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Installation and Product Safety Manual

MM-010019-001
Rev. F, Aug/10

M7200 Mobile Radio

Full-Duplex Dual-Band 700 and 800 MHz Trunk-Mount Mobile Radio with CH-721 Scan and System Control Heads

MANUAL REVISION HISTORY

REV.	DATE	REASON FOR CHANGE
E	Jun/09	Revised specifications, microphone part numbers, list of tools required, radio and control head grounding procedures, and wiring diagram.
F	Aug/10	Revised specifications, options and accessories tables, antenna part numbers, antenna installation procedures, microphone attachment procedure, and warranty information.

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CREDITS

NOTICE!

This product conforms to the European Union WEEE Directive 2002/96/EC. Do not dispose of this product in a public landfill. Take it to a recycling center at the end of its life.

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1 REGULATORY AND SAFETY INFORMATION

1.1 SAFETY SYMBOL CONVENTIONS

The following conventions are used in this manual to alert the user to general safety precautions that must be observed during all phases of operation, installation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere violates safety standards of design, manufacture, and intended use of the product. Harris assumes no liability for the customer's failure to comply with these standards.

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 Harris 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. Refer to the following websites for more information on what RF energy exposure is and how to control 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

Before it was marketed in the United States, the M7200 two-way mobile radio was tested to ensure compliance with FCC RF energy exposure limits for mobile two-way radios. 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 and Product Safety Manual and the applicable Operator's Manual include information and operating instructions required to control 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 a 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) C95.1-2005.
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-2005.
- IC Standard RSS-102, Issue 2, 2005: Spectrum Management and Telecommunications Radio Standards Specification. Radiofrequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands).

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). This data is based upon the mobile radio installed in a motor vehicle with the radio transmitting at its rated RF power level of 15 watts. Transmit only when unaware bystanders are at least the uncontrolled recommended minimum safe lateral distance away from the mobile radio's transmitting antenna.

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

ANTENNA PART NUMBER	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-125001-002 (mount) with AN-225001-001 (element)	700/800 MHz Standard Rooftop-Mount; 3 dBd Gain	15.7 Inches (40 Centimeters)	34.6 Inches (88 Centimeters)
AN-125001-002 (mount) with AN-225001-002 (element)	700/800 MHz Standard Rooftop-Mount; Elevated-Feed 3 dBd Gain		
AN-125001-002 (mount) with AN-225001-003 (element)	700/800 MHz Standard Rooftop-Mount; Elevated-Feed, No Ground Plane 3 dBd Gain		
AN-125001-002 (mount) with AN-225001-004 (element)	700/800 MHz Standard Rooftop-Mount; Low-Profile 2 dBd Gain		
AN-125001-002 (mount) with AN-225001-005 (element)	700/800 MHz Standard Rooftop-Mount; 5 dBd Gain	19.7 Inches (50 Centimeters)	43.3 Inches (110 Centimeters)
AN-125001-004 (mount) with AN-225001-001 (element)	700/800 MHz Thick Rooftop-Mount; 3 dBd Gain	15.7 Inches (40 Centimeters)	34.6 Inches (88 Centimeters)
AN-125001-004 (mount) with AN-225001-002 (element)	700/800 MHz Thick Rooftop-Mount; Elevated-Feed 3 dBd Gain		
AN-125001-004 (mount) with AN-225001-003 (element)	700/800 MHz Thick Rooftop-Mount; Elevated-Feed, No Ground Plane 3 dBd Gain		
AN-125001-004 (mount) with AN-225001-004 (element)	700/800 MHz Thick Rooftop-Mount; Low-Profile 2 dBd Gain		
AN-125001-004 (mount) with AN-225001-005 (element)	700/800 MHz Thick Rooftop-Mount; 5 dBd Gain	19.7 Inches (50 Centimeters)	43.3 Inches (110 Centimeters)

(Table Continued on Next Page)

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

ANTENNA PART NUMBER	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-125001-006 (mount) with AN-225001-001 (element)	700/800 MHz GPS Combo Rooftop-Mount; 3 dBd Gain	15.7 Inches (40 Centimeters)	34.6 Inches (88 Centimeters)
AN-125001-006 (mount) with AN-225001-002 (element)	700/800 MHz GPS Combo Rooftop-Mount; Elevated-Feed 3 dBd Gain		
AN-125001-006 (mount) with AN-225001-003 (element)	700/800 MHz GPS Combo Rooftop-Mount; Elevated-Feed, No Ground Plane 3 dBd Gain		
AN-125001-006 (mount) with AN-225001-004 (element)	700/800 MHz GPS Combo Rooftop-Mount; Low-Profile 2 dBd Gain		
AN-125001-006 (mount) with AN-225001-005 (element)	700/800 MHz GPS Combo Rooftop-Mount; 5 dBd Gain	19.7 Inches (50 Centimeters)	43.3 Inches (110 Centimeters)
AN-125001-008 (mount) with AN-225001-001 (element)	700/800 MHz Magnetic-Mount; 3 dBd Gain	15.7 Inches (40 Centimeters)	34.6 Inches (88 Centimeters)
AN-125001-008 (mount) with AN-225001-002 (element)	700/800 MHz Magnetic-Mount; Elevated-Feed 3 dBd Gain		
AN-125001-008 (mount) with AN-225001-003 (element)	700/800 MHz Magnetic-Mount; Elevated-Feed, No Ground Plane 3 dBd Gain		
AN-125001-008 (mount) with AN-225001-004 (element)	700/800 MHz Magnetic-Mount; Low-Profile 2 dBd Gain		
AN-125001-008 (mount) with AN-225001-005 (element)	700/800 MHz Magnetic-Mount; 5 dBd Gain	19.7 Inches (50 Centimeters)	43.3 Inches (110 Centimeters)

(Table Continued on Next Page)

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

ANTENNA PART NUMBER	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN102800V1	136 to 941 MHz, ¼-Wavelength**, Standard Rooftop-Mount; 0 dBd Gain	15.7 Inches (40 Centimeters)	34.6 Inches (88 Centimeters)
AN102800V2	136 to 941 MHz, ¼-Wavelength**, Thick Rooftop-Mount; 0 dBd Gain		
AN-025167-001 (Discontinued)	700/800 MHz Standard Rooftop-Mount; 3 dBd Gain	12.6 inches (32 centimeters)	27.6 inches (70 centimeters)
AN-025167-002 (Discontinued)	700/800 MHz Elevated-Feed Rooftop-Mount; 3 dBd Gain		
AN-025167-004 (Discontinued)	700/800 MHz GPS Combo Rooftop-Mount; 3 dBd Gain		
AN-025167-005 (Discontinued)	700/800 MHz GPS Combo Elevated-Feed Rooftop-Mount; 3 dBd Gain		
AN-025167-006 (Discontinued)	700/800 MHz Magnetic-Mount; 3 dBd Gain		
AN-025167-010 (Discontinued)	700/800 MHz Low-Profile Rooftop-Mount; 2 dBd Gain		
AN-025167-011 (Discontinued)	700/800 MHz GPS Combo Low-Profile Rooftop-Mount; 2 dBd Gain		
AN-025167-014 (Discontinued)	700/800 MHz Standard Rooftop-Mount; 5 dBd Gain	7.9 inches (20 centimeters)	26.4 inches (67 centimeters)
AN-025167-015 (Discontinued)	700/800 MHz GPS Combo Rooftop-Mount; 5 dBd Gain		

** Driven elements of AN102800V1 and AN102800V2 must be trimmed to proper lengths in order to minimize antenna system VSWR.

1.3.1 Mobile Antennas

The antenna(s) for the radio must be installed in accordance with Section 7 in this manual. Refer to Figure 7-1 on page 35 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 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 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 20) and/or Harris's Products and Services Catalog.

1.3.3 Contact Information

For additional information on RF exposure and other information, contact Harris using one of the contact links listed in Section 3.4 on page 19.

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:

- The push-to-talk button should only be depressed when intending to send a voice message.
- The radio should only be used for necessary work-related communications.
- The radio should only be used by authorized and trained personnel. It should never be operated by children.
- 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.
- Always use Harris-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:

- **Explosive Atmospheres** — Just as it is dangerous to fuel a vehicle with its engine running, be sure to turn the radio **OFF** while fuelling the vehicle. If the radio is mounted in the trunk of the vehicle, **DO NOT** carry containers of fuel in the trunk.

  Areas with potentially explosive atmosphere are often, but not always, clearly marked. Turn the radio **OFF** when in any area with a potentially explosive atmosphere. It is rare, but not impossible that the radio or its accessories could generate sparks.

- **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.

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

- **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. Refer to Section 1.2 for additional information.

- **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 **N**ational **F**ire **P**rotection **A**ssociation standard **NFPA 58**. This requires:
  - The space containing the radio equipment must be isolated by a seal from the space containing the LP gas container and its fittings.
  - Outside filling connections must be used for the LP gas container.
  - The LP gas container space shall be vented to the outside of the vehicle.
- **Vehicles Equipped with Airbags** — For driver and passenger safety, avoid mounting the radio's 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.

1.6 SAFE DRIVING RECOMMENDATIONS

The American Automobile Association (AAA) advocates the following key safe driving recommendations:

- Read the literature on the safe operation of the radio.
- Keep both hands on the steering wheel and the microphone in its hanger whenever the vehicle is in motion.
- Place calls only when the vehicle is stopped.
- When talking from a moving vehicle is unavoidable, drive in the slower lane. Keep conversations brief.
- If a conversation requires taking notes or complex thought, stop the vehicle in a safe place and continue the call.
- Whenever using a mobile radio, exercise caution.

1.7 OPERATING RULES REGULATIONS

Two-way radio systems must be operated in accordance with the rules and regulations of the local, regional, or national government.

In the United States, the M7200 mobile radio must be operated in accordance with the rules and regulations of the Federal Communications Commission (FCC). Operators of two-way radio equipment must be thoroughly familiar with the rules that apply to the particular type of radio operation. Following these rules helps eliminate confusion, assures the most efficient use of the existing radio channels, and results in a smoothly functioning radio network.

When using a two-way radio, remember these rules:

- It is a violation of FCC rules to interrupt any distress or emergency message. The radio operates in much the same way as a telephone "party line." Therefore, always listen to make sure the channel is clear before transmitting. Emergency calls have priority over all other messages. If someone is sending an emergency message – such as reporting a fire or asking for help in an accident, do not transmit unless assistance can be offered.
- The use of profane or obscene language is prohibited by Federal law.

- It is against the law to send false call letters or false distress or emergency messages. The FCC requires keeping conversations brief and confine them to business. To save time, use coded messages whenever possible.
- Using the radio to send personal messages (except in an emergency) is a violation of FCC rules. Send only essential messages.
- It is against Federal law to repeat or otherwise make known anything overheard on the radio. Conversations between others sharing the channel must be regarded as confidential.
- The FCC requires self-identification at certain specific times by means of call letters. Refer to the rules that apply to the particular type of operation for the proper procedure.
- No changes or adjustments shall be made to the equipment except by an authorized or certified electronics technician.

Under U.S. law, operation of an unlicensed radio transmitter within the jurisdiction of the United States may be punishable by a fine of up to $10,000, imprisonment for up to two (2) years, or both.

1.8 OPERATING TIPS

The following conditions tend to reduce the effective range of two-way radios and should be avoided whenever possible:

- Operating the radio in areas of low terrain, or while under power lines or bridges.
- Obstructions such as mountains and buildings.

In areas where transmission or reception is poor, communication improvement may sometimes be obtained by moving a few yards in another direction, or moving to a higher elevation.

2 SPECIFICATIONS[1]

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 space required for cables)
Dimensions, Control Head: (Height x Width x Depth)	2.4 x 6.9 x 3.9 inches (6 x 17.5 x 10 centimeters) (Does not include bracket and mounting screws)
Weight, Mobile Radio:	8.0 pounds (3.63 kilograms)
Weight, Control Head:	1.7 pounds (0.8 kilograms)
Operating Ambient Temperature Range:	-22 to +140° Fahrenheit (-30 to +60° Celsius)
Storage Temperature Range:	-40 to +185° Fahrenheit (-40 to +85° Celsius)
Altitude	
Operating:	15,000 feet (4572 meters) maximum
Storage:	50,000 feet (15,240 meters) maximum
DC Supply Voltage Operating Range	
For Full Performance:	+13.6 Vdc ±10% (Normal range per TIA-603)
Overall Operating Range:	+10.8 to +16.6 Vdc
De-Rated RF Operation Range:	+10.8 to +11.9 Vdc
DC Supply Current, Mobile Radio	
Receive:	1.6 A maximum
Transmit:	7.7 A maximum
Quiescent Current (Powered Off):	2 mA maximum, 1 mA typical at 13.6 Vdc
DC Supply Current, CH-721 Control Head	
With ½-Watt Speaker Output Power:	0.9 A maximum
With 10-Watt Speaker Output Power:	2.0 A maximum
With 15-Watt Speaker Output Power:	2.4 A maximum
Standby Current (Muted):	0.6 A maximum
Quiescent Current (Powered Off):	100 µA maximum

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

2.2 TRANSCEIVER

Frequency Ranges

Receive

700 MHz Operation:	764 to 767 MHz, 769 to 775 MHz and 773 to 776 MHz (repeater and talk-around operations) [See footnote [2]]
800 MHz Operation:	851 to 869 MHz

Transmit

700 MHz Talk-Around Operation:	764 to 767 MHz, 769 to 775 MHz and 773 to 776 MHz
700 MHz Repeater Operation:	794 to 797 MHz, 799 to 805 MHz and 803 to 806 MHz [See footnote [3]]
800 MHz Talk-Around Operation:	851 to 869 MHz
800 MHz Repeater Operation:	806 to 824 MHz

Transmit Output Power

700 MHz Channels in Half-Duplex Mode:	1.5 to 15 watts (excluding interoperability channels)
700 MHz Interoperability Channels:	300 milliwatts maximum
800 MHz Channels in Full-Duplex Mode:	1 to 10 watts (programmable range)
800 MHz Channels in Half-Duplex Mode:	1.5 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

Receiver Sensitivity

700 MHz OTP Mode:	-111 dBm minimum
800 MHz OTP Mode:	-111 dBm minimum
700 MHz P25 Mode (TIA-102 Method):	-116 dBm minimum, -121 dBm typical for 5% BER
800 MHz P25 Mode (TIA-102 Method):	-116 dBm minimum, -121 dBm typical for 5% BER
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:	75 dB minimum for OCF, P25, and EDACS modes

ACPR Mask

P25 Mode (TIA-102 Method):	67 dBc (minimum)
OCF, OTP and EDACS Modes:	FCC Mask G and H compliant for 800 MHz channels; per FCC Part 90.543 for 700 MHz channels

Audio Frequency Response:	300 to 3000 Hz (with <3% audio distortion)
Audio Output Power form Control Head:	15 watts RMS minimum into 4-ohm external speaker; 1 watt into 4-ohm headset
Audio Distortion from Control Head:	< 5% at 5 watts into 4-ohm external speaker

[2] 764 to 767 MHz and 773 to 776 MHz per old FCC 700 MHz band plan. 769 to 775 MHz added August 30, 2007 by new FCC 700 MHz band plan.

[3] 764 to 767 MHz, 773 to 776 MHz, 794 to 797 MHz and 803 to 806 MHz per old FCC 700 MHz band plan. 769 to 775 MHz and 799 to 805 MHz added August 30, 2007 by new FCC 700 MHz band plan.

Voice-Coding Method

OTP Mode:	Advanced Multi-Band Excitation (AMBE™)
EDACS, ProVoice & P25 Phase I Modes:	Improved Multi-Band Excitation (IMBE®)

OpenSky Data Rate: 19.2 kbps (9600 symbols-per-second)

OpenSky Compressed Voice Relative Data Rate: 2400 bps

2.3 GPS RECEIVER INTERFACE

Receive Frequency: 1575.42 MHz

Antenna

Required Type:	Externally-Mounted Active (i.e., with Internal Amplifier)
Radio-Supplied DC Bias Power:	5 volts; 15 to 32 mA typical, 100 mA maximum
Port Impedance:	50 ohms

Physical Connection: TIA/EIA/RS-232 serial interface with hardware flow control via radio I/O Cable Assembly's DB-44 connector and DB-9 connector of installation's Full-Data I/O Cable Assembly

Protocol: NMEA 0183 per National Marine Electronics Association

Serial Port Settings: 9600 baud, 8 data bits, no parity, 1 stop bit

Serial Port NMEA Output Messages: GGA, GLL, GSA, GSV, RMC, VTG and ZDA (default start-up configuration)

2.4 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

This manual contains installation procedures for the M7200 mobile radio and the CH-721 control heads. The procedures cover the mounting and cabling of the equipment as well as the basic testing of the radio and control head. An interconnection wiring diagram is included at the rear of this manual. Also, important product safety-related information is presented in Section 1.

3.1 GENERAL DESCRIPTION

The M7200 mobile radio is a high-performance full-duplex dual-band digital mobile radio. Shown in Figure 5-2 on page 28, it provides standard and advanced mobile radio communication functions. It can operate with the following radio systems/standards:

- 700 MHz and 800 MHz OpenSky® trunked radio networks using the OpenSky Trunking Protocol (OTP)
- 800 MHz Enhanced Digital Access Communications System (EDACS®) trunked radio networks
- 800 MHz ProVoice trunked radio networks
- 800 MHz APCO Project 25 Phase I compliant Common Air Interface (P25 CAI) trunked radio networks
- 700 MHz talk-around communications in accordance with the APCO Project 25 Phase I standard
- Conventional FM repeater-based and FM talk-around voice communications in 700 and 800 MHz bands in accordance with the TIA/EIA-603 conventional land-mobile radio standard

The M7200 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 maximum. The power limit for 700 MHz interoperability channel operation is 300 milliwatts maximum. This power limit guarantees 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 dBd 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 4-3.

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 can be remotely controlled by up to six (6) control heads connected to it via 3-wire Controller Area Network (CAN) cables. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio. It also carries controlling data such as button presses, radio messages, and user data such as that for a mobile data terminal connected to the serial port of the radio or control head. In multiple control head installations, two or more control heads are interconnected to the mobile radio in a series (daisy-chain) fashion via CAN link cables. Up to six (6) control heads can be connected to an M7200 in a multiple control head installation. For proper operation, the CAN link must be terminated appropriately on each end.

Control heads used with the M7200 radio include the CH-721 Scan and System model control heads. See the figures on pages 46 and 47. Both heads feature a large 3-line graphical vacuum-fluorescent display, front panel controls and buttons for user control of the mobile radio, an internal high-power audio amplifier to drive an externally-connected speaker, and a front panel microphone connector. The CH-721 System control head also has a 12-button numeric keypad that provides Dual-Tone Multi-Frequency (DTMF) functionality and easier operator system/group selection control at the control head's front panel.

As shown in Figure 9-3 on page 47, the CH-721 Scan and System model control heads have several connectors located on the rear panel. These connectors include a DC power connector, two (2) CAN port

connectors used for CAN link interconnections, an external speaker connector, a 9-pin serial port connector for connecting optional equipment such as a mobile data terminal, and a 25-pin multi-function connector.

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 utilized as 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 communications are accomplished via a "push-to-talk" (PTT) type microphone and a speaker connected to the control head.

For data communications, the radio has an industry-standard 9-pin serial interface port for connecting optional data-type equipment, such as a Mobile Data Terminal (MDT), a laptop PC, external 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 repeater output bands (mobile receive) of 764 to 767 MHz, 769 to 775 MHz and 773 to 776 MHz, and the repeater input bands (mobile transmit) of 794 to 797 MHz, 799 to 805 MHz and 803 to 806 MHz. The radio also provides talk-around operation in the 764 to 767 MHz, 769 to 775 MHz and 773 to 776 MHz bands.

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 824 MHz repeater input band and the 851 to 869 MHz band used for repeater output and talk-around communications. These bands provide a total of over 830 possible channels spread over the 806 to 824 MHz mobile transmission and 851 to 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). Alternately, the GPS antenna can be located/mounted completely separate from the mobile transmit/receive antenna.

The radio and control head exceed 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.

An M7200 radio operating on an OpenSky radio network uses Time-Division Multiple-Access (TDMA) digital modulation technology on the radio frequency link. TDMA allows multiple radio users to share a single RF channel. In addition, a single RF channel can support simultaneous digital voice and data communications.

OpenSky employs Advanced Multi-Band Excitation (AMBE) speech and data compression technology developed by Digital Voice Systems, Inc. When operating on an OpenSky radio network, AMBE gives an M7200 the ability to provide exceptional voice quality via the limited bandwidth of the radio frequency path, even when the received radio frequency (RF) signal is weak (i.e., even in "fringe" areas). AMBE is performed by a Digital Signal Processor (DSP) integrated circuit within the control head that is programmed to perform an AMBE compression algorithm during mobile transmissions, and an AMBE expansion algorithm during mobile reception.

