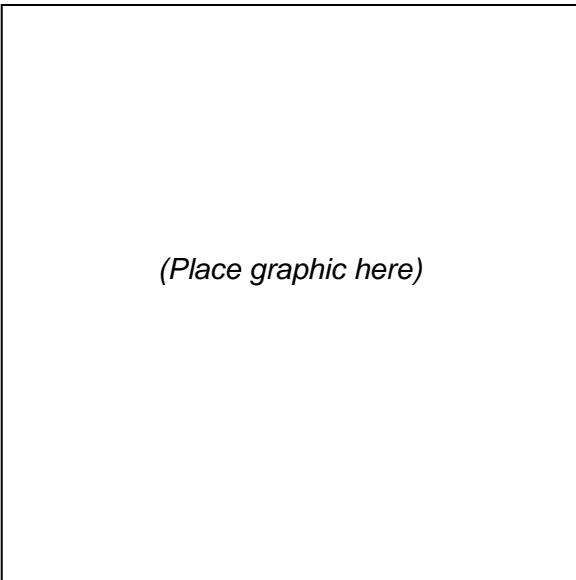


Rhein Tech Laboratories, Inc.
360 Herndon Parkway
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Herndon, VA 20170
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Client: M/A COM, Inc.
Model: M5300 900 MHz Mobile Radio
ID's: OWDTR-0049-E/3636B-0049
Standards: Part 90/RSS-119
Report #: 2007163-001

Appendix I: User Manual

Please refer to the following pages.



(Place graphic here)

M/A-COM
M5300 Series
Digital Mobile Radio

MANUAL REVISION HISTORY

REV	DATE	REASON FOR CHANGE
-	May/07	Initial Release.

M/A-COM Technical Publications would particularly appreciate feedback on any errors found in this document and suggestions on how the document could be improved. Submit your comments and suggestions to:

Wireless Systems Business Unit or fax your comments to: 1-434-455-6851
M/A-COM, Inc.

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Lynchburg, VA 24501

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NOTICE!



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

This manual covers M/A-COM products manufactured and sold by **M/A-COM, Inc.**

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitutions of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

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1 SAFETY SYMBOL CONVENTION

The following conventions are used throughout this manual to alert the user to general safety precautions that must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. M/A-COM, Inc. 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 a risk of danger, damage to the equipment, or severely degrade the equipment performance.



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



The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of **Electro-Static Discharge**. Proper precautions must be taken to prevent ESD when handling circuit modules.

2 RF ENERGY EXPOSURE INFORMATION

2.1 RF ENERGY EXPOSURE AWARENESS, CONTROL INFORMATION, AND OPERATION INSTRUCTIONS FOR FCC OCCUPATIONAL USE REQUIREMENTS

Before using your mobile two-way radio, read this important RF energy awareness and control information and operational instructions to ensure compliance with the FCC's 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 meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.



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

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

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection. All two-way radios marketed in North America are designed, manufactured, and tested to ensure they meet government established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of two-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it. Please refer to the following websites for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits.

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

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

2.1.1 Federal Communications Commission Regulations

Your M/A COM, Inc. M5300 mobile two-way radio is designed and tested to comply with the FCC RF energy exposure limits for mobile two-way radios before it can be marketed in the United States. When two-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a label directing users to specific user awareness information. Your M/A COM, Inc. M5300 two-way radio has an RF exposure product label. Also, your M5300 Installation and Operator's Manuals include information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

2.2 COMPLIANCE WITH RF EXPOSURE STANDARDS

Your MA/COM, Inc. M5300 mobile two-way radio is designed and tested to comply with a number of national and international standards and guidelines (listed below) 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 factors of up to 50% talk-50% listen and is authorized by the FCC for occupational use. In terms of measuring RF energy for compliance with the FCC exposure guidelines, your radio antenna radiates measurable RF energy only while it is transmitting (talking), not when it is receiving (listening) or in standby mode.

Your M/A COM, Inc. M5300 mobile two-way radio complies with the following RF energy exposure standards and guidelines:

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



Table 2-1 lists the recommended minimum lateral distance for a controlled environment and for unaware bystanders in an uncontrolled environment, from transmitting types of 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 lateral distance away from the transmitting antenna.

Table 2-1: Rated Power and Recommended Minimum Safe Lateral Distance

ANTENNA PART NUMBER	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA (Distance in Centimeters)	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-025177-004	Combined GPS/900 MHz, Elevated Base	24	70
AN-025177-005	900 MHz with Magnetic Mount	38	85
AN-025177-009	900 MHz with Low Profile Roof Mount	25	60

2.2.1 Mobile Antennas

Install the radio's antenna (refer to Table 2-1 for applicable antenna part numbers) in the center of the vehicle's roof. These mobile antenna installation guidelines are limited to metal body motor vehicles or vehicles with appropriate ground planes. The antenna installation should additionally be in accordance with the following.

1. The requirements of the antenna manufacturer/supplier included with the antenna.
2. Instructions in the M5300 Radio Installation Manual, including minimum antenna cable lengths.
3. The installation manual providing specific information of how to install the antennas to facilitate recommended operating distances to all potentially exposed persons.

Use only the M/A-COM approved/supplied antenna(s) or approved replacement antenna. Unauthorized antennas, modifications, or attachments could damage the radio and may violate FCC regulations.

2.2.2 Approved Accessories

This radio has been tested and meets the FCC RF guidelines when used with the M/A-COM accessories supplied or designated for use with this product. Use of other accessories may not ensure compliance with the FCC's RF exposure guidelines, and may violate FCC regulations.

For a list of M/A-COM approved accessories refer to the product manuals, M/A-COM's Products and Services Catalog, or contact M/A-COM at 1-800-368-3277.

2.2.3 Contact Information

For additional information on exposure requirements or other information, contact M/A-COM, Inc. at 1-800-528-7711 or at <http://www.macom-wireless.com>.

3 OPERATION SAFETY RECOMMENDATIONS

3.1 TRANSMITTER HAZARDS



The operator of any mobile radio should be aware of certain hazards common to the operation of vehicular radio transmitters. A list of several possible hazards is given:

- **Explosive Atmospheres** – Just as it is dangerous to fuel a vehicle with the motor running, similar hazards exist when operating a mobile radio. Be sure to turn the radio off while fueling a vehicle. Do not carry containers of fuel in the trunk of a vehicle if the radio is mounted in the trunk.

Areas with potentially explosive atmosphere are often, but not always, clearly marked. Turn OFF your radio 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 Electronics Systems** – Electronic fuel injection systems, electronic anti-skid braking systems, electronic cruise control systems, etc., are typical electronic systems that can malfunction due to the lack of protection from radio frequency energy present when transmitting. If the vehicle contains such equipment, consult the dealer and enlist their aid in determining the expected performance of electronic circuits 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 of blasting operations. Always obey the “**Turn off Two-Way Radios**” signs posted where electric blasting caps are being used. (OSHA Standard: 1926-900)
- **Liquefied Petroleum (LP) Gas Powered Vehicles** – Mobile radio installations in vehicles powered by liquefied petroleum gas with the LP gas container 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** requiring:
 - The LP gas container and its fittings.
 - Outside filling connections shall be used for the LP gas container.
 - The LP gas container shall be vented to the outside of the vehicle.

3.2 SAFE DRIVING RECOMMENDATIONS

(Recommended by AAA)

- 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.

4 OPERATING RULES AND REGULATIONS

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

In the United States, the M5300 mobile radio must be operated in accordance with the rules and regulations of the Federal Communications Commission (FCC). As an operator of two-way radio equipment, you must be thoroughly familiar with the rules that apply to your 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 your two-way radio, remember these rules:

- It is a violation of FCC rules to interrupt any distress or emergency message. As your radio operates in much the same way as a telephone “**party line**,” always listen to make sure that 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 – **KEEP OFF THE AIR!**
- 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 that you keep conversations brief and confine them to business. To save time, use coded messages whenever possible.
- Using your radio to send personal messages (except in an emergency) is a violation of FCC rules. You may send only those messages that are essential for the operation of your business.
- It is against Federal law to repeat or otherwise make known anything you overhear on your radio. Conversations between others sharing your channel must be regarded as confidential.
- The FCC requires that you identify yourself at certain specific times by means of your call letters. Refer to the rules that apply to your 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.



NOTE

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.

4.1 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, some improvement can be obtained by moving a few yards in another direction or moving to a higher elevation.

5 PRODUCT DESCRIPTION

Designed to meet the critical demands of utility and public service users, the M5300 mobile provides the latest in digital radio technology. The M5300 is capable of supporting multiple operating modes, including OpenSky[®] digital operation, EDACS[®] or ProVoice trunked modes, and conventional analog mode.

The M5300 uses Time Division Multiple Access (TDMA) technology in the OpenSky mode to allow multiple users to share a single RF channel. In addition, a single RF channel can support simultaneous digital voice and data communications.

The M5300 provides integrated voice and data services. Voice operation is provided using a microphone and speaker included in the radio installation kit. For data transfers, the M5300 is constructed with an industry-standard RS-232 interface serial port for connecting an optional laptop PC.

A PC, not included with the M5300, provides network connectivity through the standard serial (DCE-type) interface.

The M5300 has an integrated Global Positioning System (GPS) receiver. This allows the M5300 to fully support the Automatic Vehicular Locator (AVL) for fleet management and dispatch applications.

The OpenSky M5300 benefits from a flexible, software-based digital radio design. Features and user profiles are software-defined and can be reprogrammed over the air. The optional over-the-air programming feature allows communication protocols to be changed easily and added at any time.

5.1 REMOTE CONTROL HEAD OPERATION

For remote mount installations configured with a CH721 control head, all normal radio operations and interfaces can be handled via the control head connected to the radio unit by a single twisted-pair connection routed through a vehicle. Up to six control units may be attached to a trunk mount radio. Each control head provides a serial access point for data and any one (only one at a time) can be connected to a data device such as a personal computer.

Where multiple control heads are connected or where a dash-mount radio is installed with additional remote control heads, the following features are available from each position:

- Outgoing voice calls can be initiated. (Any control head can initiate a call but only one can talk at a time. All other connected control heads will hear both sides of the conversation.)
- Incoming and outgoing audio can be heard. (Outgoing audio is not broadcast at the source position.)
- Independent audio control is available.
- Radio settings such as talk group, scan mode etc., can be controlled. (Any connected control head can override the radio settings of other connected control heads.)
- Comfort settings, such as volume and display brightness that are applicable to the individual control head can be adjusted and cannot be overridden by other control heads.
- An optional intercom function is available between control units. (Audio will be broadcast to ALL connected control heads.)

5.2 INTERCOM OPERATION

The intercom option, a licensed option, allows the M5300 radio to pass audio locally between control heads and not over the network. It gives users at multiple control heads connected to the same radio the ability communicate with each other without transmitting over-the-air. When activated, incoming network radio calls are still scanned and broadcast at each control head.

6 OPERATION

6.1 CH721 FRONT PANEL COMPONENTS

The front panel of the control head includes a dot matrix display, controls for menu navigation, an emergency button, three pre-set buttons, a power button/rotary volume dial, and a microphone connector. In addition, the system model control head features a DTMF keypad. Table 6-1 lists all default front panel controls and their functions.

