

UNITY[®] XG-100M

Full-Spectrum
Front and Remote-Mount
Mobile Radios

Includes
CH-100 Control Head
and
CH-721 Scan and System
Control Heads



MANUAL REVISION HISTORY

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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 Corporation 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 two-way mobile radio, review the following important RF energy awareness and control information and operational instructions. Comply with this information and instructions in order 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 Unity XG-100M two-way mobile radio was tested to ensure compliance with FCC RF energy exposure limits for two-way mobile 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 Unity XG-100M 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 Unity XG-100M two-way mobile 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) at rated radio power for mobile radios installed in a vehicle. Transmit only when unaware bystanders are at least the uncontrolled recommended minimum safe lateral distance away from the transmitting antenna.

Based on the highest radiated RF power and the highest antenna gain in antennas to be used with Unity XG-100M, the distances listed in Table 1-1 are considered as safe distances for controlled and

uncontrolled environments with the Unity XG-100M mobile radio transmitting at a maximum 50% duty cycle:

Table 1-1: Recommended Minimum Safe Lateral Distance from a Transmitting Antenna Connected to a Unity XG-100M Mobile Radio

RF BAND	ANTENNA PART NUMBERS	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
VHF	AN-125001-002 (mount) with 12099-0310-01 (element)	28.3 inches (72 centimeters)	63.0 inches (160 centimeters)
	AN-125001-004 (mount) with 12099-0310-01 (element)		
	AN-125001-006 (mount) with 12099-0310-01 (element)		
	AN-125001-008 (mount) with 12099-0310-01 (element)		
UHF	AN-125001-002 (mount) with 12099-0310-01 (element)	24.4 inches (62 centimeters)	54.3 inches (138 centimeters)
	AN-125001-004 (mount) with 12099-0310-01 (element)		
	AN-125001-006 (mount) with 12099-0310-01 (element)		
	AN-125001-008 (mount) with 12099-0310-01 (element)		
700/800 MHz	AN-125001-002 (mount) with 12099-0310-01 (element)	7.9 inches (20 centimeters)	19.7 inches (50 centimeters)
	AN-125001-004 (mount) with 12099-0310-01 (element)		
	AN-125001-006 (mount) with 12099-0310-01 (element)		
	AN-125001-008 (mount) with 12099-0310-01 (element)		

1.3.1 Mobile Antennas

The antenna(s) for the radio must be installed in accordance with Section 6 in this manual. Refer to Table 4-7 and/or Figure 6-1 for applicable antenna part numbers. Installation guidelines presented in Section 6 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 21) and/or the 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 20.

1.4 REGULATORY APPROVALS

1.4.1 FCC Part 15

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

1.4.2 Industry Canada

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

1.5 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 only 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.

1.6 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 while its engine is running, be sure to turn the radio **OFF** while fueling the vehicle. If the radio is mounted in the trunk of the vehicle, **DO NOT** carry containers of fuel in the trunk.

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 National Fire Protection Association 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.

1.7 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.

1.8 OPERATING RULES AND 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 Unity XG-100M 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 confined to business. Use coded messages whenever possible to save time.
- 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.

1.9 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 SPECIFICATIONS¹

2.1 GENERAL

Dimensions, Height x Width x Depth (See footnote ²)

Front-Mount Radio with CH-100:	3.3 x 7.0 x 11.6 inches (8.4 x 17.8 x 29.5 centimeters)
Front-Mount Radio with CH-721:	2.4 x 6.9 x 11.3 inches (6.1 x 17.5 x 28.7 centimeters)
Remote-Mount Radio:	2.0 x 6.9 x 9.7 inches (5.1 x 17.5 x 24.7 centimeters)
CH-100 Control Head (Remote-Mount):	3.3 x 7.0 x 2.8 inches (8.4 x 17.8 x 7.1 centimeters)
CH-721 Control Head (Remote-Mount):	2.4 x 6.9 x 3.9 inches (6 x 17.5 x 10 centimeters)

Weight (See footnote ³)

Front-Mount Radio:	5.9 pounds (2.68 kilograms)
Remote-Mount Radio:	5.25 pounds (2.38 kilograms)
Control Head (Remote-Mount):	1.25 pounds (0.57 kilograms)

Operating Ambient Temperature Range: -22 to +140° Fahrenheit (-30 to +60° Celsius)

Maximum Altitude

Operating:	15,000 feet (4,572 meters)
In Transit:	40,000 feet (12,192 meters)

DC Supply Voltage Operating Ranges

For Full Performance:	+13.6 Vdc ±10% (Normal range per TIA-603)
Overall Operating Range:	+10.8 to +16.6 Vdc
Continuous without Damage:	0 to +17 Vdc

DC Supply Current Requirements

Receive (includes control head)	
With 15-Watt Speaker Output Power:	4.0 amps maximum
Transmit (includes control head):	
At 35 Watts RF:	15 amps maximum, 12 amps typical
At 50 Watts RF (VHF and UHF Bands):	20 amps maximum, 15 amps typical

Quiescent/Off Currents

Mobile Radio Only:	2 milliamps maximum
CH-100 Control Head Only:	100 microamps maximum
CH-721 Control Head Only:	100 microamps maximum

2.2 TRANSCEIVER

2.2.1 General

Frequency Ranges

VHF High Band:	136 to 174 MHz
UHF Bands:	380 to 520 MHz [See footnote ⁴]
700 and 800 MHz Bands	762 to 870 MHz [See footnote ⁵]

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

² Dimensions do not space required for mounting brackets, cables, clearance/access, etc.

³ Weights do not include respective mounting brackets, cables, etc.

⁴ Per FCC regulations, the lowest allowed UHF band transmit frequency for LMR operations is 406.1 MHz.

⁵ 700 MHz mobile receive band is 764 to 767 MHz and 769 to 776 MHz.

700 MHz mobile transmit band is 764 to 767 MHz, 769 to 776 MHz, 794 to 797 MHz and 799 to 806 MHz.

Frequency Stability:	±0.5 ppm from -30 to +60° Celsius
Channel Spacing:	12.5 kHz or 25 kHz (mode dependent)
Channel Tuning Increment:	2.5 kHz or 3.125 kHz
Channel Capacity:	12,500 (1,250 per mission plan)
Mission Plans (Personalities):	10 maximum
Zones (Systems) per Mission Plan:	64 maximum
Voice and Data Communications Modes:	Half-Duplex

2.2.2 Transmitter

Power Ranges

VHF High Band:	5 to 50 watts
UHF Band:	5 to 50 watts
700 Band:	2 to 30 watts
800 Band:	2 to 35 watts

Frequency Modulation (FM) Limiting

Wideband Channels (25 kHz)	5 kHz
NSPAC Channels	4 kHz
Narrowband Channels (12.5 kHz)	2.5 kHz

Audio Distortion: < 1.25%

2.2.3 Receiver

Sensitivity at 12 dB SINAD:	-119 dBm minimum
Sensitivity at 5% BER:	-119 dBm minimum
Typical Analog Squelch Threshold:	-124 dBm with 1 kHz tone at 3 kHz deviation

2.2.4 Audio

Audio Frequency Response:	+1 to -3 dB from 300 to 3000 Hz (transmit and receive)
Microphone Input Sensitivity:	82 ±28 mV rms (typical)
Microphone Maximum Input Level:	2500 mV peak-to-peak
Microphone Input Impedance:	600 ohms
Microphone Connector:	17-pin Conxall-style flush-mount thumbscrew-locking connector located on front panel of control head
Microphone Types Available:	Standard, DTMF, and Noise-Canceling
Speaker Audio Output Power:	15 watts RMS minimum into 4-ohm external speaker
Speaker Audio Output Distortion:	< 3% at 15 watts RMS into 4-ohm external load
Headset Audio Output Power	
At CH-100 Microphone Connector:	0.5 watts minimum into 4-ohm headset/speaker
At CH-100 DB-25 Rear Panel Connector:	35 milliwatts maximum into 24-ohm headset
At CH-721 Microphone Connector:	0.5 watts minimum into 4-ohm headset/speaker
At CH-721 DB-25 Rear Panel Connector:	35 milliwatts maximum into 24-ohm headset

External Speaker Connection

Local Control (Front-Mount Radio):	2-pin audio connector on radio's option cable
Remote Control (Remote-Mount Radio):	2-pin audio connector on rear of control head

Mic A-D and Speaker D-A Audio Conversion

CODEC Audio Sampling Rate:	8 kHz
CODEC Algorithm (Vocoding Method):	Sigma-Delta ($\Sigma\Delta$)

Voice-Coding Method

P25 Phase 1 Mode:	Advanced Multi-Band Excitation Plus (AMBE+)
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Data Rate

P25 Mode:	4800 symbols/second
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2.3 REGULATORY

Applicable FCC Rules:	Part 15 and Part 90
Applicable Industry Canada Rules:	RSS-119

3 INTRODUCTION

This manual contains installation procedures for the Unity XG-100M mobile radio, the CH-100 and CH-721 control heads used with the radio, and related equipment. Procedures cover the mounting and cabling of the equipment, as well as the basic in-vehicle performance test procedures. In addition, important product safety-related information is included.

3.1 GENERAL DESCRIPTION

The Unity XG-100M mobile radio is a high-performance multiband mobile radio with advanced capabilities and unprecedented interoperability capability. The radio supports P25 trunked, P25 conventional, and analog conventional operations. It covers the 136 to 174 MHz VHF band, the 380 to 512 MHz UHF bands, and the 762 to 870 MHz bands. In the future, the radio will also cover the 30 to 50 MHz VHF-low band with the addition of an external RF power amplifier.

The Unity XG-100M mobile radio and related equipment are designed to operate in a mobile environment, typically within a motor vehicle. The radio must be connected to an external vehicle-mounted transmit/receive antenna system approved for use with the radio. Several different types of antenna mounts and a multiband antenna element are approved and available for use with the radio. This antenna element and the mounts are listed in Table 1-1 on page 9 and in Table 4-7 on page 29.

When operating on a VHF or UHF radio channel, the Unity XG-100M radio can provide 50 watts of transmit output power in full-power transmit mode. When operating on a 700 or 800 MHz radio channel, the radio can provide 35 watts of power in full-power transmit mode.

Front-mount and remote-mount radio configurations are available. In the front-mount configuration, the control head is an integral part of the mobile radio. In the remote-mount configuration, the control head is located near the radio operator's position and the radio is mounted remotely from the control head, typically in the vehicle's trunk or on an equipment shelf. Three (3) different control heads are available for use with the radio. All three are available in both a remote-mount and a front-mount configuration:

- **CH-100 Control Head**—Shown in Figure 3-1 below in a front-mount radio configuration, the CH-100 features a 4.3-inch touchscreen sunlight-readable LCD color display, providing an easy-to-use menu-driven operator interface. This head also features a Bluetooth wireless interface for connection of optional equipment and to support radio and control head programming via a wireless connection. The front panel of the CH-100 head also features an easy-to-use on/off/volume control and group/channel selection controls, an emergency button, a home button, a USB programming port, a transmit/receive busy indicator, and a microphone connector.



Figure 3-1: Front-Mount Unity XG-100M Mobile Radio with CH-100 Control Head

- **CH-721 Scan Model Control Head**—This head features a large 3-line graphical vacuum-fluorescent display and easy-to-use front panel controls, including three (3) large menu-related buttons. Figure 8-5 on page 57 details all front panel components.
- **CH-721 System Model Control Head**— Figure 3-2 on page 18 illustrates the CH-721 System model control head in a front-mount configuration. This head is very similar to the CH-721 Scan model control head. It has an identical 3-line graphical vacuum-fluorescent display. Also, front panel controls are identical to those on the Scan model control head with the exception of the 12-key keypad and smaller menu-related buttons. The 12-key numeric keypad provides Dual-Tone Multi-Frequency (DTMF) functionality and advanced operator system/group selection control via the control head’s front panel. Figure 8-6 on page 57 details all front panel components.

All three (3) control heads feature a large easy-to-use volume/on/off rotary control and a rotary system/group/channel selection control. In addition, each head also has a front panel microphone connector, and an internal high-power audio amplifier to drive an externally-connected speaker. All heads used with remote-mount radios have rear panel connectors for DC power, CAN link, speaker audio output, serial port, and optional accessory connections.

In a remote-mount radio configuration, a Controller Area Network (CAN) cable provides the radio-to-head connection. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio, controlling data such as button presses and radio messages, and user data such as that for a mobile data terminal connected to the serial port of the radio or control head. The CAN link is basically 2-wire (with shield ground) daisy-chained high-speed serial data link. For proper operation, the CAN link must be terminated on each end with a simple resistive-type terminator.

The CAN link is also used to interconnect additional control heads to a radio in a multi-head radio installation. In a multi-head mobile radio installation, more than one control head is utilized with a radio. A multi-head installation may be required in a vehicle such as a fire truck or any large vehicle where more than one operator position must support radio use. For example, a ladder fire truck could have a front-mount XG-100M mobile radio mounted under the truck’s dash panel and a remote-mount control head mounted at the ladder operator’s position. Each control head in a multi-head installation is equipped with an external speaker, a microphone, and optionally-connected equipment. Multi-head installations provide other benefits such as intercom functionality. The XG-100M mobile radio can support up to six (6) control heads.



The CH-100 control head **cannot** be mixed with the CH-721 control head within the same multi-head radio installation. For example, a remote-mount CH-721 cannot be connected to a front-mount XG-100M radio with a CH-100 control head.

The radio and control head 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. In a remote-mount radio installation, 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 and data communications. Voice communications are accomplished via a “push-to-talk” (PTT) type microphone and an external speaker connected to the control head. When a control head is employed in a remote-mount mobile radio installation, an audio amplifier in the head drives the speaker.

FRONT VIEWS

**Front-Mount Unity XG-100M
with CH-721 System Control Head**



**Front-Mount Unity XG-100M
with CH-100 Control Head**



Remote-Mount Unity XG-100M



REAR VIEW

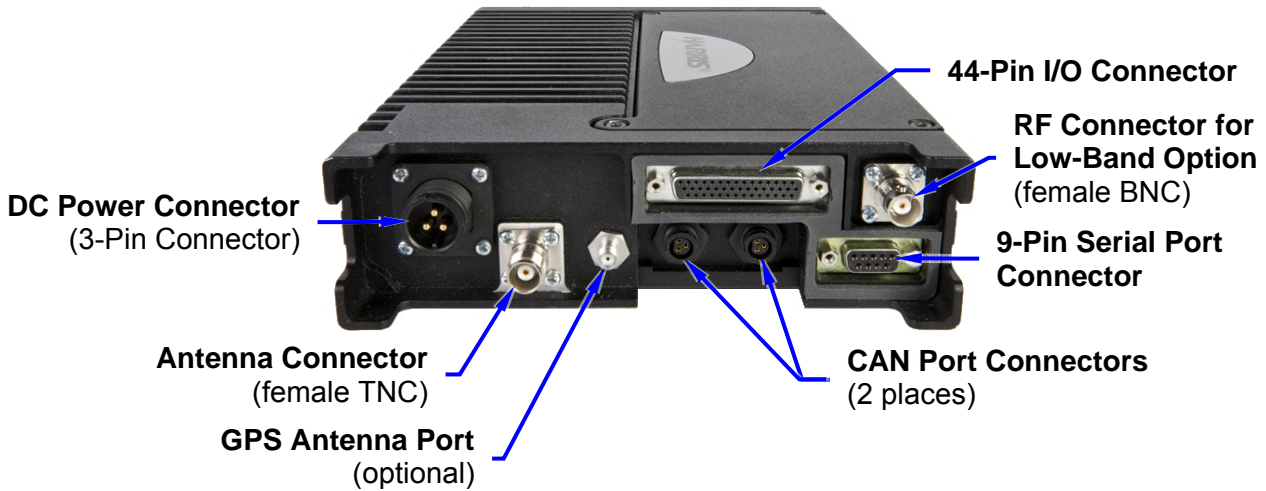


Figure 3-2: Unity XG-100M Front-Mount and Remote-Mount Mobile Radios — Front and Rear Views

For data communications, the radio has an industry-standard TIA/EIA/RS-232C type 9-pin serial interface port for connecting optional data-type equipment, such as a Mobile Data Terminal (MDT), a laptop PC, an external display, or a key-entry device. This port works seamlessly with equipment from popular manufacturers and off-the-shelf applications. This port can also be used for radio program operations, and radio diagnostic functions.

The radio also has a built-in Global Positioning System (GPS) receiver. This receiver provides position and speed tracking and accurate time via the control head's display. It also provides GPS NMEA-formatted serial data to several pins on the radio's rear panel 44-pin connector. This is provided for external equipment running third-party GPS-related software. The GPS receiver's antenna can be integrated into the mobile transmit/receive antenna (i.e., a "combination" antenna). Alternately, the GPS antenna can be located/mounted completely separate from the mobile transmit/receive antenna. As of the publication of this manual, over-the-air GPS data messaging is not supported.

For over-the-air secure radio communications, the Unity XG-100M mobile radio may be optionally equipped for 256-Bit Advanced Encryption Standard (AES) voice encryption or 64-bit Digital Encryption Standard (DES) encryption. With encryption, voice and/or user data signals transmitted and received by the radio on an RF channel are digitally encrypted ("scrambled") to virtually eliminate unauthorized monitoring via the RF channel. DES encryption is offered in both standard Output Feedback (DES-OFB) and Cipher Feedback (DES-CFB) formats.

The Unity XG-100M mobile radio and its control heads exceed tough environmental specifications included within military standard MIL-STD-810F, the radio industry standard TIA/EIA-603, and the radio standard established by the U.S. Forest Service.



Harris recommends the buyer use only an 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 about the Unity XG-100M mobile radio:

- Quick Guide for Unity XG-100M Mobile Radio
with CH-721 Control Head: 14221-1200-1000
- Operator's Manual for Unity XG-100M Mobile Radio
with CH-721 Control Head: 14221-1200-2000
- Maintenance Manual: 14221-1200-5000

The quick guide is included with each mobile radio equipment package when it ships from the factory. All publications are available at www.pspc.harris.com via an Information Center login and Tech Link.

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:

- Phone Number: 1-800-368-3277
- Fax Number: 1-321-409-4393
- E-mail: PSPC_CustomerFocus@harris.com

International:

- Phone Number: 434-455-6403
- Fax Number: 321-409-4394
- E-mail: PSPC_InternationalCustomerFocus@harris.com

3.4 TECHNICAL ASSISTANCE

If any of the radio equipment requires repair, or if there are questions or concerns about the installation of this equipment, contact the Harris Technical Assistance Center (TAC) using the following telephone numbers or e-mail address:

- United States 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 materials for a Unity XG-100M mobile radio installation includes:

- **Unity XG-100M Mobile Radio**
- **CH-100 Control Head**
or:
- **CH-721 Scan Control Head**
or:
- **CH-721 System Control Head**
- **Installation Kit XMZN6W for Front-Mount Unity XG-100M** — Contents listed in Table 4-3.
or:
- **Installation Kit XMZN9A for Remote-Mount Unity XG-100M and CH-100** — Contents listed in Table 4-4.
or:
- **Installation Kit XMZN7R for Remote-Mount Unity XG-100M and CH-721** — Contents listed in Table 4-5.
- **One or Two Antennas** — As listed in Table 4-7. (A second antenna is required for the GPS receiver if a “combo” antenna is not used.)
- **Microphone** — See Table 4-8 for microphone part numbers.