Speech compression electronic circuitry—be it AMBE or another type such as IMBE—is sometimes referred to as "vocoding" circuitry for voice coding, or simply a "vocoder" circuit.

The M7200 supports radio operation on 800 MHz APCO Project 25 Phase I compliant Common Air Interface (P25 CAI) trunked radio networks, and operation in a talk-around mode in accordance with the APCO Project 25 Phase I standard. P25 radio systems utilize Improved Multi-Band Excitation (IMBE) speech/data compression technology, also developed by Digital Voice Systems, Inc.

Harris recommends the buyer use only a Harris-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 Harris 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 PUBLICATIONS

The following publications contain additional information:

- Quick Guide for OpenSky: MM-010790-001
- Quick Guide for EDACS, Conventional & P25: MM-012506-001
- Operator's Manual: MM23016
- Maintenance Manual: MM20117

All of the above listed publications are available at www.pspc.harris.com via a Wireless Systems' Wireless Information Center login and Tech Link. In addition, the Quick Guides are included with the radio when it ships from the factory.

3.3 REPLACEMENT PARTS

Replacement parts can be ordered through the Customer Resource Center. To order replacement parts through the Customer Resource Center, call, fax or e-mail our ordering system:

United States and Canada:

- Phone Number: 1-800-368-3277 (toll free)
- Fax Number: 1-800-833-7592 (toll free)
- E-mail: PSPC_CustomerFocus@harris.com

International:

- Phone Number: 1-434-455-6403
- Fax Number: 1-434-455-6676
- E-mail: PSPC_InternationalCustomerFocus@harris.com

3.4 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 the Technical Assistance Center (TAC) using the following telephone numbers or e-mail address:

- U.S. and Canada: 1-800-528-7711 (toll free)
- International: 1-434-385-2400
- Fax: 1-434-455-6712
- E-mail: PSPC_tac@harris.com

4 UNPACKING AND CHECKING THE EQUIPMENT

4.1 MATERIALS

A typical set of M7200 installation materials includes:

- **M7200 Mobile Radio, part number RU25011-0001** (Catalog number MAMV-FDLXX)
- **CH-721 Scan Control Head, part number CU23218-0002** (Catalog number MAMV-CP9E)
  or
  CH-721 System Control Head, part number CU23218-0004 (Catalog number MAMV-CP9F)
- **Standard Microphone, part number MC-101616-041** (Part of catalog number MAMV-MC7Z). Other microphones are listed in Table 4-4 on page 23.
- **Installation Kit MAMV-NZN7W for M7200 and CH-721** (see Table 4-1 below for contents)
- **Antenna(s)** from the selection listed in Table 4-3

Installation Kit MAMV-NZN7W can be used to install the mobile radio, or individual components may be purchased separately; see Section 3.3 for additional information. Table 4-1 lists the parts included in the kit. Table 4-3 lists part numbers for radio options and accessories. Table 4-4 includes optional parts available for the CH-721 Scan and System model control heads.

Table 4-1: Installation Kit MAMV-NZN7W for M7200 and CH-721

ITEM	QTY.	PART NUMBER	DESCRIPTION
1	1	1000003678	Bracket, Base
2	2	AD00006	Screws: #8-32 Pan-Head (Package of 4)
3	1	CA-012365-001	Cable, M7200/M7300/M5300 DC Power. Includes (1) 20-Foot DC Power Cable with straight connector, (2) waterproof inline HFB-type fuse holders, (1) 3-amp AGC fuse, (1) 15-amp AGC fuse, and (1) 20-amp AGC fuse.
4	1	CA-012616-001	Cable, CH-721 DC Power. Includes (1) DC Power Cable with straight connector, (2) waterproof inline HFB-type fuse holders, (1) 3-amp AGC fuse, and (1) 5-amp AGC fuse. This DC Power Cable has a 10-foot 12-AWG red wire (main power input), a 20-foot white wire (switched power input), and a 5-foot black wire (ground).
5	1	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors
6	1	KT-008608	Kit, CH-721 Mounting Bracket. Includes (1) U-Shaped Mounting Bracket, (2) ¼-Inch #8-32 stainless-steel screws, (2) stainless-steel flat washers and (2) stainless-steel lockwashers.
7	2	MACDOS0010	Terminator, CAN; 3-pin
8	1	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable)
9	1	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector
10	2	FM-104859-001	Cap, Waterproof (For CH-721's DB-9 serial port connector)
11	2	FM-104859-002	Cap, Waterproof (For CH-721's DB-25 accessory connector)

Table 4-2: Software Feature Options for M7200 Mobile Radios

CATALOG NUMBER	DESCRIPTION
MAMV-NPL7M	256-Bit Advanced Encryption Standard (AES) for EDACS, Conventional and P25 (ECP) Modes
MAMV-NPL3V	64-Bit Data Encryption Standard (DES) for ECP Modes
MAMV-NPL8D	256-Bit AES for OpenSky Mode
MAMV-PKG8C	256-Bit AES for ECP and OpenSky Modes and 64-Bit DES for ECP Modes
MAMV-PKG8F	256-Bit AES and 64-Bit DES for ECP Modes
MAMV-NPL3Y	Status Message for EDACS, ProVoice, and P25 Trunking only
MAMV-NPL7N	Radio TextLink for EDACS, ProVoice, and P25 Trunking only
MAMV-PL1X	ProScan and Priority System Scan (Roaming) for EDACS, ProVoice, and P25 Trunking only
MAMV-PL1Y	Priority System Scan (Roaming) for EDACS, ProVoice, and P25 Trunking only
MAMV-PL3X	EDACS/ProVoice Data
MAMV-PL7P	P25 Data
MAMV-PL5K	ProFile Over-The-Air Programming (OTAP)
MAMV-PL7G	ESK/P25 Personality Lock

Table 4-3: Additional Options and Accessories for M7200 Radios

PART/MODEL NUMBER	DESCRIPTION
AN-125001-002	Antenna Mount: Standard Rooftop, NMO Mounting Base, 15-foot (4.6-meter) RF-195 (or equivalent) Low-Loss RF Cable, Male TNC RF Connector
AN-125001-004	Antenna Mount: Thick Rooftop, NMO Mounting Base, 15-foot (4.6-meter) RF-195 (or equivalent) Low-Loss RF Cable, Male TNC RF Connector
AN-125001-006	Antenna Mount: GPS Combo Rooftop, NMO Mounting Base, 17-foot (5.1-meter) RF-195 (or equivalent) Low-Loss RF Cable, Male TNC RF Connector; 17-foot (5.1-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias
AN-125001-008	Antenna Mount: Magnetic, NMO Mounting Base, 15-foot (4.6-meter) RF-195 (or equivalent) Low-Loss RF Cable, Male TNC RF Connector
AN-225001-001	Antenna Element: 700/800 MHz, 3 dBd Gain, NMO, Factory-Tuned
AN-225001-002	Antenna Element: 700/800 MHz, 3 dBd Gain, Elevated-Feed, NMO, Factory-Tuned

Table 4-3: Additional Options and Accessories for M7200 Radios

PART/MODEL NUMBER	DESCRIPTION
AN-225001-003	Antenna Element: 700/800 MHz, 3 dBd Gain, Elevated-Feed, No Ground Plane, NMO, Factory-Tuned
AN-225001-004	Antenna Element: 700/800 MHz, 2 dBd Gain, Low-Profile, NMO, Factory-Tuned
AN-225001-005	Antenna Element: 700/800 MHz, 5 dBd Gain, NMO, Factory-Tuned
AN102800V1 (Cat. No. MAMV-AN3G)	Antenna, 136 – 941 MHz Standard Rooftop-Mount; ¼-Wave, Unity-Gain, with Mounting Base, 17-foot (5.2-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable and Male TNC RF Connector; Field-Tuned; see footnote [4].
AN102800V2 (Cat. No. MAMV-AN3R)	Antenna, 136 – 941 MHz Thick Rooftop-Mount; ¼-Wave, Unity-Gain, with Mounting Base, 17-foot (5.2-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable and Male TNC RF Connector; Field-Tuned; see footnote [4].
AN-025167-001 (Discontinued)	Antenna, 700/800 MHz, Standard Rooftop-Mount, 3 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors; Factory-Tuned
AN-025167-002 (Discontinued)	Antenna, 700/800 MHz, Elevated-Feed, Rooftop-Mount, 3 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors; Factory-Tuned
AN-025167-004 (Discontinued)	Antenna, 700/800 MHz GPS Combo, Rooftop-Mount, 3 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, 16.5-foot (5-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias; Factory-Tuned
AN-025167-005 (Discontinued)	Antenna, 700/800 MHz GPS Combo, Elevated-Feed Rooftop-Mount, 3 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, 16.5-foot (5-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias; Factory-Tuned
AN-025167-006 (Discontinued)	Antenna, 700/800 MHz, Magnetic-Mount, 3 dBd Gain, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors; Factory-Tuned
AN-025167-010 (Discontinued)	Antenna, 700/800 MHz, Low-Profile, Rooftop-Mount, 2 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, Factory-Tuned
AN-025167-011 (Cat. No. MAMV-NAN5C)	Antenna, 700/800 MHz GPS Combo, Low-Profile, Rooftop-Mount, 2 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, 16.5-foot (5-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias; Factory-Tuned
AN-025167-014 (Cat. No. MAMV-NAN5U)	Antenna, 700/800 MHz, Standard Rooftop-Mount, 5 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, Factory-Tuned

[4] Driven elements of AN102800V1 and AN102800V2 must be trimmed to proper lengths in order to minimize antenna system VSWR.

Table 4-3: Additional Options and Accessories for M7200 Radios (Continued)

PART/MODEL NUMBER	DESCRIPTION
AN-025167-015 (Cat. No. MAMV-NAN5V)	Antenna, 700/800 MHz GPS Combo, Rooftop-Mount, 5 dBd Gain, NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC and Mini-UHF RF Connectors, 16.5-foot (5-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias; Factory-Tuned
AN-025187-001 (Cat. No. MAMV-NAN5F)	Antenna, GPS Receive Only, Roof-Mount, 17-foot (5.2-meter) RG174/U (or equivalent) RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias
AN-025187-003 (Cat. No. MAMV-AN3L)	Antenna, GPS Receive Only, Magnetic-Mount, 17-foot (5.2-meter) RG174/U (or equivalent) RF Cable with Male SMA RF Connector (attached); 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias
1000022242-0001	Cable, Full-Data I/O Option; see Section 13.1 (page 59)
1000022242-0002	Cable, Programming Option; see Section 13.2 (page 62)
MAMROS0055	Cable, TIA/EIA/RS-232 Serial Computer Cable (6 feet)
CA-013671-020	Cable, TIA/EIA/RS-232 Serial Computer Cable (20 feet)
MAMV-ZN7P	Kit, Installation, Remote-Mount for Data-Only Radio. Includes (1) Base Bracket for M7200, (1) DC Power Cable for M7200 (with Fuses and Waterproof Fuse Holders), (2) CAN Terminators, and hardware.
MAMROS0044	Kit, Trunk Mounting. Includes base bracket, screws.
MACDOS0010	Terminator, CAN; 3-pin

Table 4-4: Additional Options and Accessories for CH-721 Control Heads

PART/MODEL NUMBER	DESCRIPTION
CA-009562-006	Cable, CAN; 6 feet, Right-Angle-to-Straight Connectors
CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors
CA-009562-090	Cable, CAN; 90 feet, Right-Angle-to-Straight Connectors
CA-009562-250	Cable, CAN; 250 feet, Right-Angle-to-Straight Connectors
MACDOS0010	Terminator, CAN; 3-Pin
MACDOS0012	Kit, Control Head Pedestal Mounting. Includes Pedestal Mount and Mounting Screws.
MACDOS0013-CN004	Kit, Speaker; 20-Watt, Straight Connector. (Includes 4-Ohm 20-Watt Speaker LS102824V10 with 4.6-Foot Cable and 6-Inch Speaker Cable MAMROS0034-NN006.)
MC-101616-040 (Discontinued. Replaced by MC-101616-041)	Microphone, Standard with Conxall Flush-Mount 45-Degree Connector
MC-101616-041	Microphone, Standard with Conxall Flush-Mount 90-Degree Connector (Included with catalog number MAMV-MC7Z)
MC-103334-040	Microphone, DTMF with Conxall Flush-Mount 45-Degree Connector (Included with catalog number MAMV-NMC9C)
MC-103334-041	Microphone, DTMF with Conxall Flush-Mount 90-Degree Connector

Table 4-4: Additional Options and Accessories for CH-721 Control Heads (Cont.)

PART/MODEL NUMBER	DESCRIPTION
MC-103334-050 (Discontinued. Replaced by MC-103334-051)	Microphone, Noise-Canceling with Conxall Flush-Mount 45-Degree Connector
MC-103334-051	Microphone, Noise-Canceling with Conxall Flush-Mount 90-Degree Connector (Included with catalog number MAMV-NMC9D)
344A4678P1	Microphone Hanger. (Included with catalog numbers MAMV-MC7Z, MAMV-NMC9C and MAMV-NMC9D)
CA-011854-001	Cable, CH-721 Option. (See Figure 13-3 on page 64.)
FS24473	Kit, Vehicle Fuse and T-Tap. Includes (1) ATM Fuse Holder, (1) 2-Amp ATM Fuse, (2) T-Tap Quick-Disconnect Terminals and (1) ¼-Inch Crimp Tab Terminal. (Contents shown in Figure 9-8 on page 55.)
MAMV-NZN7C	Kit, CH-721 Scan Control Head for Multi-Head Installations (See Table 4-5 for kit contents.)
MAMV-NZN7D	Kit, CH-721 System Control Head for Multi-Head Installations (See Table 4-5 for kit contents.)

Table 4-5: CH-721 Control Head Kits for Multi-Head Installations MAMV-NZN7C (CH-721 Scan) and MAMV-NZN7D (CH-721 System)

PART NUMBER	DESCRIPTION	QTY. PER MAMV-NZN7C (Scan)	QTY. PER MAMV-NZN7D (System)
CU23218-0002	Control Head, CH-721 Scan Model	1	0
CU23218-0004	Control Head, CH-721 System Model	0	1
CA-012616-001	Cable, CH-721 DC Power. Includes (1) DC Power Cable with straight connector, (2) waterproof inline HFB-type fuse holders, (1) 3-amp AGC fuse, and (1) 5-amp AGC fuse. This DC Power Cable has a 10-foot 12-AWG red wire (main power input), a 20-foot white wire (switched power input), and a 5-foot black wire (ground).	1	1
CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors	1	1
KT-008608	Kit, CH-721 Mounting Bracket. Includes (1) U-Shaped Mounting Bracket, (2) ¼-Inch #8-32 stainless-steel screws, (2) stainless-steel flat washers and (2) stainless-steel lockwashers.	1	1
LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable)	1	1
MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector	1	1
FM-104859-001	Cap, Waterproof (For CH-721's DB-9 serial port connector)	1	1
FM-104859-002	Cap, Waterproof (For CH-721's DB-25 accessory connector)	1	1

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 Harris's Customer Resource Center (see page 19) immediately to discuss and arrange the return of the equipment to Harris 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

Figure 5-1 provides an example of a typical trunk-mounted M7200 mobile radio installation. 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, as applicable (i.e., the control head).
- The equipment is protected from water damage.
- The installation is neat and allows easy service access.
- The mobile radio is mounted in a location assuring the vehicle occupant's safety and out of the way of passengers and auto mechanics.

CAUTION

A professional radio installer should perform the installation!

5.2 TOOLS REQUIRED

The following tools are recommended to complete the installation. Where specific vendor names and model/part numbers are given, equivalent substitutes may be used:

- Non-Insulated Crimp Tool: Thomas & Betts WT-111-M
- Insulated Terminal Crimp Tool: Klein 1005
- Fuse Holder Crimp Tool: Thomas & Betts – WT-112M or California Terminal Products No. 1250 or Channelock No. 909
- 3-Blade Coax Cable Stripper for RG-58 Cable similar to Tyco Electronics 1490490-1 (includes blades)
- Ratcheting Hex-Crimp Tool for 50-Ohm TNC and BNC RF Connectors and RG-58 Cable similar to Tyco Electronics 58433-2 (includes Crimper 354940-1 and Die Set 58436-1) or Emerson Network Power 24-9960P
- Non-Metallic Fish Tape, 25-Foot: Klein-Lite 50156
- Two (2) Pairs of Soft-Jaw Pliers: Tessco 450520 or equivalent
- Flush-Cut and Large Wire Cutters
- Phillips-Head Screwdrivers, #1 and #2
- Flat-Blade Screwdrivers, #1 and #2
- ⅛-Inch Hex Key Wrench (Allen Wrench)
- Two $^{5}/_{16}$-Inch Combination or Open-End Wrenches
- Socket and/or Nut Driver Sets
- ¾-Inch or ⅜-Inch Hole Saw with Depth Protection: ¾-Inch = Ripley HSK 19 or Antenex HS34; ⅜-Inch = Antenex HS38
- Clutch-Type (i.e., with torque limit) Cordless Drill with Drill Bits and Driver Bits
- Deburring Tool (for ⅜-inch and smaller holes)
- Tie Wraps: 6-inches or larger
- Various Fasteners (e.g., machine screws and nuts, Tek screws, etc.)

NOTE

A separate list of test equipment is included in Section 16.2 on page 69.