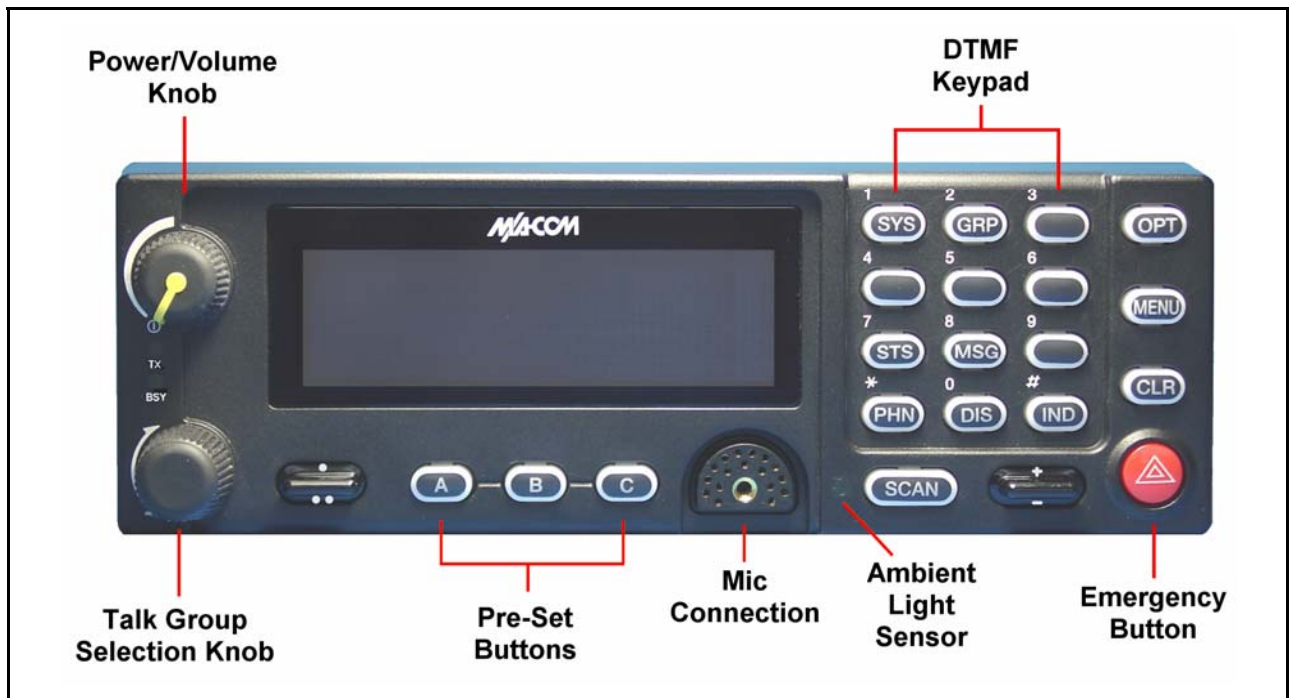


Figure 6-1: System Model



Figure 6-2: Scan Model

The buttons on the front panel are backlit for operation in a low ambient light level such as nighttime operation. Some buttons also flash to provide feedback of various operating conditions.




In addition, the front panel contains a light-level sensor that samples ambient light levels for automatic display and button backlight brightness adjustments. In other words, it automatically brightens the display and backlights when higher external light levels exist and it automatically dims the display and backlights during lower external light levels.



NOTE

Button function may vary depending upon system programming, radio hardware, and optional configurations. Complete the table in Section 9 if the keys have been remapped to provide new functions.

Table 6-1: Front Panel Default Controls and Functions

PART	FUNCTION
Power/Volume Knob	Turn knob clockwise to power on the radio and increase volume. Turn counter-clockwise to decrease volume and power off the radio.
Mic Connection	Connection for hand-held, hands-free, speaker-mic, or headset.
Emergency Button	If enabled through programming, the emergency button sends an emergency alert and opens voice communication on the currently selected talk group or the default emergency talk group (depending upon how the system is defined). To end an emergency call, press and hold the emergency button for approximately four seconds.
Ambient Light Sensor	Radio automatically adjusts the display and button backlight brightness level based on ambient light. Do not block this sensor.
 or 	While in the dwell display, scrolls through available talk groups. Scrolls through selections within the active menu (available talk groups, pre-programmed speed dial numbers, canned alert messages, etc.).
	Scrolls through available menu items.
OPT/OPTION	
CLR/CLEAR	
MENU	Press to activate the current selection. In some cases, this is not necessary as the last selection will automatically activate after a short period.
Display area	Menu selections and messages. Network Connectivity icon. Current Volume Level icon. Volume numeric representation within the display (0 = Muted, 40 = Loudest). User may select which one of several dwell displays the radio uses.
Pre-Set buttons	These buttons are used to store and recall user-selectable parameters such as scan mode, selected profile, selected talk group, and priority talk group. Different parameters can be stored at each of the three different pre-set buttons.

6.2 POWER UP AND VOLUME CONTROL

6.2.1 Power Up

1. Rotate the Power/Volume Control knob clockwise to power on the radio. The display will illuminate when the radio powers up.
2. Wait for the power-up sequence to complete, which takes approximately ten (10) seconds.

During this time, if enabled for auto registration, the radio is provisioned with a customized user personality designed for the user's specific needs by the OpenSky network administrator.

If this personality contains encrypted talk groups or if the user is authorized for, and intends to use, manual encryption, User Login must be performed. This requires a system model control head so that the User ID and password can be entered.

3. When provisioning is complete, the radio will display the Dwell Display.

If User Login is required, the bottom line of the Dwell Display will flash the message "Pls Login."

6.2.2 Volume Control

Turn the Power/Volume Control knob clockwise to increase the volume and counter-clockwise to decrease the volume.

6.3 SELF-TEST

After power-up, the M5300 radio undergoes a multi-function automatic registration procedure. As many as sixteen (16) possible radio profiles are downloaded to the radio from the network in response to the User's ID.

6.4 LOGIN TO THE NETWORK

Login occurs either automatically (auto registration) if the radio has a valid registration or, if enabled and authorized for encryption (section 6.30), requires the user to enter a User ID and password.

If encryption is enabled and authorized on the radio, the user will be prompted to "Pls Login" with the *1 login command, a User ID, and password [System Model Control Head required].

1. Press *1 (Login command).
2. Enter the full 10-digit User ID.
3. Press the # key.
4. Enter the password. See the following NOTE.
 - If the radio is configured for alpha-numeric passwords and the password has consecutive duplicate numbers ("MES33" for example), enter # between the consecutive duplicate numbers so the radio will **not** interpret the entry as a letter ("D" in this example).
 - If the radio is configured for numeric-only passwords, do not enter # between duplicated numbers.
5. Press the # key twice.

The User ID may be remembered from the previous log-in. (Refer to Section 6.5 for further details regarding log-off commands.) The password will be established before the radio is put into operation. Contact the local OpenSky network administrator for more information.



NOTE

If necessary, contact radio system administration personnel for log-in assistance and/or radio-specific log-in instructions.

6.5 LOG OFF THE NETWORK

The *0## command de-registers the radio. Typically, this is automatically performed when powering down the radio. Using this method, the User ID is remembered by the radio so only the password is needed at next log-in. Manually log-off by pressing *0## (requires System Model).

If a user is logged in using encryption features, it is necessary to log-off when encryption is no longer required.

6.6 TURNING THE RADIO OFF

To turn the radio off, rotate the **Power Button/Volume Dial** counter-clockwise. In multiple control head installations, turning off the last powered-up control head will also automatically turn off the radio.


Several user-selected radio settings (i.e., scan mode, pre-set buttons, and side tone levels) are maintained for the next operational session. At the next radio power-up, maintained settings will automatically restore, along with the network personality settings. In multiple control head installations, settings are maintained for each control head position.





NOTE

User-selected radio settings and last-tuned channel information will be lost if power is abruptly disconnected from the radio prior to executing the correct turn-off procedure. This can extend the time required for the radio to register with the network upon the subsequent power-up.

6.7 MENU DISPLAY AND CONTROL AREA

Following power-up, the radio display shows the default talk group (Figure 6-3). Pressing up or down with  changes the display to the next available menu. In many cases, the dwell display automatically re-appears after no menu buttons are pressed for a short period of time (between 10 and 30 seconds). For some menus such as the GPS and User ID menus, this does not occur until the user presses a front panel button.

When the dwell display is active, it will change dynamically to reflect the current profile, received talk group/caller ID (when available), or channel (when enabled).

The radio's display is highly interactive. It responds in the top and bottom text lines as the user presses the menu buttons (,  and **MENU**) to scroll through the menu loop and the entries for each menu. Table 6-4 outlines the basic menu structure.

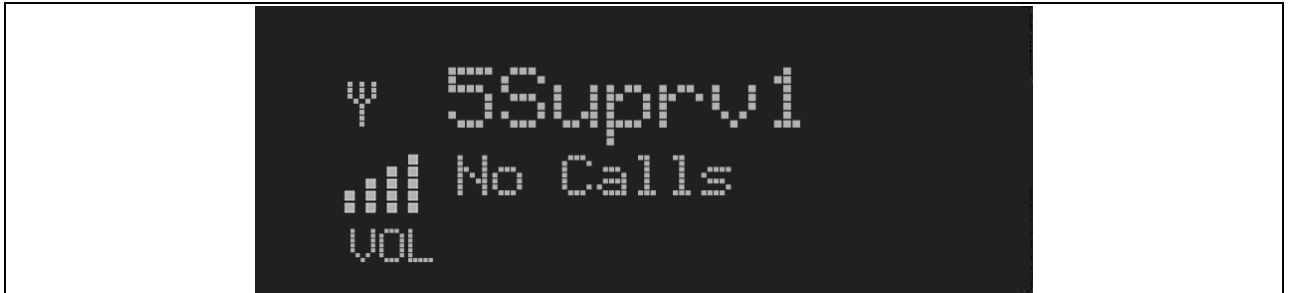




Figure 6-3: Typical Display


6.8 RADIO STATUS ICONS

Status Icons indicate the various operating characteristics of the radio. The icons show operating modes and conditions (see Table 6-2). The location of icons on the display may vary depending on configuration.

Table 6-2: ICONS and Descriptions

ICON	DESCRIPTION
	Indicates data registration.
	Volume bars – indicates relative volume level.

6.9 DWELL DISPLAY

When not engaged in menu selection, the first two lines of the display default to the user-defined display, known as the “dwell display.” The top line indicates the currently selected talk group. The second line will display the currently selected profile, caller ID/alias¹, received talk group, and current channel name. Press the  ramp control to scroll through and view one of these second line options.

6.10 PERSONALITY

As illustrated in Figure 6-4, a personality defines the profiles and talk groups available to the user. It is the structuring of a collection of profiles and privileges established by the OpenSky network administrator to provide the user with a comprehensive set of profiles to communicate effectively with the necessary talk groups or individuals.

Personalities are stored on the network and downloaded over-the-air to the radio. This process is called “provisioning.” Provisioning occurs at radio power-up and at user log-in. Each personality can contain up to sixteen (16) profiles and each profile can contain up to sixteen talk groups.

6.10.1 Profiles

As stated above, each profile can contain up to sixteen (16) talk groups. A profile also defines the radio’s emergency behavior. All transmissions are made on the selected talk group (displayed on the top line of the dwell display). The user can change the selected talk group to any of the other talk groups within the profile.

¹ Alias is a logical ID name such as “J_Smith.” The name corresponds to a user ID such as 003-542-0001.

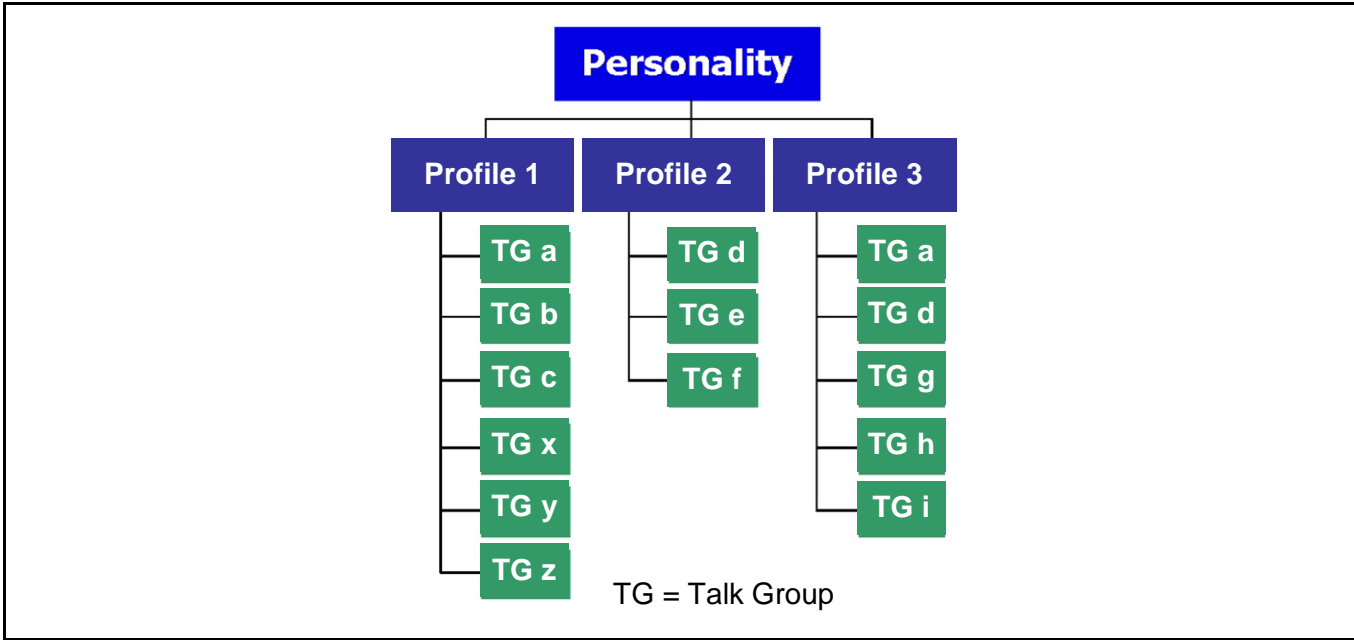


Figure 6-4: Personality Structure Example

6.10.2 Talk Groups

A talk group represents a set of users that regularly need to communicate with one another. There can be any number of authorized users assigned to a talk group. Talk groups are established and organized by the OpenSky network administrator. An OpenSky talk group is similar to a channel within a conventional FM radio system.