**Table 4-1: Unity XG-100M Mobile Radio and CH-100/CH-721 Control Head
Catalog and Part Numbers**

CATALOG NUMBER	PART NUMBER	DESCRIPTION
XM-100F	12099-1000-01	Unity XG-100M Mobile Radio without Control Head (for front or remote-mount radio applications)
XMCP9R	12099-1200-01	CH-100 Control Head, Remote-Control (for use on a remote-mount radio)
XMCP9Q	12099-1200-02	CH-100 Control Head, Local-Control (for use on a front-mount radio)
XMCP9E	CU23218-0002	CH-721 Scan Control Head, Remote-Control (for use with a remote-mount radio)
XMCP9F	CU23218-0004	CH-721 System Control Head, Remote-Control (for use with a remote-mount radio)
XMCP9G	CU23218-0001	CH-721 Scan Control Head, Local-Control (for use on a front-mount radio)
XMCP9H	CU23218-0003	CH-721 System Control Head, Remote-Control (for use on a front-mount radio)

Table 4-2: Unity XG-100M Feature Packages

CATALOG NUMBER	DESCRIPTION
XMPL4A	Feature Package: P25 CAI Conventional Digital (includes analog conventional operation) Operation Modes
XMPL4B	Feature Package: P25 Trunking Operational Mode (includes P25 conventional and analog conventional operation)
XMPL4C	Feature Package: P25 Encryption with AES and DES-OFB
XMPL4D	Feature Package: DES-CFB Encryption.
XMPL4E	Feature Package: Conventional Voter Scan
XMPL4F	Feature Package: P25 Phase 2 TDMA
XMPL4G	Feature Package: Data Operation for Mobile Data Terminal (MDT), Radio TextLink, and Status Message Applications
XMPL5K	Feature Package: P25 ProFile Over-The-Air Programming (OTAP)
XMPL5L	Feature Package: Over-The-Air Rekeying (OTAR) for P25 Trunking and P25 Conventional Modes
XMPL4M	Feature Package: Global Positioning System (GPS)

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 the Customer Resource Center (see page 20) 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.






**Table 4-3: Installation Kit XMZN6W
for Front-Mount Unity XG-100M Mobile Radio**

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
1	1 <input type="checkbox"/>	KT101533V1	Kit, Front-Mount Mounting Bracket. Includes Mounting Bracket FM101319V1 (marked KTB0310), M5 stainless-steel hardware to attach radio to bracket, self-tapping hardware to attach bracket to mounting surface, ½-inch rubber grommet, and 7-inch cable ties. For installation-related information, see Section 7.1 on page 40.	
2	1 <input type="checkbox"/>	CA-012365-001	Cable, DC Power. Includes 10-AWG, 20-Foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 20-amp AGC fuse, (1) 15-amp AGC fuse and (1) 3-amp AGC fuse. See CAUTION that follows. For installation-related information, see Section 7.2 on page 43.	
3	2 <input type="checkbox"/>	CD-014027-001	Terminator, CAN; 3-Pin, Straight Body. See Section 7.3 on page 47.	
4	1 <input type="checkbox"/>	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable). See Section 9.1 on page 67.	
5	1 <input type="checkbox"/>	CA-012349-001	Cable, Option. For installation-related information, see Section 11.1 (page 69).	
6	1 <input type="checkbox"/>	FM-104859-001	Cap, Waterproof (For covering Radio's DB-9 serial port connector).	

**Table 4-4: Installation Kit XMZN9A
for Remote-Mount Unity XG-100M Mobile Radio with CH-100 Control Head**

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
1	1 	KT23117	Kit, Remote-Mount Mobile Radio Mounting Bracket. Includes Mounting Bracket FM103111V1 and M5 stainless-steel hardware to attach radio to bracket. For installation-related information, see Section 8.1 on page 48.	
2	1 	12099-1500-01	Kit, CH-100 Swivel Mounting Bracket. Includes (1) U-Shaped Swivel-Mount Bracket and (2) Thumbscrews. For installation-related information, see Section 8.3.4 on page 58.	
3	1 	CA-012365-001	Cable, DC Power. Includes 10-AWG, 20-Foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 20-amp AGC fuse, (1) 15-amp AGC fuse and (1) 3-amp AGC fuse. See the CAUTION that follows. For installation-related information, see Section 8.2 on page 50.	
4	1 	CA-012616-001	Cable, Control Head DC Power. Includes 12-AWG, 10-foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 3-amp AGC fuse, and (1) 5-amp AGC fuse. For installation-related information, see Section 8.3.6 on page 62.	
5	2 	CD-014027-001	Terminator, CAN; 3-Pin, Straight Body. For installation-related information, see Section 8.3.5.2 on page 62.	











**Table 4-4: Installation Kit XMZN9A
for Remote-Mount Unity XG-100M Mobile Radio with CH-100 Control Head (Continued)**

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
6	1 <input type="checkbox"/>	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors. For installation-related information, see Section 8.3.5 on page 60.	
7	1 <input type="checkbox"/>	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable). For installation-related information, see Section 9.2 on page 67.	
8	1 <input type="checkbox"/>	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector. For installation-related information, see section 9.2 on page 67.	
9	2 <input type="checkbox"/>	FM-104859-001	Cap, Waterproof (For DB-9 serial port connectors on radio and control head.)	
10	2 <input type="checkbox"/>	FM-104859-002	Cap, Waterproof (For DB-25 connectors on radio and control head.)	








The 15-amp fuse included with DC Power Cable CA-012365-001 should **not** be used in the Unity XG-100M mobile radio application of this cable. Unity XG-100M radio main power should be protected with the 20-amp fuse included with the cable. Refer to Section 14 for additional information.

**Table 4-5: Installation Kit XMZN7R
for Remote-Mount Unity XG-100M Mobile Radio with CH-721 Control Head**

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
1	1 	KT23117	Kit, Remote-Mount Mobile Radio Mounting Bracket. Includes Mounting Bracket FM103111V1 and M5 stainless-steel hardware to attach radio to bracket. For installation-related information, see Section 8.1 on page 48.	
2	1 	KT-008608	Kit, CH-721 Mounting Bracket. Includes (1) U-Shaped Mounting Bracket and #8 stainless-steel hardware to attach control head to bracket. For installation-related information, see Section 8.3.4 on page 58.	
3	1 	CA-012365-001	Cable, DC Power. Includes 10-AWG, 20-Foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 20-amp AGC fuse, (1) 15-amp AGC fuse and (1) 3-amp AGC fuse. See the CAUTION that follows. For installation-related information, see Section 8.2 on page 50.	
4	1 	CA-012616-001	Cable, Control Head DC Power. Includes 12-AWG, 10-foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 3-amp AGC fuse, and (1) 5-amp AGC fuse. For installation-related information, see Section 8.3.6 on page 62.	
5	2 	CD-014027-001	Terminator, CAN; 3-Pin, Straight Body. For installation-related information, see Section 8.3.5.2 on page 62.	

**Table 4-5: Installation Kit XMZN7R
for Remote-Mount Unity XG-100M Mobile Radio with CH-721 Control Head (Continued)**

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
6	1 <input type="checkbox"/>	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors. For installation-related information, see Section 8.3.5 on page 60.	
7	1 <input type="checkbox"/>	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable). For installation-related information, see Section 9.2 on page 67.	
8	1 <input type="checkbox"/>	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector. For installation-related information, see section 9.2 on page 67.	
9	2 <input type="checkbox"/>	FM-104859-001	Cap, Waterproof (For DB-9 serial port connectors on radio and control head.)	
10	2 <input type="checkbox"/>	FM-104859-002	Cap, Waterproof (For DB-25 connectors on radio and control head.)	



The 15-amp fuse included with DC Power Cable CA-012365-001 should **not** be used in the Unity XG-100M mobile radio application of this cable. Unity XG-100M radio main power should be protected with the 20-amp fuse included with the cable. Refer to Section 14 for additional information.

Table 4-6: CH-100 Control Head with Installation Components, Kit XMZN8Z
 (This kit is used to add another CH-100 Control Head to a new or to an existing XG-100 Mobile Radio Installation)

ITEM	QTY.	PART NUMBER	DESCRIPTION	ILLUSTRATION
1	1 <input type="checkbox"/>	12099-1200-01	Control Head, Remote-Mount CH-100	
2	1 <input type="checkbox"/>	12099-1500-01	Kit, CH-100 Swivel Mounting Bracket. Includes (1) U-Shaped Swivel-Mount Bracket and (2) Thumbscrews. For installation-related information, see Section 8.3.4 on page 58.	
3		CA-012616-001	Cable, Control Head DC Power. Includes 12-AWG, 10-foot DC Power Cable with straight connector, (2) waterproof HFB fuse holders, (1) 3-amp AGC fuse, and (1) 5-amp AGC fuse. For installation-related information, see Section 8.3.6 on page 62.	
4	1 <input type="checkbox"/>	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors. For installation-related information, see Section 8.3.5 on page 60.	
5	1 <input type="checkbox"/>	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable). For installation-related information, see Section 9.2 on page 67.	
6	1 <input type="checkbox"/>	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector. For installation-related information, see section 9.2 on page 67.	
7	2 <input type="checkbox"/>	FM-104859-001	Cap, Waterproof (For DB-9 serial port connectors on radio and control head.)	
8	2 <input type="checkbox"/>	FM-104859-002	Cap, Waterproof (For DB-25 connectors on radio and control head.)	

Table 4-7: Additional Options and Accessories for the Unity XG-100M Mobile Radios

PART NUMBER	DESCRIPTION
AN-125001-002	Antenna Mount: Standard Rooftop, NMO, 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, 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, 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-Mount, NMO, 15-foot (4.6-meter) RF-195 (or equivalent) Low-Loss RF Cable, Male TNC RF Connector
12099-0310-01 (Cat. No. XMAN6H)	Antenna Element: Multi-Band (136 to 174 MHz, 380 to 520 MHz and 762 to 870 MHz), NMO, Factory Tuned.
AN-025187-001 (Cat. No. XMAN5F)	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. XMAN3L)	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
CA-012349-001 (Cat. No. MAMW-NCL8B)	Cable, Option. See page 69.
CA-013671-020	Cable, Serial Data (20 feet). See page 74.
CN-014756	Connector, RF; TNC Male Crimp-Type for RG-58A/U, RG-58/U, RGU/400, YR29586-9, YR29586-10 and Pro-Flex™ Plus 195 Coaxial Cable
CD-014027-001	Terminator, CAN; 3-Pin, Straight Body

Table 4-8: Additional Options and Accessories for the CH-100 and CH-721 Control Heads

PART 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
CA-011854-001	Cable, CH-721 Option
CA-104861	Cable, CH-721 Programming
CA-103541-001	Cable, CH-721 Mic Connector Programming
MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10-Foot, Straight Connector
MAMROS0075-N1220	Cable, DC Power; 12-AWG, 20-Foot, Straight Connector
MAMROS0075-R1210	Cable, DC Power; 12-AWG, 10-Foot, Right-Angle Connector
MAMROS0075-R1220	Cable, DC Power; 12-AWG, 20-Foot, Right-Angle Connector
MACDOS0012	Kit, Control Head Gimbal Mounting Pedestal (Includes Gimbal Mounting Pedestal and (4) #8-32 Pan-Head Screws)
12099-1501-01	Kit, Pedestal Mounting for CH-100 Control Head (Includes Adapter Bracket 12099-0341-01 and #8 stainless-steel hardware)
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.)
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 8-12 on page 65)
MC-101616-041	Microphone, Standard with Conxall Flush-Mount 90-Degree Connector (Included with catalog number MAMW-NMC7Z)
MC-103334-040	Microphone, DTMF with Conxall Flush-Mount 45-Degree Connector (Included with catalog number MAMW-NMC9C)
MC-103334-041	Microphone, DTMF with Conxall Flush-Mount 90-Degree Connector
MC-103334-051	Microphone, Noise-Canceling with Conxall Flush-Mount 90-Degree Connector (Included with catalog number MAMW-NMC9D)
344A4678P1	Microphone Hanger (Included with catalog numbers MAMW-NMC7Z, MAMW-NMC9C and MAMW-NMC9D)
CD-014027-001	Terminator, CAN; 3-Pin, Straight Body
MACDOS0010	Terminator, CAN; 3-Pin, Right-Angle Body

5 PLANNING THE INSTALLATION

5.1 GENERAL INFORMATION

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

- The installation is safe for the operator and passengers within the vehicle.
- The equipment is installed away from the airbag deployment areas.
- The installation allows for convenient access by the operator, as applicable (i.e., the control head, microphone, and other optional user-controlled equipment).
- 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.



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 or part numbers are given, equivalent substitutes may be used:

- | | |
|---|---|
| • Non-Insulated Crimp Tool: Thomas & Betts WT-111-M | • Phillips-Head Screwdrivers, #1 and #2 |
| • Insulated Terminal Crimp Tool: Klein 1005 | • Flat-Blade Screwdrivers, #1 and #2 |
| • Fuse Holder Crimp Tool: Thomas & Betts – WT-112M <u>or</u> California Terminal Products No. 1250 <u>or</u> Channelock No. 909 | • 4-Millimeter Hex Key Wrench |
| • 3-Blade Coax Cable Stripper for RG-58 Cable similar to Tyco Electronics 1490490-1 (includes blades) | • 1/8-Inch Hex Key Wrench (Allen Wrench) |
| • 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) <u>or</u> Emerson Network Power 24-9960P | • 5/16-Inch Combination or Open-End Wrench (Only Needed for GPS Receiver Option) |
| • Non-Metallic Fish Tape, 25-Foot: Klein-Lite 50156 | • 3/4-Inch or 3/8-Inch Hole Saw with Depth Protection: 3/4-Inch = Ripley HSK 19 <u>or</u> Antenex HS34; 3/8-Inch = Antenex HS38 |
| • Various Socket and Driver Sets | • Clutch-Type Cordless Drill with Drill Bits and Driver Bits |
| • Soft-Jaw Pliers: Tessco 450520 or equivalent | • Deburring Tool (for 3/8-inch and smaller holes) |
| | • Flush-Cut and Large Wire Cutters |
| | • Various Fasteners (e.g., machine screws and nuts, Tek screws, etc.) |
| | • Tie Wraps: Nylon, 6-inches or larger |



A separate list of test equipment is included in Section 15.1 on page 79.

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 radio 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.
- For a front-mount installation, the radio is typically located under the vehicle's dash panel. However, it may be mounted above the dash, or at some other location per customer requirements, available space, and/or mounting surface strength. Dimensions for the radio and control heads are listed in Section 2.1 on page 13. As noted in that section, these dimensions do not include space required at the rear of the radio for cables. Several inches of clearance space is required.
- For a remote-mount radio installation, the radio is typically located in the motor vehicle's trunk, or some other preferably unoccupied section in a vehicle, such as a fire truck's equipment shelf. The control head is typically located under the vehicle's dash panel. Dimensions for the radio and control heads are listed in Section 2.1 on page 13. As noted in that section, these dimensions do not include space required at the rear of the radio and control head for cables. Several inches of clearance space is required at the back of the control head, and at least six (6) inches is recommended at the back of the radio. In addition, several inches of clearance space is required at each side of the radio for access to the screws that secure the radio to its mounting bracket.
- When selecting a mounting location, verify sufficient clearance behind the radio can be maintained so cables will not be stressed, crushed, twisted, or bent at severe angles. This also applies to the control head in a remote-mount radio installation. Also, the front and sides of the units must have clearance for air circulation, access to mounting screws, mounting hardware, etc.
- Verify the drilling of holes and the insertion of screws will not damage or interfere with any existing vehicle components (for example, a fuel tank, fuel lines, the transmission housing, etc.), or any existing vehicle wiring.
- For antenna location and installation-related information, refer to Section 6.



The radio must be kept out of direct sunlight and away from heat sources. Adequate free-air ventilation must be provided to its rear fins. The radio will automatically reduce its transmit RF output power when its ambient temperature exceeds approximately +140° Fahrenheit (+60° Celsius).



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

6 ANTENNA INSTALLATION

6.1 ANTENNA MOUNTING LOCATIONS



At this time, review all information presented in the REGULATORY AND SAFETY INFORMATION section of this manual (see page 7). A transmitting antenna must be installed in accordance with the guidelines presented in both the REGULATORY AND SAFETY INFORMATION section, and in this section.

Figure 6-1 below illustrates recommended antenna mounting locations. Use this figure together with the minimum safe lateral distance data presented in Table 1-1 on page 9 as a guide for determining the best possible antenna mounting location(s). This is necessary in order to reduce human exposure to radio frequency (RF) electromagnetic energy when the radio is transmitting. The radio's antenna(s) must be located on the vehicle as shown in Figure 6-1. Always follow antenna mounting and installation instructions presented in this section and any instructions provided with an antenna.

See Table 4-7 on page 29 for detailed descriptions of the antenna element and the antenna mounts.

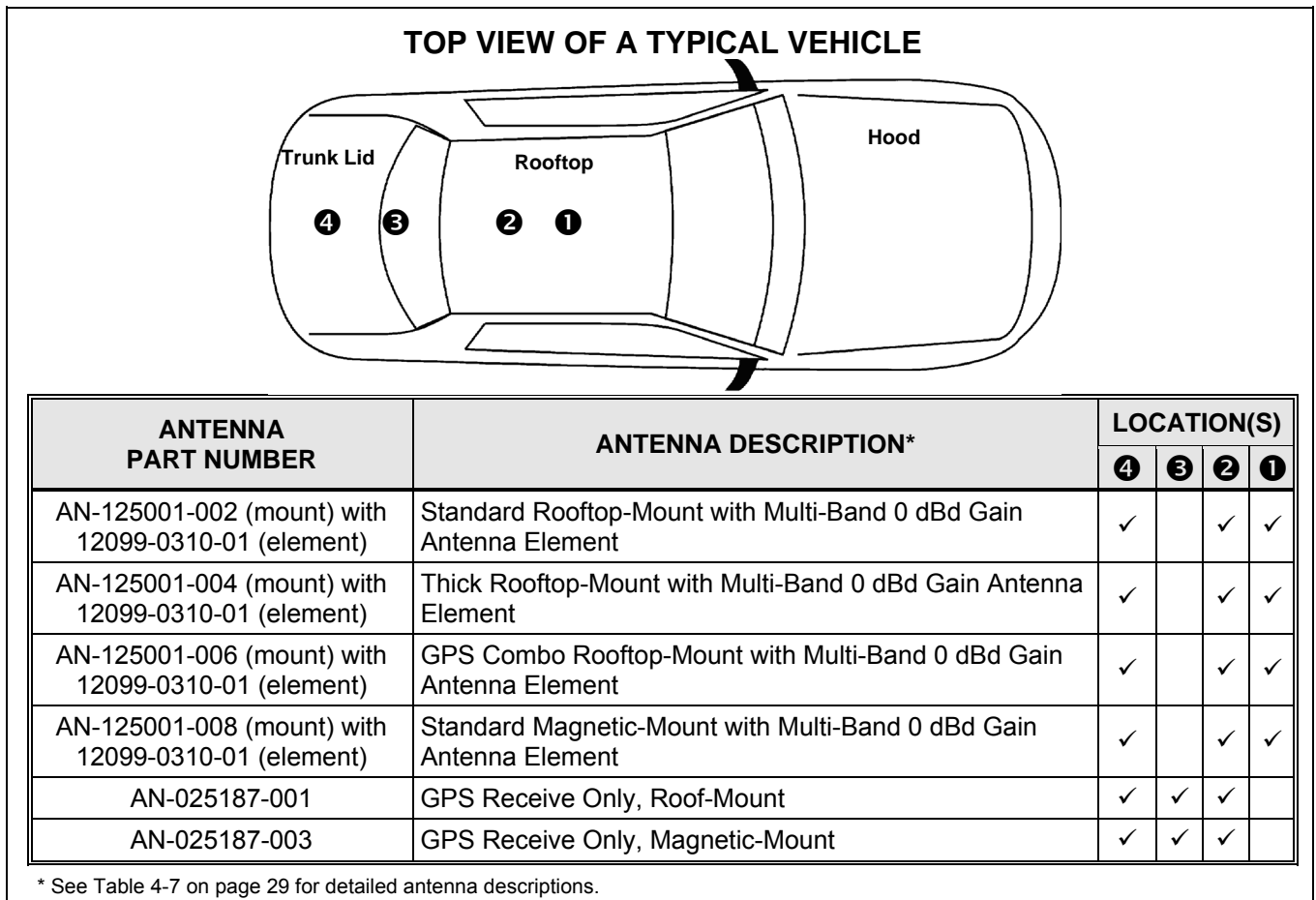


Figure 6-1: Recommended Antenna Mounting Locations with Antenna Part Numbers

6.1.1 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 the following figures). 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 the following figures).