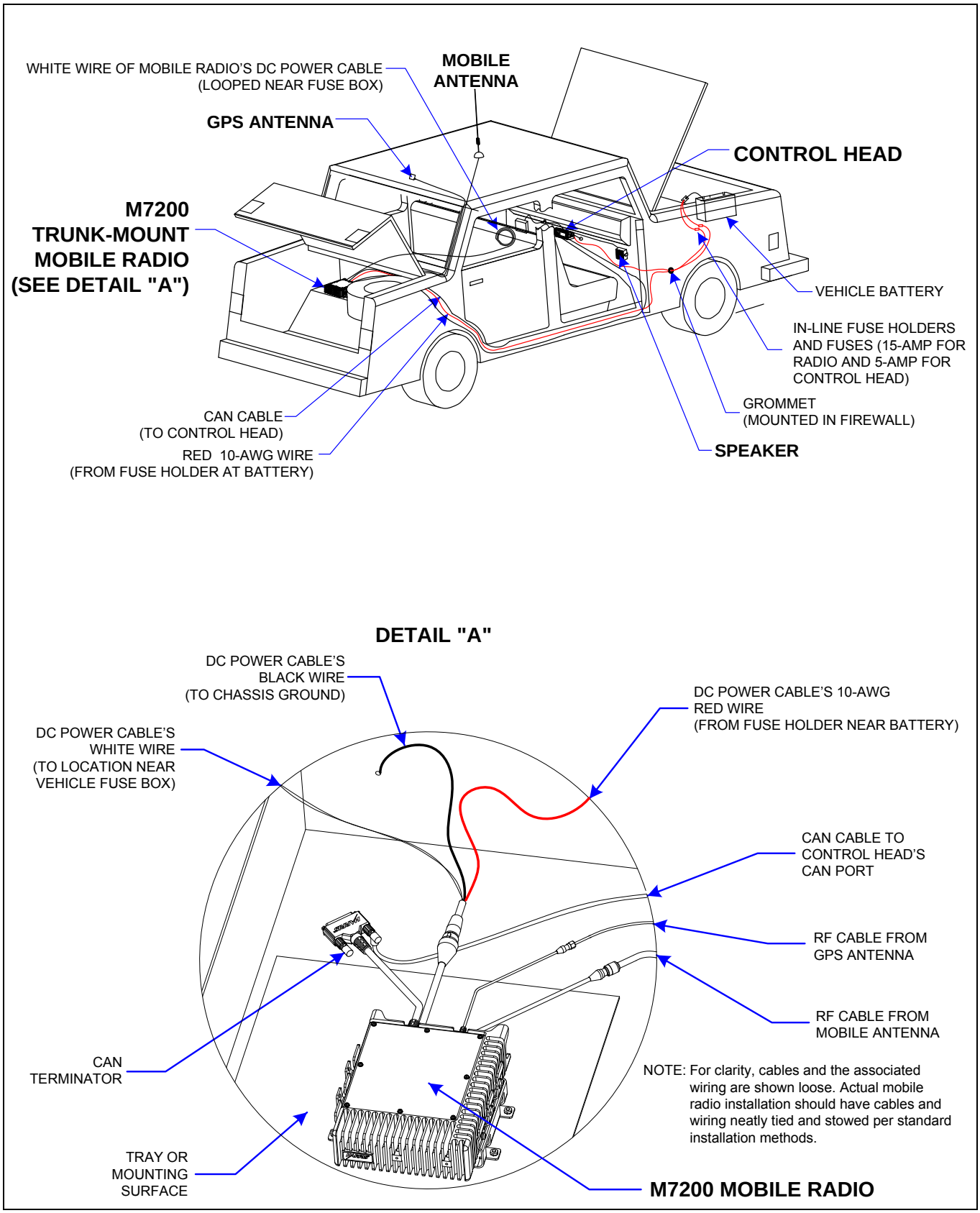


Figure 5-1: Typical Installation in a Standard Passenger Vehicle

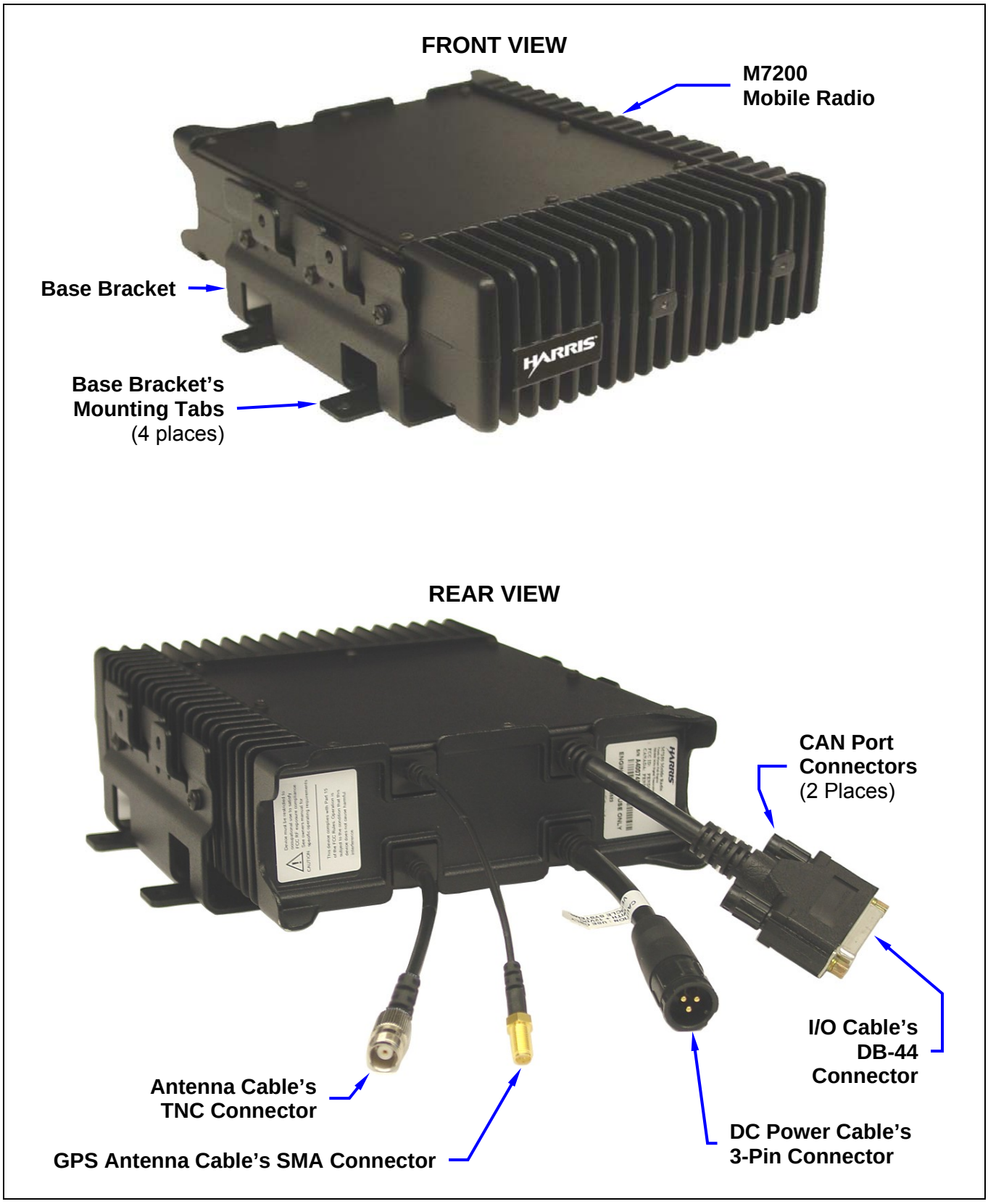


Figure 5-2: M7200 Mobile Radio — Front and Rear Views

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 length is not employed. Connections to the 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 length near each connector end. Do not bend the cables at severe angles near the connectors' ends and do not loop the cables. 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 RADIO IN THE TRUNK

This section provides details on mounting the mobile radio in the trunk of the vehicle. See Figure 5-2 and refer to the respective wiring diagram at the end of this manual as necessary. Control head installation procedures are included in Section 9 (page 46).

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-NZN7W 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 kit. Kit contents are listed in Table 4-1 on page 20.

NOTE

Prior to beginning the installation, verify the radio has the proper version of software installed and it has been configured for customer usage. Consult with the radio system network administration personnel as necessary.

CAUTION

Though generally mounted in a trunk or remote location, the mobile 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 ^{o} Fahrenheit (+60^{o} Celsius).

WARNING

At a minimum, the mounting surface should be 16-guage (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-guage 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 adequate.

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-to-back and left-to-right symmetrical.

As all installations differ, bracket-to-vehicle mounting screws are not included. The use of #10 stainless-steel machine screws, stainless-steel flatwashers and stainless-steel self-locking nuts is recommended. Alternately, #10 stainless steel self-drilling screws and stainless-steel flatwashers may be used to speed installation time and/or if the underside of the mounting surface is not easily accessible. Self-drilling screws such as "TEK" screws do not require drilling of a pilot hole prior to installation. Do **not** use common self-threading sheet metal screws because they will loosen over time with vehicle vibrations.

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 listed in Table 4-1 on page 20) as a template and/or the dimensional information shown in Figure 6-1, mark and drill mounting holes into the mounting surface as required. (Drilling is not required if using self-drilling screws.) 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.

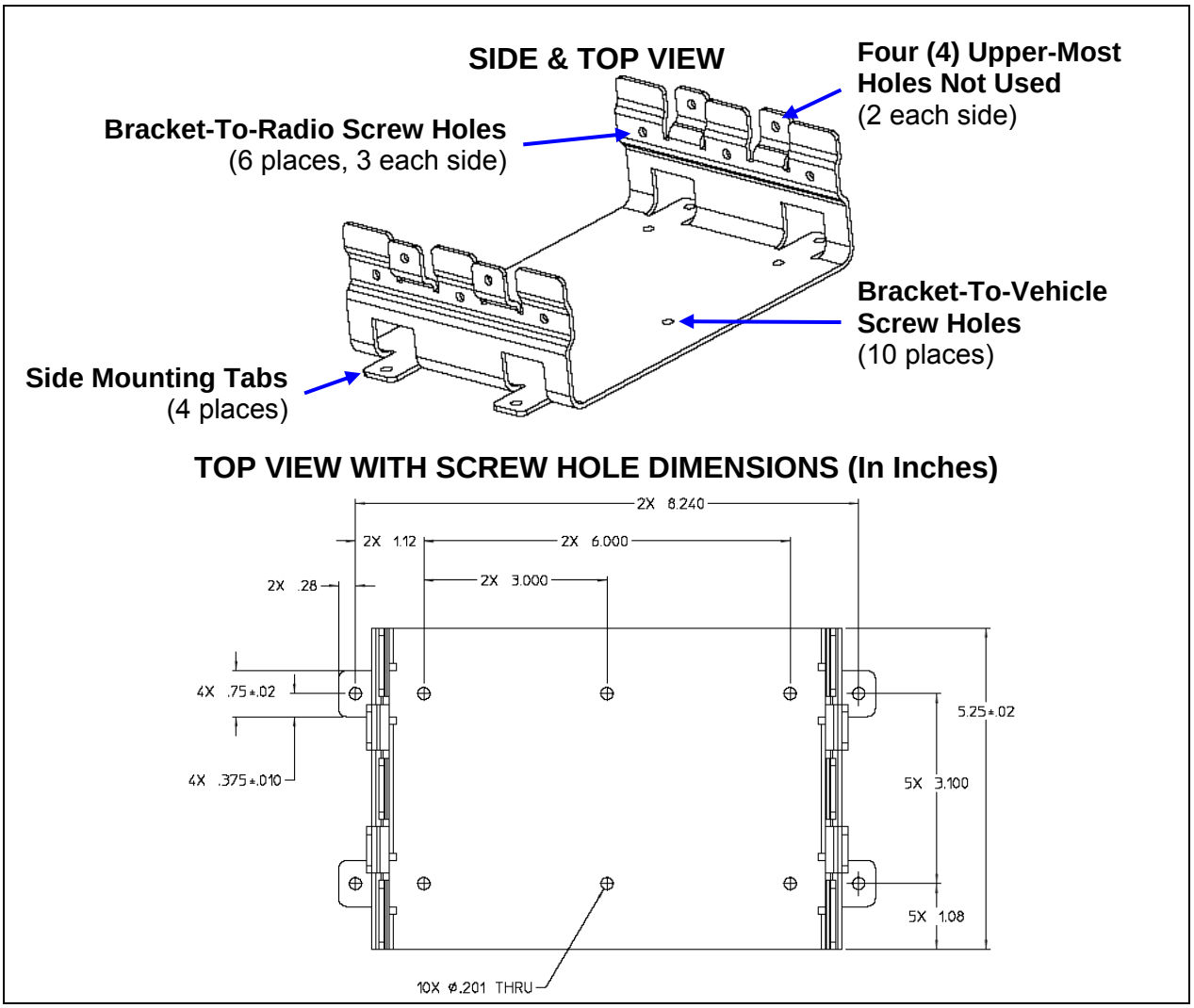


Figure 6-1: Base Bracket (Radio Not Shown)

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 2 listed in Table 4-1 on page 20) 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 length and for air circulation, plus an area to secure and stow the excess cable lengths.

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

Before starting the antenna installation, review all information presented in the REGULATORY AND SAFETY INFORMATION section of this manual (see page 6). A transmitting antenna must be installed in accordance with the guidelines presented in the REGULATORY AND SAFETY INFORMATION section. Use Table 1-1 on page 8 and Figure 7-1 below 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 (1) of four (4) 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 4-3 for additional information. Always follow manufacturer's instructions when mounting an antenna.

7.1.1 Direct Center or Center-Rear of Rooftop

The center of the vehicle's roof is the best location for a rooftop-mount antenna (location ❶ in Figure 7-1). For optimal performance, the mounting area under the antenna must be flat with a minimum radius of six (6) inches of metal ground plane. It must be located directly in the center of the roof to minimize human exposure to RF electromagnetic energy. 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 (location ❷ in Figure 7-1).

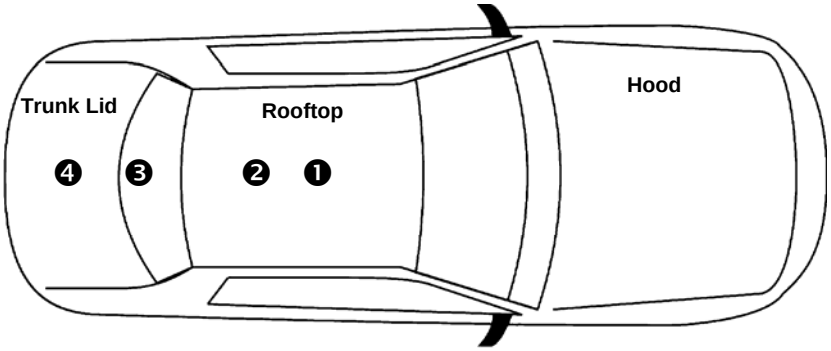
7.1.2 Center of Trunk Lid

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 (location ❹ in Figure 7-1). In this case, an elevated-feed-point antenna is recommended. Although this type of antenna does not require a metal ground plane, it must be located directly in the center of the trunk lid to minimize human exposure to RF electromagnetic energy.

7.1.3 Rear Deck Lid for Stand-Alone GPS Receive Antenna

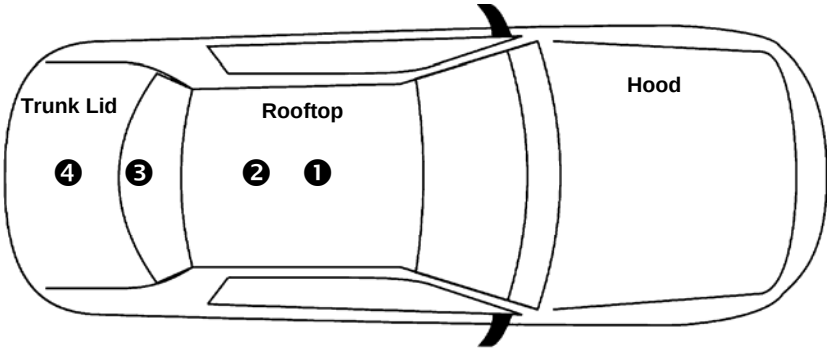
If the mobile radio installation does not use a GPS combination-type antenna, a stand-alone GPS receive antenna must be separately located and mounted, to support the radio's internal GPS receiver. The vehicle's rear deck lid (location ❸ in Figure 7-1) is the recommended mounting location for this case. This locates the GPS antenna inside the vehicle.

TOP VIEW OF A TYPICAL VEHICLE



ANTENNA PART NUMBER	ANTENNA DESCRIPTION*	LOCATION(S)			
		❹	❸	❷	❶
AN-125001-002 (mount) with AN-225001-001 (element)	700/800 MHz Standard Rooftop-Mount, 3 dBd Gain	✓			✓
AN-125001-002 (mount) with AN-225001-002 (element)	700/800 MHz Elevated-Feed Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-002 (mount) with AN-225001-003 (element)	700/800 MHz Elevated-Feed No Ground Plane Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-002 (mount) with AN-225001-004 (element)	700/800 MHz Low-Profile Rooftop-Mount, 2 dBd Gain	✓			✓
AN-125001-002 (mount) with AN-225001-005 (element)	700/800 MHz Standard Rooftop-Mount, 5 dBd Gain				✓
AN-125001-004 (mount) with AN-225001-001 (element)	700/800 MHz Thick Rooftop-Mount, 3 dBd Gain	✓			✓
AN-125001-004 (mount) with AN-225001-002 (element)	700/800 MHz Elevated-Feed Thick Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-004 (mount) with AN-225001-003 (element)	700/800 MHz Elevated-Feed No Ground Plane Thick Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-004 (mount) with AN-225001-004 (element)	700/800 MHz Low-Profile Thick Rooftop-Mount, 2 dBd Gain	✓			✓
AN-125001-004 (mount) with AN-225001-005 (element)	700/800 MHz Thick Rooftop-Mount, 5 dBd Gain				✓
AN-125001-006 (mount) with AN-225001-001 (element)	700/800 MHz GPS Combo Rooftop-Mount, 3 dBd Gain	✓			✓
AN-125001-006 (mount) with AN-225001-002 (element)	700/800 MHz GPS Combo Elevated-Feed Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-006 (mount) with AN-225001-003 (element)	700/800 MHz GPS Combo Elevated-Feed No Ground Plane Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-125001-006 (mount) with AN-225001-004 (element)	700/800 MHz GPS Combo Low-Profile Rooftop-Mount, 2 dBd Gain	✓			✓
AN-125001-006 (mount) with AN-225001-005 (element)	700/800 MHz GPS Combo Rooftop-Mount, 5 dBd Gain				✓
AN-125001-008 (mount) with AN-225001-001 (element)	700/800 MHz Magnetic-Mount, 3 dBd Gain	✓			✓
AN-125001-008 (mount) with AN-225001-002 (element)	700/800 MHz Magnetic-Mount Elevated-Feed, 3 dBd Gain	✓		✓	✓
AN-125001-008 (mount) with AN-225001-003 (element)	700/800 MHz Magnetic-Mount Elevated-Feed No Ground Plane, 3 dBd Gain	✓		✓	✓

TOP VIEW OF A TYPICAL VEHICLE



ANTENNA PART NUMBER	ANTENNA DESCRIPTION*	LOCATION(S)			
		❹	❸	❷	❶
AN-125001-008 (mount) with AN-225001-004 (element)	700/800 MHz Magnetic-Mount Low-Profile, 2 dBd Gain	✓			✓
AN-125001-008 (mount) with AN-225001-005 (element)	700/800 MHz Magnetic-Mount, 5 dBd Gain				✓
AN102800V1	136 to 941 MHz Standard Rooftop-Mount, ¼-Wave, 0 dBd Gain				✓
AN102800V2	136 to 941 MHz Thick Rooftop-Mount, ¼-Wave, 0 dBd Gain				✓
AN-025167-001 (Discontinued)	700/800 MHz Standard Rooftop-Mount, 3 dBd Gain	✓			✓
AN-025167-002 (Discontinued)	700/800 MHz Elevated-Feed Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-025167-004 (Discontinued)	700/800 MHz GPS Combo Rooftop-Mount, 3 dBd Gain	✓			✓
AN-025167-005 (Discontinued)	700/800 MHz GPS Combo Elevated-Feed Rooftop-Mount, 3 dBd Gain	✓		✓	✓
AN-025167-006 (Discontinued)	700/800 MHz Magnetic-Mount, 3 dBd Gain	✓			
AN-025167-010 (Discontinued)	700/800 MHz Low-Profile Rooftop-Mount, 2 dBd Gain	✓			✓
AN-025167-011 (Discontinued)	700/800 MHz GPS Combo Low-Profile Rooftop-Mount, 2 dBd Gain	✓		✓	✓
AN-025167-014 (Discontinued)	700/800 MHz Standard Rooftop-Mount, 5 dBd Gain				✓
AN-025167-015 (Discontinued)	700/800 MHz GPS Combo Rooftop-Mount, 5 dBd Gain				✓
AN-025187-001	GPS Receive Only, Roof-Mount	✓	✓	✓	
AN-025187-003	GPS Receive Only, Magnetic-Mount	✓	✓	✓	

* See Table 4-3 which begins on page 21 for detailed antenna descriptions.

Figure 7-1: Recommended Antenna Mounting Locations with Antenna Part Numbers

7.2 ANTENNA INSTALLATION PROCEDURE

NOTE

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

As presented in the previous section, various antenna mounting locations exist. Optimal performance is achieved via a rooftop antenna mounted in the direct center of the motor vehicle's roof. Table 4-3 which begins on page 21 lists the available antenna elements, antenna mounts.

7.2.1 Installing NMO Antenna Mounts AN-125001-001, -002, -003 and -004

These NMO style antenna mounts can each be used with several different antenna elements. Only limited access under the mounting location is typically required. The installation procedure is presented in Section 7.2.1.3.

7.2.1.1 Standard NMO Antenna Mounts AN-125001-001 and AN-125001-002

These standard ¾-inch NMO antenna mounts require a ¾-inch hole in a relatively flat area of the vehicle body, with a vehicle metal thickness of between 0.020 and 0.040 inches. AN-125001-002 has a very-low-loss coax cable (LMR-195 or equivalent).

7.2.1.2 Thick-Roof NMO Antenna Mounts AN-125001-003 and AN-125001-004

Both of these thick-roof NMO antenna mounts use either a ⅜-inch or a ¾-inch mounting hole in a relatively flat area of the vehicle body, with a vehicle metal thickness of between 0.040 and 0.1875 inches ($^{3}/_{16}$-inch maximum thickness). AN-125001-004 has a very-low-loss coax cable (LMR-195 or equivalent).

NOTE

For thick-roof NMO antenna mounts AN-125001-003 or AN-125001-004, using a ⅜-inch mounting hole will require better access to the underside of the mounting location than if a ¾-inch hole is used. This is because, in the case of a ⅜-inch hole, the antenna mount's bushing assembly must be inserted from the underside of the mounting surface.

When using a ¾-inch mounting hole to mount thick-roof NMO antenna mounts AN-125001-003 or AN-125001-004, the thickness of the mounting surface must be at least ⅛-inch (0.125-inch minimum thickness). This requirement is due to the thickness of the alignment ring used to center the bushing assembly within the ¾-inch mounting hole.

