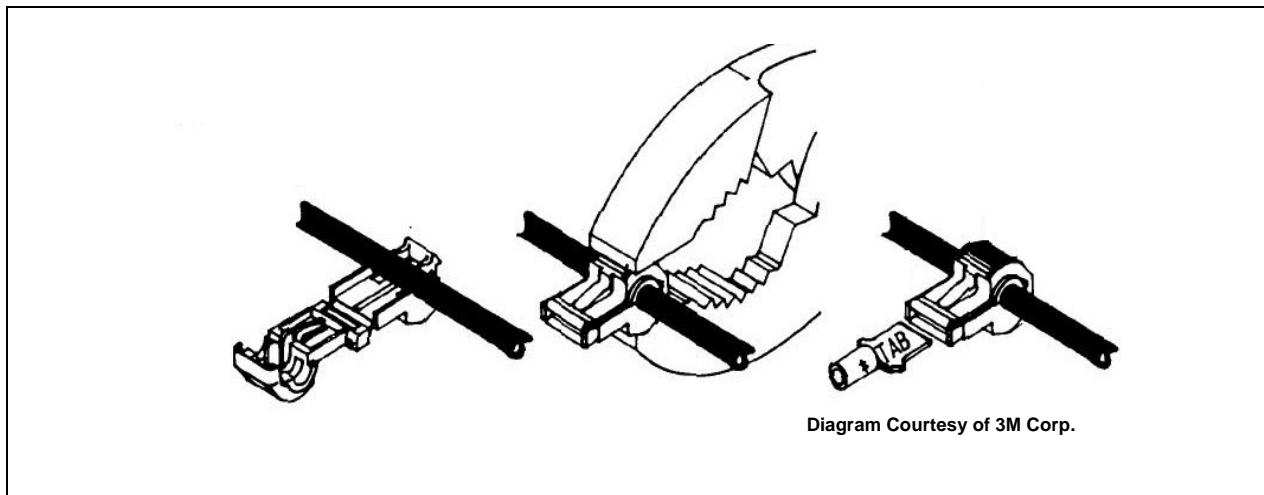


Figure 9-5: Attaching T-Tap Quick-Disconnect Terminals

11. Push the male-tab quick-disconnect terminal into the T-tap quick-disconnect terminal's inlet until it is fully engaged.
12. Install the 2-amp ATM fuse into the fuse holder. It is recommended that a piece of electrical tape be wrapped around the fuse connection to keep the fuse from being jostled out of the holder.
13. Tie and stow these wires as necessary so they remain out of the way of casual contact and wire chafe is avoided.

9.5.3.2 Control Head and Radio Turn On with a Manual Switch

With this wiring configuration, the Control Head and radio are manually turned on and off via an on/off switch mounted separately from the Control Head and radio, not through the vehicle's ignition switch/key. This configuration is used when, for example, the radio must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. In this configuration, the white wire connects to a switched power source such as a toggle switch mounted on the vehicle's dash.

1. Route the white wire of the Control Head's DC Power Cable from the back of the unit to an area near the on/off switch's location. At the back of the Control Head, be sure to maintain a cable service loop of at least six (6) inches.
2. Cut a short section (6 to 8 inches) off the end of the white wire and strip the ends.
3. Extend the length of the Time-Delay Relay's white wire so that it reaches the switch. Use the 18-AWG moisture-resistant butt-splice included in the fuse kit and extra white wire. Extra wire is not included, but in most cases there will be enough extra white wire from the DC power cable to accommodate this wire extension. Cut excess length from this wire.
4. For a new on/off switch (not supplied):
 - (a) Tap a wire off non-switched battery power from the vehicle's fuse box with an 18-AWG wire. (Use wire remaining from the power cable, if available.) Keep wiring as short as possible and use approved wiring methods. Use techniques presented in section 9.5.3.1 as a reference.
 - (b) Strip and crimp this tap to one side of the ATM fuse holder included in the fuse kit. The fuse holder has built-in crimpable joints.
 - (c) Crimp the short wire to the other side of the ATM fuse holder and connect the other end of this wire to the common terminal of the manual switch.
 - (d) Connect both the white wire of the power cable and the extended wire from the relay to the load (switched) side of the manual switch.

For an existing switch:

- (a) Crimp the short wire to one side of the ATM fuse holder and connect the other end to the load (switched) side of the manual switch.
- (b) Crimp the both white wire of the power cable and the extended wire from the relay to the other side of the ATM fuse holder.
5. Install the 2-amp ATM fuse into the fuse holder. It is recommended that a piece of electrical tape be wrapped around the fuse connection to keep the fuse from being jostled out of the holder.
6. Tie and stow these wires as necessary so they remain out of the way of casual contact and wire chafe is avoided.
7. Label this power switch accordingly. For example: "**RADIO ON/OFF**."

9.5.3.3 Control Head and Radio Are "Hot Wired"

In the "hot-wired" configuration the Control Head and radio are turned on and off only by the Control Head's on/off power button located on the front of the unit. This configuration should only be used in a temporary setting in which the operator keeps in mind that the Control Head must be turned off when not in use to avoid unnecessarily discharging the vehicle's battery. Furthermore, even when off, the Control

Head will still draw substantial current to eventually discharge the battery over a reasonably short period of time.

In this configuration, the Control Head's white wire is simply grounded to the vehicle's chassis. The ATM fuse and fuse holder included in the fuse kit are not required in the "hot wired" configuration.

1. Connect white wire of the Control Head's DC Power Cable to the same place that the black (ground) wire is attached to ground. In other words, ground the white wire along with the black wire. Use a #10 ring terminal (not included). At the back of the Control Head, be sure to maintain a cable service loop of at least six (6) inches.
2. Using an approved wiring method, splice the following three (3) wires together: the Time Delay Relay's white and red wires, and the wire from the load-side of the 30-ampere ATC fuse holder.

10 DATA-ONLY RADIO CONNECTIONS

The Data-Only configuration of the radio has no Control Head. The only difference in connections from an installation with a Control Head is with respect to ignition sense wiring. For a Data-Only radio, follow the procedure described in either section 9.5.3.1 or 9.5.3.2, except where the white wire of the *Control Head*'s DC Power Cable is referenced, make the connections with the white wire of the *radio*'s DC Power Cable instead.