6.1.2 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 ❸ in the following figures). The antenna must be located directly in the center of the trunk lid to minimize human exposure to RF electromagnetic energy.

6.1.3 Rear Deck Lid for Stand-Alone GPS Receive Antenna

If a GPS combination-type antenna is not utilized for the mobile radio installation and the radio's GPS receiver functions must be available for operational use, a stand-alone GPS receive antenna must be separately mounted and connected to the radio. The vehicle's rear deck lid (location ❹ in the following figures) is the recommended mounting location for this case. This locates the GPS antenna inside the vehicle.

6.2 ANTENNA INSTALLATION PROCEDURES



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

Table 4-7 (page 29) and Figure 6-1 list the mobile radio antennas available for use with the radio. As presented in the previous section, various mounting locations exist. Optimal performance is achieved via a rooftop antenna mounted in the direct center of the motor vehicle's roof.

6.2.1 Installing NMO Antenna Mounts AN-125001 -002 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 6.2.1.3.

6.2.1.1 Standard NMO Antenna Mount AN-125001-002

This standard ¾-inch NMO antenna mount requires 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.

6.2.1.2 Thick-Roof NMO Antenna Mount AN-125001-004

This thick-roof NMO antenna mount uses 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 (⅜-inch maximum thickness).



NOTE

For thick-roof NMO antenna mount AN-125001-004, using a 3/8-inch mounting hole will require better access to the underside of the mounting location than if a 3/4-inch hole is used. This is because, in the case of a 3/8-inch hole, the antenna mount's bushing assembly must be inserted from the underside of the mounting surface.

When using a 3/4-inch mounting hole to mount thick-roof NMO antenna mount AN-125001-004, the thickness of the mounting surface must be at least 1/8-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 3/4-inch mounting hole.

6.2.1.3 Installation Procedure for Mounts AN-125001-002 and -004

1. Select the antenna mounting location in accordance with the information presented in Sections 1 and 6.1 of this manual. If necessary, contact the Technical Assistance Center for assistance. See page 20 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 3/4-inch hole; Antenex/Laird Technologies model HS38 or equivalent for a 3/8-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. 3/8-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 to (i.e., 90 degrees from) the vehicle mounting surface so paint immediately outside of the perimeter of the hole is evenly removed.



CAUTION

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 3/4-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 3/4-inch hole.

For a 5/8-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 (5/8-inch shank) into a 3/4-inch hole, place the alignment ring onto the threaded shank of the mount. This ring has an approximate 3/4-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 6-2 and Figure 6-3, 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.

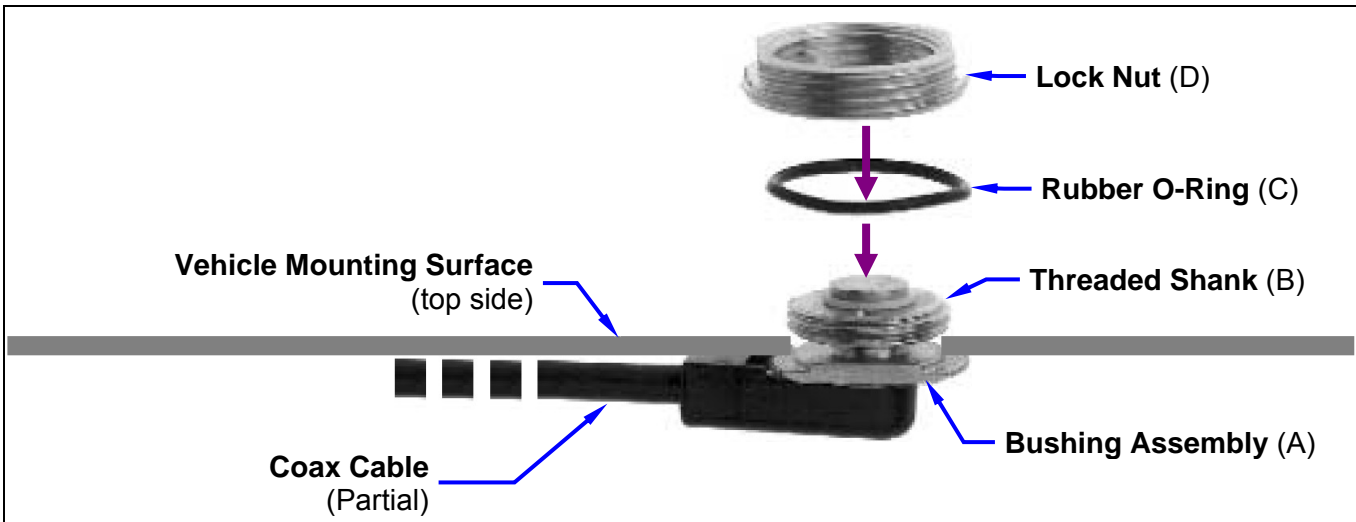


Figure 6-2: Installing Standard 3/4-Inch NMO Antenna Mount AN-125001-002

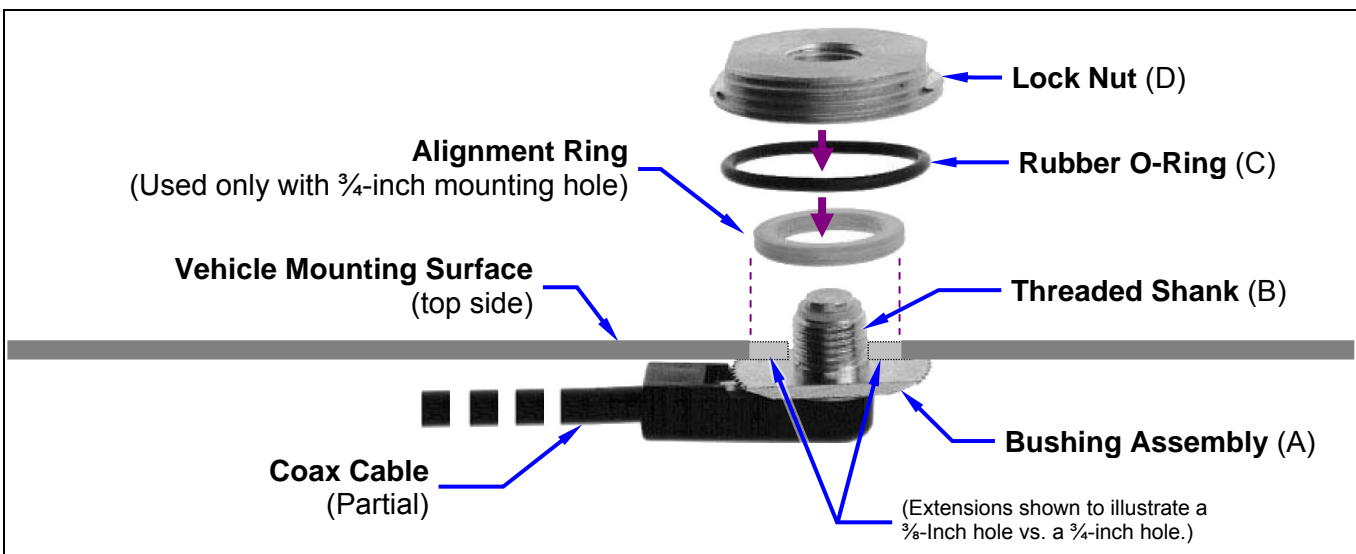


Figure 6-3: Installing Thick-Roof NMO Antenna Mount AN-125001-004

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 6.2.4.

6.2.2 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 6.2.4.



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.**

6.2.3 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.

6.2.4 Attaching the NMO Antenna Element

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 6-2 or Figure 6-3) 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.



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.

5. Continue with the connection procedure presented in the next section.

6.2.5 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.

- Using an appropriate crimp tool, crimp the supplied TNC RF connector to the end of the antenna cable. For crimping instructions, see Figure 6-4 or the instructions supplied with antenna mount.
- 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.

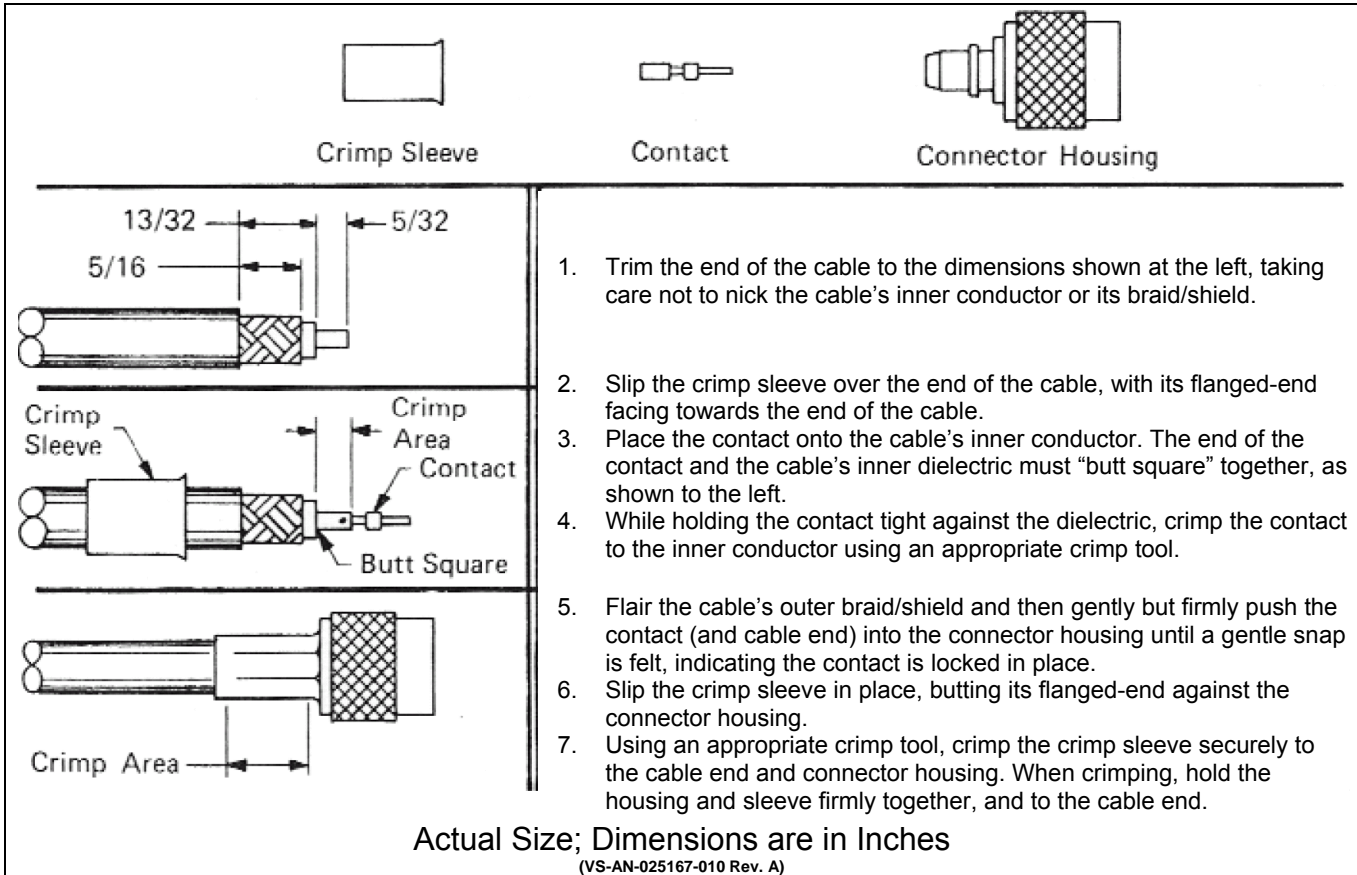


Figure 6-4: Crimping Instructions for TNC RF Connector

6.2.6 Install GPS Antenna (If Required)

If the Unity XG-100M radio must provide GPS location information via its built-in GPS receiver, the GPS receiver requires connection to an externally-mounted GPS antenna. The GPS 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. The following antenna installation procedure is recommended:



A combination (“combo”) antenna kit includes a GPS antenna built into the base of the mobile antenna. Refer to Table 4-7 on page 29 for available combo antennas.

- After selecting a mounting location, 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 20 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. The antenna cable is connected to the radio's SMA receptacle-type (female) RF connector per a procedure presented later in this manual. The cable and its (male) SMA 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.

7 FRONT-MOUNT RADIO INSTALLATION



This section includes detailed instructions for mechanically installing and wiring a front-mount Unity XG-100M mobile radio. For remote-mount Unity XG-100M mobile radio installation procedures, refer to Section 8 which begins on page 48.

7.1 MOUNTING THE FRONT-MOUNT RADIO

The Mounting Bracket Kit for the front-mount Unity XG-100M mobile radio includes a heavy-gauge steel U-shaped mounting bracket. The radio should be attached to a mounting surface using this bracket. The bracket can be mounted above or below the radio. Kit contents are shown in Figure 7-1.

Both the radio and the mounting bracket have multiple holes in both sides for adjusting the radio within the bracket. The design allows for both front-to-rear tilting of the radio within the bracket for best viewing angle, and a front-to-rear position offset. The radio has six (6) threaded mounting holes, three (3) per side, and the mounting bracket has ten (10) corresponding holes, five (5) per side. The radio must be secured to the bracket using at least four of the six M5 socket-head screws included in the Mounting Bracket Kit (2 screws per side).

Typically, the radio is front-to-rear centered within the bracket. However, it can be front-to-rear offset by approximately 2 inches (5.1 centimeters), if required. Also, the radio can be positioned straight in the bracket (i.e., parallel with the bottom surface of the bracket), or it can be tilted up or down at an angle of between approximately 10 to 20 degrees. When positioned straight and centered front-to-rear within the bracket, the radio extends approximately 2.5 inches (6.4 centimeters) from the front and rear edges of the bracket. In the rear, additional clearance must be included for cables. The area directly at the front of the radio must be completely clear of all objects (e.g., gear shift, other radio equipment, etc.) so the operator can easily access and visualize the radio's control head.

The mounting bracket must be attached to a secure metal surface that meets or exceeds the minimum 1/16-inch-thick steel sheet metal requirement in accordance with the following **WARNING**. For example, it can be attached directly to the bottom of the dash if the gauge of the sheet metal is high and the surface is firm and flat, or it can be attached to the transmission hump, etc., if a mounting wedge (not included) is utilized. The front-mount Unity XG-100M radio weighs approximately 6 pounds (2.7 kilograms).



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



In addition to improving safety of the installation, firm mounting also prevents unreasonable vibration that could damage the radio, adversely affect transceiver performance and/or cause its cable connections to loosen. An improperly mounted Unity XG-100M radio may experience degradation in the quality of voice and data communications.

7.1.1 Mounting Bracket Installation

The front-mount Unity XG-100M radio's mounting bracket is included with the Front-Mount Mounting Bracket Kit KT101533V1. Kit contents are shown in Figure 7-1. This kit is Item 1 listed in Table 4-3 (page 23).

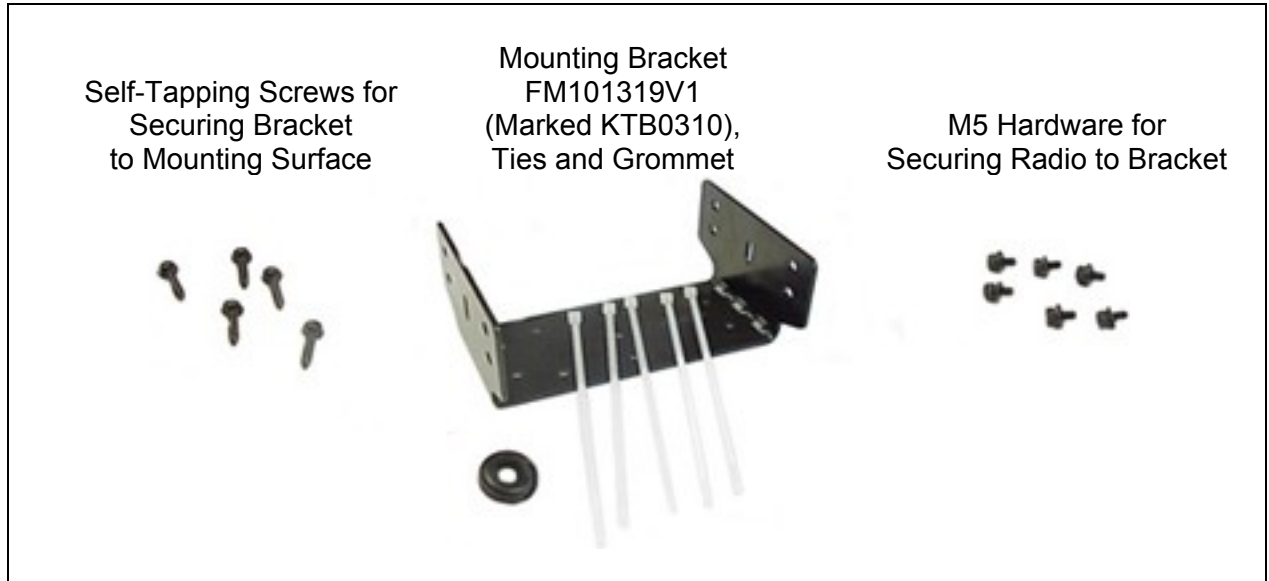


Figure 7-1: Front-Mount Mounting Bracket Kit KT101533V1

When selecting a mounting location for the radio, verify sufficient clearance can be maintained around the radio for installation and service access. A minimum clearance of approximately four (4) inches (10 centimeters) is recommended at the rear, left and right sides of the radio. As previously stated, the area directly at the front of the radio must be completely clear of objects so the operator can easily access and visualize the radio's control head.

The bracket is both left-to-right and front-to-rear symmetrical. It has eleven (11) holes for securing it to a mounting surface. At least four (4) of these holes must be used to secure the bracket to the mounting surface. Five 20-millimeter-long self-tapping screws are included in the Mounting Bracket Kit for this purpose. However, some other type of hardware (not supplied) may be used, such as #10-32 stainless-steel self-locking hardware (i.e., machine screws with washers and locking nuts), or self-drilling screws. 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 following mounting procedure is recommended:

1. Determine the best radio-to-bracket position and angle by test-fitting the radio into the mounting bracket at the selected vehicle mounting location. Slide the radio between the sides of the bracket and temporarily secure it to the bracket with several of the M5 socket-head screws from the bracket kit. When positioned straight and centered front-to-rear within the bracket, the radio extends approximately 2.5 inches (6.4 centimeters) from the front and rear edges of the bracket. In the rear, additional clearance must be included for cables. The area directly at the front of the radio must be completely clear of all objects (e.g., gear shift, other radio equipment, etc.) so the operator can easily access and visualize the radio's control head.
2. At the rear of the radio, verify sufficient clearance is available for cables and service access.