7.2.1.3 Installation Procedure for Mounts AN-125001-001 through -004

1. Select the antenna mounting location in accordance with the information presented in Sections 1 and 7.1 of this manual. If necessary, contact the Technical Assistance Center for assistance. See page 19 for TAC contact information.
2. Verify no obstructions exist immediately below the respective mounting location on the underside of the vehicle body, such as vehicle ribbing/body framing, a wiring harness, air bag equipment, etc. Also verify there is a sufficient access path and clearance for the mount's coax cable. If there is an obstruction or insufficient clearance, select another nearby mounting location.
3. Measure and mark the center point of the selected antenna mounting location. Be sure to center the mark from side-to-side of the vehicle.
4. Obtain a hole saw specifically designed for drilling NMO mounting holes of the required diameter. (e.g., Antenex/Laird Technologies model HS34 or equivalent for a ¾-inch hole; Antenex/Laird Technologies model HS38 or equivalent for a ⅜-inch hole).
5. If the vehicle's headliner panel, carpet, seats, or otherwise, is below the mounting location, move or remove the headliner panel, etc. as necessary to protect it. Alternately, apply a heat-resistant mask material (such as a fiberglass mat or thin sheet metal with masked edges) as required to "catch" the metal shavings and the metal plug (if any) produced by the hole saw. The plug (if any) may be relatively hot if/when it drops out of the saw upon completion of the hole drilling process. ⅜-inch diameter hole saws generally produce only shavings, not plugs.

6. With the hole saw and a drill, drill a hole at the marked hole center point. Position the drill square with (i.e., 90 degrees from) the vehicle mounting surface so paint immediately outside of the perimeter of the hole is evenly removed.

Excessive use of the hole saw and/or failure to position the drill square with (i.e., at a 90 degree angle from) the vehicle mounting surface may result in damage to the metal mounting surface, in the area immediately outside of the perimeter of the hole.

7. Ensure the saw removed the paint immediately around the hole as the drilling operation completes. If not, do so by reinserting the saw completely into the hole and spinning it as required. This allows proper grounding via the mount's lock nut on the top of the mounting surface. On the bottom of the mounting surface, the "teeth" of the mount's bushing assembly may not provide a good ground due to thick vehicle undercoating, thick primer, oxidation/rust, etc.

8. **For a ¾-inch hole**, feed the unterminated end of the mount's coax cable into the hole from the top surface of the vehicle until the mount's bushing assembly is in position to drop into the hole. The bushing should be tilted at a slight angle and fed into the hole. The threaded shank of the mount's bushing assembly will not fall through a ¾-inch hole.

   For a ⅜-inch hole, feed the threaded shank of the mount's bushing assembly into the hole from the underside of the mounting surface. Hold it into position until the lock nut is installed.

9. If installing a thick-roof antenna mount (⅜-inch shank) into a ¾-inch hole, place the alignment ring onto the threaded shank of the mount. This ring has an approximate ¾-inch outside diameter.

10. A tube of synthetic lubricant is included with the antenna mount. Apply this lubricant to the mount's rubber O-ring. Do **not** get any lubricant on the center contact of the mount's bushing assembly.

11. As illustrated in Figure 7-2 and Figure 7-3, add the O-ring (C) and lock nut (D) to the top of the mount's bushing assembly (A). With the O-ring in the groove in the underside of the lock nut, thread the lock nut onto the bushing assembly. Be sure the O-ring remains in the groove before tightening the lock nut.

12. Using a $^{15}/_{16}$-inch open-end wrench, tighten the lock nut until it fully compresses the O-ring and makes good contact with the vehicle mounting surface. The groove's ridges on the bottom of the lock nut must make full contact with the unpainted metal surface of the vehicle.

13. Install the antenna element per the procedure in Section 7.2.4.

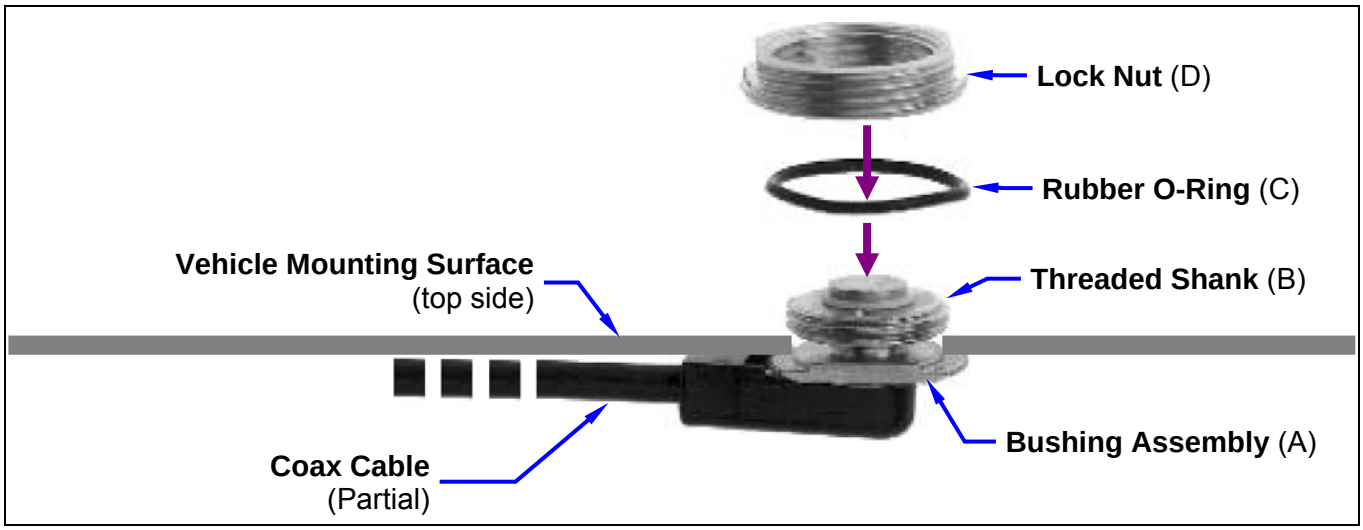


Figure 7-2: Installing a Standard ¾-Inch NMO Antenna Mount (e.g., AN-125001-001 or AN-125001-002)

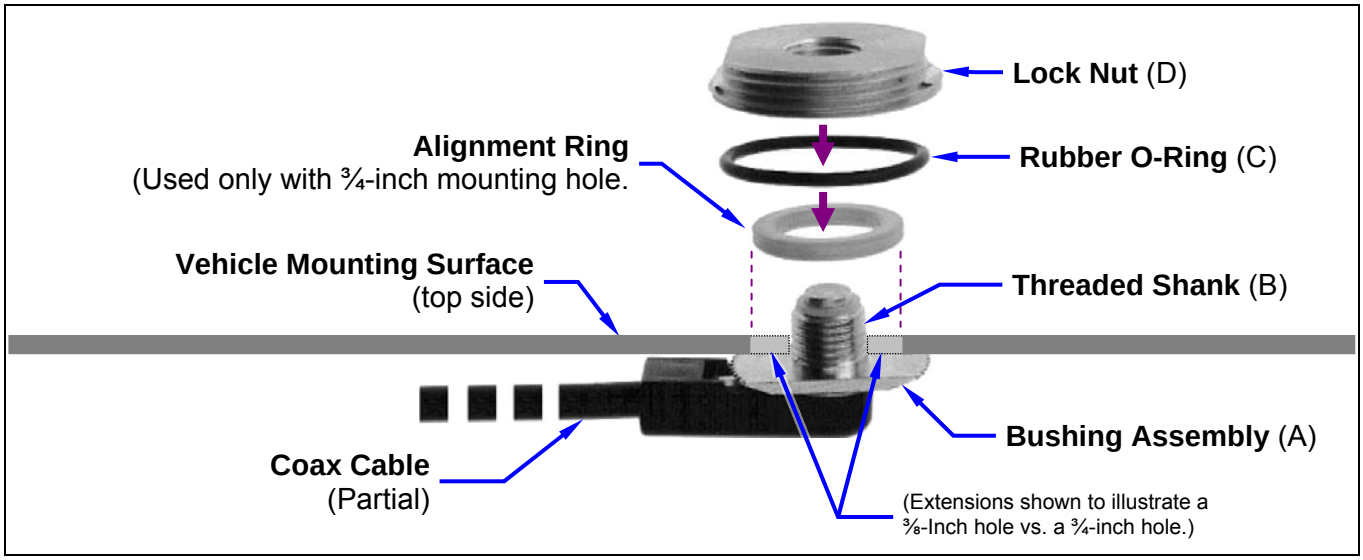


Figure 7-3: Installing a Thick-Roof NMO Antenna Mount (e.g., AN-125001-003 or AN-125001-004)

7.2.2 Installing NMO Magnetic Antenna Mount AN-125001-008

1. Thoroughly clean the bottom of the magnetic mount and the selected vehicle mounting surface by removing all dust, dirt, etc.
2. Carefully place the magnet mount onto the metal surface of the vehicle at the selected location. The coax cable exiting the mount's base should be orientated towards the point at which it will enter into the interior of the vehicle. Do not try to reposition it by sliding it on a painted metal surface.
3. Route the mount's coax cable to the radio location, passing it by the trunk lid's perimeter gasket, door perimeter gasket, etc., as necessary.
4. Install the antenna element per the procedure in Section 7.2.4.

CAUTION

To remove a magnetic antenna mount, hold it at the bottom of its base and tilt it at an angle to release the magnetic attraction force. **Do not pull on the mount's coax cable. Do not drag the mount across the mounting surface.**

7.2.3 Installing All Other Antenna Mounts

For any other type of antenna mount not covered in the previous sections, such as GPS combination antennas, install the mount in accordance with the installation instructions included with the mount.

7.2.4 Attaching NMO Antenna Elements

1. Clean the top surface of the NMO mount and the surface of the vehicle immediately around the mount.
2. Place the gasket included with the antenna element (not pictured in Figure 7-2 or Figure 7-3) around the mount and against the surface of the vehicle. If a lubricant or sealant was included with the gasket, apply it to the gasket before placing the gasket.
3. Apply the antenna element to the top of the mount and tighten it in a clock-wise direction (as viewing from the top). Use an appropriate wrench if required. Do **not** over-tighten.
4. Install a placard (not supplied) on the vehicle's dash panel, in accordance with the following **CAUTION**. Place the placard in plain view of the vehicle operator's position.
5. Continue with the coax cable installation procedure presented in the next section.

CAUTION

Before entering any automatic vehicle ("car") wash equipment, remove the antenna element from the antenna mount, and secure the element in a safe location inside the vehicle. This will prevent the wash equipment from damaging the element and/or mount. After exiting the wash equipment, thoroughly dry the top of the mount before re-installing the element.

7.2.5 Installing the Coax Cable and TNC RF Connector

1. Route the coax cable from the antenna mount to the location where the mobile radio will be installed. Remove headliner panel, interior panels, etc., as necessary. The cable must be kept out of casual contact from persons within the vehicle. Tie and stow the cable as necessary to protect it from possible chafing. Observe and follow this **WARNING**:

WARNING

Antennas Having Part Numbers Beginning with AN-0125167, and Antennas AN102800V1 and AN102800V2: The cables of these 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 re-installation considerations such as a relocation of the mobile radio within the vehicle. Installations requiring longer cables are treated as custom and separately specified.

All Other Antennas/Antenna Mounts: The antenna cables of all other antennas/antenna mounts that are approved for use with the M7200 radio can be cut to a length no shorter than six (6) feet (as measured from the base of the antenna mount).

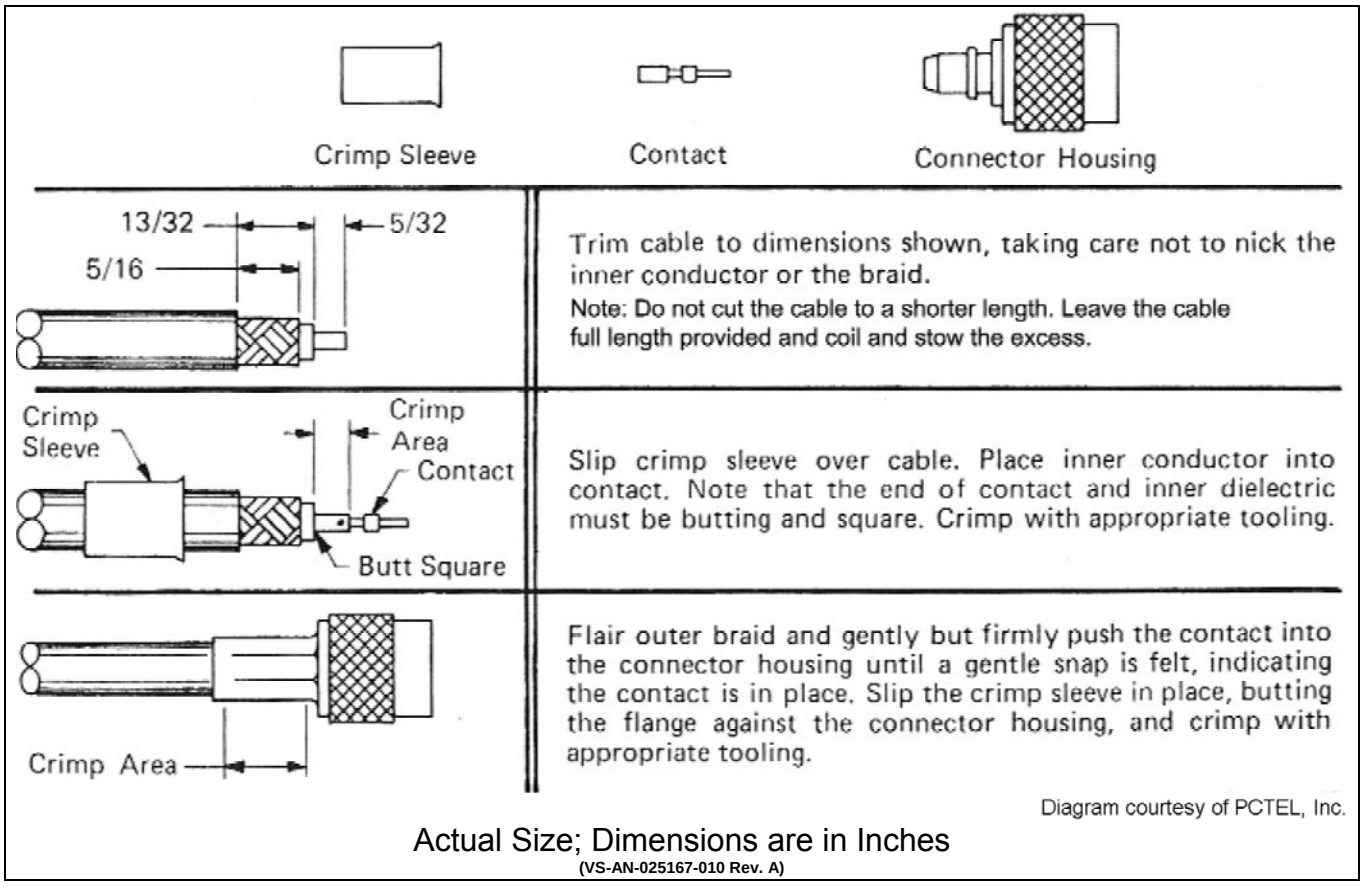


Figure 7-4: Crimping Instructions for TNC RF Connector

2. Using an appropriate crimp tool, crimp the supplied TNC RF connector to the end of the antenna cable. For crimping instructions, see Figure 7-4 or the instructions supplied with antenna mount.
3. The antenna cable is connected to the radio's TNC receptacle-type (female) RF connector per a procedure presented later in this manual. The cable and its TNC connector must be protected from damage, dirt, and/or metal shavings which may be generated during the mechanical and electrical installation of the radio. Temporarily tying the connector and cable-end within a small plastic bag is recommended.

NOTE

If the mobile radio installation includes a unity-gain antenna element, the element must be tuned for maximum performance (i.e., minimum reflection) during the test procedures presented in Section 16. Other antennas used with the M7200 are factory-tuned and therefore do not require tuning in the field.

7.2.6 Install and Connect the GPS Antenna

The M7200 mobile radio is equipped with a GPS receiver which requires connection to an externally-mounted GPS antenna, if GPS functions will be utilized. Some installations may use a magnetic-mount stand-alone GPS antenna installed separately from the 700/800 MHz transmit/receive mobile antenna.

A GPS combo antenna includes a GPS receive antenna and preamplifier built into the base of the 700/800 MHz transmit/receive mobile antenna. This type of antenna must be kept at least six (6) inches away from any other antenna mounted on the vehicle and it must have at least six inches of surface ground plane beneath it.

NOTE

Connection to a GPS antenna is only required if GPS functions will be utilized/required. For OpenSky radio system applications, the radio's GPS receiver can provide GPS data to either a locally-connected computer/mobile data terminal, or over-the-air to the radio network. For EDACS/ProVoice, P25 and conventional radio system applications, the GPS receiver is typically only used to support a computer/mobile data terminal (MDT) running GPS software connected to the radio via NMEA-formatted serial data link. Refer to Section 14 for additional information.

NOTE

A combination ("combo") antenna kit includes a GPS antenna built into the base of the mobile antenna. Refer to Table 4-3 (page 21) and/or Figure 7-1 (page 35) for available combo antennas.

The following antenna installation procedure is recommended:

1. After selecting a mounting location for the GPS antenna, refer to the antenna manufacturer's mounting and testing instructions for installation guidance. Install the antenna in accordance with these instructions. If necessary, contact the Technical Assistance Center. See page 19 for TAC contact information. **Do not alter the GPS antenna cable length; tie and stow excess cable as necessary.**
2. Route the cable from the antenna base to the location of where the radio will be installed. Remove headliner panel, interior panels, etc., as necessary. The cable must be kept out of casual contact from persons within the vehicle. Tie and stow it as necessary to protect it from possible chafing.
3. Connect the GPS antenna cable's SMA plug-type (male) connector to the radio's SMA receptacle-type RF connector. Mate the two connectors and turn the plug clockwise. Tighten using two 5/16-inch wrenches. Do not overtighten.

NOTE

Do not alter the length of cable from the GPS antenna. Tie and stow excess cable as necessary.

8 RADIO DC POWER INSTALLATION

Refer to the wiring diagram at the end of this manual as necessary when performing wiring procedures presented in this section. With regards to control head installation, power connections for the CH-721 Scan and CH-721 System control heads 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 wire of the radio's DC Power Cable is only used for the data-only radio (i.e., no control head), and it is the only means for turning the data-only radio on and off. An in-line switch for switched battery power to the radio must not be considered unless the user has the discipline to turn off the radio through the control head's on/off/volume control 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 may result in the loss of settings that have changed (e.g., volume setting, etc.) during the operating session.

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/off automatically with vehicle's ignition switch/key** — The white 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 positive (+) 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. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly. The required fuse rating for this white wire is 3 amperes.
- **Radio turns on with a manual switch** — The white 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. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly. The required fuse rating for this white wire is 3 amperes.
- **Radio turns on with control head's on/off/volume control ("hot wired")** — This configuration allows radio power on/off control only via the control head's on/off/volume control. It may be desired if, 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 not desired. In this case, the white wire of the control head's DC Power Cable must be connected to unswitched and fused vehicle power. The required fuse rating for this white wire is 3 amperes.

Both the radio's and the control head's DC Power Cables each include an inline fuse holder and 3-amp fuse for fusing the respective cable's white wire. The radio's DC Power Cable includes an inline fuse holder and a 15-amp fuse for fusing its red wire. The control head's DC Power Cable includes an inline fuse holder and a 5-amp fuse for fusing its red wire. All four (4) inline fuse holders are waterproof HFB-type fuse holders that can be located in harsh environments such as under the vehicle hood, or in the passenger compartment of the vehicle. Typically, only three of the four associated power wires must be connected to a power source.

NOTE

The white wire of the radio's DC Power Cable should only be connected to a power source (switched or unswitched) in the case of a data-only radio installation. Connecting this radio ignition sense input wire to a power source will leave the radio in the on state whenever the power source is on (e.g., ignition key is on) and main power is also applied to the radio via the cable's red wire, resulting in current drain from the vehicle battery.

8.2 POWER INSTALLATION PROCEDURE

8.2.1 DC Power Cable and Main Fuse Holder Installation

The radio's DC Power Cable has a 3-pin connector, a 20-foot red wire (for the main power connection), a 20-foot white wire (only connected in a data-only radio installation), and a 4-foot black wire (for the ground connection). It is supplied with waterproof inline fuse holders, three AGC fuses, and non-insulated ring terminals. The following installation procedures are recommended:

8.2.1.1 Black Wire Connection (Ground Wire)

1. Connect the radio's DC Power Cable to the radio by mating its 3-pin connector to the radio's 3-pin power cable 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.