**NOTE**

The ignition sense is the only means for turning on/off the Data-Only radio. The “hot wired” configuration cannot be utilized for the Data-Only radio, since this configuration does not employ the DC Power Cable’s white wire.

11 MICROPHONE INSTALLATION

11.1 CH-103 AND CH-103PA CONNECTIONS

There are several versions of microphones available for use with the radio. In all cases, there is a 14-pin connection to the front panel of the Control Head.

1. Plug the microphone's 14-pin connector to the Control Head's microphone connector as follows: Align the white arrows on the mating connectors, then push the cable's connector into the mate—the outer ring of the connector will rotate during the insertion. The outer ring will lock into place (arrows aligned) when full connection is made and a click will be sensed.



NOTE

For safety reasons, the mating of the 14-pin microphone connector can be pulled out with sufficient force. This will prevent incidental cable damage or personal injury if a snag occurs. However, the cable must be stretched substantially before enough force is exerted to unlock these mating connectors.

A microphone clip is included with the microphone head. The radio can be configured to provide a monitor function when the microphone is cradled in the clip.

2. Using the microphone clip as a template, drill mounting holes in the surface of the selected location.
3. Attach the microphone clip to the mounting surface using self-threading screws.
4. The microphone clip must be grounded to the vehicle's chassis. If not mounted to a grounded metal surface, complete this requirement by adding a jumper wire attached from chassis ground to the clip.

11.2 COMMON MICROPHONE INTERFACE CONNECTIONS (CH-103PA ONLY)

Microphone audio can be channeled to an optional Federal Signal Electronic Siren/Light Control System (purchased separately) for broadcasting through a public address (PA) speaker. This feature is only supported through the Common Microphone Interface of the CH-103PA. See and follow the procedure below to make the connections:

1. Connect the 4-pin connector of the Common Microphone Interface Cable (part number MACDOS0014-RN050 for right-angle connector or MACDOS0014-NN050 for straight) to the "AUX" connector on the back of the CH-103PA. See Figure 9-3. Visually align the $\frac{3}{4}$ -moon-shaped keys of the connectors, and then push and turn the outer locking ring of the cable connector clockwise until it stops. A mild click will be sensed to confirm proper mating.
2. Route both the black cable and purple wire through the vehicle's channeling to the Federal Signal unit. Remove interior panels, door kick panels, etc., as necessary. Protect the cable from possible chafing as necessary.
3. Connect the phone plug at the end of the black cable to the MIC input jack on the Federal Signal unit.
4. Using the supplied butt-splice, strip and crimp the purple wire to the purple wire in the Federal Signal unit's cable harness. Fifty feet of this wire is supplied; cut off and discard excess length.
5. Loop and tie-up the cable and wire as necessary.
6. Follow the installation instructions included with the Federal Signal unit to complete its installation, if necessary.

12 SPEAKER INSTALLATION

1. Install the speaker (Item 8 in Table 4-3) in an area of the front or rear dash that will allow for proper listening range with a moderate volume level setting. Use the hardware and mounting bracket supplied with it. Refer to the speaker manufacturer's instructions included in the speaker assembly kit for additional installation guidance.
2. Install the Speaker Cable Assembly (Item 9 in Table 4-3) onto the 2-pin connector at the rear of the Control Head by visually aligning the $\frac{3}{4}$ -moon-shaped keys of the connectors, and then push and turn the outer locking ring of the cable connector clockwise until it stops. A mild click will be sensed to confirm proper mating.
3. **CH-103 Control Head:** Connect the speaker's 2-pin plastic connector to the mating connector on the Speaker Cable Assembly.

CH-103PA Control Head: A Speaker Y-Cable (part number MACDOS0015-NN050 for a straight connector or MACDOS0015-RN050 for a right-angle connector) can be purchased in order to connect the radio's audio output to both the speaker (included in the Control Head Installation Kit) and to the Federal Signal unit's PA speaker. To complete these connections:

- a. Connect the Speaker Y-Cable's 2-pin male connector to the Speaker Cable Assembly's 2-pin female connector.
- b. Connect the speaker's 2-pin male connector to the female connector on the Speaker Y-Cable assembly.
- c. Route the speaker cable through the vehicle's channeling to the Federal Signal unit. Remove interior panels, door kick panels, etc., as necessary. Protect the cable from possible chafing as necessary.
- d. Using the supplied butt splices, strip and crimp the two wires of the speaker cable to the wires of the speaker cable in the Federal Signal unit's cable harness. Fifty feet of this wire is supplied; cut off and discard any excess length. Polarity for this connection does not need to be followed.
- e. Follow the installation instructions included with the Federal Signal unit to complete its installation, if necessary.

4. Route the excess cable(s) out of the way of casual contact and tie and stow it.

13 OPTIONAL CABLES

13.1 FULL-DATA I/O OPTION CABLE

The Full-Data I/O Option Cable 1000022242-0001 connects to the radio's 44-pin I/O cable connector. It breaks out into three (3) separate D-subminiature 9-pin (DB-9) type connectors. It also has blunt-end wires (i.e., not stripped or terminated with a connector) for optional/miscellaneous connections. This combination allows straightforward access to all external I/O connections provided by the radio. It also helps speed radio removal and re-installation time when required.

When connected, each DB-9 connector of the Full-Data I/O Option Cable is a TIA/EIA-232 data interface port for the radio. The connector labeled "SERIAL" is the radio's serial programming port. The connector labeled "MODEM" supports the RF modem function that the radio can provide. The connector labeled "GPS" provides NMEA-formatted GPS serial data connections for the external computer processing the NMEA-formatted GPS data received by the radio's internal GPS receiver. The intent is for this option cable to adapt to standard 9-pin serial computer cables, or alternatively plug directly into the computer's or mobile data terminal's serial port connector.

The blunt-end wires of the Full-Data I/O Option Cable provide connections for the following: (2) vehicle signal inputs, (2) TTL logic level inputs, (2) open-collector logic outputs, and a baseband audio in/out with PTT input and activate output. Table 13-1 shows the wiring of the Full-Data I/O Option Cable.