6.11 ALERT TONES

The M5300 radio also provides audible Alert Tones or “beeps” to indicate the various operating conditions (see Table 6-3).

Table 6-3: M5300 OpenSky Mode Alert Tones























NAME	STONE	DESCRIPTION
Call Queued	one low tone/two high tones	Call queued for processing.
Call Denied	three short	Radio is out of coverage area or requested talk group is active.
Grant (or Go-Ahead)	single short beep	Sounded when resources become available for a call request placed in the queue (if enabled) upon channel access. If the radio roams to another site while transmitting, then it will auto rekey and begin transmitting on that tower. It gives a second grant tone to let the user know they have roamed.
Call Removed	single long low-pitched tone	Notifies the user access to the channel has been lost (out of coverage area or pre-empted by higher-priority call)

NAME	STONE	DESCRIPTION
Selective Alert Received	four short tones	Only played once to indicate a selective alert has been receive
Emergency Alert Tone	three (3) short beeps	Sounds when an emergency alert is declared
Emergency Cleared Tone	one long low-pitched tone	Sounds when an emergency is cleared
Selective Call Ring Tone	a ringing tone similar to a telephone	Ringng is repeated every four (4) seconds until the call is accepted or rejected by the radio being called or until the network drops the call if unanswered after one (1) minute
PSTN Ring Tones	a single medium-pitch reiterative tone.	Two ring tone - one generated by the radio when there is an incoming telephone call or an outgoing telephone call attempt is waiting for the telephone interconnect gateway equipment to dial the Public Switched Telephone Network (PSTN). The second ring tone sounds when the gateway equipment has dialed the number.
Roam Tone	Two short tones, one high-pitched and one low-pitched	Sounds when the radio transitions from one radio base station site to another.

6.12 BASIC MENU STRUCTURE

Table 6-4 illustrates the basic M5300 OpenSky menu structure. Menu items will vary depending upon system programming, radio hardware, and optional configurations. All menus except the dwell display menu can be turned off by network administration personnel.

Table 6-4: Basic Menu Structure

Menu Name	Radio Displays (top and bottom lines)	Usage Notes
	To/From Dwell Display 	
Engineering Display (Menu may not be available per programming.)	registration, RF sync and transceiver status codes bit-error rates and RSSI data 	Displays radio system connection data. For engineering use.
Silent Emergency	OFF/ON "SilentEmerg" 	Use  to toggle OFF/ON.
Operating Mode (e.g., OTP, OCF)	available modes "Mode Menu" 	Use  to choose an available mode. Press MENU and confirm (Y/N) with  and MENU again.
GPS Fix	current latitude and longitude "GPS Fix" 	Radio's current GPS latitude and longitude position scrolls across top line of the display. Applies to GPS-equipped radios only.
User ID	User ID # of user currently logged in "User ID" 	User's identification/name scrolls across top line of the display (if programmed).
IP Address	Radio's IP address "IP Address" 	Radio's Internet Protocol (IP) address scrolls across top line of the display.
Station Identification	station's call sign "Station ID" 	Station's identification/name scrolls across top line of the display (if programmed).
Stealth Mode	"OFF" "StealthMenu" 	Use  to turn on. Press any button to turn it off.
Treble Level	"LOW", "MEDIUM", "MEDHIGH", "HIGH" "Treble Menu" 	Use  to choose speaker/headset treble level. Press Select to return to dwell display.
Display Brightness	"<< >>" "Bright Menu" 	Use  to dim or brighten backlighting. Press MENU to return to dwell display.
Side Tone Level	"OFF", "LOW", "MED", "HIGH" "Side Menu" 	Use  to choose side tone level. Press MENU to return to dwell display.
Intercom	"ON" or "OFF" "INTERCOM" 	Use  to turn intercom on and off. Press MENU to return to dwell display.
Selected Channel (Menu may not be available per radio programming)	selected channel "ChannelMenu" 	Displays the current channel. Press MENU to return to dwell display.

See Next Page

Menu Name	Radio Displays (top and bottom lines)	Usage Notes
	See Previous Page 	
Scan Mode	current scan mode "ScnModeMenu"	Use to turn scan on and off. Press MENU to return to dwell display.
Talk group Lock Out	talk group "<" "LockOutMenu"	Use to choose a talk group for locking/unlocking. Press MENU to toggle "<" on (locked out) and off.
Priority 1 Talk group	current priority talk group "Priority2"	Use to choose new priority talk group. Press MENU to return to dwell display.
Priority 2 Talk group	current priority talk group "Priority1"	Use to choose new priority talk group. Press MENU to return to dwell display.
Emergency Dismiss	alert received "EmgDismiss"	Use to choose emergency talk group. Press MENU to dismiss.
Alerts Received	time/sender's name/ alias/message text "AlertsRcvd" or oldest message	"No alerts" or alert message text scrolls in display. Use to view messages.
Alert Destination	current speed dial # "AlertDest"	Use to choose a speed-dial number. Press MENU to go to "AlertMsg" menu. Scroll through canned messages with . Press MENU to send message and return to dwell display.
Speed Dial	current speed dial # "SpeedDial"	Use to choose a speed-dial number. Press MENU , then use to select canned message.
Profile Selection	currently active profile "ProfileMenu"	Use to choose an available profile. Press MENU to return to dwell display.
Talk group Selection	selected talk group "TalkGrpMenu"	Use to choose a talk group in current profile. Press MENU to return to dwell display.
Dwell Display	Selected talk group (bottom line option)	Use to scroll top line through talk groups. Press MENU to change bottom line option.
		Use , CLR , or OPT to scroll through menus.



NOTE

Menus and button function will vary depending upon system programming, radio hardware, and optional configurations.

6.13 DUAL-TONE MULTI-FREQUENCY

Dual-Tone Multi-Frequency (DTMF) is the system used by touch-tone telephones. DTMF assigns a specific tone frequency to each key so a microprocessor can easily identify its activation. The radio supports DTMF with a system model control head (Figure 6-1). This allows for specific tasks such as entering a user ID and password, or selective calling.

When a key on the DTMF keypad is pressed, a single low-pitched tone will be heard from the microphone. The key tones are not adjustable.

6.14 KEYPAD COMMANDS (SYSTEM MODEL CONTROL HEAD)

To perform a command from the keypad, press the * key followed by one of the pre-set function keys as follows:

Table 6-5: Keypad Function Commands

*0	Log-off command: *0## (logs the user off the system). See page 16 for additional information.
*1	Log-in command: *1<User ID> # <Password> ## (required for encryption). See page 15 for additional information.
*4	Enter Scene of Incident Mode (SOI) on specified channel. Exit SOI Mode with *4#.
*7	Initiate Selective Alert command: *7<Target ID>#[Choose Message]#. See page 30 for additional information.
*8	Radio-to-Radio Call command: Selective call number # (PTT to dial).
*9	Public Switched Telephone Network (PSTN) Call command: See page 32 for additional information.
*32	Begin Manual Encryption command: *32<Pre-Determined Encryption Key ># 1 – 16 digit encryption key for 128 bit encryption; 17 – 32 digit encryption key for 256 bit encryption. See page 36 for additional information.
*33	End Manual Encryption command.

6.14.1 Password Entry

Password entry requires a system model control head. Password characters are encrypted on the display using symbols to indicate the entry. The encryption symbols for each entry will appear in the display as they are scrolled through, for example: '-' and '+'. Press the # key twice to complete the entry process.



NOTE




If the password is wrong, the radio will not successfully register with the network for wide area voice reception. The radio can still be used in single-site mode.

6.14.2 DTMF Overdial

Using the keypad on a System Model, the radio can transmit DTMF tones corresponding to numbers/characters 0 — 9, * and # on the keypad. To overdial numbers/characters, transmit by pressing and holding the PTT button and then, press the corresponding keys (one at a time) on the keypad.

6.15 CHANGING THE ACTIVE PROFILE



The radio can store up to sixteen (16) standard profiles, one of which is the currently active profile. To change the currently active profile:

1. Press up or down using  until “ProfileMenu” is displayed.
2. Use  to scroll through the list of available profiles.
3. Profile becomes active when selected for longer than 2 seconds, when the **MENU** is pressed, or when the menu is changed using .


6.16 CHECKING OR CHANGING THE SELECTED TALK GROUP

Each profile stored in the radio can have up to sixteen (16) talk groups. One talk group within the currently active profile is set as the “selected talk group.” For the radio user, the selected talk group is typically the focus of most voice transmissions and receptions. There are two ways to change the selected talk group:

First Method:



1. Use  to scroll through the menu until “TalkGrpMenu” appears on the bottom line of the display. The currently selected talk group appears in the top line of the display.
2. Use  to scroll through the available list of talk groups in the active profile. This list is determined by the OpenSky network administrator.

Second Method:

From the dwell display, use the talk group selection knob or  to scroll through the available list of talk groups in the active profile.

6.17 ADJUSTING DISPLAY & BUTTON BACKLIGHT BRIGHTNESS

The radio uses a light sensor on the front panel to automatically adjust display brightness and button backlight brightness to ambient light conditions. The display and backlights automatically brighten at higher external light levels and automatically dim at lower external light levels. However, the “Bright Menu” gives the user some manual brightness control as follows:



1. Using , scroll through the menu until “Bright Menu” appears.
2. Use  to increase or decrease brightness. Display and button backlight brightness will immediately dim or brighten.

6.18 STEALTH MODE

For some users, it is important to be able to turn off the radio’s display lights, button backlighting, volume and side tones, but not the radio traffic. For example, in covert operations, lights and sounds could inadvertently expose an otherwise unobservable radio user. For this purpose, the radio has a Stealth feature that disables the radio display light, indicator light and audible side tones.

When stealth mode is on, the radio continues to scan the programmed list of talk groups and the user can key-up on the selected talk group.

6.18.1 Enabling Stealth Mode

1. Using , scroll through the menu until “StealthMenu” appears.
2. To immediately turn stealth mode on, press up or down with .
3. To turn stealth mode off, press any button on the radio’s front panel.

6.18.2 Disabling Stealth Mode

Pressing any radio button other than the mic’s PTT button or the emergency button on front panel will immediately turn stealth mode off. For example, pressing the **MENU** button on the front panel will turn stealth mode off.



With stealth mode on, pressing any radio button (other than the mic’s PTT button or the emergency button) on front panel will immediately turn stealth mode off.

6.19 ADJUSTING SIDE TONE AUDIO LEVEL



The radio sounds confirming tones called “side tones” when its buttons are pressed. Most users find this audible confirmation helpful when navigating the menus. Side tone audio level can be adjusted or turned completely off using the “Side Menu.”