Do not confuse the radio's DC Power Cable which has a 10-AWG red wire with the control head's DC Power Cable which has a 12-AWG red wire. The radio requires much more DC operating current than the control head. Therefore, it requires the larger wire size of 10-AWG. **The part number of the radio's DC Power Cable is CA-012365-001.**

2. **Prepare to connect the cable's black wire to vehicle ground by locating an area of vehicle metal within approximately three (3) feet of the radio. This surface must have a solid and stable connection to vehicle ground (i.e., battery ground).**

The radio must have a solid and stable ground connection to vehicle ground. If there is no well-grounded metal surface within approximately three (3) feet of the radio, a metal grounding strap or a heavy-gauge wire (with proper wire terminals) must be added between the metal surface and a solid and stable vehicle grounding point, preferably near the battery. Some vehicles are equipped with a high-current DC power access point (option) that provides high-current power and ground studs, typically in the vehicle's trunk area. In this case, the ground stud of the power access point can be considered a good vehicle ground, and used as such. Metal surfaces should be stripped of all paint and dirt to expose bare metal before attaching a grounding strap or wire terminal. To make all ground connections, the use of stainless-steel hardware with machine-screw threads, shelf-locking nuts and washers is recommended.

3. Strip the area of any paint or dirt to expose a bare metal surface, approximately ¾-inch square.
4. Drill a hole in the approximate center of the bare metal surface, and deburr it. A ⅜-inch non-insulated ring terminal is supplied with the cable to make this ground connection. Therefore, hole diameter should be appropriate for the utilized grounding screw/bolt size and type used to connect the ring terminal to the bare metal surface. This hardware is not supplied.
5. Cut the black wire to the required length plus some additional length for a service loop, then strip insulation back approximately ¼-inch.
6. Crimp a ⅜-inch non-insulated ring terminal (supplied with the cable) to the end of the black wire.
7. Attach the ring terminal and black wire to the bare metal surface using stainless-steel self-locking hardware (i.e., machine screws with washers and locking nuts) or other appropriate hardware to ensure a reliable terminal-to-metal contact. Tighten securely.
8. Apply an approved paint or rust-inhibitor over the remaining exposed bare metal surface and around the ring terminal(s). Do not use an acid-based sealant.

8.2.1.2 Red Wire and Main Fuse Holder Connection (Radio's Main Power Wire)

1. Continue installation of the radio's DC Power Cable by routing its 20-foot 10-AWG red wire to the location of the vehicle's battery (or its main DC bus bar or stud). Remove interior panels, door kick panels, etc., and route the wire through existing channels in the vehicle to the location of the battery. Protect the wire from possible chafing where necessary. Tie and stow it as necessary.

Plan the routing of the 10-AWG red wire carefully, using an existing access hole in the vehicle's firewall if possible. Alternately, drill a new hole approximately ⅜ inches 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 sealer before completing the installation.**

Do **not** install any wiring or fuse holder over or in the near vicinity of the vehicle's engine. Excessive engine heat can cause permanent damage to these components and can lead to intermittent electrical connection to the battery.

Before making connections to the battery's positive post, carefully disconnect the battery's negative (ground) cable(s). This will prevent tools or other metallic objects which come in contact with the battery's positive terminal from shorting to vehicle ground, causing sparks or even a fire or an explosion! When disconnecting the negative cable(s), cover/insulate the positive post(s) if it is not already so a tool cannot short between the posts. Some vehicles, such as those with diesel engines have more than one battery; in this case, disconnect the negative cables at all batteries.

Radio and control head fuses should not be installed until all wiring is complete. This will prevent the radio from powering up prematurely and/or causing an in-rush of current that could lead to shorting of the battery, sparks, or even fire.

2. Obtain one of the waterproof inline fuse holders (HFB type) included with the DC Power Cable.
3. **Observe and follow the previously presented WARNING!**
4. Cut the red wire to the required length for connection to the battery's positive (+) battery terminal (or the main DC bus bar or stud).
5. Prepare to splice the inline fuse holder into the red wire by cutting the red wire again, at approximately three (3) to six (6) inches from the end.
6. Strip all three (3) wire ends back approximately ⅜-inch, place a fuse holder shell on each wire, and securely crimp a fuse holder terminal to each wire end. Before crimping, verify fuse holder shells are oriented in the correct directions (i.e., with each large end towards the wire end).
7. Label this fuse holder and red wire appropriately (e.g., "M7200 Main Power: 15-AMP FUSE")
8. **Do NOT install a fuse into the fuse holder at this time.**
9. Crimp an appropriate electrical terminal to the short red wire. A ⅜-inch ring terminal is included with the cable for this purpose, but another terminal type (not supplied) may be used if required.
10. Connect the 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).

NOTE

Most M7200 radio installations have one or more control heads connected to the radio. In an installation of this type, the white wire of the radio's DC Power Cable requires no electrical connection. Rather than be cut from the cable, it is recommended that it be routed up to the vehicle's fuse box, coiled, labeled, and stowed for possible future use. The white wire of the control head's DC Power Cable is the radio installation's ignition sense input for on/off power control of both the control head and radio. Radio on/off power control is accomplished by the control head. The control head "wakes-up" the radio via data activity on the CAN link.

8.2.1.3 White Wire Connection (for Data-Only Radio Installations ONLY)

In the case of a data-only radio installation (i.e., no control head connected to the radio), the white wire of the **radio's** DC Power Cable is used as the radio installation's ignition sense input. Therefore, it requires electrical connection to a fused switched power source. The following procedure is recommended:

1. Route the 20-foot white wire of the radio's DC Power Cable to the location of the vehicle's switched power source connection point, typically identified as "Accessory" power. Remove interior panels, door kick panels, etc., and route the wire through existing channels in the vehicle body as necessary. Protect the wire from possible chafing where necessary. Tie and stow the wire as necessary.
2. Connect this white wire through a fuse to the switched power source in accordance with the instructions presented within the respective subsection of Section 9.4.2 (page 52) for the *control head's* white wire. Follow the procedure in Section 9.4.2.1 (page 53) if the vehicle's ignition switch/key must control the data-only radio's on/off power. Follow the procedure in Section 9.4.2.2 (page 54) if a manually-controlled switch must control the data-only radio's on/off power.

NOTE

The white wire of the radio's DC Power Cable should only be connected to a power source (switched or unswitched) in the case of a data-only radio installation. Connecting this radio ignition sense input wire to a power source will leave the radio in the on state whenever the power source is on (e.g., ignition key is on) and main power is also applied to the radio via the cable's red wire, resulting in current drain from the vehicle battery.

The control head wakes up the radio via the CAN port when power is applied. However, connection of this wire may be needed in future configurations that do not use the control head (e.g., data-only radio applications). Therefore, it is recommended that the radio's 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.

CAUTION

When servicing the radio and/or control head, always manually power-down the radio equipment via the control head's on/off/volume control knob, and then remove the main power fuses for radio and control head(s), and the ignition sense input fuse.

CAUTION

Installing a fuse with the wrong amperage rating could cause an unsafe condition or a blown fuse condition. When replacing fuses, always verify the correct fuse value and type of fuse is installed! The radio requires a 15-amp AGC main power fuse (red wire), and the control head requires a 5-amp main power fuse (red wire) and a 3-amp fuse on its ignition sense input (white wire).

9 CONTROL HEAD INSTALLATION

9.1 GENERAL INFORMATION

Since the M7200 is a remote-mount mobile radio, each radio must be connected to a control head to provide the operator-to-radio interface. Two different control heads are available—the CH-721 Scan model and the CH-721 System model. See Figure 9-1 and Figure 9-2 respectively. The CH-721 Scan model control head features three (3) large menu selection buttons. The System model control head has a 12-button keypad to allow advanced operations without the need of a DTMF-capable microphone.

Figure 9-3 on page 47 illustrates the rear panel of the two control head models. Both models have identical rear panels and rear panel connectors.

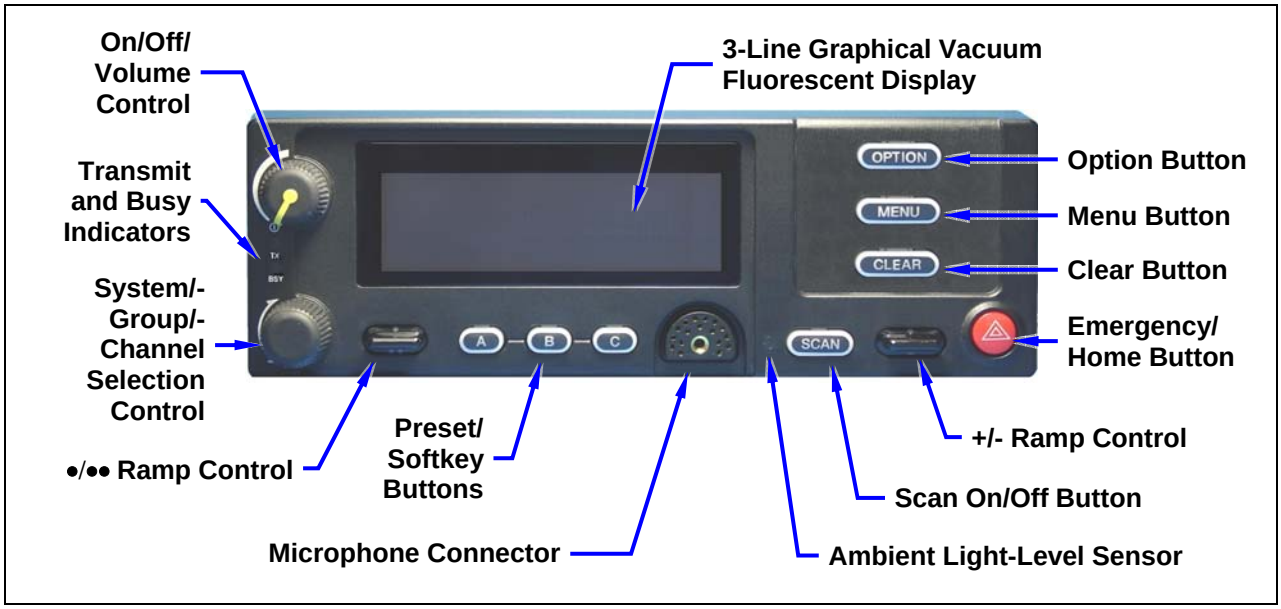


Figure 9-1: CH-721 Scan Model Control Head Front Panel

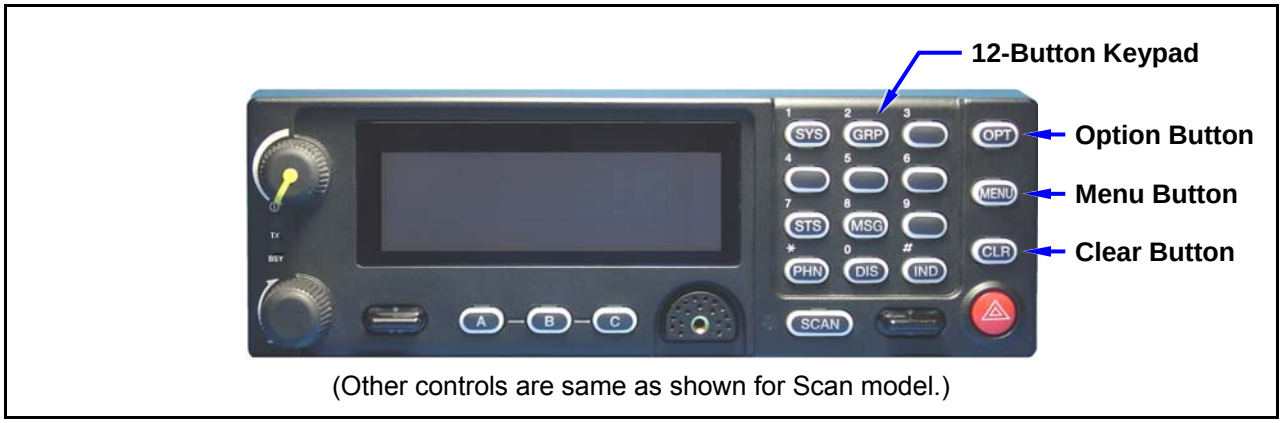


Figure 9-2: CH-721 System Model Control Head Front Panel

The CH-721 control heads feature a large easy-to-read 3-line graphical vacuum fluorescent display, an on/off/volume control knob, menu controls and buttons, trunking mode buttons, an emergency/home button, a scan on/off button, and three (3) preset buttons. Other front panel components include a microphone connector and LED-type indicators. One LED indicator is the busy indicator that lights when

the radio is receiving a call and one is the transmitter-enabled indicator that lights when the radio is transmitting. The front panel also has an ambient light sensor for automatic display dimming.

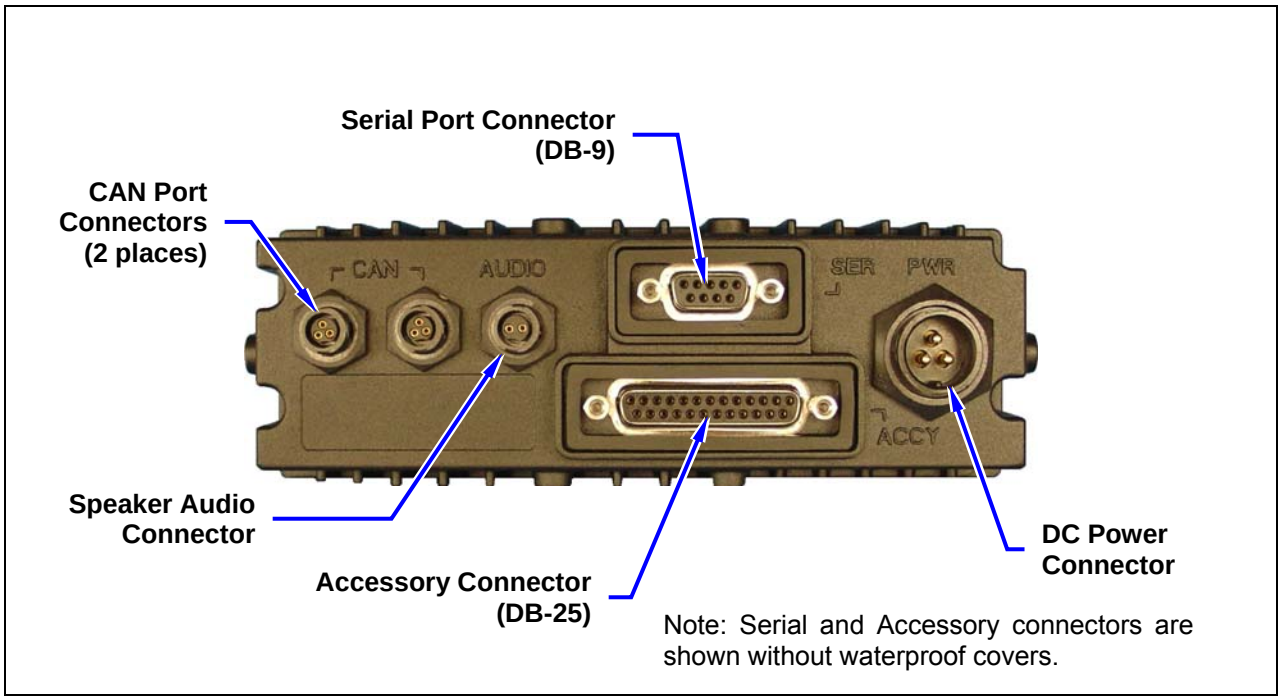


Figure 9-3: CH-721 Rear Panel (both control head models)

NOTE

Prior to installing the control head, verify it has the proper software version installed and verify it has been properly configured for customer use.

In a mobile installation, more than one control head can be connected to one mobile radio for multi-head installations. A multi-head installation may be required in a vehicle such as a fire truck or any large vehicle where more than one operator may require use of the radio. Multi-head installations also provide other benefits such as intercom functionality.

9.2 CONTROL HEAD MECHANICAL INSTALLATION

9.2.1 Selecting the Mounting Location

When selecting a location for the CH-721 control head, first observe the safety and operator-convenience related information presented in Section 5.1 on page 26. Also always consider and include clearance for the microphone's connector that must mate to the mic connector on the front panel of the head, and clearance for the connectors/cables that must mate to the connectors on the rear panel of the head. The CH-721 control head can be mounted under or on top of a mounting surface (typically the vehicle's dash) as space permits using either the standard U-shaped mounting bracket or the optional mounting pedestal.

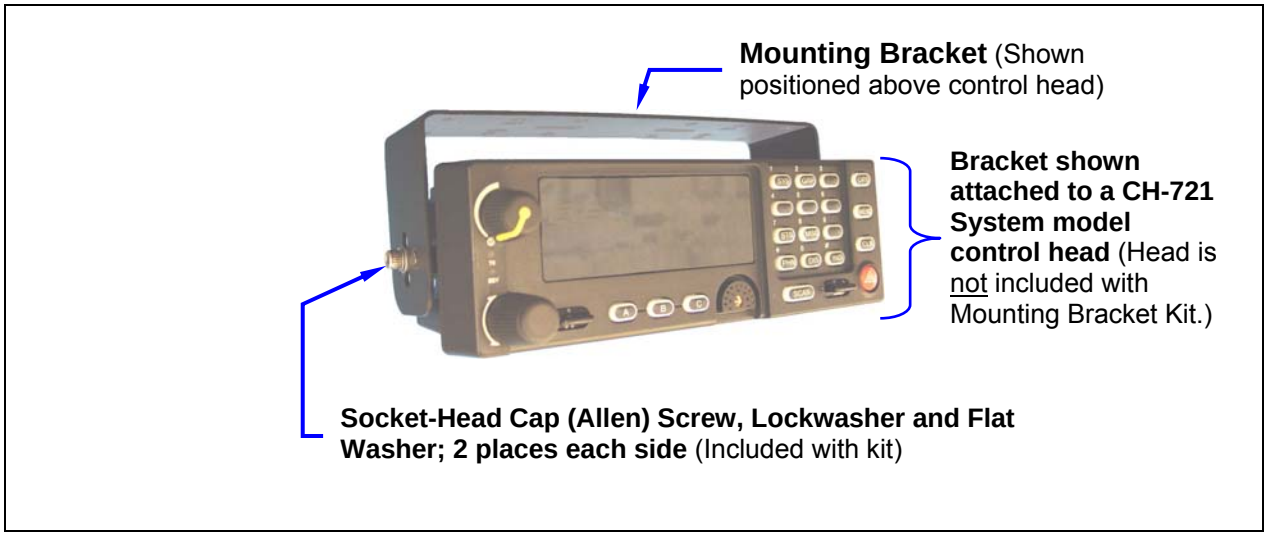


Figure 9-4: Standard U-Shaped Control Head Mounting Bracket (Kit Part Number KT-008608)

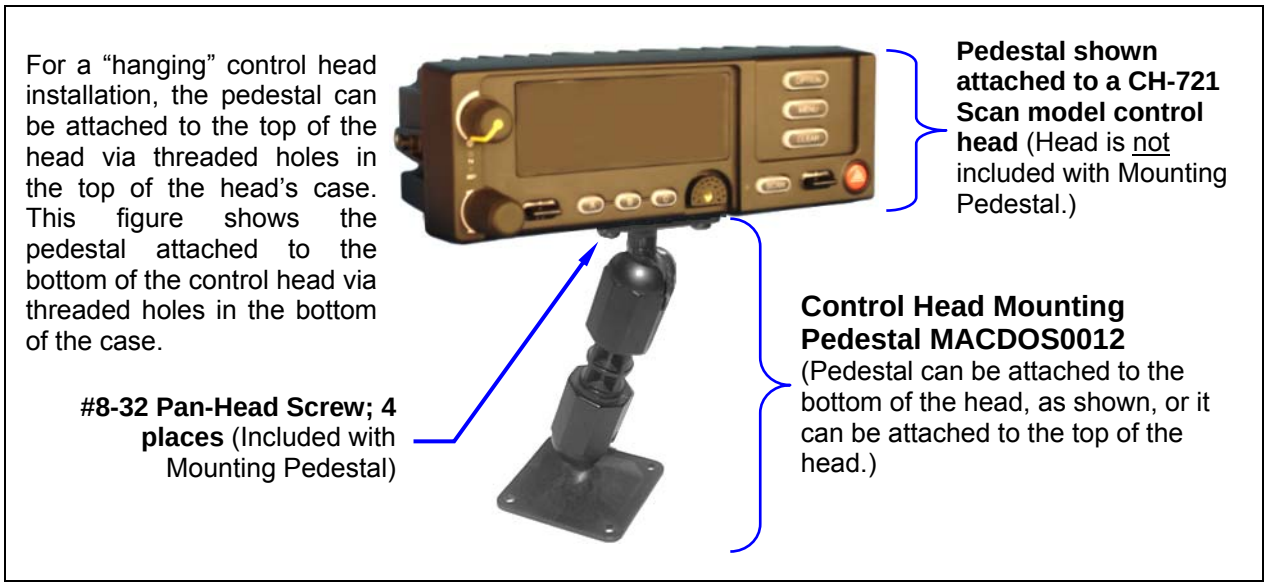


Figure 9-5: Optional Control Head Mounting Pedestal (Part Number MACDOS0012)

9.2.2 Using the Standard U-Shaped Mounting Bracket

If the standard U-shaped Mounting Bracket will be used to mount the control head, the following mounting procedure is recommended. This bracket is a part of Mounting Bracket Kit KT-008608 (Item 6 listed in Table 4-1 on page 20).