Table 13-1: Full-Data I/O Option Cable 1000022242-0001 Wire Interconnections

44-PIN I/O CABLE CONNECTOR PIN	DB-9 CONNECTOR NAME & PIN ²	SIGNAL NAME	DESCRIPTION
1	SERIAL pin 7	CTS_A	TIA/EIA-232 Signal, Radio Serial Port
2	SERIAL pin 8	RTS_A	TIA/EIA-232 Signal, Radio Serial Port
3	SERIAL pin 1	DCD_A	TIA/EIA-232 Signal, Radio Serial Port
4	GPS pin 3	GPS_NMEA_RD	TIA/EIA-232 Signal, GPS Output Data
5	(N/C)		(Pin 5 of 44-pin connector not used.)
6	MODEM pin 6	DSR_B	TIA/EIA-232 Signal, Modem Input
7	MODEM pin 4	DTR_B	TIA/EIA-232 Signal, Modem Input
8	MODEM pin 2	RD_B	TIA/EIA-232 Signal, Modem Input
9	MODEM pin 9	RI_B	TIA/EIA-232 Signal, Modem Input
10	(Wht/Blk)	AUD_IN_PTT*	Push-to-Talk for Audio Input (active low)
11	(Orange)	TTL_IN1	TTL Digital Input #1
12	(Blue)	TTL_IN2	TTL Digital Input #2
13	(Gray)	OC_OUT2	Open-Collector Digital Output #2
14	(Yellow)	IN_SHLD	Baseband Audio Input Shield
15	(Wht/Red)	AUD_IN_L	Differential Audio Input Low (1/2 of twisted pair)
16	SERIAL pin 2	TD_A	TIA/EIA-232 Signal, Radio Serial Port
17	SERIAL pin 5 (shell)	GND_A	TIA/EIA-232 Ground, Radio Serial Port

² No connection (n/c) terminations and blunt-wire colors are shown in parentheses.

Table 13-1: Full-Data I/O Option Cable 1000022242-0001 Wire Interconnections

44-PIN I/O CABLE CONNECTOR PIN	DB-9 CONNECTOR NAME & PIN ²	SIGNAL NAME	DESCRIPTION
18	SERIAL pin 4	DSR_A	TIA/EIA-232 Signal, Radio Serial Port
19	(N/C)		(Pin 19 of 44-pin connector not used.)
20	GPS pin 5, shell	GPS_GND	TIA/EIA-232 Ground, GPS Output Data
21	(N/C)		(Pin 21 of 44-pin connector not used.)
22	MODEM pin 5, shell	GND_B	TIA/EIA-232 Ground, Modem Input
23	MODEM pin 3	TD_B	TIA/EIA-232 Signal, Modem Input
24	(N/C)		(Pin 24 of 44-pin connector not used.)
25	I/O-shell	GND_SHLD	Overall Cable Shield/Radio Ground
26	(N/C)		(Pin 26 of 44-pin connector not used.)
27	(N/C)		(Pin 27 of 44-pin connector not used.)
28	(Red)	OC_OUT1	Open-Collector Digital Output #1
29	(Wht/Grn)	AUD_OUT_ACT	Audio Output Activate
30	(Wht/Gra)	AUD_IN_H	Differential Audio Input High (½ of twisted pair)
31	SERIAL pin 3	RD_A	TIA/EIA-232 Signal, Radio Serial Port
32	SERIAL pin 6	DTR_A	TIA/EIA-232 Signal, Radio Serial Port
33	SERIAL pin 9	RI_A	TIA/EIA-232 Signal, Radio Serial Port
34	GPS pin 2	GPS_NMEA_TD	TIA/EIA-232 Signal, GPS Output Data
35	(Wht/Yel)	SGND1	Signal Ground Reference
36	MODEM pin 7	RTS_B	TIA/EIA-232 Signal, Modem Input
37	MODEM pin 8	CTS_B	TIA/EIA-232 Signal, Modem Input
38	MODEM pin 1	DCD_B	TIA/EIA-232 Signal, Modem Input
39	(N/C)		(Pin 39 of 44-pin connector not used.)
40	(Yellow)	VEHICLE_IN1	+12V Control Input #1 from Vehicle
41	(Green)	VEHICLE_IN2	+12V Control Input #2 from Vehicle
42	(N/C)		(Pin 42 of 44-pin connector not used.)
43	(Wht/Orn)	AUD_OUT_H	Differential Audio Output High (½ of twisted pair)
44	(Wht/Yel)	AUD_OUT_L	Differential Audio Output Low (½ of twisted pair)

13.2 PROGRAMMING OPTION CABLE

Related to the Full-Data I/O Option Cable is the Programming Option Cable 1000022242-0002. This option cable presents only the DB-9 serial interface necessary to program, control, or establish a data connection with the radio. The intent is for this option cable to adapt to standard 9-pin serial computer cables, or alternatively plug directly into the computer's or mobile data terminal's serial connector. Table 13-2 shows the wiring of the Programming Option Cable.

Table 13-2: Programming Option Cable 1000022242-0002 Wire Interconnections

44-PIN I/O CABLE CONNECTOR PIN	DB-9 "SERIAL" CONNECTOR PIN³	SIGNAL NAME	DESCRIPTION
1	7	CTS_A	TIA/EIA-232 Signal, Radio Serial Port
2	8	RTS_A	TIA/EIA-232 Signal, Radio Serial Port
3	1	DCD_A	TIA/EIA-232 Signal, Radio Serial Port
16	2	TD_A	TIA/EIA-232 Signal, Radio Serial Port
17	5 (shell)	GND_A	TIA/EIA-232 Ground, Radio Serial Port
18	4	DSR_A	TIA/EIA-232 Signal, Radio Serial Port
31	3	RD_A	TIA/EIA-232 Signal, Radio Serial Port
32	6	DTR_A	TIA/EIA-232 Signal, Radio Serial Port
33	9	RI_A	TIA/EIA-232 Signal, Radio Serial Port

³ No connection (n/c) terminations and blunt-wire colors are shown in parentheses.