For covert operations, it may be necessary to turn off side tones. For safety’s sake, turning off the radio during covert operations is not recommended.




To temporarily disable the side tones that could expose the user’s presence and position, use the menu buttons to access the “Side Menu” and select “Off” from the menu choices.

If the radio is operating properly but side tones are not heard when the menu buttons are pressed, the side tones are probably turned off. To turn them back on, access the “Side Tone” menu and select a setting other than “off.”

Use the following procedure set side tone level:

1. Use  to cycle through the menu until the “Side Menu” appears in the bottom line of the display.
2. Use  to change to the desired level (Off, Low, Medium, and High). To turn side tones completely off, use the “Off” setting.

6.20 CHANGE OPERATING MODE

1. Use  to cycle through the menu until the “Mode Menu” appears in the bottom line of the display.
2. Use  to choose an available mode. Press **MENU** and confirm (Y/N) with  and **MENU** again.
3. Press the **MENU** button to confirm.

6.21 RECEIVING AND TRANSMITTING VOICE CALLS

As soon as the radio completes the startup/log-on/provision/self-test sequence and registers on the OpenSky network, voice calls from talk groups in the active profile will be audible.

6.21.1 Receiving a Voice Call

No action is required to receive a voice call. The display responds to incoming voice calls as follows:

- If the dwell display is set to received talk group/caller ID/alias, the display indicates either the User ID of the incoming caller, if available, or the talk group's name. If the selected talk group matches the receive talk group, caller ID/alias is displayed. Otherwise, the talk group (name) is displayed.
- If the dwell display is not set to received talk group, the display indicates the data appropriate to those displays, but provides no indication as to the identity of the incoming caller.

Refer to section 6.25 for detailed information on talk group scanning. Refer to section 6.30 for detailed information regarding sending and receiving encrypted calls.

6.21.2 Transmitting a Voice Call



Transmit a voice call as follows:

1. Turn the radio on.
2. If required, log-in to the network using a user ID and password. See section 6.4 beginning on page 15 as necessary.
3. Select the desired talk group for transmitting on.
4. Depress and hold the **Push-to-Talk (PTT)** button on the hand-held microphone, pause for a moment, and then speak normally. For maximum clarity, hold the microphone approximately 1 ½ inches from the mouth and do not shout or whisper into it. If the call is queued by the network, wait for the grant tone to sound before speaking.
5. Release the PTT button when finished speaking.

Refer to section 6.30 for detailed information regarding sending and receiving encrypted calls.


6.22 ADJUSTING AUDIO TREBLE LEVEL


The tone of received signals can be adjusted using the radio's "Treble Menu" as follows:

1. Use  to scroll through the menu until "Treble Menu" appears. The radio's current treble level setting indicates in the top line of the display. There are four levels available: low, medium, medium-high and high.
2. Use  to increase or decrease.
3. Press the **MENU** button or wait a few seconds to return to the Dwell Display.

6.23 INTERCOM MODE

The optional intercom mode gives users at multiple control heads connected to the same radio the ability communicate with each other without transmitting over-the-air. Turn intercom mode on and off using the "INTERCOM" menu as follows:

1. Use  to cycle through the available menu items until "INTERCOM" appears in the display.

2. Use  to toggle between “On” and “Off.”

When intercom mode is turned on:

- Incoming voice calls will override intercom communications for the duration of the voice call. The radio and associated control heads will remain in intercom mode and intercom communications will resume when the voice call ends.
- “TG: INTERCOM” appears in the control head’s display when talking on the intercom. This indicates microphone audio is not sent out on the selected talk group; rather, it remains localized between the radio control positions (i.e., the control heads connected to the mobile radio).
- If a call exists on the currently selected talk group when a PTT button is pressed at one of the control heads, “TG: in use” appears in the display to indicate intercom mic audio cannot preempt the call on the talk group.



A user at a radio with only one control head/front panel can turn intercom mode on. In this case, pressing the microphone’s PTT button will not send microphone audio anywhere.

6.24 TALK GROUP LOCK OUT

There are two ways of focusing voice communications by suppressing calls from talk groups in the currently active profile:

1. **No Scan.** By turning scan off (selecting “No Scan” via the “ScnModeMenu”), only the selected talk group is audible.
2. **Lock Out.** By locking out selected talk groups, the “chatter” of the locked-out talk groups cannot be heard. This focuses the user’s scanning resources to calls only on desired talk groups.

Talk group lock out is a scan-related feature. With lock out, one or more talk groups in the active profile can be temporarily disabled from being scanned. Calls are not received on locked-out talk groups. Lock out settings are not retained between profile changes or when the radio is power cycled.



Lock out is a listening (receive) function and only blocks received calls on locked out talk groups. Lock out does not affect transmit capability. The above methods do not apply to recent emergency lock outs.



Only talk groups in the active profile can be locked out, since they are the only talk groups whose voice calls can be heard on the radio.



If the Scan Mode is “Fixed,” P1 and P2 groups CANNOT be locked out. See Section 6.25 for more information.

The default emergency and emergency-capable talk groups can be locked out if they are NOT in an emergency state. If a talk group is locked out and is subsequently changed to the currently selected talk group, it will automatically be unlocked by the radio so the user can hear calls on the talk group. The radio may be configured so all talk groups are automatically locked out by default. In this case, they must be manually unlocked, if desired.



6.24.1 Lock Out a Talk Group

1. Use  to scroll through the menu until “LockOutMenu” appears in the bottom line of the display. The name of a talk group in the currently active profile will appear in the top line.
2. Use  to scroll through the list of talk groups, if any, until the desired talk group for lock out appears in the top line of the display.
3. Press the **MENU** button to lockout the displayed talk group. A less than symbol (<) appears next to the talk group’s name.
4. Repeat steps 2 and 3, as needed, to lockout additional talk groups.

The dwell display will re-appear a few seconds after button presses end.

While scrolling through talk groups in the active profile, the only talk groups that appear in the “LockOutMenu” are those in the active profile.

6.24.2 Unlock a Talk Group

1. Use  to scroll through the menu until “LockOutMenu” appears in the bottom line of the display. The name of a talk group in the currently active profile will appear in the top line.
2. Use  to scroll through the list of talk groups, if any, until the talk group desired for unlocking appears in the top line of the display. A less-than symbol (“<”) appears next to the name of a talk group that is currently locked out.
3. Press the **MENU** button to unlock the talk group. The less-than symbol (“<”) next to the name of the talk group disappears. The dwell display appears as soon as the radio acknowledges the selection.



NOTE

- Changing the active profile removes any lockouts you have made.
- Turning off the radio removes any lockouts you have made.

6.25 SCANNING

Three scanning modes are available for the radio, but only one can be active at any time. Changing the scanning mode changes the way the radio scans voice calls for all of profiles in the radio personality, no matter which profile is or becomes active.



As described in Table 6-6, the choice of scanning mode changes the span of communications with all the talk groups in the radio’s profiles, but does not affect interaction with the talk groups.

Table 6-6: Scan Modes

SCAN MODE	EXPLANATION
No Scan	<p>Eliminates distractions.</p> <p>Full communications (transmit and receive) on selected talk group.</p> <p>No calls received from other talk groups.</p>
Normal (Default)	<p>The user can scan all talk groups in the active profile that are not locked out as long as there is demand on the site.</p> <p>Priority (P1 and P2) groups are user selectable.</p> <p>Receive calls from more than one talk group, if available from the current site.</p> <p>Allows dragging of the selected talk group, P1, P2, and default emergency talk groups to the site on which the radio is registered. (If other calls are available at the site, they also can be heard but they will not be actively dragged.)</p> <p>The default emergency talk group, as well as any emergency-enabled talk groups, is only dragged if it is in emergency mode.</p>
Fixed	<p>The priority groups are fixed to the selected profile's pre-defined P1 and P2 groups (configured via the UAS). In this mode, P1 and P2 groups CANNOT be locked out.</p> <p>The user can scan all talk groups in the active profile that are not locked out, as long as there is demand on the site.</p> <p>Allows dragging of the P1, P2, and selected talk group to the site on which the radio is registered. If other calls are available at the site, they can also be heard, but they will not be actively dragged.</p> <p>The default emergency talk group, as well as any emergency-enabled talk groups, is only dragged if in emergency mode.</p>

6.25.1 Checking or Changing Active Scan Mode

The currently active scan mode does not appear in the dwell display. To check it, access "ScnModeMenu" and observe it in the top line of the display. To change the active scan mode:

1. Use  to scroll through the menus until "ScnModeMenu" appears in the display.
2. Use  to scroll through the scan options until the desired mode appears. See Table 6-6.

6.25.2 Scanning Priority



The following lists the scanning priority order (from highest to lowest):

1. Selected talk group in emergency state.
2. Default emergency group in emergency state.
3. Selected talk group.
4. Emergency capable group in emergency state
5. Priority 1 talk group.
6. Priority 2 talk group.

7. Other (non-priority)

6.25.2.1 Changing Scanning Priority

Follow this procedure to set talk groups in the current profile as the Priority 1 or Priority 2 talk group:

1. Use  to scroll through the menu until “Priority1” or “Priority2” appears in the bottom line of the display (Priority1 group has higher priority than the Priority2 group. The talk group currently set as the priority talk group appears in the top line of the display).
2. Use  to select a new priority talk group.
3. Press the **MENU** button to set the newly selected talk group as the priority talk group.

6.26 MAKING SELECTIVE CALLS

Selective calling is a feature that allows two radio units to obtain and utilize an independent voice path for a private call. Radios can be configured to both initiate and receive selective calls or to only receive selective calls.

In the OpenSky system, a source radio can be configured to initiate selective calls through a pre-programmed list in memory. This method uses the “speed dial list” set up by the OpenSky network administrator and provisioned as part of the registration process.

In addition, a properly equipped source radio can initiate a selective call to any radio in the system by entering the ten-digit voice user ID (which looks like a telephone number) of the target device. Entering a selective call number without using the speed dial feature requires a system model control head (Figure 6-1). See section 6.13 for more detail.



Selective calls are terminated if an emergency is declared. The network limits selective calls to ten (10) minutes maximum.



6.26.1 Manually Dialing a Selective Call (System Model Control Head)

1. Press *8 on the keypad.
2. Enter the number of the radio to be called (e.g., 027-001-0006). If the region number (first 3 digits; 027 in this example) is the same as this radio’s region number, these digits do not need to be entered. Likewise, if the region and agency numbers (first 6 digits; 027-001 in this example) are the same as this radio’s numbers, these digits do not need to be entered. Leading zeros can also be ignored.
3. Press and release the # key.
4. Wait approximately two (2) seconds.
5. Press and release the PTT button to initiate the selective call request. When the called party accepts the call, press the PTT again and begin speaking.

6.26.2 Speed Dialing a Selective Call



Speed dial numbers are defined and provisioned by the OpenSky network administrator and cannot be manually entered into the radio by the user. Contact the administrator if changes to the speed dial list are required.

1. Scroll through the Menu options using  until “SpeedDial” appears in the bottom line of the display.
2. Using , scroll through the pre-programmed speed-dial numbers until the desired number appears in the display.
3. Press and release the PTT button to ring the other user.
 - a. The ring tone is sounded.
 - b. If the other user accepts the call, the called user’s alias will appear in initiating caller’s display. The two are now in a private call until one ends the call, the call is terminated due to an initiated emergency, or the maximum time limit of ten (10) minutes is reached.
4. To end the call, press the **MENU** button.

6.26.3 Receiving a Selective Call

When someone calls in from another radio using the selective call function, a ring will sound in the speaker and/or headset. Use the + ramp control to answer the call and press the microphone’s PTT button when speaking (transmitting) to the caller. Press the **MENU** button to end the call.

A selective call will be interrupted if an emergency is declared on a monitored talk group.

6.27 SELECTIVE ALERT

Selective alert messaging is an OTP feature allowing one of up to eight (8) pre-programmed text messages (refer to section 6.27.3) to be sent from one radio to another. The user specifies a destination radio’s User ID, selects one of the pre-programmed text messages, and then transmits it to the destination radio. The message delivery system adds time-of-day information and forwards the message to the destination (receiving) radio. The sending radio receives a brief message noting the status of the transmission. Refer to Table 6-7 for a list of possible status messages.