1. Using the Mounting Bracket as a template, mark and drill mounting holes into the mounting surface as required. The round and elliptical holes in the bracket's vehicle mounting surface are symmetrical so forward/backwards positioning is not important during this step. However, positioning is important in the next step.

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 (i.e., deburr the holes) before placing the bracket and installing the mounting screws.

2. Postion the bracket at the mounting surface so the two round holes in its two side "ears" are nearest to the normal location of the operator (typically towards the rear of the vehicle) and the two slotted holes are farthest from the normal location of the operator (typically towards the front of the vehicle).
3. Install and tighten the mounting screws. Screws for mounting the bracket to the mounting vehicle's surface are not included, as all installations differ. Self-tapping screws are recommended. Do **not** use common self-threading sheet metal screws because they will loosen over time with vehicle vibrations.
4. 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.
5. Slide the control head into the bracket, placing the two pegs protruding from its left and right sides into the respective round holes in the bracket's two side "ears."
6. In each side "ear" of the mounting bracket, start a #8-32 socket-head cap (Allen) head screw with a lockwasher and a flat washer by inserting the screw through the slotted hole in the bracket and then into the threaded hole in the side of the control head. This hardware is included with Mounting Bracket Kit. The lockwasher should be adjacent to the screw head and the flat washer should be adjacent to the bracket. Turn each screw clockwise as observed from the head of the screw.
7. The control head can be positioned at various angles for best display viewing at the normal position of the operator. As necessary, turn it on the pegs to a good position and tighten both screws using an ⅛-inch hex key (Allen) wrench until the control head is held firmly in place. Do not over-tighten.

9.2.3 Using the Mounting Pedestal (Optional)

An optional Mounting Pedestal, part number MACDOS0012, may be purchased separately to replace the standard U-shaped Mounting Bracket. This pedestal can be attached to the bottom of the control head as shown in Figure 9-5 and then mounted to a mounting surface below the two. It can also be attached to the top of the head and then mounted to a mounting surface above the two.

9.3 CAN CONNECTIONS

9.3.1 General Information

The installation requires a CAN cable between every two "CAN devices" and CAN terminators on each end of the CAN link. The M7200 mobile radio is considered a CAN device, and each CH-721 control head in the installation is also considered a CAN device. Figure 9-6 illustrates CAN cable and CAN terminator connections for a single control head installation. Figure 9-7 illustrates this for a multi-head control head installation where, for example, one control head is located at the main operator location and another is located near the rear of the vehicle. Because CAN devices do not have internal terminators, the CAN link must be terminated at both ends via a CAN terminator.

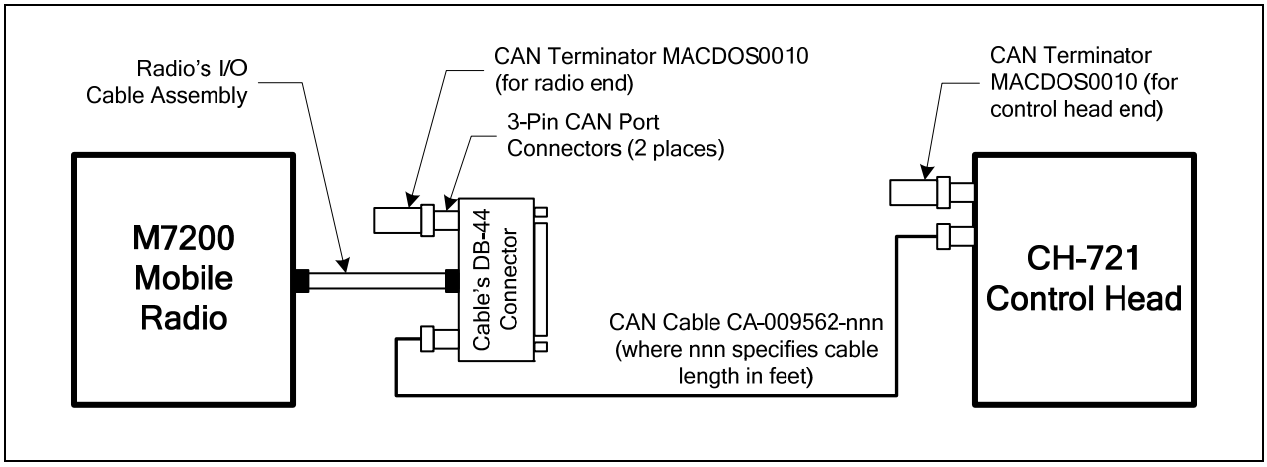


Figure 9-6: CAN Link Connections for a Single Control Head Installation

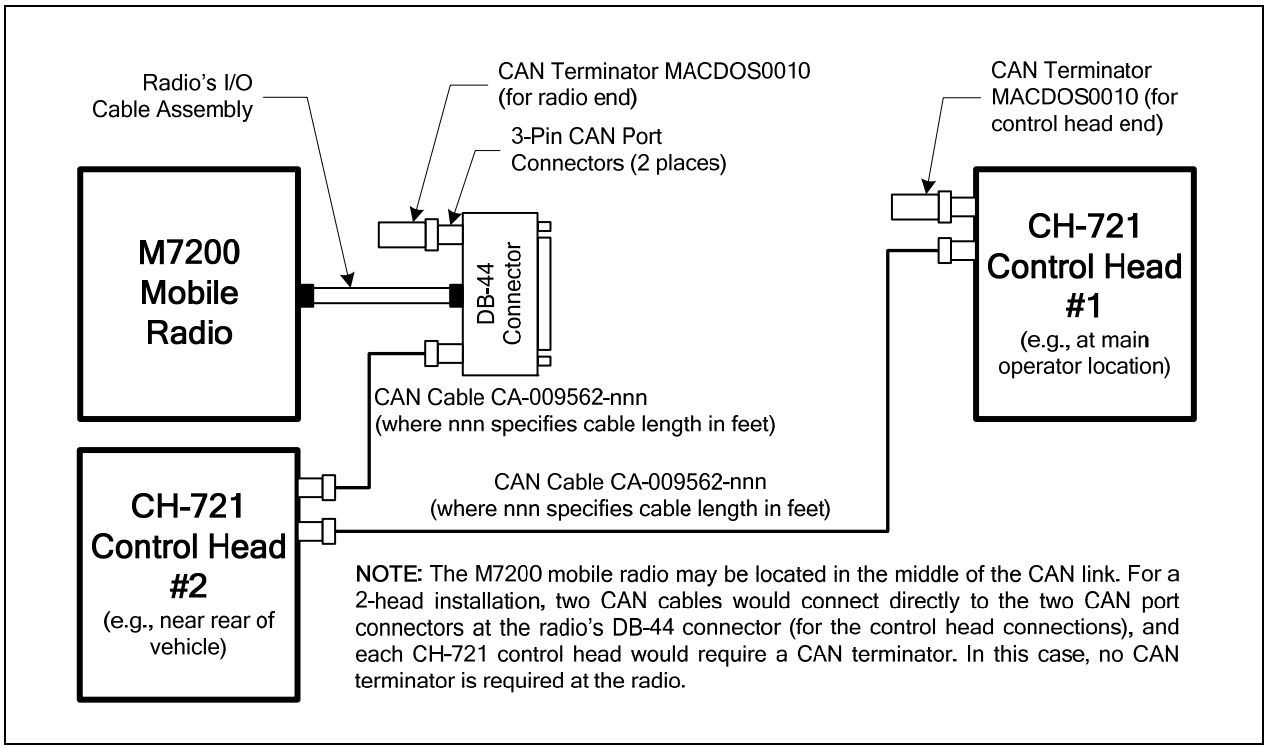


Figure 9-7: Typical CAN Link Connections for a Multi-Control Head Installation

Both the radio and the control head have two CAN ports to support "daisy-chaining" of multiple control heads or other CAN devices. Figure 5-2 on page 28 shows the radio's two CAN port connectors, which are located on cable side of the I/O cable's DB-44 connector. Figure 9-3 on page 47 shows the two ports on the control head's rear panel.

9.3.2 Make CAN Link Terminations and Cable Connection

Follow this procedure for an installation which has only one control head. For a multi-control head installation, refer to Figure 9-7 presented in the previous section as necessary.

1. Connect the CAN Terminator (Item 7 listed in Table 4-1 on page 20) onto either one of the two smaller 3-pin connectors on the rear of the CH-721. This action makes the CAN termination at the control head end of the CAN link.

When mating any CAN connection (terminators and cables), visually align the ¾-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. 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.

2. Route the CAN Cable (Item 5 listed in Table 4-1 on page 20) through the vehicle's interior wire/cable channeling to the radio. Remove interior panels, door kick panels, etc., as necessary. Protect the cable from possible chafing as necessary.
3. Attach the CAN Cable's connector to one of the two CAN port connectors on the radio's I/O cable.
4. Connect the other end of the CAN Cable to the open CAN port connector at the rear of the control head.
5. Connect the CAN Terminator (Item 7 in Table 4-1) onto either one of the two smaller 3-pin connectors on the radio's I/O cable. This action makes the CAN termination at the radio end of the CAN link.
6. Tie and stow the excess cable as necessary.

9.4 CONTROL HEAD POWER CABLE INSTALLATION

Plan the route of the control head's DC Power Cable carefully. Do not route the cable where it will be damaged by heat sources or by casual contact, and protect it from wire chafe per standard installation methods. The following procedures are recommended:

9.4.1 Install DC Power Cable and Make Power and Ground Connections

1. Connect the control head's DC Power Cable (Item 4 listed in Table 4-1 on page 20) to the large 3-pin connector at the rear of the 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, locate a nearby section of vehicle chassis ground and strip this area of any paint or dirt to expose a bare metal surface.
3. Cut the black wire of the control head's DC Power Cable to the required length, plus a service loop of at least six (6) inches, then strip it and crimp a ⅜-inch ring terminal to it. Two (2) ring terminals of this type are included with the cable.

4. Drill a hole as necessary and attach this ring terminal to chassis ground. Use stainless-steel self-locking hardware (i.e., machine screws with washers and locking nuts) or other appropriate hardware to ensure a reliable terminal-to-metal contact. Tighten securely.

The control head must have a solid and stable ground connection to vehicle ground. If there is no well-grounded metal surface within approximately four (4) feet of the control head, the DC Power Cable's black wire should be extended to a solid and stable vehicle grounding point, preferably near the battery. Some vehicles are equipped with a high-current DC power access point (option) that provides high-current power and ground studs, typically in the vehicle's trunk area. In this case, the ground stud of the power access point can be considered a good vehicle ground, and used as such. Metal surfaces should be stripped of all paint and dirt to expose bare metal before attaching a ground wire. To make all ground connections, the use of stainless steel hardware with machine-screw threads, shelf-locking nuts and washers is recommended. To extend the length of the ground wire, use at least 12-AWG wire and approved wire splicing techniques.

5. At the back of the control head, tie and stow the cable as necessary.
6. For the positive 12-volt DC main power source connection, route the cable's red wire to the location of an **unswitched** 12-volt DC power source, typically near the vehicle's battery. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing as necessary. This is the control head's main DC power source.
7. Obtain one of the waterproof inline fuse holders (HFB-type) included with the control head's DC Power Cable.
8. Cut excess length from the red wire and splice the fuse holder into it, near the location of the unswitched 12-volt DC power source connection point.
9. Label this fuse holder and red wire appropriately (e.g., "CH-721 Main Power: 5-AMP FUSE")
10. Using an appropriate electrical terminal, connect the red wire to the unswitched DC power source. A ⅜-inch ring terminal is included with the cable for this purpose, but another terminal type (not supplied) may be used if required.
11. Obtain the 5-amp AGC fuse included with the cable, and install it into the fuse holder.

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.

The fuse rating for the control head's red wire is 5 amperes. The 3-amp fuse included with the cable must **not** be used for fusing the control head's main DC power. It fuses the head's white wire.

9.4.2 Connect DC Power Cable's White Wire

A review of the information presented in Section 8.1 (page 41) may be beneficial at this time. As required per the chosen power-up configuration, connect the white wire by following **one** of the three procedures presented in the respective sub-section that follows.

NOTE

Only the control head'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.

9.4.2.1 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 sometimes referred to as the "white ignition switch wire" or the "ignition sense input 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. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly.

NOTE

The white ignition sense wire must be connected to a 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 vehicle's switched ignition or "Accessory" power connection point that will be used for the switched ignition 12-volt DC power source. This point is typically located at or near the vehicle's fuse panel. 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 the area near this connection point. Protect the wire from possible chafing as necessary.
3. Obtain one of the waterproof inline fuse holders (HFB-type) included with the control head's DC Power Cable **or** see the following **NOTE**.
4. Cut excess length from the white wire and splice the fuse holder into it, near the location of the connection point.
5. Using an appropriate electrical terminal, connect the white wire to the switched power connection point. An open-barrel spade terminal is included with the cable for this purpose, but another type of terminal (not supplied) may be used as required.
6. Obtain the 3-amp AGC fuse included with the cable, and install it into the fuse holder.
7. Tie and stow all wiring as necessary so it remains out of the way of casual contact and wire chafe is avoided.

NOTE

The waterproof inline fuse holder and AGC fuse included with the DC Power Cable **must** be used if the white wire connection point is located in a harsh environment such as in the vehicle's engine compartment. However, if the connection point is **not** in a harsh environment, such as under the vehicle's dash panel, Vehicle Fuse and T-Tap Kit FS24473 may be ordered and used to make the white wire connection. As shown in Figure 9-8, this kit includes an ATM fuse holder and fuse, T-tap crimp terminals for tapping into an existing vehicle switched power wire, and a quick-disconnect terminal. See Section 9.4.3 on page 54 for additional information.

9.4.2.2 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 and/or required. In this configuration, the white wire connects to a fused switched power source such as that provided by a toggle switch mounted on the vehicle's dash panel. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly.

1. Route the white wire of the control head's DC Power Cable from the back of the head to an area near the location of the panel-mounted on/off switch. Protect the wire from possible chafing as necessary.
2. Cut a short section (6 to 8 inches) off the end of the white wire and strip the ends.
3. Obtain one of the waterproof inline fuse holders (HFB-type) included with the control head's DC Power Cable, and crimp one half of it to one end of the short section of wire.
4. Using an appropriate electrical terminal, connect this short white wire to unswitched 12-volt DC power source at or near the vehicle's fuse box.
5. Cut another section of white wire from the cable. This wire must be long enough to reach from this fuse holder to the location of the panel-mounted on/off switch.
6. Strip one end of this wire and crimp the other half of the fuse holder to this wire end.
7. Strip the other end of this wire and, using an appropriate electrical terminal, connect it to the common terminal of the switch.
8. Connect the white wire of the power cable to the load (switched) side of the switch.
9. If not already, mount the switch to the vehicle's dash panel, or other customer-selected location.
10. Obtain the 3-amp AGC fuse included with the cable, and install it into the fuse holder.
11. Tie and stow these wires as necessary so they remain out of the way of casual contact and wire chafe is avoided.
12. Label this power switch accordingly. For example: "**RADIO ON/OFF**."

9.4.2.3 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/volume control located on the front panel of the control head. In this configuration, the control head's white wire must be connected to **unswitched and fused 12-volt** vehicle power. Follow the procedure presented in Section 9.4.2.1, except connect the white wire to **unswitched** battery power instead of switched ("Accessory") power.

9.4.3 Using Vehicle Fuse and T-Tap Kit (Optional) Instead of Waterproof Inline Fuse Holder (Standard)

The waterproof inline fuse holder and AGC fuse included with the DC Power Cable **must** be used if the white wire connection point is located in a harsh environment such as in the vehicle's engine compartment. In this case, disregard all information presented in this section, and follow one of the three procedures presented in Section 9.4.2 to connect the white wire.

However, if the connection point is **not** in a harsh environment, such as under the vehicle's dash panel, Vehicle Fuse and T-Tap Kit FS24473 may be ordered and used to make the white wire connection. As

shown in Figure 9-8, this kit includes an ATM fuse holder and fuse, T-tap crimp terminals for tapping into an existing vehicle switched power wire, and a quick-disconnect terminal. The following installation procedure is recommended for this optional kit:

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 length of at least six (6) inches and do not loop the cable.
3. Cut a short section (6 to 8 inches) off the end of the white wire and strip each end of this short wire.

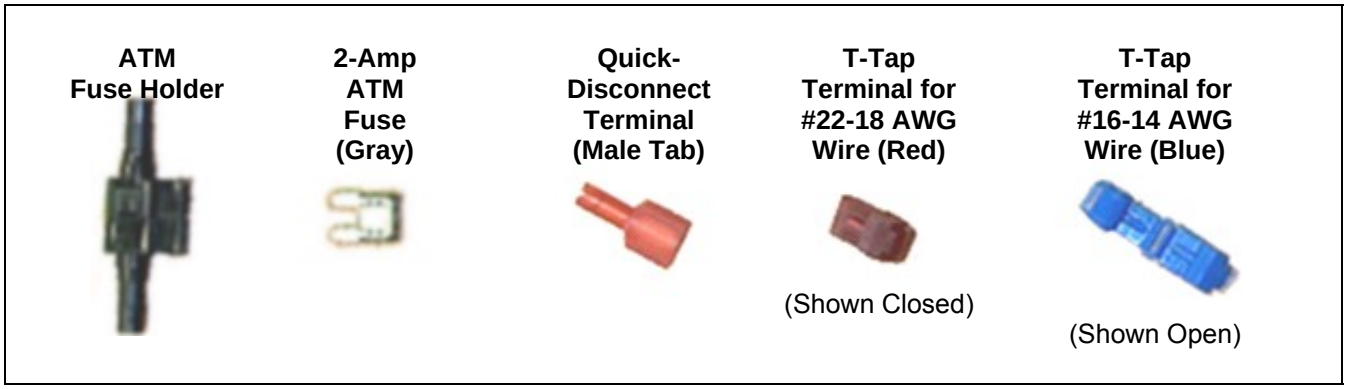


Figure 9-8: Contents of Vehicle Fuse and T-Tap Kit FS24473

4. From the Vehicle Fuse and T-Tap Kit, locate the male-tab quick-disconnect terminal and crimp it to one end the short wire.
5. From the same kit, locate the ATM fuse holder and crimp it to the other end of the short wire. The holder has built-in crimpable joints.
6. 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.
7. Pull enough of the switched ignition source wire out of the vehicle's wiring harness so one of the T-tap terminals may be attached to it.
8. Two T-tap terminals are included in the kit. Based on the gauge of wire, select the proper terminal size: Red is for connecting to a 22 to 18-AWG wire, and blue is for connecting to an 18 to 14-AWG wire.
9. Attach the selected T-tap terminal by fitting the wire into its wire groove and snapping the two halves together with a pair of pliers as shown in Figure 9-9.

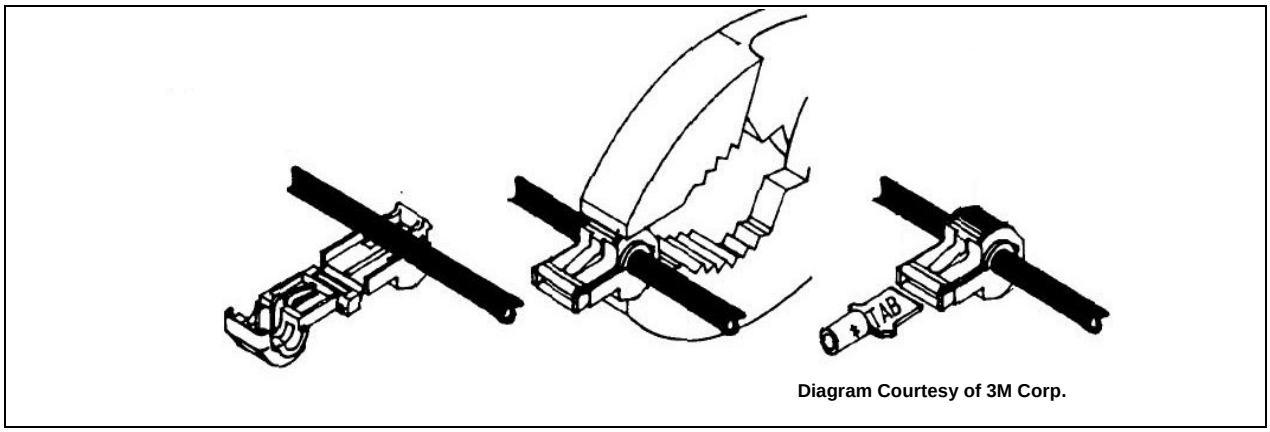


Figure 9-9: Attaching T-Tap Terminals to a Switched Power Wire

10. Push the male-tab quick-disconnect terminal into the T-tap terminal's inlet until it is fully engaged.
11. 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.
12. Tie and stow these wires as necessary so they remain out of the way of casual contact and wire chafe is avoided.