14 GPS NMEA-FORMATTED SERIAL DATA CONNECTION

In order to obtain the GPS NMEA-formatted serial data from the radio, the Full-Data I/O Option Cable 1000022242-0001 is needed. However, the user may create a custom cable assembly that adapts to the three GPS signals noted in Table 13-1.

Follow this procedure to complete the GPS NMEA-formatted serial data connections using the Full-Data I/O Option Cable:

1. Connect Full-Data I/O Option Cable's 44-pin male connector to the radio's 44-pin female connector. Tighten the two jackscrews with a small flathead screwdriver. Do not over-tighten.
2. Connect the cable's DB-9 female connector labeled "GPS" to the computer's serial port DB-9 male connector — either directly or with an optional MAMROS0055 serial cable — and tighten the screws until firm. Route the cabling as required.
3. Follow the manufacturer's instructions on processing the NMEA-formatted GPS data from the radio.

**NOTE**

Industry software to process GPS information through this interface is not supported by M/A-COM.

15 INITIAL POWER-UP TEST

1. At the installation's main ATC fuse holder located near the vehicle battery, open the fuse holder's cap and install the 30-amp ATC fuse. This fuse is a part of the Fuse Distribution Rail Kit (a part of Item 2 in Table 4-1). Push the cap back onto the holder until the plastic tab snaps into place.
2. Optionally, fasten the cap to the wheel well or other vehicle surface via the hole in the cap's mounting tab and a self-threading screw (not supplied).



The installation's main fuse is a 30-ampere ATC fuse. Installing the wrong fuse value could lead to improper operation and/or damage. Verify the ATC fuse supplying power to the Fuse Distribution Rail Assembly has the correct rating! The color of a 30-amp ATC fuse is green.

3. Carefully reconnect the vehicle's battery ground cable.
4. Verify the Control Head has powered-up by checking the display. If the display is not lit, depress the on/off button for two (2) seconds until an asterisk appears on the display and the display lights up. If necessary, see Section 8.1.



Unlike many mobile radio products, the radio powers-up to the **state of last control**.

As long as the software configuration parameters have been loaded, successful installation is almost immediately realized:

- After a short boot-up sequence, the Control Head displays a channel number, the signal strength and volume setting.
- If no errors are displayed, the installation is most-likely properly wired.
- If an error is displayed, recheck all cable connections, verify all fuses are properly installed, and verify battery power is getting to the Fuse Blocks. If problems persist, contact M/A-COM's Technical Assistance Center (see page 13).
- Consult the Operator's Manual for operational information.

Refer to the following section for performance test information.

16 PERFORMANCE TESTS

This section includes procedures to verify the performance of the radio installation. Testing requires a wattmeter to measure RF power. There are three procedures in this section:

- Changing Operating Modes
- Testing into a Dummy Load
- Testing with the Antenna

The normal operating mode of the radio for voice or data communications with the CH-103 and CH-103PA Control Head is the OpenSky Trunking Protocol (OTP) mode. However, the radio must be operating in a test mode in OTP for testing the antenna connection. The reason for this is OTP employs a Time Division Multiple Access (TDMA) protocol in which power does not transmit at a 100% duty cycle. In this case, a measurement error would result in transmission power level, as indicated on a typical power meter that reads average or RMS power instead of peak power. The test mode allows for 100% duty-cycle transmissions, thus not forcing the consideration of duty cycle factors.



NOTE

The accuracy of test results depends upon a DC power source in the range of 13.8 to 16 volts dc, with a current capacity of greater than 8 amps. Make sure the vehicle's battery is fully charged by running the engine for a few minutes before the test, and keep the engine running during the test procedures. **The vehicle's location should be well ventilated so exhaust fumes from the engine do not cause harm!** Alternatively, instead of running the vehicle's engine for an extended period of time, a 12-volt vehicle battery charger with a current capacity of at least 15 amps can be connected to the vehicle's battery. If using a battery charger, **observe polarity** when making the connections to the battery.



NOTE

If a vehicle equipped with this radio requires jump-starting, the installation's main ATC fuse should be removed from the holder prior to jump-starting. Doing so will prevent damage to the radio system.



Prior to installation, the radio's power level should be configured appropriately. The wide range of power levels indicated in the following procedures takes into account such things as: customer's requirements; measurement errors, especially to include uncalibrated equipment; cabling losses; and voltage and temperature variations. By no means should the result from Performance Testing in this section be construed as the exact value of power level output from the radio, as that value is set and more accurately measured in the factory. The values obtained in these test procedures determine a successful installation only.

16.1 CHANGING OPERATING MODE FOR TESTS

Operating the radio is accomplished through the navigation pad on the CH-103/CH-103PA Control Head's front panel. Follow the actions below to change modes in order to test the transmitter and antenna.

1. If necessary, apply power to the radio and turn it on.
2. Press the ▲ (up arrow) button on the navigation pad repeatedly until the message “MODE” appears on the display. Press the **SELECT** button.
3. Press the ► (right arrow) button on the navigation pad repeatedly until the message “OTP” appears. Press the **SELECT** button.
4. Press the ► button once to confirm the selection, and then press the **SELECT** button to choose the OTP mode.