3. If the mounting surface is not flat (such as the top of a transmission hump), construct a suitable mounting wedge as necessary, and attach the wedge to the surface using an approved attachment method. Never mount the bracket directly to a non-flat surface.
4. On the mounting surface, mark the selected location for the bracket, and then remove the radio from the bracket.
5. Clean and remove any foreign material from the mounting surface.
6. Using the bracket as a template, mark and drill at least four (4) mounting holes into the mounting surface as required per the type of hardware used.



Before drilling holes and/or installing mounting screws, verify these operations will not damage or interfere with any existing vehicle component (the fuel tank, a fuel line, the 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.

7. Temporarily remove the bracket and deburr all of the newly drilled holes.
8. If necessary, apply an approved paint or rust-inhibitor at the holes in the mounting surface.
9. Set the bracket back into place.
10. Install and tighten the mounting screws/hardware.
11. 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.
12. If the rear of the radio is easily accessible when the radio is positioned in the selected position within the bracket, it is recommended that the radio be temporarily inserted into the bracket. Otherwise, do not mount the radio into the bracket at this time, because several cable connections must be made at the rear of the radio.

7.1.2 Inserting the Radio into the Mounting Bracket

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

1. Lay the radio into the mounting bracket with the front of the radio facing in the correct direction (usually towards the rear of the vehicle).
2. Secure the radio to the bracket using at least four (4) of the six (6) M5 x 10 mm stainless-steel socket-head screws included with the Mounting Bracket Kit. These screws have captive lockwashers. Kit contents are shown in Figure 7-1. This kit is Item 1 listed in Table 4-3 (page 23).
3. Tighten all screws using a 4-millimeter hex key wrench until each lockwasher is fully compressed and the radio is firm and flush in between the brackets.
4. Check the mounting area for proper clearance for cable service looping and for air circulation, plus an area to secure and rest the excess cable lengths.



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.

7.2 FRONT-MOUNT RADIO'S DC POWER INSTALLATION

7.2.1 Overview of On/Off Power Wiring Configurations

The following power wiring configurations are supported:

- **Radio turns on and off automatically with vehicle's ignition switch/key** — This configuration allows the on/off state of the vehicle's ignition switch/key to control the on/off power state of the radio. The white wire of the radio's DC Power Cable is connected to a fused switched power source, typically identified as vehicle "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. The required fuse rating is 3 amperes. When using this configuration, the on/off/volume control must be left in the on position for automatic power-up/down to function properly.



NOTE

In a front-mount Unity XG-100M radio installation, to fuse the white wire of the radio's DC Power Cable, a yellow waterproof (HFB type) fuse holder and a 3-amp AGC fuse are included with the cable.

- **Radio turns on and off with a manual switch** — This configuration is used when, for example, the radio has to remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. The white wire of the radio's DC Power Cable is connected to one side of a manually-controlled switch, and the other side of this switch is connected to unswitched and fused vehicle power. The required fuse rating is 3 amperes. When using this configuration, the on/off/volume control must be left in the on position for automatic power-up/down to function properly.
- **Radio turns on with its on/off/volume control ("hot wired")** — This configuration allows radio on/off power control only via its on/off/volume control. It may be desired if, for example, the radio has to remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is not desired and/or not acceptable. The white wire of the radio's DC Power Cable must be connected to unswitched and fused vehicle power. The required fuse rating is 3 amperes.

In all of the above cases, the radio's main DC power input (red wire) must be connected through an in-line fuse to unswitched vehicle DC power. The red wire must be connected to raw battery power (positive battery terminal) via the supplied fuse.

7.2.2 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 (for the switched power source connection), and a 4-foot black wire (for the ground connection). It is supplied with waterproof fuse holders, two AGC-type fuses, and non-insulated ring terminals. The following installation procedures are recommended:

7.2.2.1 **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.
2. Prepare to connect the cable's black wire to vehicle ground by locating an area of vehicle metal within approximately two (2) feet of the radio. This surface **must** have a solid and stable connection to vehicle ground. If not, add grounding strap(s) as necessary.
3. Strip the area of any paint or dirt to expose a bare metal surface, approximately 3/4-inch square.

4. Drill a hole in the approximate center of the bare metal surface, and deburr it. A $\frac{3}{8}$ -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 $\frac{1}{4}$ -inch.
6. Crimp a $\frac{3}{8}$ -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.

7.2.2.2 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 body as necessary. Protect the wire from possible chafing where necessary. Tie and stow the wire 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 $\frac{1}{2}$ -inch in diameter and install a small rubber grommet (one supplied with the bracket kit) to protect the wire from chafing at the hole's sharp metal edge. **To prevent fumes from entering the passenger compartment, this hole/grommet/wire combination must also be sealed with a silicon-based sealer before completing the installation.**



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 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 the orange waterproof (HFB type) fuse holder 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 fuse holder into the red wire by cutting it again, at approximately three (3) to six (6) inches from the end.
6. Strip all three (3) wire ends back approximately 3/8-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., “XG-100M Radio Main Power: 20-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 corrosion-resistant 3/8-inch ring terminal is included with the cable for this purpose, but another size corrosion-resistant terminal type (not supplied) may be used if required.
10. Connect the ring terminal directly to the battery’s positive post (or if present, to a stud on the battery’s main/non-switched power distribution terminal block).



A front-mount Unity XG-100M mobile radio installation may be connected to additional control heads to form a multi-head radio installation. In this case, refer to Section 8.3 for control head installation procedures.



The CH-100 control head **cannot** be mixed with the CH-721 control head within the same multi-head radio installation. For example, a remote-mount CH-721 cannot be connected to a front-mount XG-100M radio with a CH-100 control head.

7.2.2.3 White Wire Connection

A review of the information presented in Section 7.2.1 (page 43) 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.

7.2.2.3.1 Radio Turns On and Off with Vehicle’s Ignition Switch/Key

With this wiring configuration, the radio and its control head automatically turn on and off with the vehicle’s ignition switch/key. The white wire 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 control head’s on/off/volume control must be left in the on position for automatic power-up/down to function properly.



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

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 radio's DC Power Cable from the back of the radio to the area near this connection point. Protect the wire from possible chafing as necessary.
3. Obtain the other waterproof (HFB-type) fuse holder included with the radio's DC Power Cable.
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-type 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.
8. Continue with the speaker installation procedures presented in Section 9.1 on page 67.

7.2.2.3.2 Radio Turns On and Off with a Manual Switch

With this wiring configuration, the radio (and its control head) is manually turned on and off via an on/off switch mounted separately from the 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 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 radio's DC Power Cable from the back of the radio 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 the other waterproof (HFB-type) fuse holder included with the radio'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 the 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 waterproof 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-type 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.**"
13. Continue with the speaker installation procedures presented in Section 9.1 on page 67.

7.2.2.3.3 Radio Is “Hot Wired”

In the “hot-wired” configuration, the radio (and its control head) is 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 white wire must be connected to **unswitched and fused 12-volt** vehicle power. Follow the procedure presented in Section 7.2.2.3.1, except connect the white wire to **unswitched** battery power instead of switched (“Accessory”) power. Be sure to fuse this connection with the provided in-line fuse holder and 3-amp AGC fuse.

7.3 TERMINATE CAN PORTS

Add a CAN Terminator to each CAN port connector on the rear of the radio. Two (2) CAN Terminators are included in the installation kit for this purpose (item 3 in Table 4-3).



NOTE

A front-mount Unity XG-100M mobile radio installation may be connected to additional control heads to form a multi-head radio installation. In this case, refer to Section 8.3 for control head installation procedures.

In a multi-head radio installation with a front-mount XG-100M mobile radio, at least one CAN port connector on the rear of the radio will not have a CAN terminator mated to it. Instead a CAN cable will be mated to it for linking to the additional control head(s).



NOTE

Different control head types **cannot** be mixed within the same radio installation. For example, a remote-mount CH-721 cannot be connected to a front-mount XG-100M radio with a CH-100 control head.

8 REMOTE-MOUNT RADIO INSTALLATION



This section includes detailed instructions for mechanically installing and wiring a remote-mount Unity XG-100M mobile radio. For front-mount Unity XG-100M mobile radio installation procedures, refer to Section 7 which begins on page 40.

8.1 MOUNTING THE REMOTE-MOUNT RADIO

This section provides details on mounting a remote-mount Unity XG-100M mobile radio in the vehicle. Control head installation procedures are included in Section 8.3 which begins on page 55.

The remote-mount radio weighs approximately 5.25 pounds (2.38 kilograms). The preferred mounting of the radio is on top of a firm, flat surface. Radio dimensions included in Section 2.1 on page 13.



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



Though generally mounted in a trunk or remote location, the remote-mount 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 side fins. The radio reduces its RF output power when its ambient temperature exceeds approximately +140° Fahrenheit (+60° Celsius).



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



Before drilling holes and/or installing mounting screws, verify these operations will not damage or interfere with any existing vehicle component (the fuel tank, a fuel line, the 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.

8.1.1 Mounting Bracket Installation

The remote-mount radio's mounting bracket is included with the Remote-Mount Mounting Bracket Kit KT23117. Kit contents are shown in Figure 8-1. This is item 1 in the respective remote-mount installation kit (i.e., Table 4-4 for CH-100 control head and Table 4-5 for the CH-721 control head).

Typically, the radio's mounting bracket is mounted in the vehicle's trunk, on the top surface of the trunk tray or on the trunk floor. However, it can be suspended from the trunk's rear deck if the surface is completely flat and the thickness of deck's sheet metal is adequate.

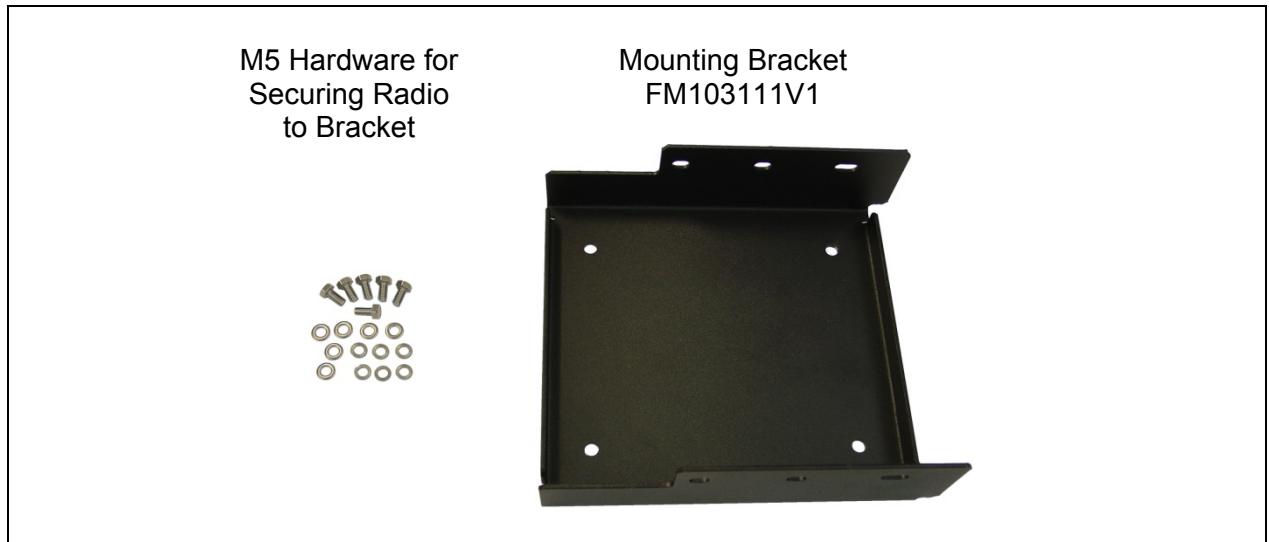


Figure 8-1: Remote-Mount Mounting Bracket Kit KT23117

When selecting a mounting location for the radio, verify sufficient clearance can be maintained around the radio for installation and service access. A minimum clearance of four (4) inches (approximately 10 centimeters) is recommended at the rear, left and right sides of the radio, and at least 2 inches (approximately 5 centimeters) of clearance is recommended at the front of the radio.

The bracket is left-to-right symmetrical and the shortest portion of its side rails are at the rear.

As installations differ, bracket-to-vehicle mounting screws are not included. Utilization of ¼-inch-diameter, 28-thread-per-inch (¼-28) stainless-steel self-locking hardware (i.e., machine screws with washers and locking nuts) is highly recommended. However, ¼-inch stainless-steel self-drilling screws may be employed to speed installation time. 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 four (4) available mounting holes. All four must be used to secure the bracket to its mounting surface.

The following mounting procedure is recommended:

1. Using the mounting bracket as a template, mark and drill four (4) mounting holes into the mounting surface as required per the type of hardware used. When the radio is installed in the bracket, it will extend approximately one (1) inch past the front edge bracket, and at the rear, it will extend approximately ½-inch past the rear edge of the bracket. This distance at the rear does not include space required for cable connections at the rear of the radio. As previously stated, a clearance of least four (4) inches (approximately 10 centimeters) at the rear of the radio is recommended.
2. Temporarily remove the bracket and deburr all of the newly drilled holes.
3. If necessary, apply an approved paint or rust-inhibitor at the holes in the mounting surface.
4. Set the bracket back into place, and verify front-to-rear orientation.
5. Install and tighten the mounting screws/hardware.
6. 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.

8.1.2 Inserting the Radio into the Mounting Bracket

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

1. Lay the radio down into the mounting bracket with the front of the radio at the front of the mounting bracket.
2. Attach the radio into the mounting bracket using the six (6) M5 x 10 mm stainless-steel hex-head screws, and flatwashers and lockwashers included with the Mounting Bracket Kit (item 1 in the respective remote-mount installation kit). Tighten all six screws using a $\frac{5}{16}$ -inch wrench (or a $\frac{1}{4}$ -inch-drive ratchet with a $\frac{5}{16}$ -inch socket) until each lockwasher is fully compressed and the radio is firm and flush in between the brackets.
3. Check the mounting area for proper clearance for cable service looping 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.

8.2 REMOTE-MOUNT RADIO'S DC POWER INSTALLATION

8.2.1 Overview of On/Off Power Wiring Configurations

Radio on/off power control is accomplished by the control head. In a standard installation, when the control head is turned on, it “wakes-up” the radio via data activity on the CAN link. The following power wiring configurations are supported:

- **Radio turns on and off automatically with vehicle's ignition switch/key** — This configuration allows the on/off state of the vehicle's ignition switch/key to control the on/off power state of the radio. The white wire of the control head's DC Power Cable is connected to a fused switched power source, typically identified as vehicle “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. The required fuse rating is 3 amperes. When using this configuration, the control head's on/off/volume control must be left in the on position for automatic power-up/down to function properly.



In a remote-mount radio installation, to fuse the white wire of the control head's DC Power Cable, a yellow waterproof (HFB type) fuse holder and a 3-amp AGC fuse are included with the cable.

- **Radio turns on and off with a manual switch** — This configuration is used when, for example, the radio must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. The white wire of the control head's DC Power Cable is connected to one side of a manually-controlled switch, and the other side of this switch is connected to unswitched and fused vehicle power. The required fuse rating is 3 amperes. When using this configuration, the control head's on/off/volume control must be left in the on position for automatic power-up/down to function properly.
- **Radio turns on with control head's on/off/volume control (“hot wired”)** — This configuration allows radio on/off power 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 and/or not acceptable. The white wire of the

control head's DC Power Cable must be connected to unswitched and fused vehicle power. The required fuse rating is 3 amperes.

In all of the above cases, both the radio's main DC power input (red wire) and the control head's main DC power input (also a red wire) must each be connected through an in-line fuse to unswitched vehicle DC power. The red wire of the radio's DC Power Cable must be connected to raw battery power (positive battery terminal) via the supplied fuse. Likewise, the red wire of the control head's DC Power Cable must also be connected to unswitched vehicle DC power via another supplied fuse. The white ignition wire of the radio's DC Power Cable is not used.

8.2.2 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 4-foot black wire for the ground connection, and a 20-foot white wire which is not used. The cable is supplied with waterproof fuse holders, two AGC-type fuses, and non-insulated ring terminals. The following installation procedures are recommended:

8.2.2.1 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 two (2) feet of the radio. This surface **must** have a solid and stable connection to vehicle ground. If not, add grounding strap(s) as necessary.
3. Strip the area of any paint or dirt to expose a bare metal surface, approximately 3/4-inch square.
4. Drill a hole in the approximate center of the bare metal surface, and deburr it. A 3/8-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 1/4-inch.
6. Crimp a 3/8-inch non-insulated ring terminal (supplied with the cable) to the end of the black wire.