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 Section 8.2, except make the connection of the white wire of the ***radio's*** DC Power Cable as detailed in the control head Section 9.4.2.1 (page 53) or Section 9.4.2.2 (page 54).

NOTE

The radio's ignition sense input (DC Power Cable's white wire) is the only means for turning the Data-Only radio on and off. The "hot wired" configuration cannot be used in a Data-Only radio installation.

11 SPEAKER INSTALLATION

Select a location for the speaker that will allow for proper listening range with a moderate volume setting. Total speaker cable length (of both cables) is approximately five (5) feet. Therefore, to include service lengths in the cables, the speaker must be mounted within approximately 4.5 feet of the control head.

1. Install the speaker (Item 8 listed in Table 4-1 on page 20) using the hardware and mounting bracket supplied with it. Also refer to the instructions included in the speaker for additional mechanical installation information.
2. Route the speaker's cable to the rear of the control head.
3. Mate the Speaker Cable (Item 9 listed in Table 4-1 on page 20) to the 2-pin connector at the rear of the control head by visually aligning the ¾-moon-shaped keys of the connectors, and then pushing and turning the outer locking ring of the cable connector clockwise until it stops. A mild click will be sensed to confirm proper mating.
4. Connect the speaker's 2-pin plastic connector to the respective mating connector on the Speaker Cable.
5. Route the cables out of the way of casual contact. Tie and stow as necessary. Do not loop the cables.

12 MICROPHONE ATTACHMENT

There are several versions of microphones available for use with the radio. Each has a 17-pin flush-mount type connector that mates with the microphone (mic) connector on the front panel of the control head. The mic's connector includes a captive thumbscrew that secures it to the mic connector on the front panel of the control head. A microphone clip is included with each microphone. The radio can be configured to provide a monitor function when the microphone is cradled in the clip. Connect the mic to the control head and install the clip as follows:

1. As illustrated in Figure 12-1, grasp the mic's connector with a thumb and index finger on the sides of the connector just adjacent to the thumbscrew.
2. Position connector just in front of the control head's mic connector so its male pins can engage straight into the female (socket) pins of the control head's mic connector. The thumbscrew must be oriented directly above the hanging mic cable.
3. Mate the two connectors by pressing them fully together. Do **not** apply any force to the thumbscrew when mating the connectors.
4. Tighten the thumbscrew finger-tight. Do **not** use a screwdriver to *tighten* it.
5. Using the microphone clip as a template, drill mounting holes in the surface of the selected location.
6. Select a mounting surface location that has clearance for the mic when it is clipped to the clip, and then attach the microphone clip to the surface. Use self-locking hardware (i.e., machine screws with washers and locking nuts), self-drilling screws, or other appropriate hardware as necessary. Tighten securely. Microphones used with the CH-721 control head have integrated hookswitches. Therefore, the microphone clip does **not** need to be grounded.
7. Clip the microphone to the clip.

Figure 12-1: Attaching the Microphone to the CH-721Control Head

13 OPTIONAL CABLES

13.1 FULL-DATA I/O OPTION CABLE 1000022242-0001

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. This cable is shown in Figure 13-1.

When connected, each DB-9 connector of the Full-Data I/O Option Cable is a TIA/EIA/RS-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: two 0-to-12-volt-level logic inputs, two TTL-level logic inputs, two open-collector logic outputs, and a "baseband" audio interface. The baseband interface is a 4-wire balanced-line audio interface with a PTT logic input and a receiver unsquelched (RUS) logic output. Table 13-1 shows the wiring of the Full-Data I/O Option Cable.

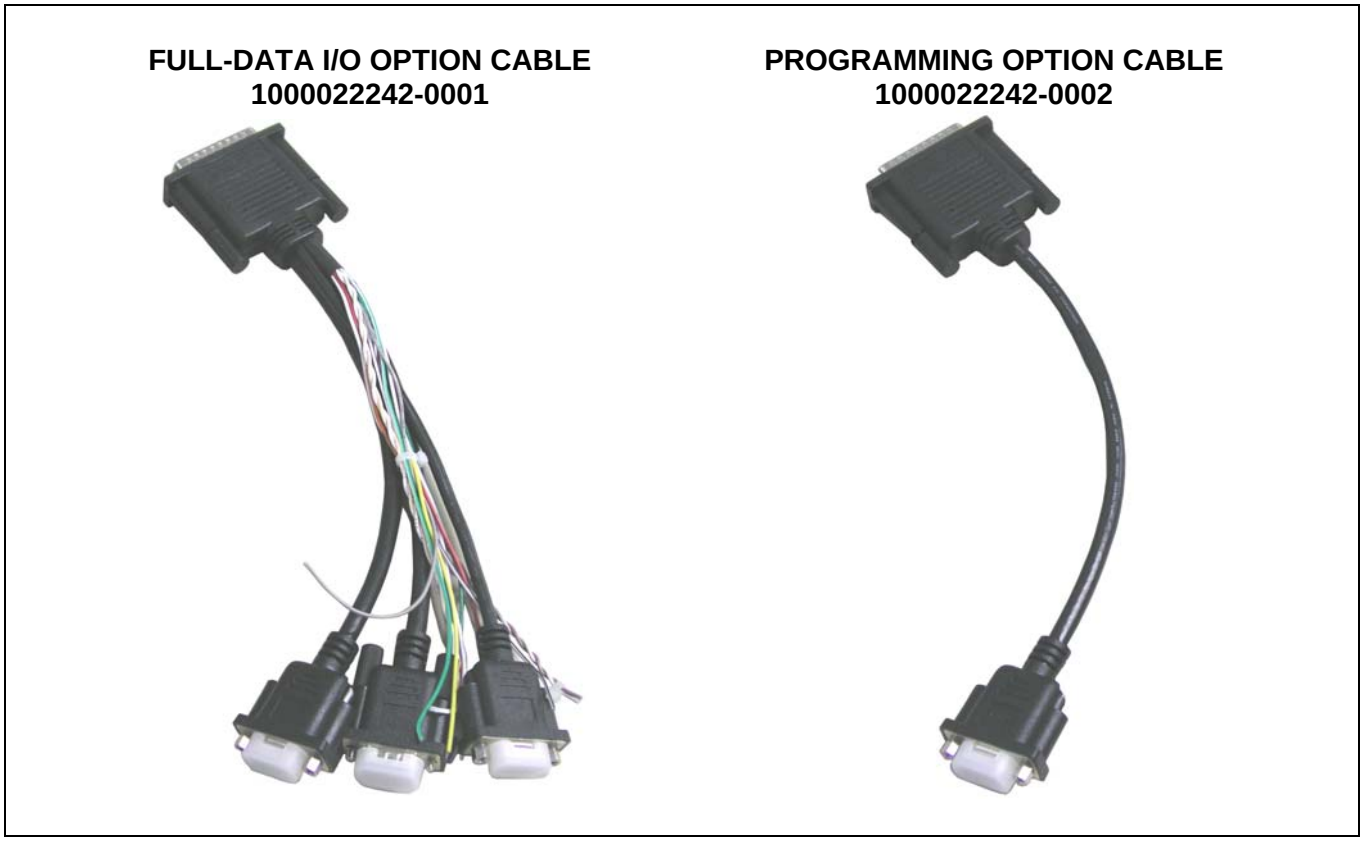


Figure 13-1: Full-Data I/O Option Cable 1000022242-0001 and Programming Option Cable 1000022242-0002

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[5]	SIGNAL NAME	DESCRIPTION
15	(Tan)	AUD_IN_L	Baseband audio interface's balanced-line audio input (high & low connections). 6 mV rms = approx. 2.5 kHz transmit deviation. 10 mV rms = approx. full-scale deviation (limiting). Use pin 14 (IN_SHLD) for shield ground.
30	(White/Gray)	AUD_IN_H	
14	(White/Blue)	IN_SHLD	Baseband audio interface's balanced-line audio input shield. Use with pins 15 and 30.
10	(White/Black)	AUD_IN_PTT*	Baseband audio interface's push-to-talk (PTT) logic input (active low). Use pin 35 (SGND1) for ground. Aux Input #1 must be mapped as "PTT" via programming software. For ECP mode, this logic input is called "Aux I/O Input 1" in the Radio Personality Manager (RPM) programming software.
35	(White/Violet)	SGND1	Baseband audio interface's signal ground reference. Used with pin 10.
44	(White/Brown)	AUD_OUT_L	Baseband audio interface's balanced-line audio output (high & low connections). 1 kHz tone @ 3 kHz receive deviation = approx. 280 mV AC. 1 kHz tone @ 4.5 kHz receive deviation = approx. 286 mV AC.
43	(White/Orange)	AUD_OUT_H	
29	(White/Green)	AUD_OUT_ACT	Baseband audio interface's audio output active open-collector logic output. 500 mA / 30 V maximum. For OpenSky, this output is a receiver unsquelch (RUS) logic output, which is configurable via the AT@MUTE_POLARITY command. For example, AT@MUTE_POLARITY0 causes this output to go to the low state (near ground potential) when the radio mutes. For ECP mode, this is auxiliary output 1, which is called "Aux I/O output 1" in the RPM programming software.
34	GPS pin 2	GPS_NMEA_TD	TIA/EIA/RS-232 serial port signals and ground for GPS NMEA-formatted serial data interface. See Section 14 on page 65 for additional information.
4	GPS pin 3	GPS_NMEA_RD	
20	GPS pin 5, shell	GPS_GND	
25	I/O-shell	GND_SHLD	Overall cable shield (radio ground).
38	MODEM pin 1	DCD_B	TIA/EIA/RS-232 serial port signals for modem connections
8	MODEM pin 2	RD_B	
23	MODEM pin 3	TD_B	
7	MODEM pin 4	DTR_B	
22	MODEM pin 5, shell	GND_B	
6	MODEM pin 6	DSR_B	
36	MODEM pin 7	RTS_B	
37	MODEM pin 8	CTS_B	
9	MODEM pin 9	RI_B	

[5] 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 (Cont.)

44-PIN I/O CABLE CONNECTOR PIN	DB-9 CONNECTOR NAME & PIN[5]	SIGNAL NAME	DESCRIPTION
3	SERIAL pin 1	DCD_A	TIA/EIA/RS-232 serial port signals for radio programming/configuration and Mobile Data Terminal (MDT) connections
16	SERIAL pin 2	TD_A	
31	SERIAL pin 3	RD_A	
18	SERIAL pin 4	DSR_A	
17	SERIAL pin 5, shell	GND_A	
32	SERIAL pin 6	DTR_A	
1	SERIAL pin 7	CTS_A	
2	SERIAL pin 8	RTS_A	
33	SERIAL pin 9	RI_A	
11	(Orange)	TTL_IN1	TTL-level digital logic input #1. For OpenSky mode only. This input is not operational in an ECP mode.
12	(Blue)	TTL_IN2	TTL-level digital logic input #2. For OpenSky mode only. This input is not operational in an ECP mode.
28	(Red)	OC_OUT1	Open-collector digital logic output #1. 500 mA / 30 V maximum. For OpenSky mode only. This output is not operational in an ECP mode.
13	(Gray)	OC_OUT2	Open-collector digital logic output #2. 500 mA / 30 V maximum. For OpenSky, this a “ready-to-talk” logic output, which is configurable via the AT@POLARITY_TALK command. This output is not operational in an ECP mode.
41	(Green)	VEHICLE_IN1	+12V-level control logic input #1 from vehicle.
40	(Yellow)	VEHICLE_IN2	+12V-level control logic input #2 from vehicle. (Normally used in V-TAC installations to enable/disable an Extended Coverage mode via an external toggle switch.)
21	(N/C)	USB_D-	USB port data- line.
5	(N/C)	USB_D+	USB port data+ line.
19	(N/C)	USB_VBUS	USB port voltage bias line.
24	(N/C)	—	(Pin 24 of 44-pin connector not used.)
26	(N/C)	—	(Pin 26 of 44-pin connector not used.)
27	(N/C)	—	(Pin 27 of 44-pin connector not used.)
39	(N/C)	—	(Pin 39 of 44-pin connector not used.)
42	(N/C)	—	(Pin 42 of 44-pin connector not used.)

13.2 PROGRAMMING OPTION CABLE 1000022242-0002

Related to the Full-Data I/O Option Cable is Programming Option Cable 1000022242-0002, also shown in Figure 13-1. This option cable presents only the DB-9 serial interface necessary to program, control, or establish a data connection with the radio. It adapts to a standard 9-pin serial computer cable, or alternatively it plugs 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 PIN	SIGNAL NAME	DESCRIPTION
1	7	CTS_A	TIA/EIA/RS-232 Signal, Radio Serial Port
2	8	RTS_A	TIA/EIA/RS-232 Signal, Radio Serial Port
3	1	DCD_A	TIA/EIA/RS-232 Signal, Radio Serial Port
16	2	TD_A	TIA/EIA/RS-232 Signal, Radio Serial Port
17	5, shell	GND_A	TIA/EIA/RS-232 Ground, Radio Serial Port
18	4	DSR_A	TIA/EIA/RS-232 Signal, Radio Serial Port
31	3	RD_A	TIA/EIA/RS-232 Signal, Radio Serial Port
32	6	DTR_A	TIA/EIA/RS-232 Signal, Radio Serial Port
33	9	RI_A	TIA/EIA/RS-232 Signal, Radio Serial Port

13.3 SERIAL PROGRAMMING CABLE CA-013671 -020

Serial Programming Cable CA-013671-020 (20 feet long) can be used to extend the length of the radio-to-computer serial link during a radio programming/configuration operation. This cable can also be used to extend the radio-to-computer serial link in a NMEA-format GPS data serial link. See Section 14 for additional information on GPS data serial link connections.

The male DB-9 connector on end of the cable connects to the female DB-9 serial port connector of Full-Data I/O Option Cable 1000022242-0001 or Programming Option Cable 1000022242-0002. The female DB-9 connector on the other end of the cable connects to the PC's serial port. If the utilized PC is not equipped with a DB-9 serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. Cable assembly and wiring diagrams are shown in Figure 13-2 below.

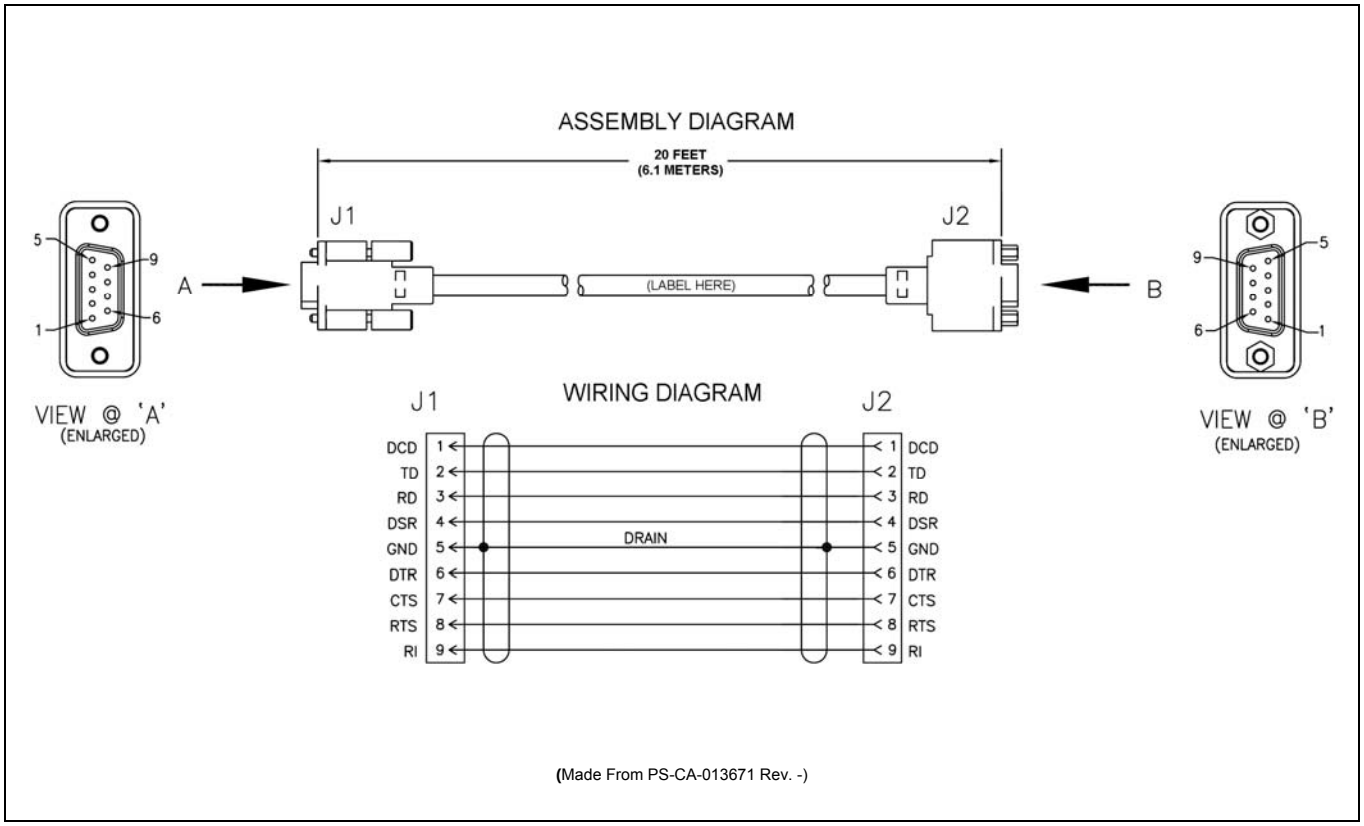
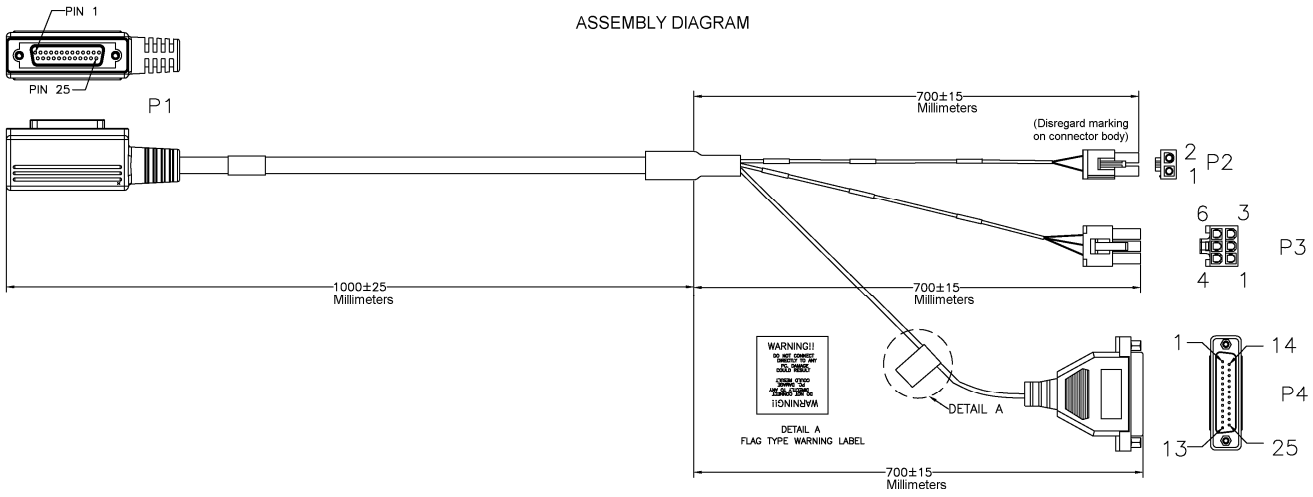


Figure 13-2: Serial Programming Cables CA-013671-010 and CA-013671-020

13.4 CH-721 OPTION CABLE CA-011854-001

CH-721 Option Cable CA-011854-001 can be used to connect optional equipment to the 25-pin D-subminiature (DB-25) connector on the rear of the CH-721. This cable expands the connections available at the 25-pin connector to three (3) separate connectors. The cable's assembly and wiring diagrams are shown in Figure 13-3.