16.2 REQUIRED TEST EQUIPMENT

Table 16-1: Required Test Equipment

TEST EQUIPMENT	COMMENTS																				
PC or Laptop PC	<ul style="list-style-type: none"> With Microsoft Windows® 95 (or greater) operating system and a terminal application to issue commands through the COM1 serial port (such as HyperTerminal). <p><u>Recommended HyperTerminal Settings:</u></p> <table> <tr> <td><u>General (tab):</u></td><td><u>Settings (tab):</u></td></tr> <tr> <td>Connect Using: COM1</td><td>Terminal Keys (selected)</td></tr> <tr> <td>Configure (button)</td><td>Emulation = VT100</td></tr> <tr> <td>Bits Per Second = 19200</td><td>Backscroll Buffer Line = 500</td></tr> <tr> <td>Data Bits = 8</td><td>ASCII Setup (button)</td></tr> <tr> <td>Parity = None</td><td>Everything unchecked</td></tr> <tr> <td>Stop Bits = 1</td><td>Line Delay & Character = 0</td></tr> <tr> <td>Flow Control = None</td><td>Terminal Settings (button)</td></tr> <tr> <td></td><td>132 Column Mode = unchecked</td></tr> <tr> <td></td><td>Character Set = ASCII</td></tr> </table>	<u>General (tab):</u>	<u>Settings (tab):</u>	Connect Using: COM1	Terminal Keys (selected)	Configure (button)	Emulation = VT100	Bits Per Second = 19200	Backscroll Buffer Line = 500	Data Bits = 8	ASCII Setup (button)	Parity = None	Everything unchecked	Stop Bits = 1	Line Delay & Character = 0	Flow Control = None	Terminal Settings (button)		132 Column Mode = unchecked		Character Set = ASCII
<u>General (tab):</u>	<u>Settings (tab):</u>																				
Connect Using: COM1	Terminal Keys (selected)																				
Configure (button)	Emulation = VT100																				
Bits Per Second = 19200	Backscroll Buffer Line = 500																				
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Parity = None	Everything unchecked																				
Stop Bits = 1	Line Delay & Character = 0																				
Flow Control = None	Terminal Settings (button)																				
	132 Column Mode = unchecked																				
	Character Set = ASCII																				
TIA/EIA-232 Serial Cable	<ul style="list-style-type: none"> With 9-pin D-Subminiature Male-Female Connectors, 1:1, shielded (Option MAMROS0055 or equivalent) 																				
Wattmeter	<ul style="list-style-type: none"> Bird Electronic Corporation Model 43 or equivalent, with N-type female connectors on both the input and output sides. <p>As an alternative to using a wattmeter, a Voltage Standing Wave Ratio (VSWR) meter, Bird Electronic Corporation Model 4391A or equivalent can be used to carry out the required RF (Radio Frequency) power testing.</p>																				
Wattmeter Slug	For use with the wattmeter; rated power of 25 watts and frequency range appropriate to the 800 MHz output of the mobile radio [Bird Electronics Element 25E (25 watts, 400–1000 MHz) or equivalent].																				
Coaxial Jumper Cable	<ul style="list-style-type: none"> 50 Ohm Coaxial Cable with TNC-type male connector on one end and N-type male connector on the other end, approximately three feet in length (Pasternack Enterprises PE3661-36 or equivalent). <p>This cable must have VSWR below 1.5:1 at 800 MHz.</p>																				
N-Type to TNC Adapter	N-type male to TNC-type female (Pasternack Enterprises PE9090 or equivalent).																				
Dummy Load	RF terminator rated at 50-ohm resistance and greater than 50 watts power, with N-type male connector (Pasternack Enterprises PE6106 or equivalent).																				
Vehicle-Mounted Antenna	Tests are performed with the vehicle-mounted antenna per the installation described in Section 7 of this manual.																				

16.3 TESTING WITH A DUMMY LOAD

Figure 16-1 shows basic interconnections required for the following test procedure.

1. Using the N-type male to TNC-type male coaxial jumper cable, connect the radio's antenna connector to the wattmeter's input.
2. Connect the dummy load to the wattmeter's output (in place of the antenna cable and the antenna).