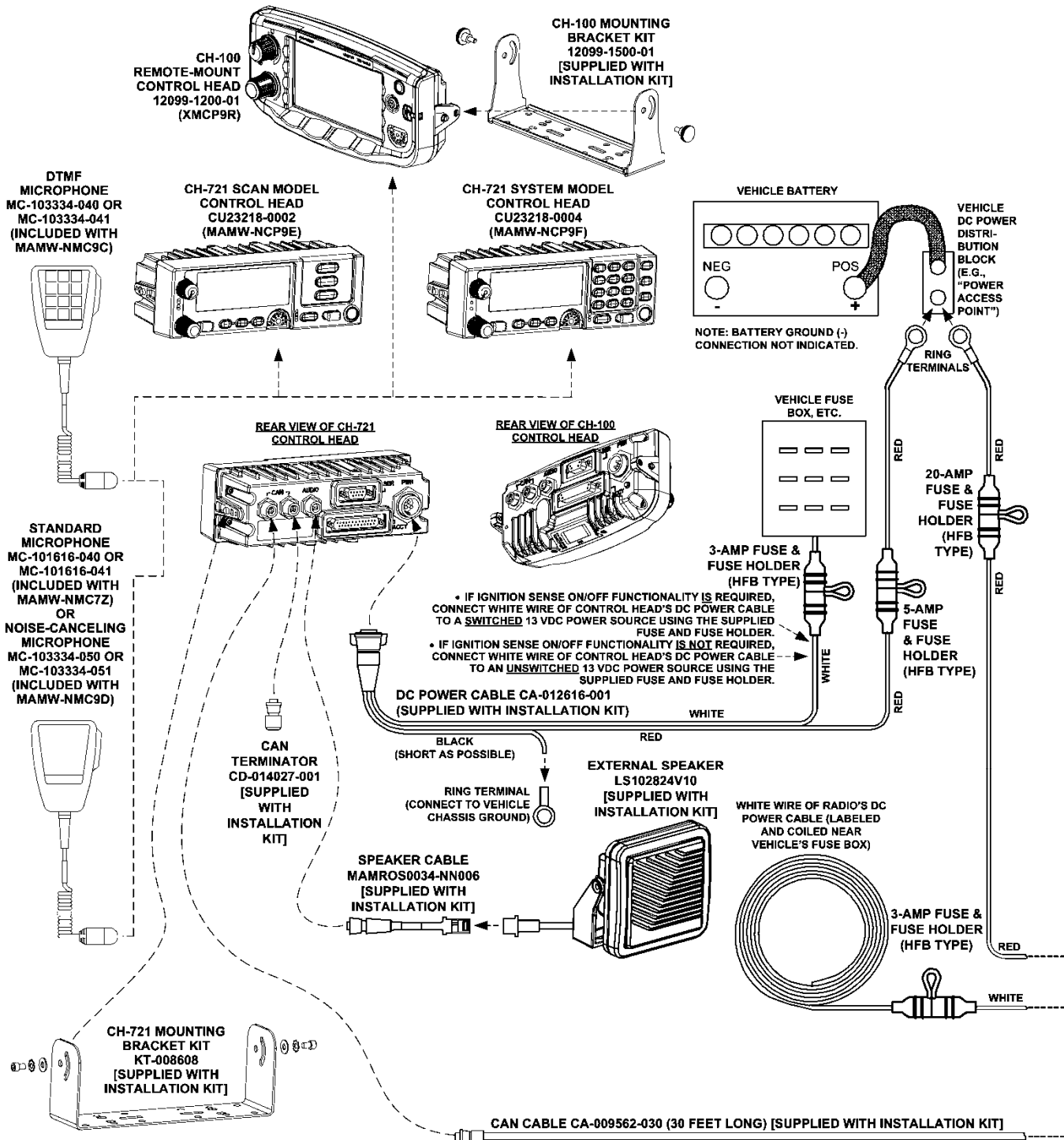


Figure 8-2: Wiring Diagram for a Remote-Mount Radio Installation

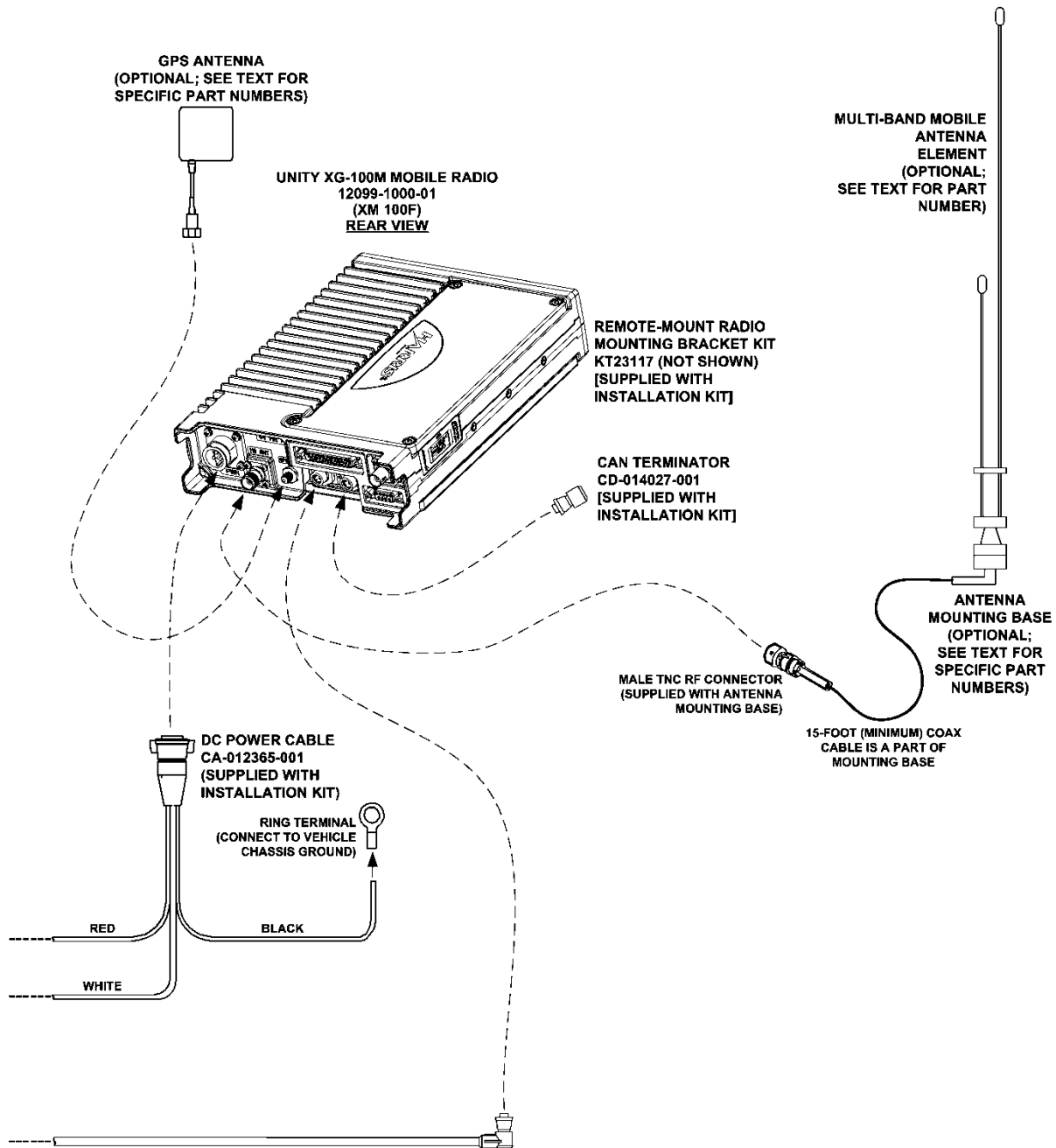


Figure 8-2: Wiring Diagram for a Remote-Mount Radio Installation (Cont.)

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.

8.2.2.2 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 body as necessary. Protect the wire from possible chafing where necessary. Tie and stow the wire as necessary.



CAUTION

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 $\frac{3}{8}$ -inch in diameter and install a small rubber grommet to protect the wire from chafing on the hole's sharp metal edge. **To prevent fumes from entering the passenger compartment, this hole/grommet/wire combination must also be sealed with a silicon-based sealer before completing the installation.**



CAUTION

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.



WARNING

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 the orange waterproof (HFB type) fuse holder 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 waterproof fuse holder into the red wire by cutting it again, at approximately three (3) to six (6) inches from the end.
6. Strip all three (3) wire ends back approximately $\frac{3}{8}$ -inch each, 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., “XG-100M Radio Main Power: 20-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 corrosion-resistant 3/8-inch ring terminal is included with the cable for this purpose, but another size corrosion-resistant terminal type (not supplied) may be used if required.
10. Connect the ring terminal directly to the battery’s positive post (or if present, to a stud on the battery’s main/non-switched power distribution terminal block).



NOTE

Most Unity XG-100M 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.

8.3 CONTROL HEAD INSTALLATION

The remote-mount Unity XG-100M mobile radio must be connected to a control head to provide the operator-to-radio interface. Three (3) different control heads are available — The CH-100 control head, and the CH-721 Scan and System model control heads. See Figure 8-3 through Figure 8-6 respectively. A control head is interfaced to the radio via a CAN cable. Each head is separately fused and powered by an individual DC power cable.

8.3.1 General Information on the CH-100 Control Head

The CH-100 features a 4.3-inch touchscreen sunlight-readable LCD color display, providing an easy-to-use menu-driven operator interface. This head also features a Bluetooth wireless interface for connection of optional equipment and to support radio and control head programming via a wireless connection. The front panel of the CH-100 head also features an easy-to-use on/off/volume control and group/channel selection controls, an emergency button, a home button, a USB programming port, a transmit/receive busy indicator, and a microphone connector.

The CH-100 control head’s mounting bracket allows pitch-axis (tilt) positioning for best viewing angle. Pitch adjustments are accomplished by loosening thumbscrews on each side of the bracket, changing the pitch/tilt of the head as needed, and then retightening the thumbscrews. A 150-degree pitch/tilt angle is provided. A gimbal-type mounting bracket will be available in the future.



Figure 8-3: CH-100 Control Head Front Panel

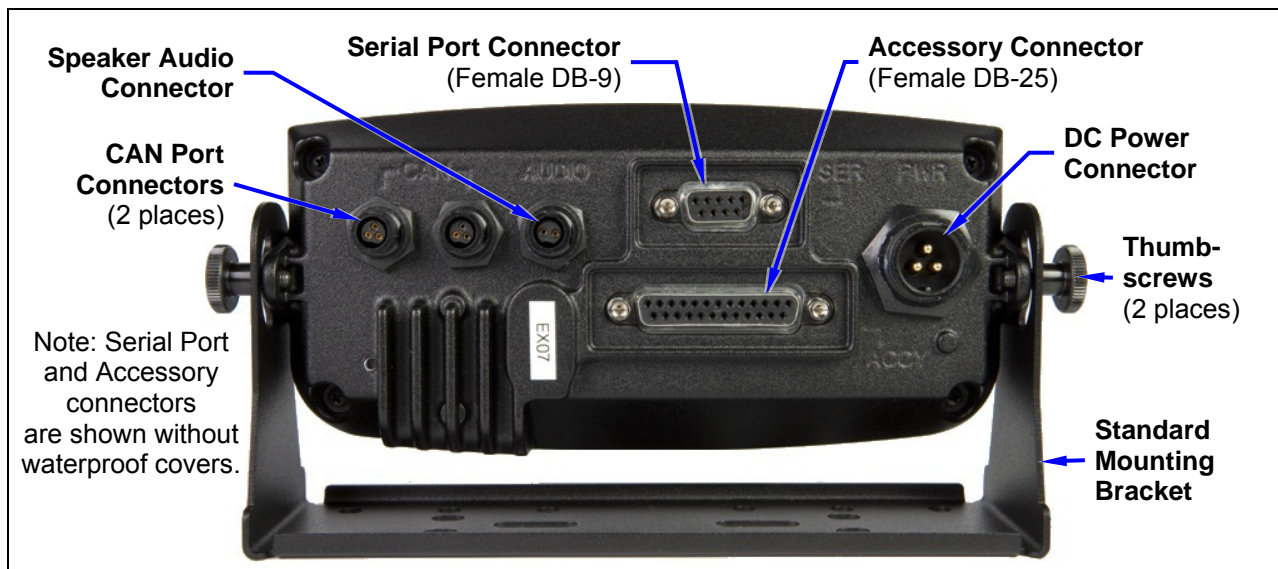


Figure 8-4: CH-100 Control Head Rear Panel (shown with Standard Mounting Bracket)

8.3.2 General Information on the CH-721 Control Head

The CH-721 Scan and System model control heads feature a large easy-to-read 3-line graphical vacuum fluorescent display, an on/off/volume control, 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 two 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. All buttons are backlit for viewing in low-light conditions.

As illustrated in Figure 8-5, the CH-721 Scan model control head features three (3) large menu selection buttons. The System model control head, shown in Figure 8-6, has a 12-key keypad to allow advanced operations without the need of a DTMF-capable microphone.

Figure 8-7 illustrates the rear panel of the two CH-721 control head models. Both models have identical rear panels and rear panel connectors.

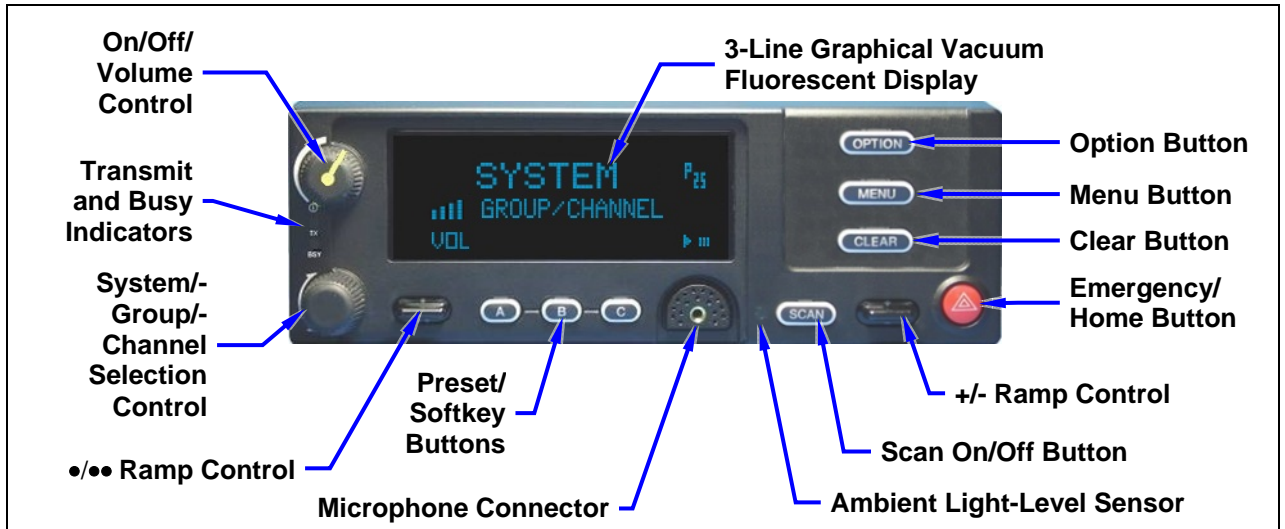


Figure 8-5: CH-721 Scan Model Control Head Front Panel



Figure 8-6: CH-721 System Model Control Head Front Panel

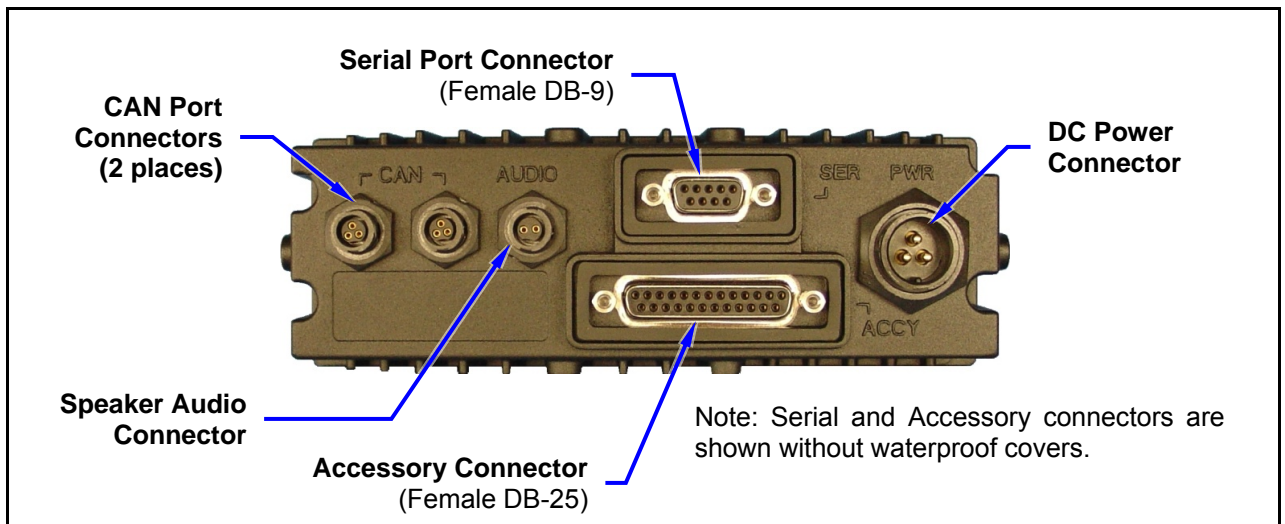


Figure 8-7: CH-721 Rear Panel (both control head models)

8.3.3 Multi-Head Radio Installations

In a multi-head mobile radio installation, more than one control head is utilized with a radio. A multi-head installation may be required in a vehicle such as a fire truck or any large vehicle where more than one operator position must support radio use. For example, a ladder fire truck could have a front-mount XG-100M mobile radio mounted under the truck's dash panel and a remote-mount control head mounted at the ladder operator's position. Each control head in a multi-head installation is equipped with an external speaker, a microphone, and optionally-connected equipment. Multi-head installations provide other benefits such as intercom functionality. The XG-100M mobile radio can support up to six (6) control heads.

**NOTE**

The CH-100 control head **cannot** be mixed with the CH-721 control head within the same multi-head radio installation. For example, a remote-mount CH-721 cannot be connected to a front-mount XG-100M radio with a CH-100 control head.

For a multi-head radio installation, mechanical installation and DC power connections for each additional head are accomplished in the same manner as for a single-head remote-mount radio installation. See Sections 8.3.4 and 8.3.6 respectively.

Refer to Section 8.3.5 for CAN link installation information. Figure 8-11 in that section illustrates CAN cable and CAN terminator connections for a two-head installation.

8.3.4 Control Head Mechanical Installation

**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. Consult the radio system administration personnel as necessary.

8.3.4.1 Selecting the Mounting Location

When selecting a location for the control head, first observe the safety and operator-convenience related information presented in Section 5.1 on page 31. 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 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.

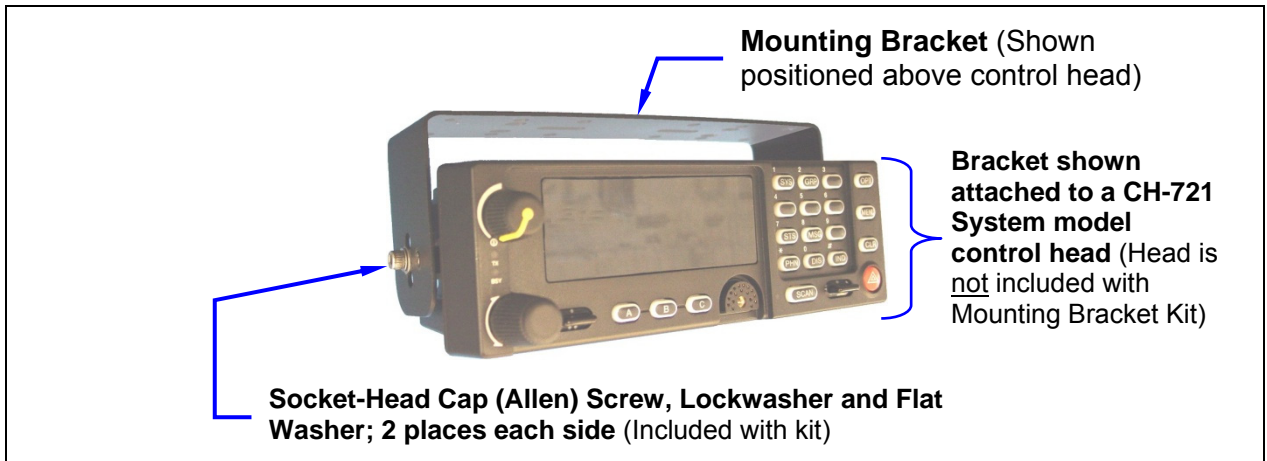


Figure 8-8: Standard U-Shaped Control Head Mounting Bracket for CH-721 Control Head (Kit Part Number KT-008608)

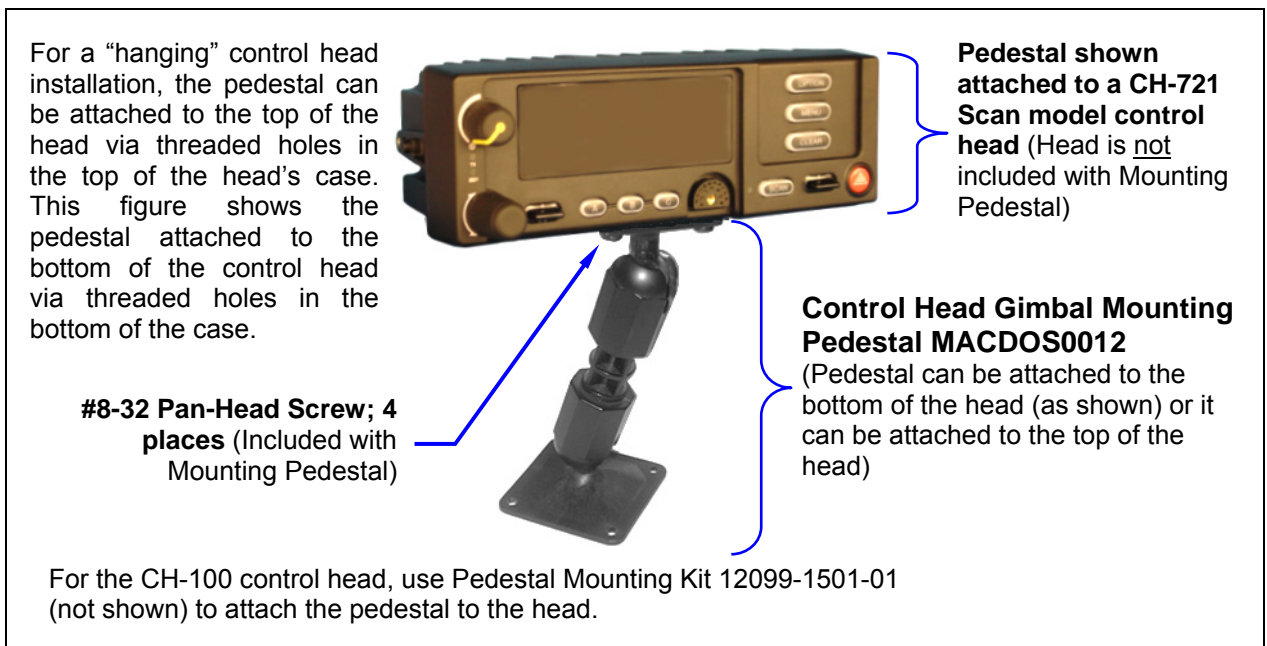


Figure 8-9: Optional Control Head Gimbal Mounting Pedestal (Part Number MACDOS0012)

8.3.4.2 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.