The first few characters of a message are part of the message text entered when the message is programmed. This programming is performed by the system or network administration personnel.

Messages successfully received by the destination radio are stored until deleted or until it is power cycled.

6.27.1 Sending Selective Alert Messages

The destination radio’s User ID can be selected via the menu or via the keypad on the system model control head.

Menu Button Method:

1. Using , scroll through the menu until “AlertDest” (Alert Destination) appears in the bottom line of the display. The current speed dial number scrolls on the top line.
2. Use  to change to a different speed-dial number.

3. When the desired speed-dial number appears, press the **MENU** button to activate the selection.
4. Choose and send the message.

Keypad Method (System Model Control Head):

To select the destination radio's User ID using the keypad, perform the following:

1. Press *7 on the keypad. "AlertDest" appears in the display.
2. Enter the number of the destination radio (e.g., 027-001-0006) using the DTMF keypad. If the region number (first 3 digits; 027 in this example) is the same as this radio's region number, these digits do not need to be entered. Likewise, if the region and agency numbers (first 6 digits; 027-001 in this example) are the same as this radio's numbers, these digits do not need to be entered. Leading zeros can also be ignored. Refer to Section 6.13.
3. Press the # key to enter the number.

Choosing and Sending the Message

After specifying the destination radio's User ID (Section 6.27.1), the radio automatically allows you to choose a message. The current message scrolls across the top line of the display. To choose a message:


1. Scroll through the message list using . The next available message in the list is displayed. Pause between each arrow button depress to observe the entire message as it scrolls across the top line of the display.
2. To select and send the displayed message, press the **Select** button, or press the # button on the keypad.
3. The status of the sent message will be momentarily displayed (Table 6-7).



Table 6-7: Status of Selective Alert

STATUS MESSAGE	DEFINITION
Delivering	Select Alert message transmit attempt
Busy	Too busy – Try again
Dest Down	Receiving radio not logged on – Not registered
Not Reg	Transmitting radio not logged on – Not registered
Delivered	Transmission complete
Unreachable	No response
Partial	Transmission interrupted

6.27.2 Receiving Messages

When a selective alert message is received by a radio, a four-beep tone is heard and "NewAlert" flashes until the new message is read. Up to eight (8) received messages are stored. If another message is received, the first (oldest) message is automatically deleted to make room for new incoming messages.

Displaying Received Messages

1. Using , scroll through the menu until “AlertsRecvd” (Alerts Received) appears in the bottom line of the display. “No alerts” or the last received (newest) message appears in the display. It is preceded by the time the message was received, and the sender’s name/alias.
2. View other received messages using .
3. To delete the message currently being viewed, press the **MENU** button.

Deleting Received Messages

To delete a received message:

1. Display the message.
2. Delete the message by pressing the **MENU** button.
3. Confirm the deletion by pressing the **MENU** button again.

6.27.3 Defining Pre-Programmed Messages

All selective alert messages are pre-defined by the radio system’s maintenance personnel. These messages are sometimes referred to as “canned” messages. Custom selective alert messages cannot be created by the radio user. The entire selective alert message, including the abbreviation, can include up to two hundred (200) text characters.

6.28 TELEPHONE INTERCONNECT CALLS (SYSTEM MODEL CONTROL HEAD)

If the radio system is equipped with Public Switched Telephone Network (PSTN) interconnect equipment, telephone calls can be made from the M5300 using this procedure:

1. Press the *9 keys.
2. Enter the telephone number. (Ignore dashes/spaces, and precede the number with any required access digits such as a 1 for long distance.)
3. Press the # key.
4. Wait a few seconds and then press and release the mic’s PTT button to initiate the call. An initial ring tone plays indicating call initiation. Once the gateway picks up the call, the ring tone changes.
5. When the caller answers, depress the PTT button when speaking and release it to listen to the caller.
6. To hang-up, press the **MENU** button on the front panel.

6.29 EMERGENCY COMMUNICATIONS

The M5300 mobile radio can transmit both emergency voice calls and emergency alerts over the entire network. OpenSky handles emergency calls and alerts with the highest priority.

For critical voice communications, an emergency call can be raised on the default talk group or the currently selected talk group by “declaring” an emergency on the talk group. The exact talk group is determined by the currently active profile. After successfully declaring an emergency on a talk group, the declaring radio’s microphone remains “hot” for a predetermined amount of time. In other words, the radio transmits audio for a period of time even when the microphone’s PTT button is not depressed. An emergency talk group is provided greater priority and infinite hang-time by the radio system’s infrastructure. Hang-time is the maximum duration of quiet time between transmissions on the talk group

before the infrastructure assets are automatically taken away. Because an emergency call is handled on a talk group, it is received by all radios and consoles monitoring the talk group.

An emergency alert is a data message sent by the radio to the MIS console (or any console capable of receiving it). It identifies the radio declaring the emergency, and the radio's location (if the radio is equipped with a GPS receiver). Voice audio is not automatically transmitted during the emergency if the administrator configures the radio for alert notification only.

6.29.1 Declaring an Emergency Call or Alert

To declare an emergency call or emergency alert, press and release the orange Emergency button. This button is located just to the right of the 5-button Menu and Select keypad; see Figure 6-1 on page 13. Note the following:

- The OpenSky network administrator determines if the Emergency button is used to declare an emergency call or if it is used to declare an emergency alert. This is based upon the radio's currently active profile.
- The OpenSky network administrator also determines if the emergency is declared on the currently selected talk group or a "default" emergency talk group. Again, this is based upon the radio's currently active profile. A talk group upon which an emergency is declared on is considered an "emergency talk group."
- Upon successful emergency declaration:
 - An emergency tone will sound in the radio's speaker/headset if the radio is not in stealth mode.
 - At the declaring radio, the Emergency button flashes red if the radio is not in stealth mode. The administrator can configure the radio to automatically transmit upon successful emergency declaration, at which point the **MENU** button will flash red. However, the **MENU** button flashing red is not a requirement for successful emergency declaration.
 - For an emergency call declaration, "EMERGENCY" indicates in the bottom line of the display. In addition, the emergency talk group's name appears in the top line of the display, followed by an asterisk (*). The emergency talk group can be forwarded across the OpenSky network for emergency communications.
 - For an emergency alert declaration, "EMERG ALERT" indicates in the bottom line of the display.
 - For an emergency call declaration, other radio users and/or dispatchers at consoles will hear the emergency signal, a distinctive 3-tone burst. They will also hear audio from the declaring radio's "hot" microphone, if any.
 - For an emergency alert declaration, only dispatchers at consoles will hear the emergency signal and, if any, audio from the declaring radio's "hot" microphone.
 - For an emergency call the declaring radio's microphone remains "hot" for a predetermined amount of time. In other words, the radio transmits audio for a period of time even when the microphone's PTT button is not depressed. Audio is transmitted over the emergency talk group. When the microphone is "hot" for this initial period (typically ten seconds), simply speak into it for voice transmission.

If an emergency declaration is not successful, the radio will periodically re-attempt until it is successful. During this retry period, the radio will flash "EMERG PEND" on the bottom line of the display. It will display "EMERG RETRY" for each attempt.

6.29.2 Silent Emergency

When this feature is enabled and an emergency call or alert is declared by pressing the emergency button, the radio will not play a tone and will display an abbreviated emergency message (default is EBA). This feature is enabled or disabled via programming or via the menu.



NOTE

If the Silent Emergency feature is enabled or disabled via programming, the setting will survive power cycle. Enable/Disable selection via the menu will NOT survive power cycle and the enable/disable state will revert to the programmed setting at power up.

6.29.3 Clearing an Emergency Call or Alert

To clear an emergency, press and hold the Emergency button for at least three seconds. However, this can only be accomplished at the radio where the emergency was originally declared (the initiating radio), by a dispatcher at a console, at a supervisory radio, or by the network administrator. When the emergency is successfully cleared, the remove tone will sound at the initiating radio. Also, for an emergency call, the asterisk (*) will clear from the display.

6.29.4 Receiving an Emergency Call

Upon receiving an emergency call declared by another radio:

- An emergency tone sounds in the radio's speaker/headset (three short high-pitched beeps).
- "EMERGENCY" flashes in the display if the radio is not in stealth mode.
- When the emergency talk group is selected, an asterisk (*) follows its name in the top line of the display. The asterisk identifies the selected talk group is in an emergency state. Some radios may be programmed by the system or network administration personnel to flash the **Emergency** button (red) when an emergency call is received. This occurs only if the radio is not in stealth mode.
- If scan mode is set to "No Scan" and the emergency was declared on the selected talk group, audio on the emergency talk group is heard in the speaker/headset. See page 27 for additional information on "No Scan" operation. Also see the following NOTE.
- If scan mode is set to "No Scan" and the emergency was declared on a talk group **other than** the selected talk group, the emergency talk group (identified by an "**") must be selected before audio on it is heard in the speaker/headset.
- If scan mode is set to "Normal" and the emergency was declared on the selected talk group, the selected/emergency talk group's name remains in the top line of the display. Audio on the emergency talk group is heard in the speaker/headset.
- If scan mode is set to "Normal" and the emergency was declared on a talk group **other than** the selected talk group, the emergency talk group's name appears in the bottom line of the display. Audio on the emergency talk group is heard in the speaker/headset.
- The declaring radio's alias appears in the bottom line of the display when the emergency talk group is selected.
- An emergency call can be dismissed as described in the following section.



NOTE

A radio declaring an emergency on a talk group has a “hot” mic time period of typically ten (10) seconds just after it declares the emergency. This time period may be adjusted by system or network administration personnel on a per radio basis.



6.29.5 Dismissing an Emergency Call



NOTE

An emergency is dismissed for a configurable amount of time only (default = 5 minutes).

To ignore an emergency call declared by another radio user:

1. Press  until “EmgDismiss” appears in the display.
2. Press  until the talk group in the emergency state appears, as indicated by an asterisk (*) following the talk group’s name.
3. Press the **MENU** button.



NOTE

The emergency dismiss timer is cleared when the emergency is cleared.

6.30 ENCRYPTION

In the OpenSky network, both data and voice use a 128-bit or 256-bit key encryption standard published by the Federal Information Processing Service (FIPS), called Advanced Encryption Standard (AES). AES is approved by the U.S. Department of Commerce for encryption of classified materials.

When encryption is enabled on the network, data is encrypted from the MDIS to the Mobile End System (MES) (e.g., M5300 mobile radio). This form of encryption provides air-link security.

Voice encryption is handled either automatically or manually. Automatic encryption is initiated through the Unified Administration Server (UAS) for a specific talk group and requires nothing from the user. Manual encryption is initiated by two or more radio users and requires system model control heads. Both methods of encryption are discussed in the following sections.

6.30.1 Automatic Encryption

For automatic encryption, a network administrator will select the talk group to be encrypted at the interface to the UAS. Once the talk groups have been selected and identified as secure, credentials for key generation are generated automatically by the system and provisioned to authorized users. This process requires that authorized users login to the network and be authenticated. Encryption keys require no manual handling and are never sent “in the clear” over any network interface or air-link.

1. “Pls Login” appears displayed in the bottom line of the dwell display.
2. Login normally using the keypad on a system model control head to enter User ID and Password.

If a user is engaged in a call on a talk group encrypted at the network administrator level, “Secure Call” will appear in the bottom line of the dwell display if the user is logged in to that talk group.

If a secure call is in progress elsewhere and the user has not logged in, the bottom of the dwell display will alternate between “No Access” and the alias of the radio that is currently engaged in the secure call.

6.30.2 Manual Encryption (System Model)

Two or more users can manually encrypt a call, if enabled, without an established encrypted talk group. A pre-determined key is required at each radio.



NOTE

The key must be pre-determined by the users prior to making a manually encrypted call on a talk group and is entered into the radio using the keypad. For 128 bit encryption, this key is between 1 and 16 digits. For 256 bit encryption, this key is between 17 and 32 digits.

If two communicating radios have different (manually-defined) keys, receive audio at each radio will sound garbled.