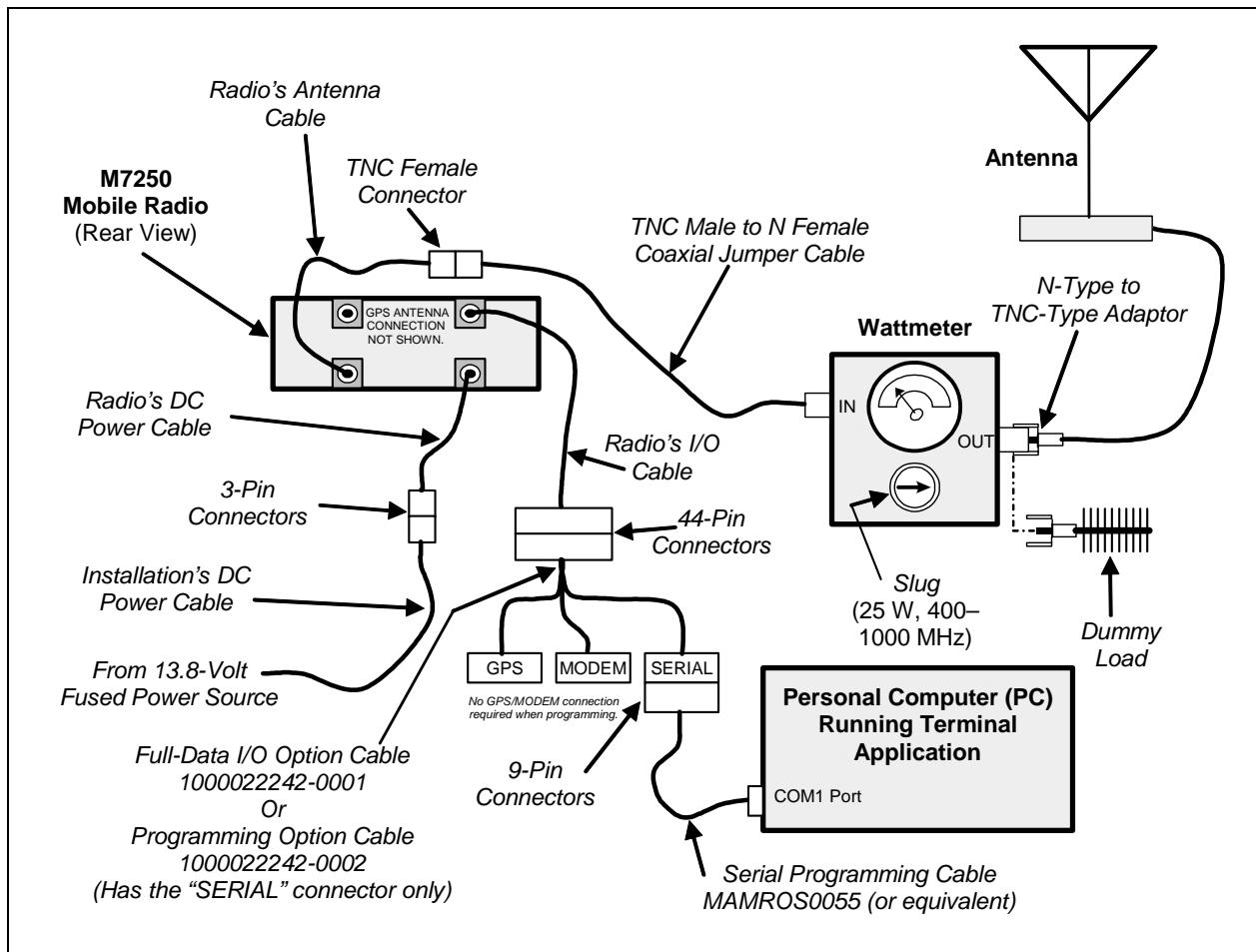


Figure 16-1: Wattmeter Connections

3. If necessary, apply power to the radio and turn it on.
4. Set the radio to a test channel.
5. Position the wattmeter's slug to measure forward RF output power. Rotate it if necessary. The arrow on the face of the slug must point away from the radio and towards the dummy load for forward power measurements.
6. Using Full-Data I/O Option Cable 1000022242-0001 and Serial Programming Cable MAMROS0055 (or equivalent), connect the radio's serial port to the Personal Computer's COM1 serial port. The Serial Programming Cable is a standard modem-type serial interface cable.
7. At the computer, start the terminal application (e.g., HyperTerminal) and verify its configuration as listed in Table 16-1.
8. Measure the radio's RF output power by typing these commands. Send the commands in the order presented. For the `^` symbol, type `^` (shifted 6 key on a standard keyboard). For letters, observe case (e.g., type `W`, not `w`). Press the `<Enter>` key after typing each command:
 - `^8` — puts the radio into 100% duty cycle test mode
 - `^W` — causes the radio to transmit
 - `^X` — causes the radio to terminate transmissions
 - `atz9` — causes the radio to reboot

**NOTE**

Transmit only for as long as needed to take the measurement, then immediately disable the transmission.

9. Compare the wattmeter reading with the target RF output power range of **11.8 – 20.0 watts**.
10. Record the wattmeter reading for RF output power into the dummy load, or take remedial action and measure the output again:
 - **If the wattmeter reading is within the range**, record the measured value in the appropriate space on the data collection form near the end of this manual.
 - **If the wattmeter reading is outside the range**, verify the radio's power supply voltage (i.e., battery voltage) is within the specified range, recheck all connections and measure the RF output power again. If this fails to produce a reading within the range, replace it and repeat this procedure.

16.4 TESTING WITH THE ANTENNA

The radio must be set to OTP mode (see Section 16.1) to perform the following tests. It is recommended that a test channel be allocated for this testing; otherwise, interference with network users tuned to the channel on which the radio is transmitting may occur. **Also, observe the safety information presented in Section 1 (page 5) of this manual!**

1. Connect the radio's antenna connector to the wattmeter and antenna as shown in Figure 16-1.
2. If necessary, apply power to the radio, turn it on, and set it to OTP mode.
3. Set the radio to a test channel, if available.
4. Position the wattmeter's slug to measure forward RF output power. Rotate it if necessary. The arrow on the face of the slug must point away from the radio and towards the antenna for forward power measurements.
5. Using the Full-Data I/O Option Cable 1000022242-0001 and Serial Programming Cable MAMROS0055 (or equivalent), connect the radio's serial port to the Personal Computer's COM1 serial port. The Serial Programming Cable is a standard modem-type serial interface cable.
6. At the computer, start the terminal application (e.g., HyperTerminal) and verify its configuration as listed in Table 16-1.
7. Measure the radio's forward RF output power into the antenna by typing these commands. Send the commands in the order presented.

`^8` — puts the radio into 100% duty cycle test mode
`^W` — causes the radio to transmit
`^X` — causes the radio to terminate transmissions
`atz9` — causes the radio to reboot

**NOTE**

Transmit only for as long as needed to take the measurement, then immediately disable the transmission.

8. Compare the wattmeter reading with the target RF output power range of **11.8 – 20.0 watts**.

9. Record the wattmeter reading for forward power into the antenna, or take remedial action and measure the output again.
 - **If the wattmeter reading is within the range**, record the value in the appropriate space on the data collection form near the end of this manual.
 - **If the wattmeter reading is outside the range**, verify the radio's power supply voltage (i.e., battery voltage) is within the specified range, recheck all connections, and measure the forward power again. If this fails to produce a reading within the range, check all cabling and connections, and repeat the testing procedure to this point. In the event the wattmeter reading still falls outside the range, replace the antenna, make sure all connections are seated firmly, and repeat the testing procedure.
10. Position the wattmeter's slug to measure reverse (reflected) RF power from the antenna. The arrow on the face of the slug must point away from the antenna and toward the radio to measure reverse power.
11. Measure the reverse (reflected) RF power from the antenna by typing these commands:

^8 — puts the radio into 100% duty cycle test mode
^W — causes the radio to transmit
^X — causes the radio to terminate transmissions
atz9 — causes the radio to reboot



NOTE

Transmit only for as long as needed to take the measurement, then immediately disable the transmission.

12. Compare the wattmeter reading with the RF power output range of **2 watts or less**.
13. Record the wattmeter reading for reverse RF power from the antenna, or take remedial action and measure the output again.
 - **If the wattmeter reading is within the range**, record the value in the appropriate space on the data collection form near the end of this manual.
 - **If the wattmeter reading is outside the range**, make sure the antenna is consistent with the specified frequency range of the radio. Recheck all antenna connections, and measure the reverse power again. If this fails to produce a reading within the range, replace the antenna and repeat the entire antenna test procedure. Any value exceeding the maximum allowable reflected power value will result in a diminished RF output signal.
14. Disconnect the coaxial cable jumper and wattmeter.
15. Permanently connect the mobile antenna cable to the radio's antenna cable by mating the two TNC connectors together. Use two pairs of slip-jaw pliers to gently tighten this connection. Do not over tighten and do not twist either cable.



NOTE

To prevent RF leakage and ensure peak performance, make sure the RF connectors are tight, but do not over tighten so connector damage will not occur.



Improper installation of the RF cables may lead not only to poor radio performance but also to harmful exposure to RF electromagnetic energy.