1. Obtain the mounting bracket from the respective installation kit. For the CH-100 control head, this is item 2, as illustrated Table 4-4 on page 24. For the CH-721 control head, this is item 2 as illustrated in Table 4-5 on page 26.
2. 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 forwards/backwards positioning is not important during this step. However, positioning is important in the next step.



Before drilling holes and/or installing mounting screws, verify these operations will not damage or interfere with any existing vehicle component (the fuel tank, a fuel line, the 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.

3. Position 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 furthest from the normal location of the operator (typically towards the front of the vehicle).
4. 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-threading screws are recommended. Use of self-drilling screws may cause damage to some mounting surfaces, such as a plastic dash panel.
5. 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.
6. 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.”
7. In each side “ear” of the mounting bracket, start a #8-32 hex-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.
8. 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 1/8-inch hex key (Allen) wrench until the control head is held firmly in place. Do not over-tighten.

8.3.4.3 Using the Optional Gimbal Mounting Pedestal

An optional Gimbal Mounting Pedestal, part number MACDOS0012, may be purchased separately to replace the standard U-shaped mounting bracket.

For the CH-100 control head, the MACDOS0012 pedestal attaches to the bottom of the head with Pedestal Mounting Kit 12099-1501-01. This kit includes Adapter Bracket 12099-0341-01 and stainless-steel #8 hardware. The complete assembly is then mounted to a mounting surface located below the assembly, such as the top of the vehicle’s dash panel.

For the CH-721 control head, the MACDOS0012 pedestal attaches directly to the bottom of the control head as shown in Figure 8-9. The pedestal is then mounted to a mounting surface located below or above the assembly.

8.3.5 Control Head-to-Radio CAN Cable Connections

8.3.5.1 General Information

A remote-mount radio installation requires a CAN cable between every two “CAN devices” and CAN terminators on each end of the CAN link. The Unity XG-100M mobile radio is considered a CAN device, and each control head in the installation is also considered a CAN device. Figure 8-10 illustrates CAN cable and CAN terminator connections for a single control head installation. Figure 8-11 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 external CAN terminators, as depicted in the following figures.

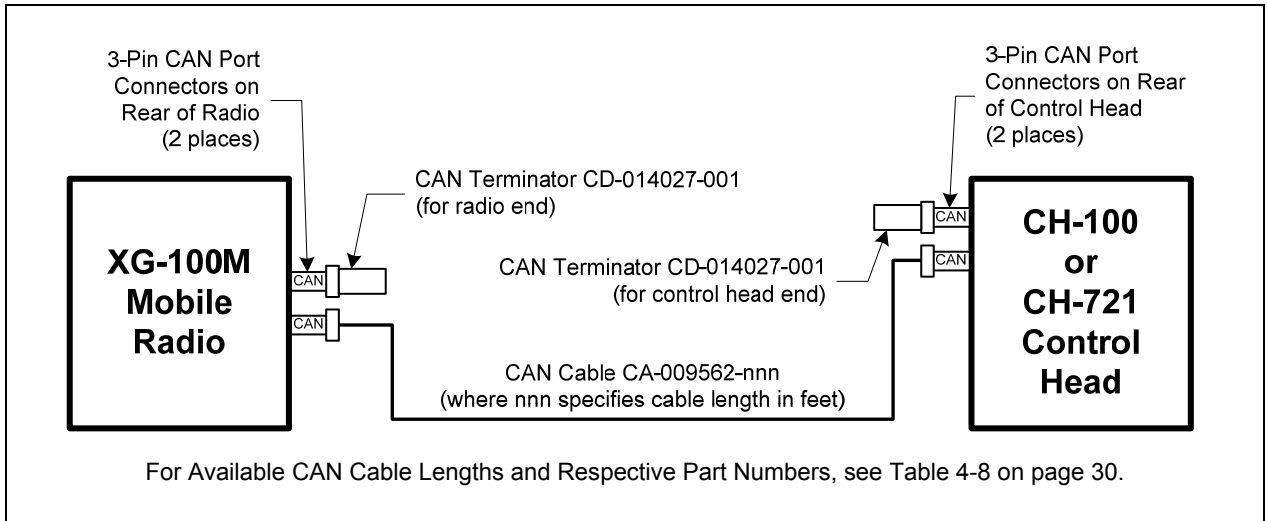


Figure 8-10: CAN Link Connections for a Single Control Head Installation

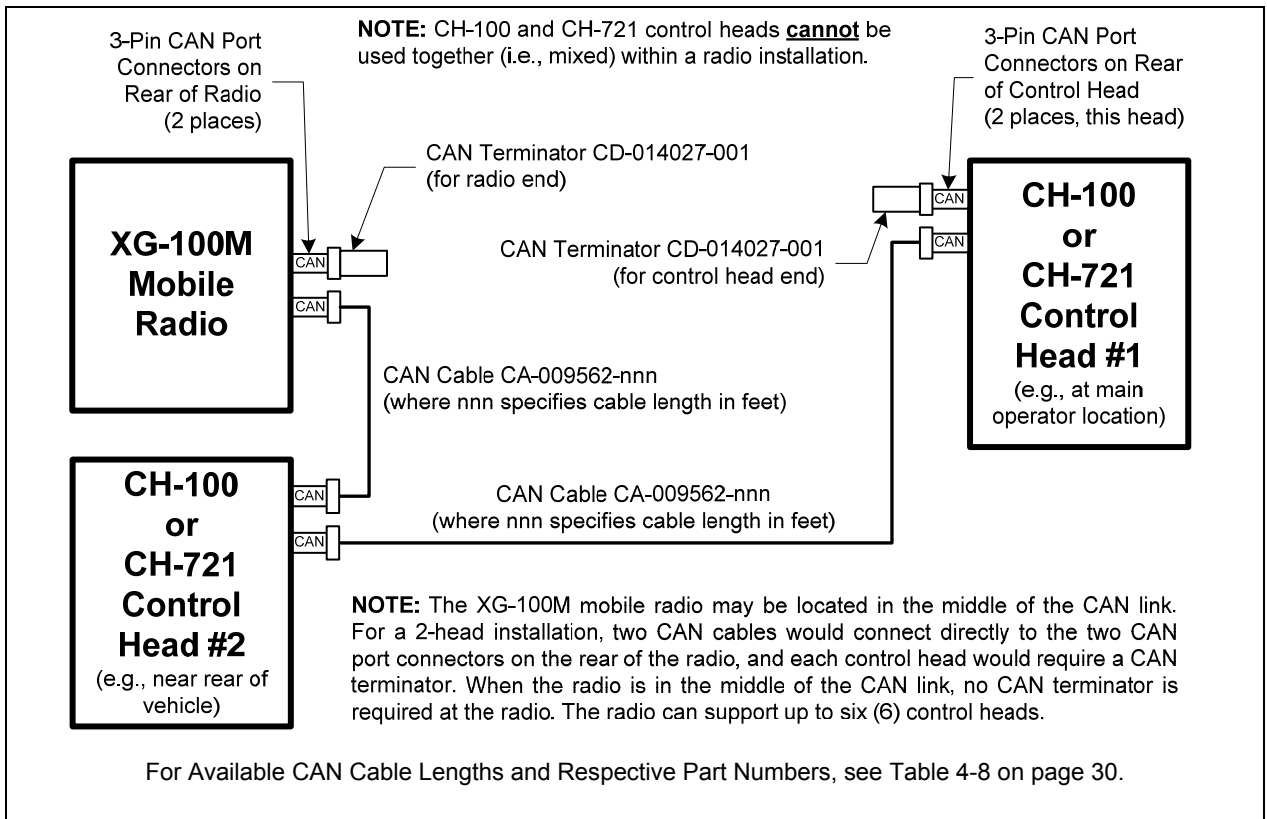


Figure 8-11: Typical CAN Link Connections for a Multi-Control Head Installation

Both the radio and the control head have two CAN ports to support “daisy-chaining” of multiple control heads or other CAN devices. Figure 3-2 on page 18 shows the radio’s two CAN port connectors, which are located near the center of the radio’s rear panel. Figure 8-7 on page 57 shows the two CAN port connectors on the control head’s rear panel.

8.3.5.2 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 8-11 as necessary.

1. Obtain the two (2) CAN terminators from the respective installation kit. For the CH-100 control head, they are item 5 illustrated in Table 4-4. For the CH-721 control head, they are item 5 illustrated in Table 4-5.
2. Obtain the CAN cable from the same installation kit.
3. Mate one terminator to either one of the two smaller 3-pin CAN port connectors on the rear panel of the control head. This action makes the CAN termination at the control head end of the CAN link.



NOTE

When mating any CAN connection (terminators and cables) to a rear panel connector, visually align the $\frac{3}{4}$ -moon-shaped keys of the connectors, and then gently push and turn the outer locking ring of the plug (male) connector clockwise until it stops. A mild click will be sensed to confirm proper mating. 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.

4. Mate it to the other CAN port connector on the rear panel of the control head.
5. Route the CAN cable 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.



NOTE

If the mobile radio installation must be interfaced to GPS and/or MDT equipment, simultaneous routing of the related interface cables along with the CAN cable will be time-saving. For GPS and MDT equipment cable part numbers and cable installation procedures, refer to Sections 12 and 13 respectively.

6. Mate this other end of the cable to one of the two CAN port connectors on the rear panel of the radio.
7. Mate the second CAN terminator to the other CAN port connector on the rear panel of the radio. This action makes the CAN termination at the radio-end of the CAN link.
8. Loop, tie and stow the excess cable as necessary, leaving a service loop at the back of the radio and at the back of the control head.

8.3.6 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:

8.3.6.1 Install DC Power Cable and Make Power and Ground Connections

1. Obtain the control head's DC Power Cable from the respective installation kit. For the CH-100 control head, this is item 4 illustrated in Table 4-4. For the CH-721 control head, this is item 4 illustrated in Table 4-5.
2. Connect this cable 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.

3. 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.
4. 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 3/8-inch ring terminal to it. Two ring terminals of this type are included with the cable.
5. 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.
6. At the back of the control head, tie and stow the cable as necessary.
7. 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.
8. Obtain one of the yellow waterproof (HFB-type) fuse holders included with the control head's DC Power Cable.
9. 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.
10. Using an appropriate electrical terminal, connect the red wire to the unswitched DC power source. A 3/8-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-type fuse included with the cable, and install it into the fuse holder.



NOTE

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



CAUTION

The fuse for the control head's red wire is rated at 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.

8.3.6.2 Connect DC Power Cable's White Wire

A review of the information presented in Section 8.2.1 (page 50) 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.

8.3.6.2.1 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 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 fused power source that switches from approximately zero volts to approximately +13.6 volts when the vehicle's ignition switch/key is turned from the OFF position to the ACCESSORY and RUN positions. Use of a switched power source that is subject to voltage changes as a result of other actions, such as opening a vehicle door, may result in undesirable radio power cycles.

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 yellow waterproof (HFB-type) fuse holders included with the control head's DC Power Cable.
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-type 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.

8.3.6.2.2 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 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 yellow waterproof (HFB-type) fuse holders 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 waterproof 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-type 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.**”

8.3.6.2.3 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 8.3.6.2.1, except connect the white wire to unswitched battery power instead of switched (“Accessory”) power. Be sure to fuse this connection with the provided in-line fuse holder and 3-amp AGC fuse.

8.3.7 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 8.3.6.2 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 8-12, 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.

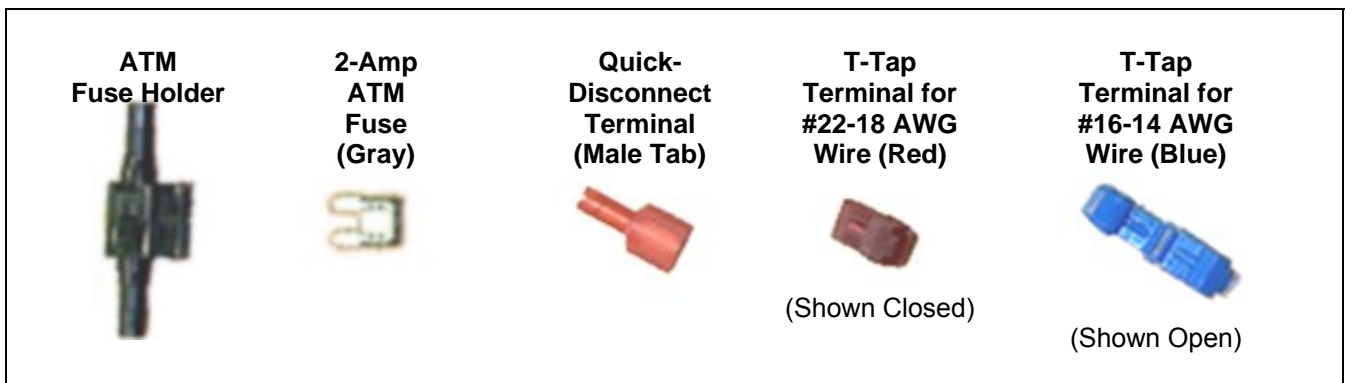


Figure 8-12: Contents of Vehicle Fuse and T-Tap Kit FS24473

4. From the Vehicle Fuse and T-Tap Kit, locate the male-tab quick-disconnect terminal and crimp it to one end of 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 use with a 22 to 18-AWG wire, and blue is for use with 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 8-13.
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.

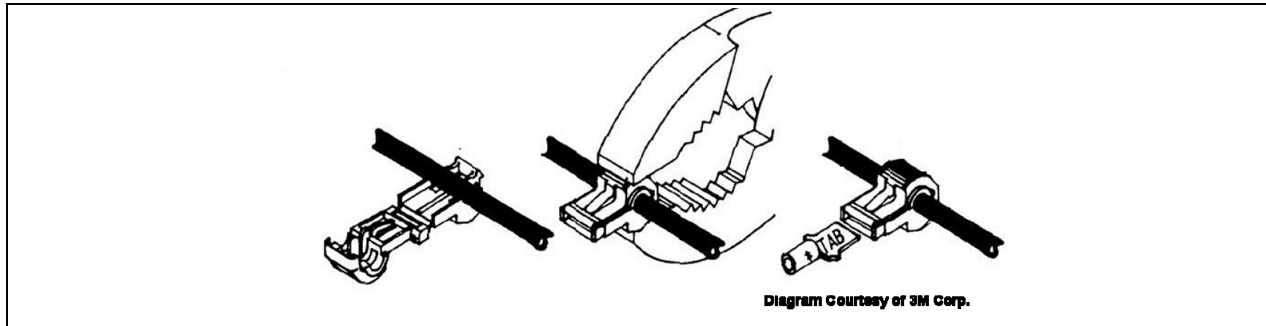


Figure 8-13: Attaching T-Tap Terminals to a Switched Power Wire

9 SPEAKER INSTALLATION

9.1 FRONT-MOUNT RADIO INSTALLATION

In a front-mount radio installation, total speaker cable length (of both cables) is approximately 10 feet (308 centimeters). Therefore, to include service loops in these cables, the speaker must be mounted within approximately 9.5 feet (290 centimeters) of the radio.

1. Select a location for the speaker that will allow for proper listening range with a moderate volume setting.
2. Install the speaker using the hardware and mounting bracket supplied with it. For the speaker's part number, see Table 4-3 on page 23.
3. Route the speaker cable to the rear of the radio.
4. Connect Option Cable CA-012349-001 (item 5 in Table 4-3) to the DB-44 connector on the rear of the radio. Tighten the cable's two (2) jackscrews securely. See Section 11.1 for additional information on this cable.



If the approximate speaker cable length of 10 feet is not long enough, 20-foot Speaker-Only Option Cable CA-012349-007 can be used in place of Option Cable CA-012349-001. However, Speaker-Only Option Cable CA-012349-001 does **not** support any optional connections at the 44-pin (DB-44) connector on the rear of the radio. Use of Speaker-Only Option Cable CA-012349-001 will provide approximately 25 feet of total cable length for the speaker connection.

5. Mate the Option Cable's 2-pin connector (identified P2 with green and white wires) to the 2-pin connector on the end of the speaker cable. A mild click will be sensed to confirm proper mating.
6. Route the cables out of the way of casual contact. Tie and stow as necessary.

9.2 REMOTE-MOUNT RADIO INSTALLATION

In a remote-mount mobile radio installation, an audio amplifier in the head drives the external speaker.

For this case, total speaker cable length of both cables between the control head and speaker is approximately five (5) feet. Therefore, to include service loops in these cables, the speaker must be mounted within approximately 4.5 feet of the installation's control head.

1. Select a location for the speaker that will allow for proper listening range with a moderate volume setting.
2. Install the speaker using the hardware and mounting bracket supplied with it. For the speaker's part number, see Table 4-5 (page 26).
3. Route the speaker cable to the rear of the control head.
4. Mate the 6-inch speaker cable, part number MAMROS0034-NN006, to the 2-pin connector at the rear of the control head by visually aligning the $\frac{3}{4}$ -moon-shaped keys of the connectors, and then 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.
5. Connect the speaker cable's 2-pin plastic connector to the respective mating connector on the 6-inch speaker cable.
6. Route the cables out of the way of casual contact. Tie and stow as necessary.

10 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 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 10-1, 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. The microphones have integrated hookswitches. Therefore, the microphone clip does **not** require grounding.
7. Clip the microphone to the clip.