With manual encryption enabled, unencrypted radio users on the talk group can still make standard voice (unencrypted) calls on the talk group. However, if an unencrypted user attempts to transmit on the talk group when one of the encrypted users is already transmitting on the talk group, the unencrypted radio will sound a deny tone and “No Access” will appear in the display. Also, the encrypted user can hear standard unencrypted calls, but cannot respond while still manually encrypted.



CAUTION

Do *not* set a talk group for manual encryption if it has been set for encryption by the network administration personnel.

Perform the following to transmit or receive manually encrypted calls:

1. Press *32 on the keypad.
2. Enter the key (1 – 16 digits for 128 bit encryption; 17 – 32 digits for 256 bit encryption).
3. Press the # key.
4. To end manual encryption, press *33#.

If a user is engaged in a call on a talk group that has been manually encrypted at the radio level, the user will see “Secure Call” on the bottom of the dwell display.

If a secure (encrypted) call is in progress, and the user has not entered the key, the bottom of the dwell display will alternate between “No Access” and the alias of the radio that is currently engaged in the secure call.

Once the user has terminated manual encryption, “UnSecure” appears temporarily in the bottom line of the dwell display.

6.31 PRESET BUTTONS

The front panel contains three buttons labeled A, B, and C. By holding one of these buttons down for approximately three (3) seconds, the following current information is saved to the function of that button:

- Selected talk group
- Selected profile
- Selected priority talk group
- Lockouts
- Scan mode

- Intercom mode

Presets are saved and restored to/from non-volatile memory. Changing the User ID (login in as a different user) will clear the presets since they are stored on a per-user basis. Changing control heads will not recall presets for the previous control head.

6.32 DYNAMIC REGROUPING



Dynamic regrouping requires that the network administrator determine which radio users should be formed into an impromptu talk group to respond to particular emergency conditions.

The administrator will edit the personalities of the affected radios to include an emergency profile and then page the affected radios to re-register with the network to receive their edited personalities.

In response, affected radios automatically re-register to receive their edited personalities. During re-registration, subscriber equipment will default to the emergency profile selected by the administrator.

6.33 GPS COORDINATES

The radio's current latitude and longitude coordinates may be displayed using the "GPS" menu. The following procedure assumes a GPS antenna is connected to the radio and it is receiving adequate signals from GPS satellites:

1. Press  until the "GPS" menu appears in the bottom line of the display. Current GPS coordinate latitude and longitude data continuously scrolls in the top line of the display in a degrees:minutes:seconds format.
2. Use  to change to another menu.



If the internal GPS receiver's data is expired (30 minutes or more) or unavailable, the radio uses the serving base station's coordinates [GPS (Site) is displayed]. The GPS Menu will also indicate if the data is aged (2 minutes or more) [GPS (Aged) is displayed]

7 BASIC TROUBLESHOOTING

If the radio is not operating properly, check Table 7-1 for likely causes. For additional assistance, contact a qualified service technician.

Table 7-1: Basic Troubleshooting

SYMPTOM	CAUSE	SOLUTION
Radio will not turn on.	No power.	Test the connection to the vehicle power supply.
Radio will not turn off.	If in multiple control head configuration, one of the attached control heads is still powered up.	Power off all control heads.
Radio will not register or does not receive provisioning data.	Bad logon credentials.	Check logon and password.
No audio.	Speaker volume is muted.	Increase the volume level.
Poor audio.	Transmitting or receiving in a poor coverage area or subject to interference.	Check network connectivity and move to a better coverage area if possible. Report the area without coverage to an authorized network technician.
Poor display visibility.	Ambient Light Sensor is obstructed.	Clear the obstruction and give the sensor a clear path to ambient light.
No network connectivity icon in display.	Radio is out-of-range or cannot connect with the OpenSky network. Base station network connection has failed.	Return to coverage area if possible and wait for condition to clear. Use single-site trunking or switch to an alternate channel.
Radio will not transmit.	Radio may be out of coverage area or may be overheated.	Return to coverage area if possible. If overheated, let radio cool before retrying transmission. Report this failure to an authorized technician.
Radio will not transmit (transmit indicator does not flash).	Radio may be experiencing low voltage.	The M5300 will cease to transmit if the voltage drops below 8.5 volts. Have the battery checked by an authorized technician.
Radio powers off for no apparent reason.	Radio may be experiencing very low voltage.	The M5300 automatically powers down when voltage drops below +5.0 volts. Have the battery checked by an authorized technician.
“Warning: No MRU” Message.	Radio control head is unable to communicate with mobile radio unit (radio transceiver).	Have the radio connections checked by an authorized technician.

SYMPTOM	CAUSE	SOLUTION
Control head randomly changes display.	In multiple control head configurations, another user is operating the radio from another control head.	None
Encrypted calls cannot be made.	Not authorized to use.	Contact system administrator to request encryption privileges.
Screen displays: UNAUTH3	The radio network ID has not been added to the network.	Contact system administrator.
Screen displays: NOAUTHV	Radio authentication of the VNIC failed.	Contact system administrator.
Screen displays: NOAUTHM	VNIC authentication of the radio failed.	Contact system administrator.
Screen displays: NOSUPRT	The voice authentication security policy is set to only allow authenticated users.	Contact system administrator.
Encrypted calls cannot be made.	User not logged in.	Log in (refer to Section 6.14.1).

8 TECHNICAL ASSISTANCE

The Technical Assistance Center's (TAC) resources are available to help with overall system operation, maintenance, upgrades and product support. TAC is the point of contact when answers are needed to technical questions.

Product specialists, with detailed knowledge of product operation, maintenance and repair provide technical support via a toll-free (in North American) telephone number. Support is also available through mail, fax and e-mail.

For more information about technical assistance services, contact your sales representative, or call the Technical Assistance Center at:

North America: 1-800-528-7711

International: 1-434-385-2400

Fax: 1-434-455-6712

E-mail: tac@tycoelectronics.com

9 KEYPAD REMAPPING

If the keys have been remapped to provide new functions, fill in the following template for future reference.

Button	Function	Button	Function
Emergency		1	
Preset A		2	
Preset B		3	
Preset C		4	
Rocker •		5	
Rocker ••		6	
Rocker +		7	
Rocker -		8	
MENU		9	
OPT/OPTION		*	
CLR/CLEAR		0	
SCAN		#	

10 WARRANTY

- A. M/A-COM, Inc. (hereinafter "Seller") warrants to the original purchaser for use (hereinafter "Buyer") that Equipment manufactured by or for the Seller shall be free from defects in material and workmanship, and shall conform to its published specifications. With respect to all non-M/A-COM Equipment, Seller gives no warranty, and only the warranty, if any, given by the manufacturer shall apply. Rechargeable batteries are excluded from this warranty but are warranted under a separate Rechargeable Battery Warranty (ECR-7048).
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Mobile Radio with CH-721
Scan and System Control Heads

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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. M/A-COM, Inc. assumes no liability for the customer's failure to comply with these standards.



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



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



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

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

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



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



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

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

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for exposure to RF energy. These standards provide recommended levels of RF exposure for

both workers and the general public. These recommended RF exposure levels include substantial margins of protection. All two-way radios marketed in North America are designed, manufactured, and tested to ensure they meet government-established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of two-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it. 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 is marketed in the United States, the M5300 two-way mobile radio is tested to ensure compliance with FCC RF energy exposure limits for mobile two-way radios. When two-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a label directing users to specific user awareness information. The radio has an RF exposure product label. Also, this Installation and Product Safety Manual and the applicable Operator's Manual include information and operating instructions required to control RF exposure and to satisfy compliance requirements.

1.3 COMPLIANCE WITH RF EXPOSURE STANDARDS

The M5300 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 M5300 mobile two-way radio complies with the following RF energy exposure standards and guidelines:

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



Table 1-1 lists the recommended minimum safe lateral distances for a controlled environment and for unaware bystanders in an uncontrolled environment, from transmitting antennas (i.e., monopoles over a ground plane, or dipoles) at rated radio power for mobile radios installed in a vehicle. Transmit only when unaware bystanders are at least the uncontrolled recommended minimum safe lateral distance away from the transmitting antenna. Based on the highest radiated RF power and with respect to the cables supplied with the antennas, the distances listed in Table 1-1 are considered as safe distances for controlled and uncontrolled environments for the listed antennas.

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

ANTENNA PART NUMBER (Catalog Number)	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA (Distance in Centimeters)	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-025177-004	900 MHz GPS Combo, Elevated-Feed, Rooftop-Mount; 3 dBd Gain	24	70
AN-025177-005	900 MHz GPS Combo, Magnetic-Mount; 3 dBd Gain	38	85
AN-025177-009	900 MHz Low-Profile Rooftop-Mount; 3 dBd Gain	25	60

1.3.1 Mobile Antennas

The antenna(s) for the radio must be installed in accordance with Section 6 in this manual. Refer to Figure 6-1 on page 24 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 the M/A-COM approved/supplied antenna(s) or an approved replacement antenna. Unauthorized antennas, modifications, or attachments can cause the FCC RF exposure limits to be exceeded.

1.3.2 Approved Accessories

The radio has been tested and meets FCC RF guidelines when used with M/A-COM accessories supplied or designated for use with it. Use of other accessories may not ensure compliance with the FCC's RF exposure guidelines, and may violate FCC regulations. For a list of approved accessories refer to Section 4 in this manual (begins on page 17) and/or M/A-COM's Products and Services Catalog.

1.3.3 Contact Information

For additional information on RF exposure and other information, contact M/A-COM using one of the contact links listed in Section 3.4 on page 16.

1.4 OCCUPATIONAL SAFETY GUIDELINES AND SAFETY TRAINING INFORMATION

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

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

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

1.5 COMMON HAZARDS



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

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

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.

1.6 SAFE DRIVING RECOMMENDATIONS

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

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

1.7 OPERATING RULES REGULATIONS

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

In the United States, the M5300 mobile radio must be operated in accordance with the rules and regulations of the Federal Communications Commission (FCC). Operators of two-way radio equipment, must be thoroughly familiar with the rules that apply to the particular type of radio operation. Following these rules helps eliminate confusion, assures the most efficient use of the existing radio channels, and results in a smoothly functioning radio network.

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

- It is a violation of FCC rules to interrupt any distress or emergency message. The radio operates in much the same way as a telephone “party line.” Therefore, always listen to make sure the channel is clear before transmitting. Emergency calls have priority over all other messages. If someone is sending an emergency message – such as reporting a fire or asking for help in an accident, do not transmit unless assistance can be offered.
- The use of profane or obscene language is prohibited by Federal law.
- It is against the law to send false call letters or false distress or emergency messages. The FCC requires keeping conversations brief and confine them to business. To save time, use coded messages whenever possible.
- Using the radio to send personal messages (except in an emergency) is a violation of FCC rules. Send only essential messages.
- It is against Federal law to repeat or otherwise make known anything overheard on the radio. Conversations between others sharing the channel must be regarded as confidential.
- The FCC requires self-identification at certain specific times by means of call letters. Refer to the rules that apply to the particular type of operation for the proper procedure.
- No changes or adjustments shall be made to the equipment except by an authorized or certified electronics technician.