16. Disconnect the computer's COM1 serial port from the radio's serial port.

Testing is complete. The radio is now ready for normal communications.

16.5 TEST PERFORMANCE DATA FORM

Clip  Here

1. Enter the information requested on this data collection form. Clip this form and file it as a permanent record of the tested performance of the installed Full-Duplex M7250.

Mobile Radio
Serial Number

Antenna Make and Model

 /

Date of Test
(mm/dd/yyyy)

Company Performing Installation

Technician Performing Test

Watts

Power Into a Dummy Load

Watts

Forward Power With Antenna

Watts

Reflected Power With Antenna

tyco / Electronics

MACOM

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17 COMPLETE THE INSTALLATION

Double-check the following items before considering the installation completed:

- Verify all newly installed mechanical hardware is mounted securely and all respective mounting hardware is tight.
- Verify all electrical interconnections are connected properly and the associated connector attachment hardware is tight. Pay special attention to all RF antenna cables!
- Verify all related fuses are correctly installed and properly rated.
- Verify all electrical cables and wiring are tied, stowed, and protected so they are out of the way of casual contact, away from sources of extreme heat, and wire chafing cannot occur. Pay special attention to all RF antenna cables!
- To prevent fumes from entering the vehicle's passenger compartment, seal the hole/grommet/wire combination at the firewall with a silicon-based sealer.
- Verify all vehicle components are properly reinstalled such as kick panels, headliners, and seats.
- If the installation includes a separately-mounted on/off power switch for manually turning the radio (and possibly others systems) on and off, verify it is labelled accordingly. For example: "**Radio ON/OFF**."
- Remove all tools and unused hardware from the vehicle.
- Verify the test performance data has been recorded on the data collection form shown in this manual.

18 WARRANTY

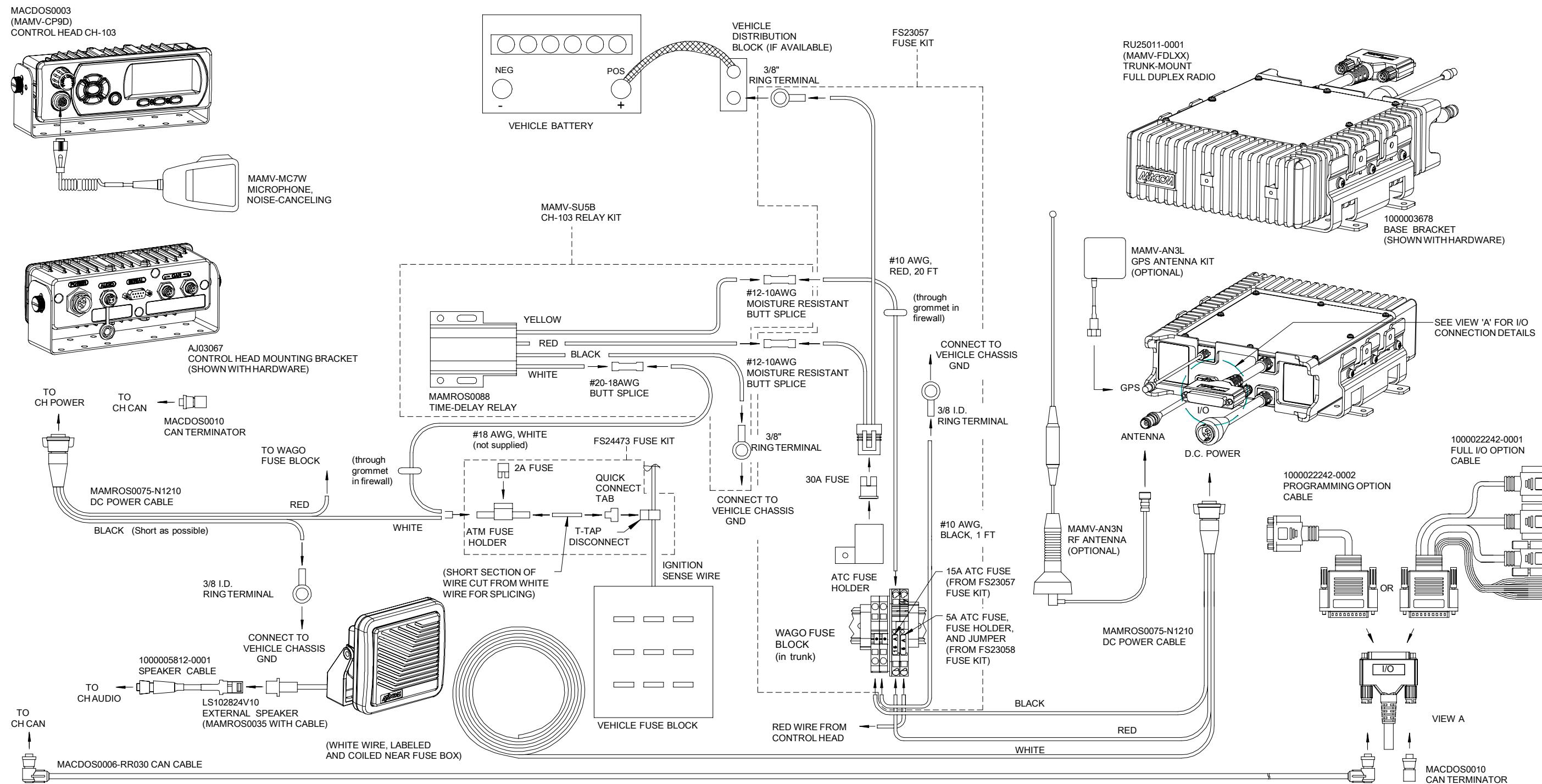
- A. M/A-COM, Inc. (hereinafter "Seller") warrants to the original purchaser for use (hereinafter "Buyer") that Equipment manufactured by or for the Seller shall be free from defects in material and workmanship, and shall conform to its published specifications. With respect to all non-M/A-COM Equipment, Seller gives no warranty, and only the warranty, if any, given by the manufacturer shall apply. Rechargeable batteries are excluded from this warranty but are warranted under a separate Rechargeable Battery Warranty (ECR-7048).
- B. Seller's obligations set forth in Paragraph C below shall apply only to failures to meet the above warranties occurring within the following periods of time from date of sale to the Buyer and are conditioned on Buyer's giving written notice to Seller within thirty (30) days of such occurrence:
 1. for fuses and non-rechargeable batteries, operable on arrival only.
 2. for parts and accessories (except as noted in B.1) sold by Seller's Service Parts Operation, ninety (90) days.
 3. for PANTHER™ Series hand-portable and mobile radios, two (2) years.
 4. for all other equipment of Seller's manufacture, one (1) year.
- C. If any Equipment fails to meet the foregoing warranties, Seller shall correct the failure at its option (i) by repairing any defective or damaged part or parts thereof, (ii) by making available at Seller's factory any necessary repaired or replacement parts, or (iii) by replacing the failed Equipment with equivalent new or refurbished Equipment. Any repaired or replacement part furnished hereunder shall be warranted for the remainder of the warranty period of the Equipment in which it is installed. Where such failure cannot be corrected by Seller's reasonable efforts, the parties will negotiate an equitable adjustment in price. Labor to perform warranty service will be provided at no charge during the warranty period only for the Equipment covered under Paragraph B.3 and B.4. To be eligible for no-charge labor, service must be performed at a M/A-COM factory, by an Authorized Service Center (ASC) or other Servicer approved for these purposes either at its place of business during normal business hours, for mobile or personal equipment, or at the Buyer's location, for fixed location equipment. Service on fixed location equipment more than thirty (30) miles from the Service Center or other approved Servicer's place of business will include a charge for transportation.
- D. Seller's obligations under Paragraph C shall not apply to any Equipment, or part thereof, which (i) has been modified or otherwise altered other than pursuant to Seller's written instructions or written approval or, (ii) is normally consumed in operation or, (iii) has a normal life inherently shorter than the warranty periods specified in Paragraph B, or (iv) is not properly stored, installed, used, maintained or repaired, or, (v) has been subjected to any other kind of misuse or detrimental exposure, or has been involved in an accident.
- E. The preceding paragraphs set forth the exclusive remedies for claims based upon defects in or nonconformity of the Equipment, whether the claim is in contract, warranty, tort (including negligence), strict liability or otherwise, and however instituted. Upon the expiration of the warranty period, all such liability shall terminate. The foregoing warranties are exclusive and in lieu of all other warranties, whether oral, written, expressed, implied or statutory. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES.