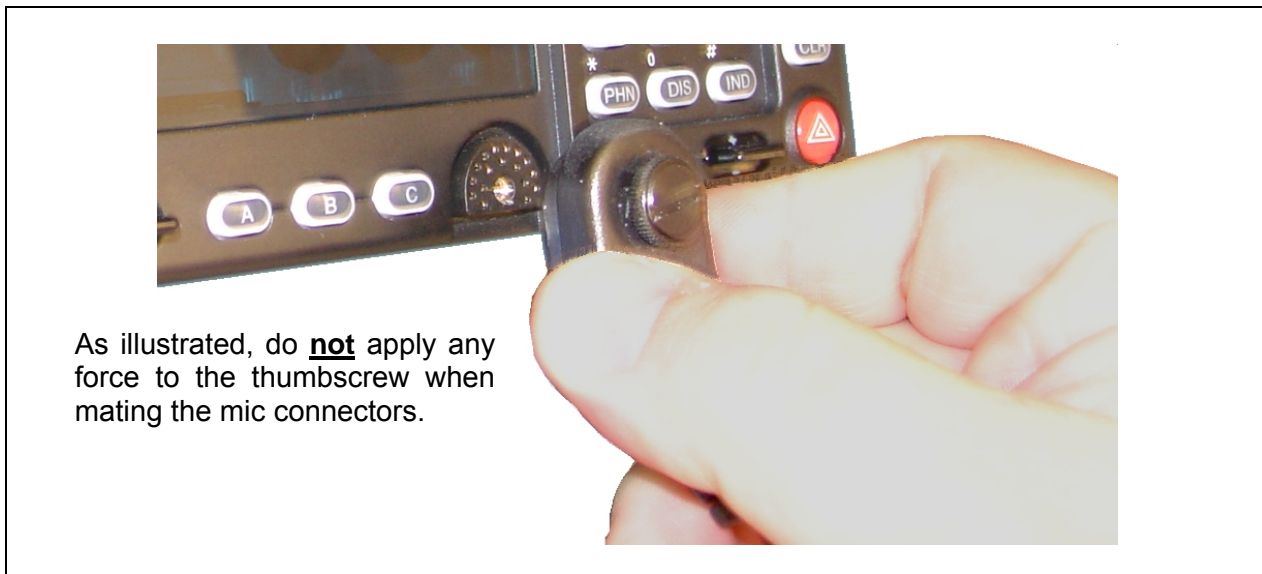


Figure 10-1: Attaching the Microphone to the Control Head (CH-721 shown)

11 OPTIONAL CABLES AND CONNECTIONS

11.1 OPTION CABLE CA-012349-001

Option Cable CA-012349-001 connects to the 44-pin I/O connector on the rear of the radio. It breaks out into several smaller standardized connectors, allowing straightforward access to external I/O interfaces provided by the radio. The cable also shortens radio removal and re-installation time when required. The cable is shown in Figure 11-1 below. The cable's 44-pin D-subminiature connector that mates with the connector on the rear of the radio is identified P1.



Observe caution before connecting any external device to the radio via its 44-pin I/O connector. If an external device has its own DC power source/cable (i.e., if it is powered separately from the radio), both the radio **and** the external device must be properly grounded to the vehicle **before** connecting the two units together and before making a positive (+) DC power connection to either unit. Otherwise, equipment damage may occur.

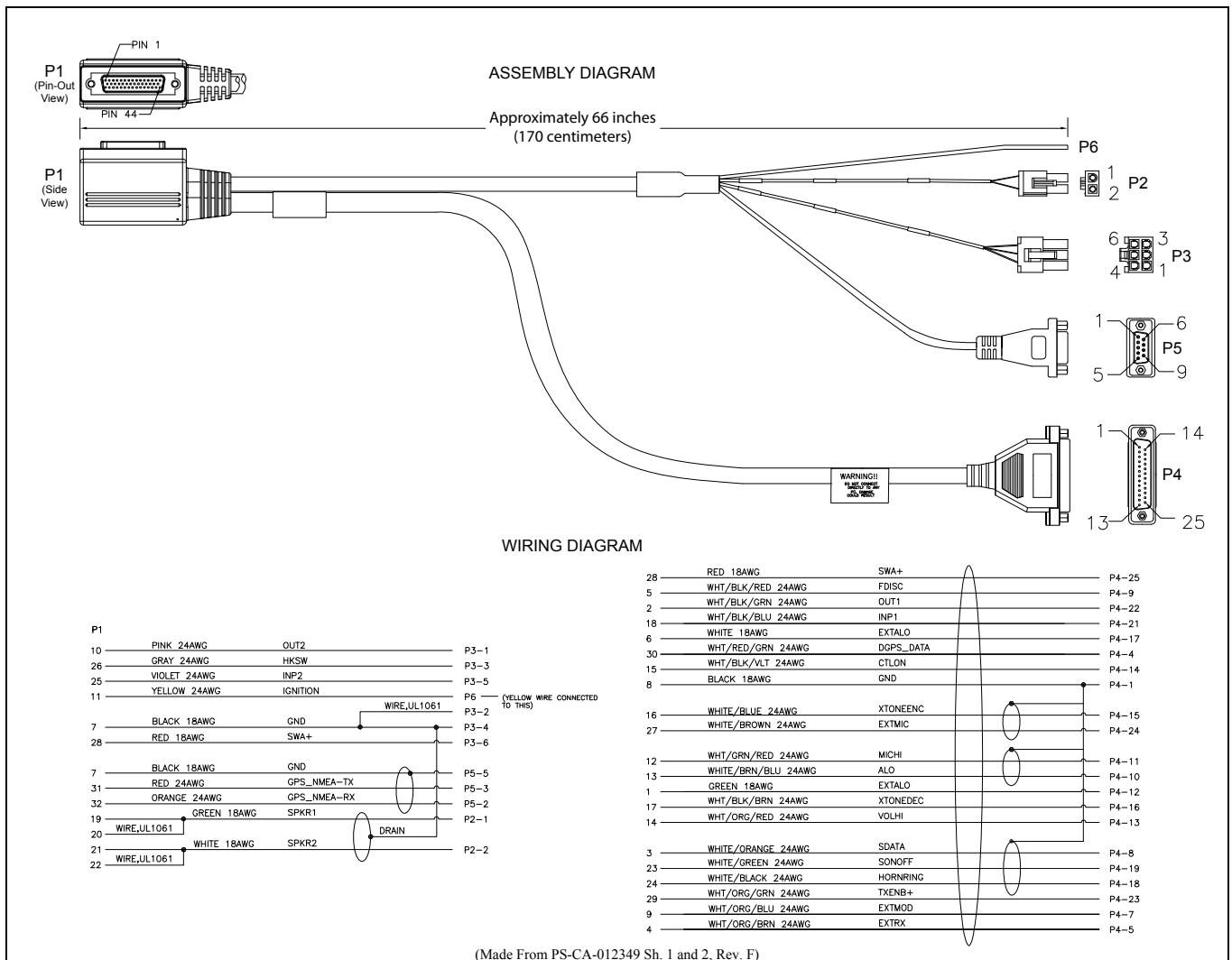


Figure 11-1: Option Cable CA-012349-001

P2, the cable's 2-pin connector, provides connections for an external speaker in a front-mount radio installation. For the respective installation information, see Section 9.1. P2 is not used in a remote-mount radio installation, since the audio amplifier in the head drives the external speaker (speaker connection is made at the rear of the control head).

P3, the cable's 6-pin connector, is a connector for basic accessories (e.g., hookswitch, etc.).

P4, the cable's D-subminiature 25-pin connector, provides audio and data connections for optional equipment such as an external siren and light system (e.g., Federal Signal SS2000 SmartSiren®).

P5, the cable's D-subminiature 9-pin connector, 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. See Section 12 on page 76 for additional information.

Table 11-1: Option Cable CA-012349-001 Interconnections

44-PIN I/O CABLE CONNECTOR P1 PIN	SIGNAL NAME	TO/FROM	DESCRIPTION
19	SPKR1	P2 pin 1	Speaker Audio Outputs 1 and 2. In a front-mount radio installation, this differential output drives the radio installation's external speaker. This output is <u>not</u> functional in a remote-mount radio installation; in this case, the speaker output from the control head drives the external speaker.
20	SPKR1		
21	SPKR2	P2 pin 2	
22	SPKR2		
10	OUT2	P3 pin 1	Digital Output 2 (open-collector, 100 mA / 17 V maximum). An external pull-up resistor is needed if required by the external device's input during the high/off state. Use P3 pin 2 or 4 for ground. Configure via the "External Output Control Line 2" in Radio Personality Manager's (RPM's) External I/O dialog box. For example, an external logging recorder's record enable/disable input can be controlled by setting "External Output Control Line 2" to "Extern. Tx Indicator."
7	GND	P3 pins 2 & 4	Chassis Ground (fused on radio's PK Board).
26	HKSW	P3 pin 3	Digital Input for Hookswitch (default) or for radio PTT. Active = Ground. Inactive = Open.
25	INP2	P3 pin 5	Digital Input 2. Active = Ground. Inactive = Open. Use P3 pin 2 or 4 for ground. Configure via the "Auxiliary Input 2" in Radio Personality Manager's (RPM's) External I/O dialog Box.
28	SWA+	P3 pin 6	Switched A+ (DC Power) Output.
8	GND	P4 pin 1	Chassis ground (fused on PK Board).
30	DGPS_DATA	P4 pin 4	GPS Receiver Module DGPS Correction Data Serial Data Input (NMEA formatted).
4	EXTRX	P4 pin 5	External Rx Audio Input (from external/2 nd receiver; summed).
9	RESERVED	P4 pin 7	Not used.

Table 11-1: Option Cable CA-012349-001 Interconnections

44-PIN I/O CABLE CONNECTOR P1 PIN	SIGNAL NAME	TO/FROM	DESCRIPTION
3	SDATA	P4 pin 8	In a front-mount radio installation, this pin for the siren/PA interface is the siren serial data output (open-collector/open-drain) from the radio's mounted (local) control head. It serially transfers siren and light control data from the control head to a connected third-party siren and light system (e.g., Federal Signal SS2000 SmartSiren). Data rate = 1200 bps. Connects to SS2000's DB-9 pin 3. For a remote-mount radio installation, see footnote ⁶ .
5	FDISC	P4 pin 9	Buffered Filtered Discriminator Audio Output (not normally used). A fixed-level audio output with DC bias. Approximately 200 mV rms into a 600-ohm load at rated deviation. Does <u>not</u> contain signaling (e.g., CTCSS). Mutes when speaker mutes. Use a 33 μ F / 50 V (or greater) coupling capacitor to connect to a 600-ohm load. Use P4 pin 12 for ground.
13	ALO	P4 pin 10	In a front-mount radio installation, this 600-ohm AC-coupled differential audio output from the mounted (local) control head is typically not used. In a remote-mount radio installation, these two pins of the radio's DB-44 connector are not functional.
12	MICHI	P4 pin 11	
1	EXTALO	P4 pin 12	In a front-mount radio installation, VOLHI (a single-ended AC-coupled audio signal) and EXTALO (signal ground) provide public address (PA) mic audio from the mounted (local) control head to a siren and light system, such as the Federal Signal SS2000 SmartSiren. Pin 13 connects to SS2000's DB-9 pin 5. Pin 12 connects to SS2000's DB-9 pin 6. For a remote-mount radio installation, these two pins can provide an unmuted volume-level-controlled single-ended audio signal to external devices. P1 pin 1 (EXTALO) is over-current protected on radio's PK Board by a 1-amp fuse.
14	VOLHI	P4 pin 13	
15	CTLON	P4 pin 14	Control-On Digital Input. Logically OR'd on radio's PK Board with a CAN receiver activity logic signal, so either input can turn on the radio. Not normally used.
16	XTONEENC	P4 pin 15	External Tone Encode Audio Input (default) or Auxiliary Mic Audio Input.
17	XTONEDEC	P4 pin 16	External Tone Decode Audio Output.
6	EXTALO	P4 pin 17	Reference/Ground for external audio. Over-current-protected on radio's PK Board by a 1-amp fuse.

⁶ In a remote-mount XG-100M radio installation, this pin on the radio's DB-44 connector is typically not used. For the CH-721 control head, use the respective pin on the CH-721 Option Cable's female DB-25 pin connector; see Section 11.2 for additional information.

Table 11-1: Option Cable CA-012349-001 Interconnections

44-PIN I/O CABLE CONNECTOR P1 PIN	SIGNAL NAME	TO/FROM	DESCRIPTION
24	HORNRING	P4 pin 18	In a front-mount radio installation, this pin for the siren/PA interface is the horn/ring logic input to the radio's mounted (local) control head. When a connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) has its horn/ring function active, this input is used to signal the head/radio as such. Connects to SS2000's DB-9 pin 8. For a remote-mount radio installation, see footnote ⁶ .
23	SONOFF	P4 pin 19	In a front-mount radio installation, this pin for the siren/PA interface is the siren on/off logic output (open-collector) from the radio's mounted (local) control head. It is the signal that powers the connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) on and off. Connects to SS2000's DB-9 pin 4. For a remote-mount radio installation, see footnote ⁶ .
18	INP1	P4 pin 21	Digital Input 1. Active = Ground. Inactive = Open. Use P4 pin 1 for ground. Configure via the "Auxiliary Input 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
2	OUT1	P4 pin 22	Digital Output 1 (open-collector, 100 mA / 17 V maximum). An external pull-up resistor is needed if required by the external device's input during the high/off state. Use P4 pin 1 for ground. Configure via the "External Output Control Line 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
29	TXENB+	P4 pin 23	Transmit Enable B+ Output (open-collector). Active/Radio Transmitting = Ground. Inactive/Not Transmitting = Open. (not normally used).
27	EXTMIC	P4 pin 24	External/Auxiliary Mic Audio Input. Fixed-level audio input (i.e., input gain is not adjustable). Approximately 120 mV rms gives full-rated deviation. Use P4 pin 17 for ground.
28	SWA+	P4 pin 25	Switched A+ DC Power Output (not normally used).
32	GPS_NMEA_RX	P5 pin 2	NMEA-Formatted GPS Receiver Position Data Serial Data Output.
31	GPS_NMEA_TX	P5 pin 3	NMEA-Formatted GPS Receiver Module Initialization Data Serial Data Input.
7	GND	P5 pin 5	Ground for GPS Serial Data Signals (fused on radio's PK Board).
11	IGNITION	Yellow Wire	Unused/Spare ignition sense input.
33 — 44	—	(no connections)	These twelve pins of P1 are not used/not connected when Option Cable CA-012349-001 is connected.

11.2 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 11-2 below.

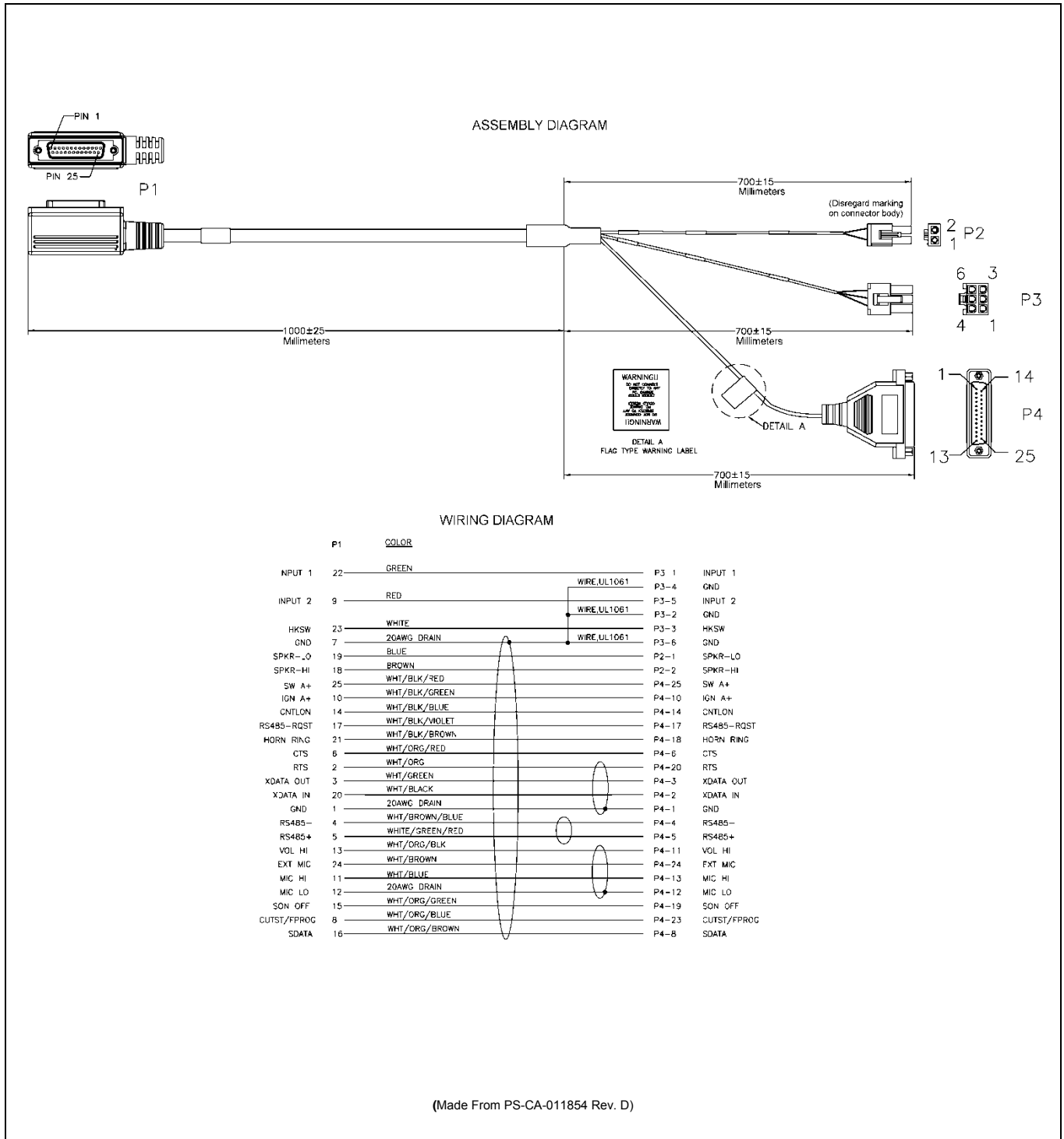


Figure 11-2: CH-721 Option Cable CA-011854-001

11.3 SERIAL DATA CABLE CA-013671-020

Serial Data Cable CA-013671-020 (20 feet long) can be used to make data connections to the radio to support data communications equipment such as an MDT or a GPS NMEA-format device. It can also be used to program and configure the radio via a Personal Computer (PC). The cable's assembly and wiring diagrams are shown in Figure 11-3 below.

The cable's male DB-9 connector (J1) mates to the female DB-9 serial port connector on the rear of the radio. Alternately, if the cable is being used to carry GPS NMEA-formatted serial data from the radio, this male DB-9 connector mates to connector P5 of Option Cable CA-012349-001.

The cable's female DB-9 connector (J2) mates to a PC's male DB-9 serial port connector. 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. As of the publication of this manual, CN24741-0001 is available via the Customer Resource Center; refer to Section 3.3 on page 20 for contact information.