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

1.8 OPERATING TIPS

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

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



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

2 SPECIFICATIONS¹

2.1 GENERAL

Dimensions, Remote-Mount Mobile Radio: (Height x Width x Depth)	2.0 x 6.9 x 9.2 inches (5.1 x 17.5 x 23.4 centimeters) (Includes bracket but <u>not</u> space required for cables)
Dimensions, Control Head: (Height x Width x Depth)	2.4 x 6.9 x 3.9 inches (6 x 17.5 x 10 centimeters) (Does <u>not</u> include bracket and mounting screws)
Weight, Remote-Mount Mobile Radio:	8.13 pounds (3.69 kilograms)
Weight, Control Head:	1.7 pounds (0.8 kilograms)
Operating Ambient Temperature Range:	-22 to +140° Fahrenheit (-30 to +60° Celsius)
Storage Temperature Range:	-40 to +185° Fahrenheit (-40 to +85° Celsius)
Altitude:	15,000 feet (4572 meters) maximum
DC Supply Voltage Operating Range:	+13.6 Vdc ±10% (Normal range per TIA-603)
DC Supply Current Requirements	
Receive:	1.5 amps maximum at 0.5-watt speaker audio output power (includes control head)
Transmit	
At 12 watts RF output power:	8 amps maximum, 6 amps typical (includes control head)
At 30 watts RF output power:	15 amps maximum, 12 amps typical (includes control head)
Quiescent/Off Current	
Mobile Radio:	100 microamps maximum
Control Head:	100 microamps maximum

2.2 TRANSCEIVER

Frequency Ranges	
Receive and Talk-Around Transmit:	935 to 940 MHz
Transmit:	896 to 901 MHz
Transmit Output Power	
OpenSky Trunking Protocol (OTP) Mode:	12 watts
EDACS/ProVoice Mode:	30 watts
Channel Spacing	
OTP Mode:	12.5 kHz
EDACS/ProVoice Mode:	25 kHz
Voice and Data Communications Modes:	Half-Duplex
Frequency Stability:	±1.5 ppm
Receiver Sensitivity	
TIA-102 Method:	-115 dBm minimum for 5% BER
TIA-603 Method:	-116 dBm minimum for 12 dB SINAD

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

Receiver Intermodulation Rejection:	70 dB minimum at 12.5 kHz
Audio Frequency Response:	300 to 3000 Hz (with <3% audio distortion)
Audio Output Power (Control Head):	15 watts RMS maximum into 4-ohm external speaker; 1 watt into 4-ohm headset
Voice-Coding Method:	
OTP Mode:	Advanced Multi-Band Excitation (AMBE™)
EDACS, ProVoice and P25 Modes:	Improved Multi-Band Excitation (IMBE™)
OpenSky Data Rate:	9.6 kbps

2.3 REGULATORY

FCC Type Acceptance:	OWDTR-0049-E
Applicable FCC Rules:	Part 15 and Part 90
Industry Canada Certification:	3636B-0049
Applicable Industry Canada Rules:	RSS-119

3 INTRODUCTION

3.1 GENERAL DESCRIPTION

The M5300 mobile radio is a high-performance half-duplex digital mobile radio. It can operate on 900 MHz OpenSky trunked radio networks using the OpenSky Trunking Protocol (OTP). Other future radio operating modes include talk-around communications in accordance with the APCO Project 25 phase I standard, and conventional FM repeater-based and FM talk-around voice communications in accordance with the TIA/EIA-603 conventional land-mobile radio standard.



The initial release of this radio only supports operations on 900 MHz OpenSky trunked radio networks. Later releases of the radio will add other modes to support other trunked radio networks, and conventional FM repeater-based and FM talk-around voice communication modes.

The M5300 is designed to operate in a mobile environment, typically within a motor vehicle. It must be connected to an external transmit/receive antenna such as one mounted to the vehicle's rooftop or trunk lid. In high-power OTP mode, the radio's 900 MHz RF transmit output power is rated at 12 watts. Several different types of external-mount antennas are approved and available for use with the radio, as listed in Table 1-1 and Table 4-2.

In the remote-mount configuration of the M5300, 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. The remote-mount radio is shown in Figure 5-2 on page 22.

Control heads used with the M5300 radio include the CH-721 Scan and the CH-721 System model control heads. See Figure 7-2 (page 33) through Figure 7-4. Both heads feature a large 3-line graphical vacuum-florescent display, front panel controls and buttons for user control of the mobile radio, an internal high-power audio amplifier to drive an externally-connected speaker, and a front panel microphone connector. The CH-721 System control head also has a 12-button numeric keypad that provides Dual-Tone Multi-Frequency (DTMF) functionality and easier operator system/group selection control at the control head's front panel.

The remote-mount M5300 radio is designed for remote mounting in a motor vehicle's trunk, or some other preferably unoccupied section in a vehicle, such as a fire truck's equipment shelf. It is remotely controlled by a control head(s) connected to it via 3-wire Controller Area Network (CAN) cables. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio, controlling data such as button presses and radio messages, and user data such as that for a mobile data terminal connected to serial port of the radio or control head. For proper operation, the CAN link must be terminated appropriately on each end. In multiple control head installations, two or more control heads are interconnected to the mobile radio in a series ("daisy-chain") fashion via CAN link cables. Up to five (5) control heads can be connected to a remote-mount M5300.

As shown in Figure 7-4 on page 34, the CH-721 Scan and System model control heads used in remote-mount radio installations have several connectors located on the head's rear panel. These connectors include a DC power connector, two (2) CAN port connectors used for CAN link interconnections, an external speaker connector, a 9-pin serial port connector for connecting optional equipment such as a mobile data terminal, and a 25-pin multi-function connector.

The radio must be powered by an external +13.6-volt (nominal) DC power source. In mobile applications, the motor vehicle's electrical system is utilized as the source of DC power. 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 a speaker connected to the control head.

For data communications, the radio has an industry-standard 9-pin serial interface port for connecting optional data-type equipment, such as a Mobile Data Terminal (MDT), a laptop PC, a third-party display, or a key-entry device. This port works seamlessly with equipment from popular manufacturers and off-the-shelf applications. OpenSky employs User Datagram Protocol over Internet Protocol (UDP/IP) data packet transfers, providing “plug and play” connectivity for data-type devices.

900 MHz operating bands of the radio include 896 to 901 MHz repeater input band (mobile transmit) and the 935 to 940 MHz band used for repeater output and talk-around communications.

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

The radio and control head exceed many 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.

An M5300 radio operating on an OpenSky radio network uses Time-Division Multiple-Access (TDMA) digital modulation technology on the radio frequency link. TDMA allows multiple radio users to share a single RF channel. In addition, a single RF channel can support simultaneous digital voice and data communications.

OpenSky employs Advanced Multi-Band Excitation (AMBE™) speech/data compression technology developed by Digital Voice Systems, Inc. When operating on an OpenSky radio network, AMBE gives an M5300 the ability to provide exceptional voice quality via the limited bandwidth of the radio frequency path, even when the received radio frequency (RF) signal is weak (i.e., even in “fringe” areas). AMBE is performed by a Digital Signal Processor (DSP) integrated circuit within the radio programmed to perform an AMBE compression algorithm during mobile transmissions, and an AMBE expansion algorithm during mobile reception.

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

Future M5300 radio upgrades will also support radio operation on 800 MHz APCO Project 25 phase I compliant Common Air Interface (P25 CAI) trunked radio networks, and operation in a talk-around mode in accordance with the APCO Project 25 phase I standard. P25 radio systems utilize Improved Multi-Band Excitation Plus (IMBE™) speech/data compression technology, also developed by Digital Voice Systems, Inc.

This manual contains installation procedures for the M5300 mobile radio and the CH-721 control heads. The procedures cover the mounting and cabling of the equipment as well as the basic testing of the radio and control head. An interconnection wiring diagram is included at the rear of this manual.



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

3.2 RELATED DOCUMENTS

The following documents contain additional information:

- OpenSky Quick Guide: MM-(TBD)
- OpenSky Operator's Manual: MM-012125-001 (available at www.macom-wireless.com)
- Maintenance Manual: MM012126-001

3.3 REPLACEMENT PARTS

Replacement parts can be ordered through M/A-COM's Customer Resource Center. To order replacement parts through the Customer Resource Center, call, fax or email our ordering system:

North America:

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

International:

- Asia Pacific: 1-434-455-9223
- Latin America & Middle-East: 1-434-455-9229
- Europe: 1-434-455-9219
- Fax Number: 1-434-455-6685
- E-mail: InternationalCustomerFocus@tycoelectronics.com

3.4 CONTACTING M/A-COM FOR TECHNICAL ASSISTANCE

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

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

4 UNPACKING AND CHECKING THE EQUIPMENT

4.1 MATERIALS

A typical set of materials for a remote-mount M5300 mobile radio installation includes:

- **Remote-Mount 900 MHz Mobile Radio, part number RU-144750-181**
- **CH-721 Scan Control Head, part number CU23218-0002** (Catalog number MAMV-CP9E)
or
CH-721 System Control Head, part number CU23218-0004 (Catalog number MAMV-CP9F)
- **Standard Microphone, part number MC-101616-040** (Part of catalog number MAMV-MC7Z)
- **Remote-Mount Mobile Radio Installation Kit MAHK-NZN7R**
- **One or Two Antennas** as listed in Table 4-2 on page 18

Table 4-1 below lists the contents of Installation Kit MAHK-NZN7R available for a remote-mount M5300 mobile radio installation. Table 4-2 on page 18 lists part numbers for radio-related options and accessories. Table 4-3 on page 18 lists options and accessories available for the CH-721 Scan and System model control heads.

Table 4-1: Remote-Mount Mobile Radio and CH-721 Installation Kit MAHK-NZN7R

ITEM	QTY.	PART NUMBER	DESCRIPTION
1	1	KT23117	Kit, Remote-Mount Mobile Radio Mounting Bracket. Includes M5300/M7100/M7300 Mounting Bracket FM103111V1 and M5 stainless-steel hardware to attach radio to bracket.
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.
3	1	CA-012365-001	Cable, M5300/M7300 DC Power. Includes 10-AWG, 20-Foot DC Power Cable with straight connector, (1) waterproof HFB fuse holders and (1) 3-amp AGC fuse.
4	1	CA-012616-001	Cable, CH-721 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.
5	2	AD00006	Screws: #8-32 Pan-Head (Package of 4)
6	2	MACDOS0010	Terminator, CAN; 3-Pin
7	1	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors
8	1	LS102824V10	Speaker, External Mobile; 20-Watt (with 4.6-foot cable)
9	1	MAMROS0034-NN006	Cable, Speaker; 6-Inch, Straight Connector
10	1	FM-104859-001	Cap, Waterproof (For CH-721's DB-9 serial port connector)
11	1	FM-104859-002	Cap, Waterproof (For CH-721's DB-25 accessory connector)

Table 4-2: Additional Options and Accessories for M5300 Mobile Radios

PART NUMBER	DESCRIPTION
AN-025177-004	Antenna, 900 MHz GPS Combo, Elevated-Feed Rooftop-Mount, 3 dBd Gain, with NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC RF Connector, 16.4-foot (5-meter) RG174/U (or equivalent) GPS RF Cable with Male SMA RF Connector; 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias; Factory-Tuned
AN-025177-005	Antenna, 900 MHz, 3 dBd Gain, Magnetic-Mount Base, 11.8-foot (3.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable, Male TNC RF Connector; Factory-Tuned
AN-025177-009	Antenna, 900 MHz Low-Profile Rooftop-Mount, 3 dBd Gain, with NMO Mounting Base, 15-foot (4.6-meter) RG-58 A/U (or equivalent) Low-Loss RF Cable and Male TNC RF Connector; Factory-Tuned
AN-025187-001 (Cat. No. MAHK-NAN5F)	Antenna, GPS Receive Only, Roof-Mount, with 16.4-foot (5-meter) RG174/U (or equivalent) RF Cable; 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias
AN-025187-002 (Cat. No. MAHK-NMK5F)	Antenna, GPS Receive Only, Magnetic-Mount, with 16.4-foot (5-meter) RG174/U (or equivalent) RF Cable; 2.7 to 3.3 Vdc Bias Only
AN-025187-003 (Cat. No. MAHK-NAN5F)	Antenna, GPS Receive Only, Magnetic-Mount, with 16.4-foot (5-meter) RG174/U (or equivalent) RF Cable; 2.7 to 3.3 Vdc or 4.8 to 5.2 Vdc Bias
KT-012350-001	Kit, GPS Receiver for M5300/M7300.
MACDOS0010	Terminator, CAN; 3-pin
MAMROS0055	Cable, TIA/EIA-232 Serial Programming (6 feet)

* Driven element must be trimmed to proper length.