WIRING DIAGRAM

	P1	COLOR			
INPUT 1	22	GREEN		P3–1	INPUT 1
			WIRE,UL1061	P3–4	GND
INPUT 2	9	RED		P3–5	INPUT 2
			WIRE,UL1061	P3–2	GND
HKSW	23	WHITE		P3–3	HKSW
GND	7	20AWG DRAIN	WIRE,UL1061	P3–6	GND
SPKR–LO	19	BLUE		P2–1	SPKR–LO
SPKR–HI	18	BROWN		P2–2	SPKR–HI
SW A+	25	WHT/BLK/RED		P4–25	SW A+
IGN A+	10	WHT/BLK/GREEN		P4–10	IGN A+
CNTLON	14	WHT/BLK/BLUE		P4–14	CNTLON
RS485–RQST	17	WHT/BLK/VIOLET		P4–17	RS485–RQST
HORN RING	21	WHT/BLK/BROWN		P4–18	HORN RING
CTS	6	WHT/ORG/RED		P4–6	CTS
RTS	2	WHT/ORG		P4–20	RTS
XDATA OUT	3	WHT/GREEN		P4–3	XDATA OUT
XDATA IN	20	WHT/BLACK		P4–2	XDATA IN
GND	1	20AWG DRAIN		P4–1	GND
RS485–	4	WHT/BROWN/BLUE		P4–4	RS485–
RS485+	5	WHITE/GREEN/RED		P4–5	RS485+
VOL HI	13	WHT/ORG/BLK		P4–11	VOL HI
EXT MIC	24	WHT/BROWN		P4–24	EXT MIC
MIC HI	11	WHT/BLUE		P4–13	MIC HI
MIC LO	12	20AWG DRAIN		P4–12	MIC LO
SON OFF	15	WHT/ORG/GREEN		P4–19	SON OFF
CUTST/FPROG	8	WHT/ORG/BLUE		P4–23	CUTST/FPROG
SDATA	16	WHT/ORG/BROWN		P4–8	SDATA

(Made From PS-CA-011854 Rev. D)

Figure 13-3: CH-721 Option Cable CA-011854-001

14 GPS NMEA-FORMATTED SERIAL DATA CONNECTION

To obtain GPS NMEA-formatted serial data from the radio, use of the Full-Data I/O Option Cable 1000022242-0001 is recommended. Follow this procedure to complete the GPS NMEA-formatted serial data connections if using the Full-Data I/O Option Cable:

1. Connect the 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 extended via an optional standard serial cable with DB-9 connectors. Available serial cables for extending the length include MAMROS0055 (6 feet), CA-013671-010 (10 feet), and CA-013671-020 (20 feet). Tighten the jackscrews firmly and then route the cabling as required. If the computer is not equipped with a DB-9 serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001.
3. Follow the manufacturer's instructions on processing the NMEA-formatted GPS data from the radio.

If the Full-Data I/O Option Cable is not available, a 3-wire serial cable can be field-fabricated. On the radio end, this cable must interface to the three GPS-related signals of the radio's 44-pin I/O Cable connector (pins 4, 20 and 34). See Table 13-1 for additional information.

Industry software to process GPS information through this interface is not supported by Harris.

15 INITIAL POWER-UP TEST

1. At the radio's main inline fuse holder (located near the vehicle battery), insert the **15-amp AGC fuse** included with the radio's DC Power Cable.

Do <u>not</u> use the 20-amp AGC fuse included with the radio's DC Power Cable! An M7200 mobile radio installation requires a 15-amp fuse for the radio's main power connection. The 20-amp fuse is included with the cable for an M7200 V-TAC mobile radio installation, which uses this same DC Power Cable.

2. Tie and stow all fuse holders and wiring at this location necessary to prevent excess vibration/-movement.
3. Carefully reconnect the vehicle's battery ground cable(s).
4. If not already, temporarily connect the mobile antenna cable from the vehicle-mounted antenna to the female TNC RF connector at the rear of the radio. This is a temporary connection until test procedures in Section 16 are complete.
5. If the installation is wired so the vehicle's ignition key/switch turns the radio on and off, turn the switch to the Accessory or Run position.
6. If the control head is not already powered up, do so by rotating its on/off/volume control clockwise out of the detent position.
7. Verify the control head has powered-up by observing its display. If the display is not lit, refer to Section 8.1 as necessary.

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 login information and/or a talk group.
- 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 fuses. If problems persist, contact the Technical Assistance Center (see page 19).
- 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's mobile antenna system. There are three (3) main procedures in this section:

- Changing Operating Mode for Tests
- Testing by Transmitting into a Dummy Load (a 50-Ohm RF Terminator)
- Testing by Transmitting into the Mobile Antenna

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. **Abide by the following WARNING!** 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.

If the vehicle's engine must remain running, the vehicle location should be well ventilated so exhaust fumes from the engine do not cause harm!

If a vehicle equipped with this radio requires jump-starting, the radio installation's AGC fuses should be removed from the fuse holders 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 the 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

To complete the tests, placing the radio in a conventional mode and using an average-responding wattmeter to measure RF transmit power is recommended. However, if the radio is not programmed for conventional mode operations (i.e., OpenSky Trunking Protocol (OTP) is available but EDACS Conventional P25 (ECP) is not), performance tests will require a peak-reading RF wattmeter to measure RF transmit power. To select either conventional or OpenSky mode, use one of the following procedures as necessary:

16.1.1 Changing from OpenSky to Conventional

1. If necessary, apply power to the radio and turn it on.

2. Use the control head's •/•• **Ramp Control** to scroll through the menu until **Mode Menu** appears in the middle line of the display. This control is shown in Figure 9-1 and in Figure 9-2 on page 46.
3. Use the **+/- Ramp Control** to select an available conventional channel/system.
4. Confirm the selection by pressing the **MENU** button, then toggling the **+/- Ramp Control** once (to select **Y** for Yes), followed by pressing the **MENU** button again. The radio will enter the selected mode as indicated by the display.
5. Select a conventional channel for test transmissions using either the •/•• **Ramp Control** or the **System/Group/Channel Selection Control** (required control per programming).

16.1.2 Changing from Conventional to OpenSky

1. If necessary, apply power to the radio and turn it on.
2. Use the control head's •/•• **Ramp Control** to scroll through the menu until an OpenSky system's name is displayed.
3. After a few seconds, the radio will automatically transition to OTP mode for operations on the selected OpenSky system.
4. If the radio is not programmed for auto-login, login to the OpenSky system. For login instructions, refer to the respective Quick Guide (publication MM-010790-001) included with the radio when it shipped from the factory, or to the respective Operator's Manual (publication MM23016). See Section 3.2 on page 19 for additional information on these publications.
5. Select a talk group for test transmissions using either the •/•• **Ramp Control** or the **System/-Group/Channel Selection Control** (required control per programming).

16.2 REQUIRED TEST EQUIPMENT

Table 16-1: Required Test Equipment

TEST EQUIPMENT	MODEL / PART NUMBER & DESCRIPTION
Average-Responding Wattmeter (for conv. measurements)	• Bird Electronic Corp. Model 43 (or equivalent) with Type N female connectors at input and output ports.
or	
Peak-Reading Wattmeter (for OpenSky measurements)	• Bird Electronic Corp. Model 4314B (or equivalent) with Type N female connectors at input and output ports.
Wattmeter Slug	• Bird Electronic Corp. Element 25E, 25 watts, 400 - 1000 MHz (or equivalent).
RF Coaxial Jumper Cable	• Pasternack Enterprises PE3661-36 (or equivalent) 50-Ohm Coaxial Cable with TNC male connector and Type N male connector, approximately three (3) feet in length. The utilized cable **must** have VSWR below 1.5:1 within the RF passband.
N-to-TNC RF Adapter	• Pasternack Enterprises PE9090 (or equivalent) Type N male to TNC female adapter. Required to connect the cable of the vehicle-mounted 700/800 MHz antenna to the wattmeter.
50-Ohm RF Terminator ("Dummy Load")	• Pasternack Enterprises PE6106 (or equivalent) 50-ohm RF terminator rated at greater than 50 watts power, with Type N male connector.
Vehicle-Mounted Antenna	Tests are performed with the vehicle-mounted 700/800 MHz antenna per the installation described in Section 7 of this manual.

16.3 TRANSMITTING INTO A DUMMY LOAD

1. Using the Type N male to TNC male RF coaxial jumper cable, connect the radio's antenna connector to the wattmeter's input connector. Refer to Figure 16-1 as necessary.
2. Connect the 50-ohm dummy load to the wattmeter's output connector, in place of the antenna cable from the vehicle-mounted 700/800 MHz antenna.

NOTE

As previously stated, if conventional mode is not available per radio programming (i.e., OTP mode is available but ECP mode is not), a peak-reading RF wattmeter is required to measure RF transmit power. Otherwise, the use of an average-responding wattmeter is recommended. Recommended wattmeter types are listed in Table 16-1.

3. If not already, turn the radio on and set it to the required operating mode (based upon available radio programming and test equipment). Refer to Section 16.1 as necessary.
4. Set the radio to a test talk group or conventional channel, if available.

NOTE

It is recommended that a test talk group/channel be allocated for this testing. This same group should be used during the antenna test procedure which is presented in the subsequent section.

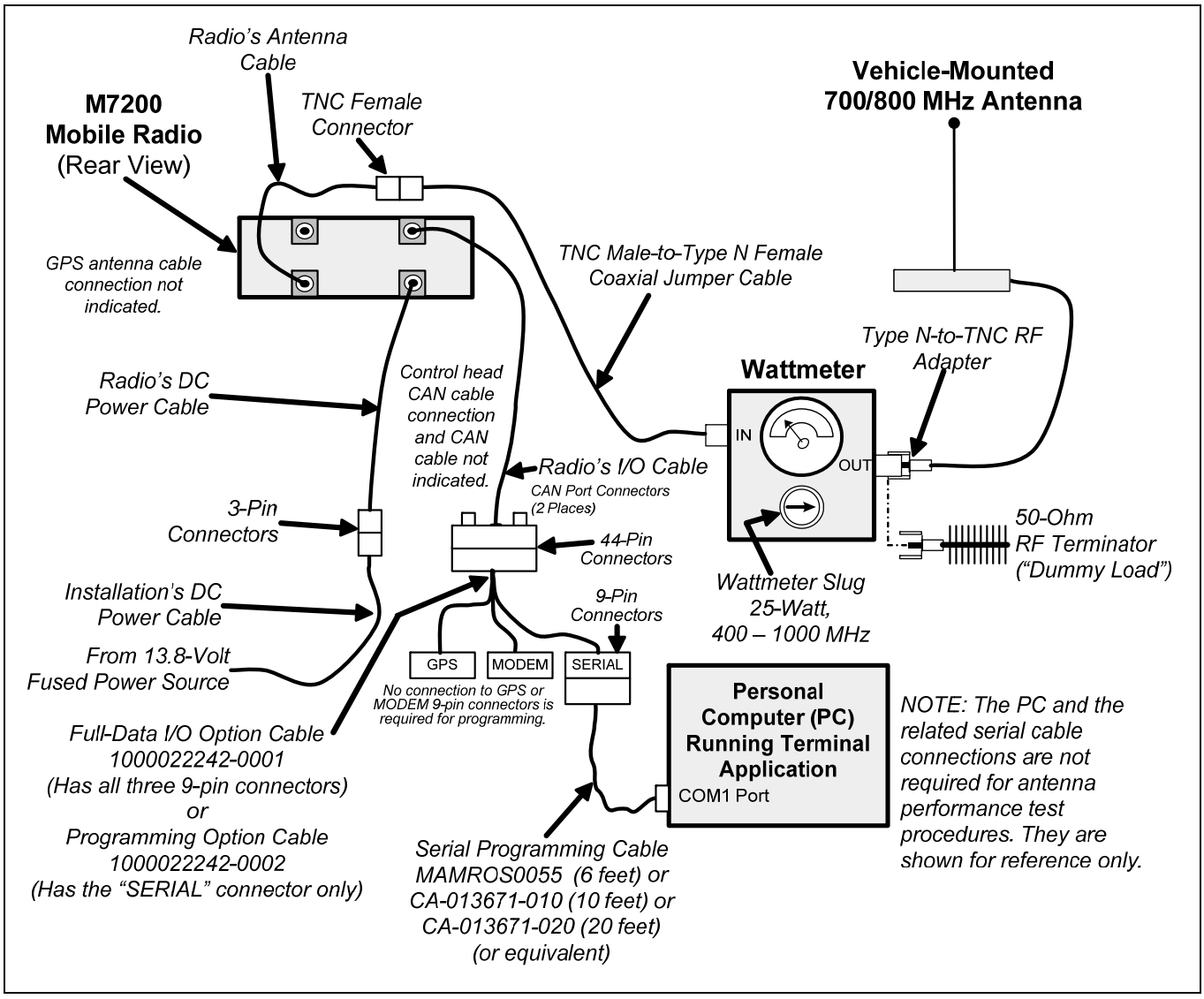


Figure 16-1: **Wattmeter Connections for Antenna System Tests**

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. **For conventional mode transmissions**, set the wattmeter to measure average RF power.

   For OpenSky mode transmissions, set the wattmeter to measure peak RF power.
7. Key the radio's transmitter via the microphone's PTT button.
8. Compare the wattmeter's reading with the target RF output power range of **11.8 – 20.0 watts.** This transmit output power range assumes the radio is currently configured for high-power transmit.

NOTE

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

9. **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. If problems persist, contact the Technical Assistance Center (see page 19).

16.4 TRANSMITTING INTO THE MOBILE ANTENNA

1. Connect the antenna cable from the vehicle-mounted 700/800 MHz antenna to the wattmeter as shown in Figure 16-1.
2. If not already, turn the radio on and set it to the required operating mode (based upon available radio programming and test equipment). Refer to Section 16.1 as necessary.
3. Set the radio to a test talk group or conventional channel, if available.

NOTE

It is recommended that a test talk group/channel be allocated for this testing. Otherwise, interference with other radio users in the system may occur. **Also, during transmissions, always observe the RF exposure-related safety information presented in Section 1.2 (begins on page 6).**

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. **For conventional mode transmissions**, set the wattmeter to measure average RF power.

   For OpenSky mode transmissions, set the wattmeter to measure peak RF power.
6. Key the radio's transmitter via the microphone's PTT button.
7. Compare the wattmeter reading with the target RF output power range of **11.8 – 20.0 watts.** This transmit output power range assumes the radio is currently configured for high-power transmit.

NOTE

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

8. **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 the installation employs a ¼-wave unity-gain antenna, observe the following **NOTE**. If these checks/corrections fail 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. If problems persist, contact the Technical Assistance Center (see page 19).

NOTE

If the mobile radio installation employs a ¼-wave unity-gain antenna (part number AN102800V1 or AN102800V2), the driven element (i.e., whip) of the antenna must be trimmed to the proper length in order to minimize antenna system VSWR. Refer to the instructions included with the antenna for trimming instructions.

9. 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.
10. Key the radio's transmitter via the microphone's PTT button.
11. Compare the wattmeter reading with the RF power output range of **2 watts or less.**

NOTE

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

12. **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 the installation employs a ¼-wave unity-gain antenna, observe the **NOTE** that follows step 8. If these checks/corrections fail 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. If problems persist, contact the Technical Assistance Center (see page 19).
13. Disconnect the coaxial cable jumper and wattmeter.
14. Permanently connect the cable from the vehicle-mounted 700/800 MHz antenna to the radio's antenna cable by mating the two TNC connectors together. Use two pairs of soft-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.

WARNING

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

15. Make several test calls on the radio system to verify its operation. Before making the calls, select other talk groups or conventional channels, as required to verify operation.

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

16.5 TEST PERFORMANCE DATA FORM

Clip ✂ Here

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 M7200 mobile radio installation.

Mobile Radio Serial Number	*Antenna Make and Model Numbers*

/ /		
Date of Test (mm/dd/yyyy)	*Company Performing Installation*	*Technician Performing Test*

Watts	Watts	Watts
Power Into a Dummy Load	*Forward Power With Antenna*	*Reflected Power With Antenna*

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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 REGISTRATION

Please register this product within ten (10) days of purchase. Registration validates the warranty coverage, and enables Harris to contact you in case of any safety notifications issued for this product.

Registration can be made on-line at www.pspc.harris.com/CustomerService or by contacting Harris Warranty Administration at the following:

United States and Canada:

- Phone Number: 1-800-368-3277, Option 4 (toll free)
- Fax Number: 1-434-455-6821
- E-mail: WarrantyClaims@Harris.com

International:

- Phone Number: 1-434-455-6403
- Fax Number: 1-434-455-6676
- E-mail: WarrantyClaims@Harris.com

19 WARRANTY

A. Harris Corporation, a Delaware Corporation, through its RF Communications Division (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-Seller 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), ninety (90) days.
3. for P7300, P7200, P7100^{IP}, P5400, P5300, P5200, P5100, P3300, M7300, M7200 (including V-TAC), M7100^{IP}, M5300 and M3300 radios, two (2) years, effective 10/01/2007.
4. for Unity® XG-100P, three (3) years.
5. 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 Seller's 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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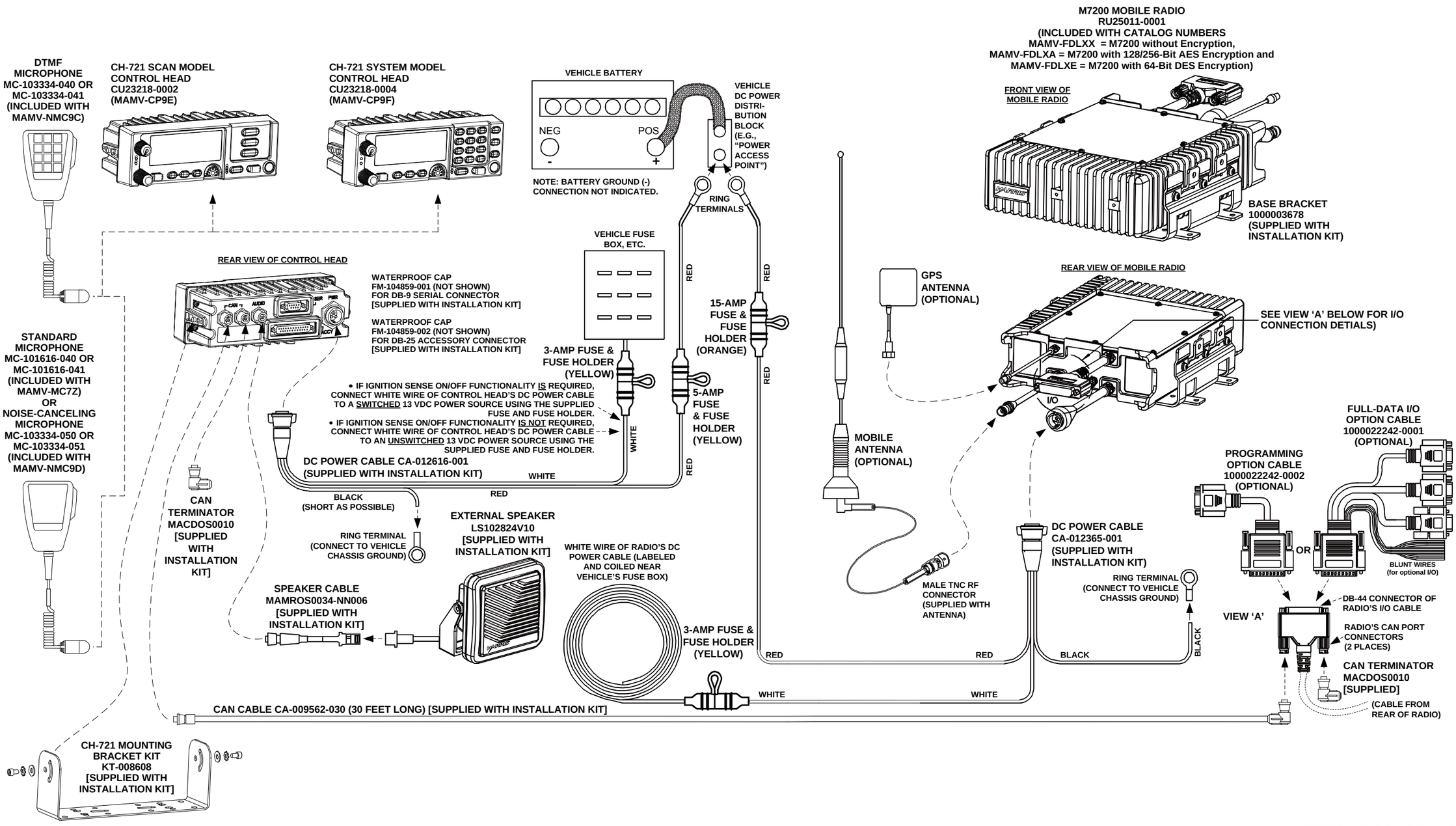
ECR-7047L

20 WIRING DIAGRAM: M7200 MOBILE RADIO WITH CH-721 CONTROL HEAD



WIRING DIAGRAM
M7200 Mobile Radio with
CH-721 Control Head

Wiring Diagram Inside

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