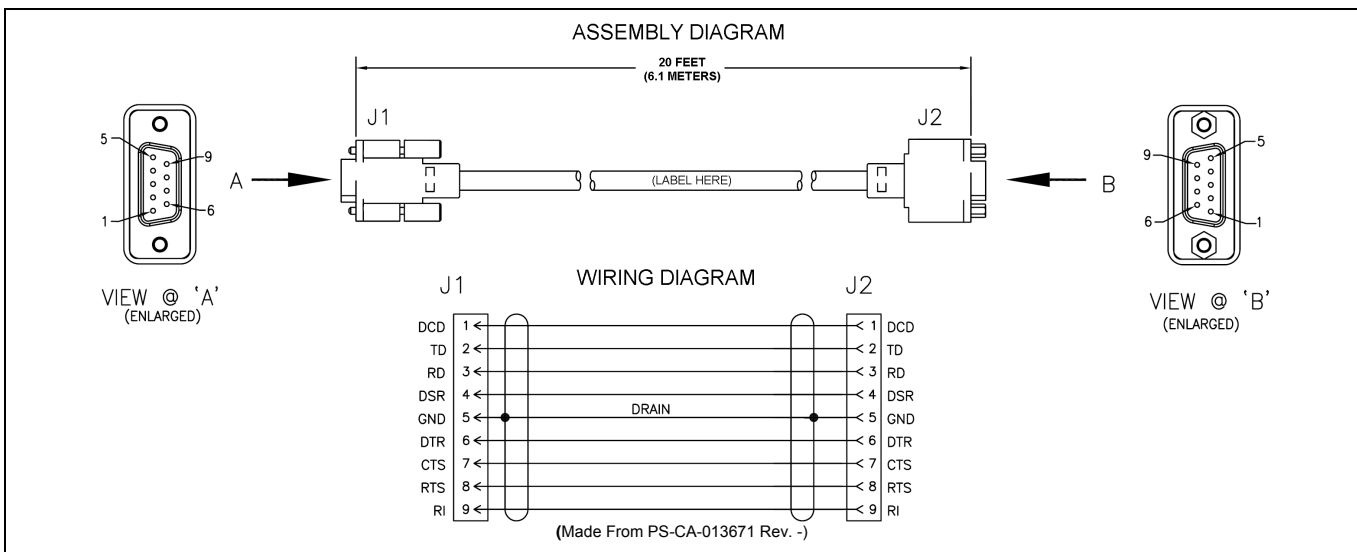


Figure 11-3: Serial Data Cable CA-013671-020

11.4 CH-721 SERIAL PROGRAMMING CABLE CA-104861

Serial Programming Cable CA-104861 (5 feet long) can be used to program and configure the CH-721 control head via a Personal Computer. It has a female DB-9 connector on one end for connection to the PC's serial port connector and a male DB-9 connector on the other end for connection to the serial port connector on the rear of the head. Refer to the respective Software Release Notes for programming and configuration information.

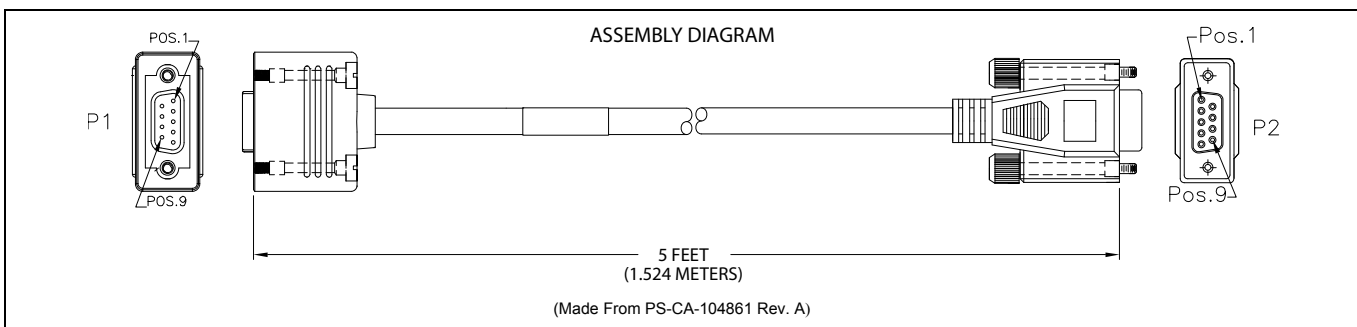


Figure 11-4: CH-721 Serial Programming Cable CA-104861

11.5 CH-721 MIC CONNECTOR PROGRAMMING CABLE CA-103541-001

CH-721 Mic Connector Programming Cable CA-103541-001 (4 feet long) can be used to program and configure the CH-721 control head via its front-panel microphone connector. It has a female DB-9 connector on one end for connection to a PC's serial port connector and a 17-pin Conxall-style connector on the other end for connection to the head's mic connector. Refer to the respective Software Release Notes for programming and configuration information.

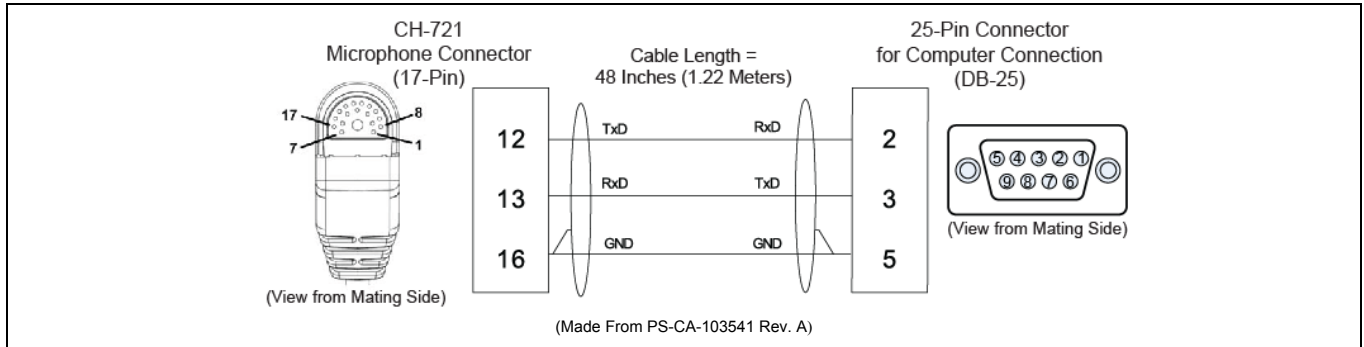


Figure 11-5: CH-721 Serial Programming Cable CA-103541-001

11.6 SPEAKER-ONLY OPTION CABLE CA-012349-007

Speaker-Only Option Cable CA-012349-007 is used when only speaker connections to a front-mount radio must be made. Other connections to the 44-pin (DB-44) connector on the rear of the radio **cannot** be made when this 20-foot cable is employed. It connects the radio's high-power speaker audio output to the 2-wire leads of the speaker. Refer to Section 9.1 on page 67 for the respective installation instructions. Connector P1 mates to the 44-pin connector on the rear of the radio. Connector P2 mates to the speaker's 2-pin connector.

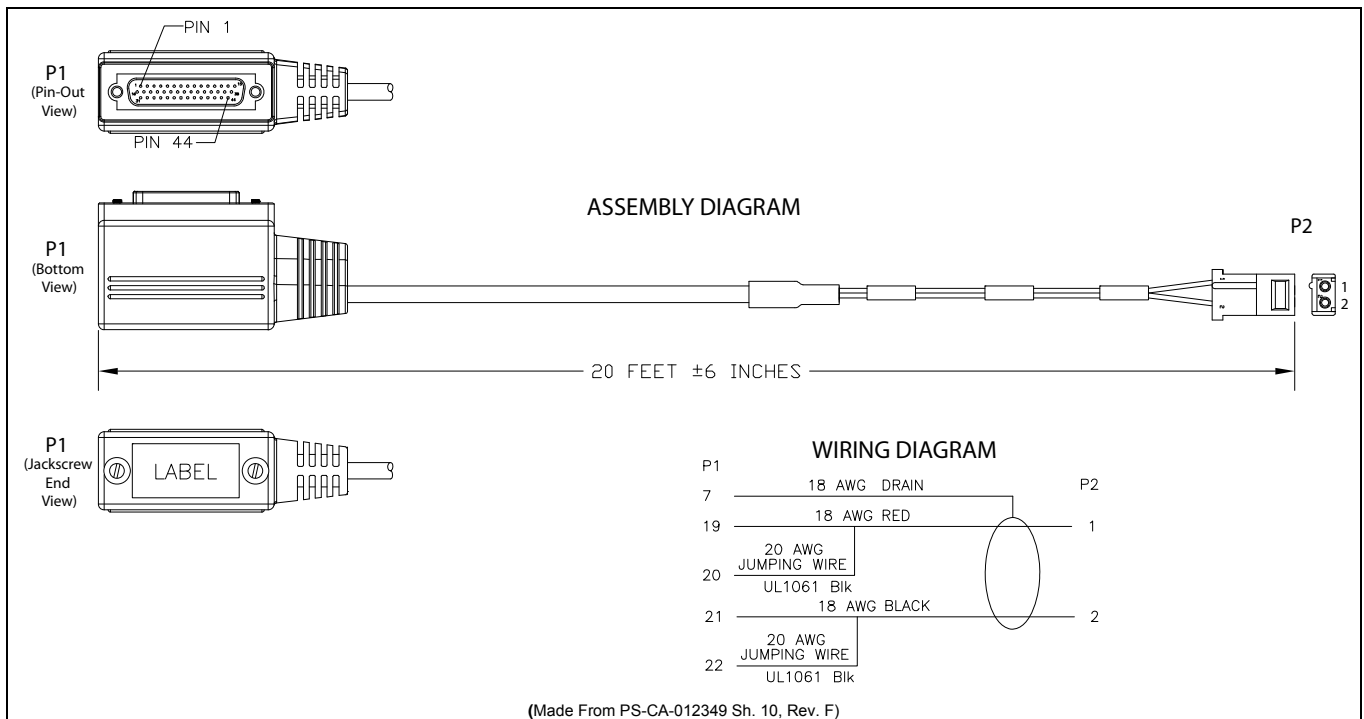


Figure 11-6: Speaker-Only Option Cable CA-012349-007

12 GPS NMEA-FORMATTED DATA CONNECTION

To obtain GPS NMEA-formatted serial data from the radio, Option Cable CA-012349-001 is required. Follow this procedure to complete the GPS NMEA-formatted serial data connections:

1. Obtain Option Cable CA-012349-001. Each “leg” of this cable is approximately 65 inches long (166 centimeters).
2. Connect the cable’s 44-pin D-subminiature (DB-44) male connector to the DB-44 female connector on the rear panel of the radio. Tighten the two jackscrews with a small flathead screwdriver. Do not over-tighten.
3. Connect the cable’s DB-9 female connector to the computer’s serial port DB-9 male connector—either directly or extended via cable CA-013671-020 (a 20-foot-long cable); see Section 11.3. Tighten the screws 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.
4. Follow the manufacturer’s instructions on processing the NMEA-formatted GPS data from the radio.



NOTE

If the 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 7, 31 and 32). See Table 11-1 for additional information.

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

13 MOBILE DATA CONNECTION

If the radio installation must support mobile data communications of a computer running Mobile Data Terminal (MDT) or similar software, follow this procedure to connect the computer to the radio:

1. Obtain cable CA-013671-020 (or equivalent). This is a 20-foot-long standard serial data cable.
2. Connect this cable’s male DB-9 connector to the female DB-9 connector on the rear of the radio. Tighten the two (2) jackscrews securely.
3. Route the cable through the vehicle’s interior wire/cable channeling to the computer. Remove interior panels, door kick panels, etc., as necessary. Protect the cable from possible chafing and tie-and-stow it as necessary.
4. Connect the cable’s female DB-9 connector to the computer. If the computer is not equipped with a DB-9 serial port connector, use a suitable adapter, such as USB-to-RS-232 Adapter Cable CN24741-0001.



NOTE

As of the publication of this manual, mobile data should not be obtained from the serial port of the CH-721 control head.



NOTE

Before data communications can occur on a P25 system, the respective data option must be enabled. Contact the Technical Assistance Center (TAC) for additional information. TAC contact information is included on page 20.

14 INITIAL POWER-UP TEST

1. At the radio's main waterproof (HFB-type) fuse holder installed near the vehicle battery, insert the 20-amp AGC-type fuse that was included with the radio's DC Power Cable.
2. Tie and stow all fuse holders at this location to prevent excess vibration/movement.
3. Carefully reconnect the vehicle's battery ground cable.
4. If not already, temporarily connect the mobile antenna cable from the vehicle-mounted mobile antenna to the female TNC RF connector on the rear panel of the radio. This is a temporary connection until performance tests in Section 15 are complete.
5. Permanently connect the antenna cable from the GPS antenna (or mobile/GPS combo antenna) to the female SMA connector on the rear panel of the radio. The male SMA connector on most GPS antenna cables has a 5/16-inch hex collar, so the use of a wrench of this same size is normally required for tightening. However, some may have collars with only knurled surfaces, so a standard wrench or torque wrench cannot be used. In either case, do not over tighten the connector and do not twist the cable when tightening.
6. 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.
7. If the control head is not already powered up, do so by rotating its on/off/volume control clockwise out of the detent position.
8. Verify the control head has powered-up by observing its display. If the display is not functioning, refer to Section 8.2.1 as necessary.

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 on the load side of the fuses, etc. If problems persist, contact the Technical Assistance Center (see page 20).
 - Consult the Operator's Manual for operational information.
9. Advance to Section 15 and complete the performance test procedures.

15 PERFORMANCE TESTS

This section includes procedures to verify the performance of the installation's mobile antenna system. There are two (2) procedures in this section:

- 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 13.6 volts DC $\pm 10\%$, with a current capacity of greater than 20 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!**



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 main AGC fuse (20-amp) should be removed from the holder prior to jump-starting. Doing so will prevent damage to the radio system.



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

15.1 REQUIRED TEST EQUIPMENT

Table 15-1: Required Test Equipment

TEST EQUIPMENT	MODEL / PART NUMBER & DESCRIPTION
Peak-Reading Wattmeter	Bird Electronic Corp. Model 4314B (or equivalent) with Type N female connectors at input and output ports.
Wattmeter Slug	Bird Electronic Corp. Element 50C or 100C (50 or 100-Watt max. respectively), 100 - 250 MHz frequency range (or equivalent).
Wattmeter Slug	Bird Electronic Corp. Element 50E (50-Watt max.), 400 - 1000 MHz frequency range (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 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 antenna per the installation described in Section 6 of this manual.

15.2 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 15-1 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 antenna.
3. Turn the radio on and set it to a VHF P25 conventional channel allocated for radio testing. This same channel should be used during the antenna test procedures presented in the subsequent section.

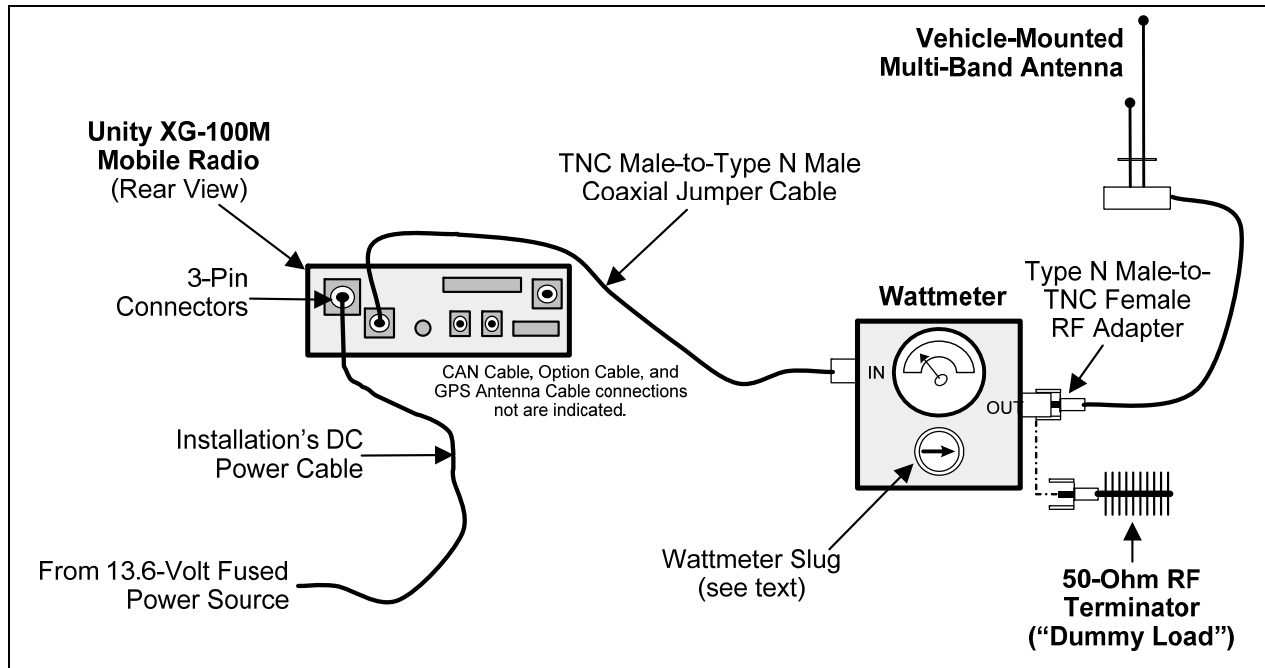


Figure 15-1: Wattmeter Connections for Antenna System Tests

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 dummy load for forward power measurements.
5. Set the wattmeter to measure peak RF power.
6. Key the radio's transmitter via the microphone's PTT button.
7. For a VHF or a UHF band transmission, compare the wattmeter's reading with the target RF output power range of between **39.8 and 63 watts** (50 watts \pm 1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.

For a 700 MHz band transmission, compare the wattmeter's reading with the target RF output power range of between **23.8 and 37.8 watts** (30 watts \pm 1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.

For an 800 MHz band transmission, compare the wattmeter's reading with the target RF output power range of between **27.8 and 44.1 watts** (35 watts \pm 1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.



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 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 20).

9. Repeat on test channels within the other RF bands, until at least one channel in all bands has been tested.

15.3 TRANSMITTING INTO THE MOBILE ANTENNA

1. Connect the antenna cable from the vehicle-mounted antenna to the wattmeter as shown in Figure 15-1.
2. Turn the radio on and set it to a VHF P25 conventional channel allocated for radio testing. This should be the same channel that was used during the previous test procedure.



When transmitting into an antenna, always observe the RF exposure-related safety information presented in Section 1.2 (begins on page 7).

3. 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.
4. Set the wattmeter to measure peak RF power.
5. Key the radio’s transmitter via the microphone’s PTT button.
6. For a VHF or a UHF band transmission, compare the wattmeter’s reading with the target RF output power range of between **39.8 and 63 watts** (50 watts ±1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.

For a 700 MHz band transmission, compare the wattmeter’s reading with the target RF output power range of between **23.8 and 37.8 watts** (30 watts ±1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.

For an 800 MHz band transmission, compare the wattmeter’s reading with the target RF output power range of between **27.8 and 44.1 watts** (35 watts ±1 dB). This transmit output power range assumes the radio is currently configured for high-power transmit.



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

7. **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 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 20).

8. 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 to the radio to measure reverse power.
9. Key the radio’s transmitter via the microphone’s PTT button.
10. Compare the wattmeter reading with the RF power output range of **2 watts or less**.



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

11. **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 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 20).

12. Repeat on test channels within the other RF bands, until at least one channel in all bands has been tested.
13. Disconnect the coaxial cable jumper and wattmeter.
14. Permanently connect the cable from the vehicle-mounted 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.
15. Make several test calls on the radio system to verify operation of the mobile radio. Before making the calls, select other talk groups or conventional channels, as required to verify operation.

**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.

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

15.4 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 M7300 mobile radio installation.

Mobile Radio Serial Number

Antenna Make and Model Number(s)

*Date of Test
(mm/dd/yyyy)*

Company Performing Installation

Technician Performing Test



<i>Watts</i>	<i>RF Band</i>
	VHF
	UHF
	700 MHz
	800 MHz

*Tx Power into
50-Ohm Load*

<i>Watts</i>	<i>RF Band</i>
	VHF
	UHF
	700 MHz
	800 MHz

*Forward Tx Power
with Antenna*

<i>Watts</i>	<i>RF Band</i>
	VHF
	UHF
	700 MHz
	800 MHz

*Reflected Tx Power
with Antenna*

16 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 other 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.

17 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

18 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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