This warranty applies only within the United States.

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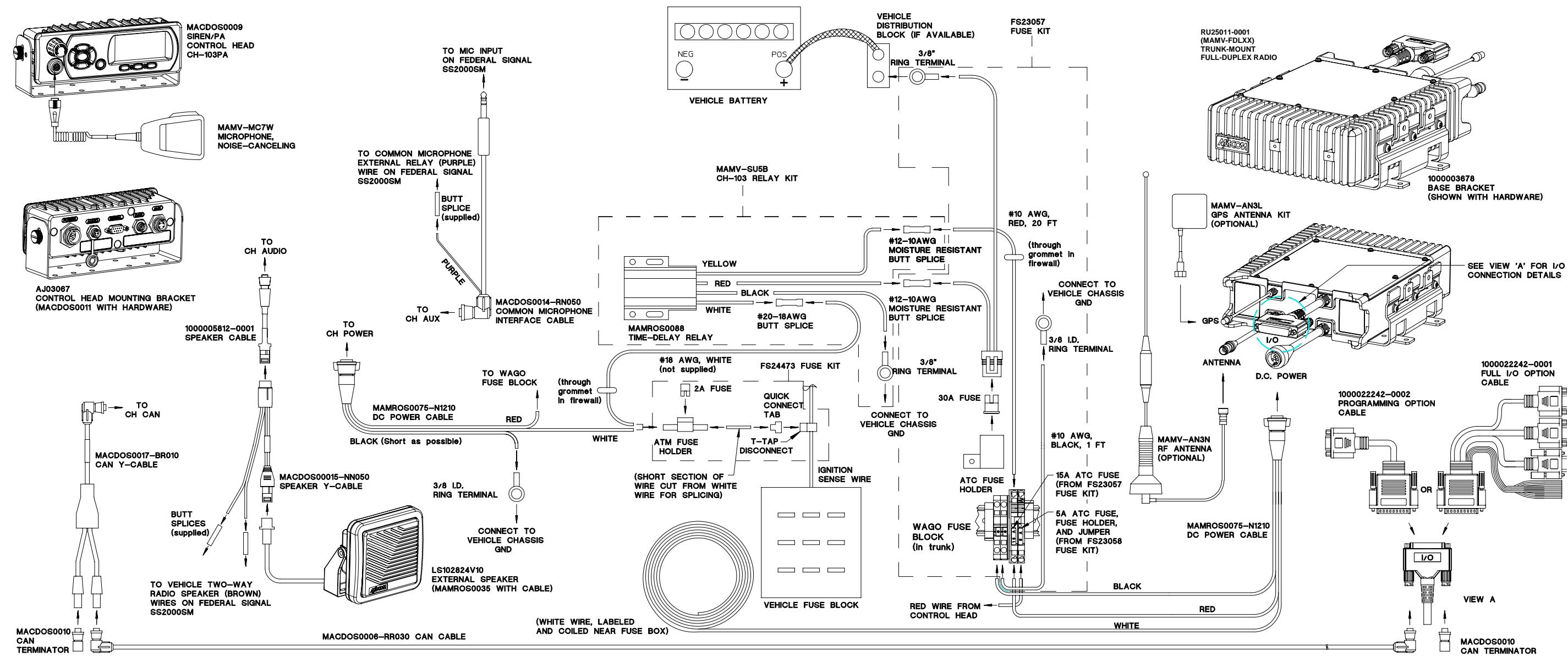
M/A-COM, Inc.
221 Jefferson Ridge Parkway
Lynchburg, VA 24501
1-800-528-7711

19 WIRING DIAGRAM: MOBILE RADIO WITH CH-103 CONTROL HEAD



**Wiring Diagram Inside
(With CH103)**

20 WIRING DIAGRAM: MOBILE RADIO WITH CH-103PA CONTROL HEAD



**Wiring Diagram Inside
(With CH-103PA)**