Table 4-3: Additional Options and Accessories for 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
MACDOS0010	Terminator, CAN; 3-Pin
MACDOS0012	Kit, Control Head Pedestal Mounting. Includes Pedestal Mount and Mounting Screws.
MACDOS0013-CN004	Kit, Speaker; 20-Watt, Straight Connector
MACDOS0013-CR004	Kit, Speaker; 20-Watt, Right-Angle Connector
MC-101616-040	Microphone, Standard with Conxall Flush-Mount Connector (Included with catalog number MAMV-MC7Z)
MC-103334-040	Microphone, DTMF with Conxall Flush-Mount Connector (Included with catalog number MAMV-NMC9C)
MC-103334-050	Microphone, Noise-Canceling with Conxall Flush-Mount Connector (Included with catalog numbers MAMV-NMC9D)
344A4678P1	Microphone Hanger. (Included with catalog numbers MAMV-MC7Z, MAMV-NMC9C and MAMV-NMC9D)
MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10-Foot, Straight Connector
MAMROS0075-N1220	Cable, DC Power; 12-AWG, 20-Foot, Straight Connector

Table 4-3: Additional Options and Accessories for CH-721 Control Heads

PART NUMBER	DESCRIPTION
MAMROS0075-R1210	Cable, DC Power; 12-AWG, 10-Foot, Right-Angle Connector
MAMROS0075-R1220	Cable, DC Power; 12-AWG, 20-Foot, Right-Angle Connector

4.2 MATERIAL INSPECTION



After removal from the carton, examine the radio, control head and other components for broken, damaged, loose or missing parts. If any are noted, contact M/A-COM's Technical Assistance Center (see page 16) immediately to discuss and arrange the return of the equipment to M/A-COM for replacement. Any unauthorized attempts to repair or modify this equipment will void the warranty and could create a safety hazard.

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



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

5 PLANNING THE INSTALLATION

5.1 GENERAL INFORMATION

Figure 5-1 illustrates a typical remote-mount radio installation. Before starting, plan the installation carefully so it will meet the following requirements:

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



A professional radio installer should perform the installation!

5.2 TOOLS REQUIRED

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

- Non-Insulated Crimp Tool: Thomas & Betts WT-111-M
- Insulated Terminal Crimp Tool: Klein 1005
- Fuse Holder Crimp Tool: Thomas & Betts – WT-112M or California Terminal Products No. 1250 or Channelock No. 909
- Ratcheting Coaxial Crimp Tool: Cambridge 24-9960P
- Non-Metallic Fish Tape, 25-Foot: Klein-Lite 50156
- Two Pairs of Slip-Jaw Pliers
- Various Socket and Driver Sets
- Various Fasteners
- Phillips-Head Screwdrivers, #1 and #2
- Flat-Blade Screwdrivers, #1 and #2
- 1/8-Inch Hex Key Wrench (Allen Wrench)
- 4-Millimeter Hex Key Wrench
- 3/4-Inch Hole Saw with Depth Protection: Ripley HSK 19 or Antenex HS34
- Clutch-Type Screw Cordless Gun/Drill with Driver Bits: Makita #6096DWE
- Cordless Electric Drill with Bits
- Deburring Tool (for 3/8-inch and smaller holes)
- Flush-Cut and Large Wire Cutters



A separate list of test equipment is included in Section 13.2 on page 50.

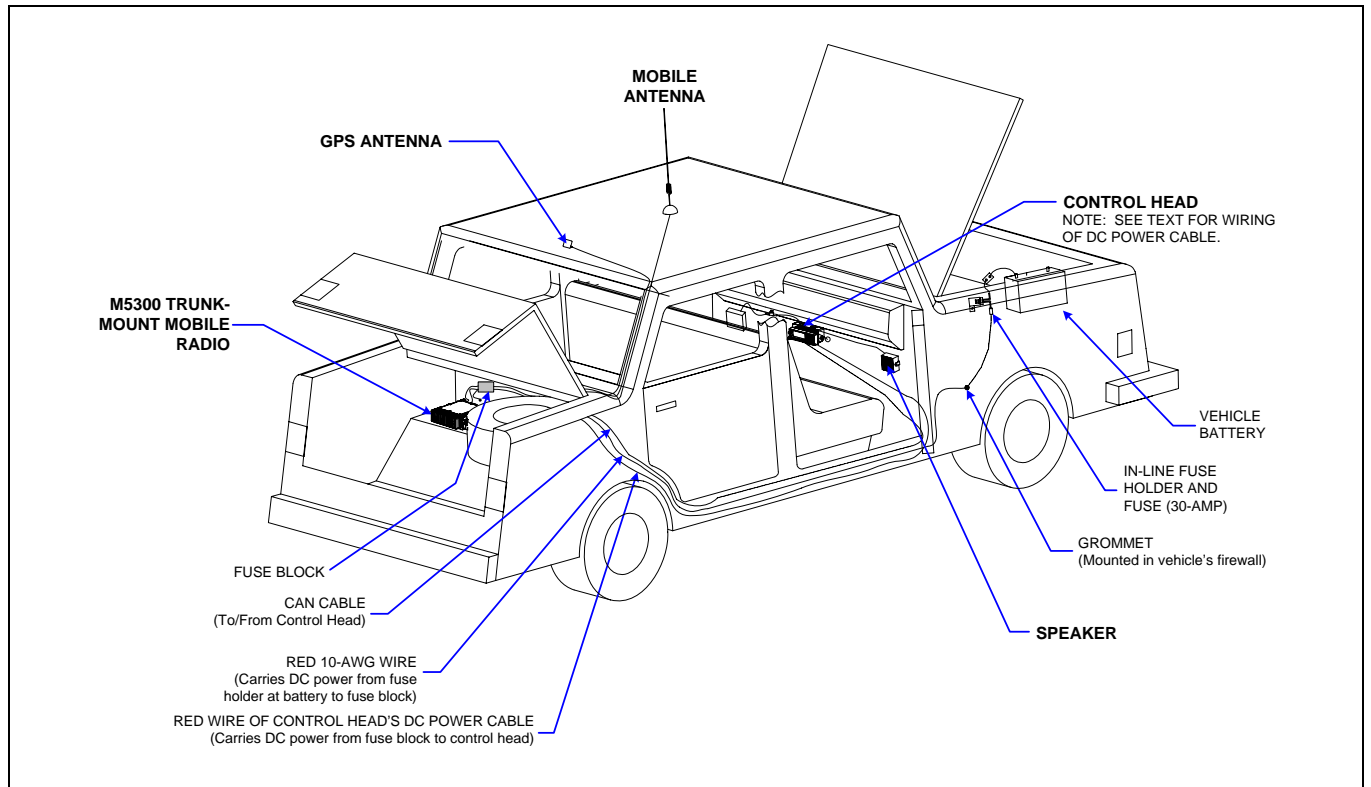


Figure 5-1: Typical Remote-Mount Mobile Radio Installation in a Standard Passenger Vehicle

FRONT VIEW



REAR VIEW

(Shown Without Any Installation-Related Cables)

(image not available)

Figure 5-2: M5300 Remote-Mount Mobile Radio — Front and Rear Views

5.3 LOCATING COMPONENTS

Plan the mounting locations of all components (radio, control head, antenna, and cables) and determine the routes for all wiring and cables. Particularly consider the connection of the 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 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, and the control head is typically located under the vehicle's dash panel. Radio and control head dimensions are listed in Section 2.1 on page 12. 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 that follows.



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 (begins on page 6). A transmitting antenna must be installed in accordance with the guidelines presented in the **REGULATORY AND SAFETY INFORMATION** section. Use Table 1-1 on page 8 and Figure 6-1 below as a guide for determining the best possible mounting configuration/location in order to reduce human exposure to radio frequency (RF) electromagnetic energy during transmit mode.

Antennas must be mounted in one of three possible locations on the vehicle as described in the following subsections. Figure 6-1 shows the recommended locations and antenna part numbers for each location. Also, see Table 4-2 for additional information. Always follow the antenna manufacturer’s instructions when mounting an antenna.

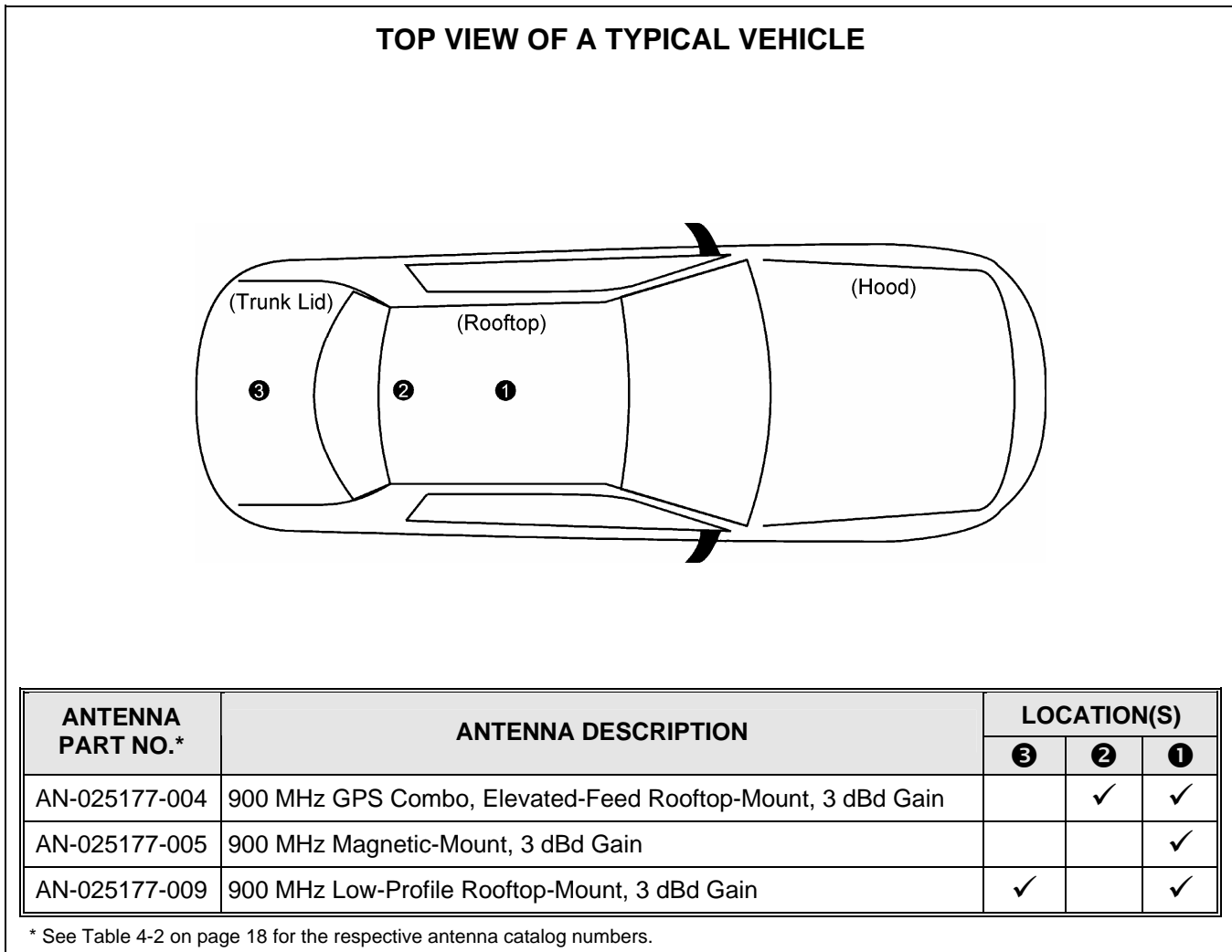


Figure 6-1: Recommended Antenna Mounting Locations with Antenna Part Numbers

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

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 Figure 6-1). In this case, an elevated-feed-point antenna is recommended. Although this type of antenna does not require a metal ground plane, it must be located directly in the center of the trunk lid to minimize human exposure to RF electromagnetic energy.



WARNING

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

6.2 ANTENNA INSTALLATION PROCEDURE



NOTE

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

6.2.1 Install and Connect the Mobile Antenna

Table 4-2 (page 18) and Figure 6-1 (page 24) 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. The following mobile antenna installation procedure is recommended:

1. Once the mounting location is selected, refer to the antenna manufacturer's mounting and testing instructions included with the antenna kit for installation guidance. Install the antenna in accordance with these instructions. If necessary, contact M/A-COM's Technical Assistance Center. See page 16 for TAC contact information. **As noted in the previously presented WARNING, do not cut the cable to a shorter length!**
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 possible chafing.
3. If not already, attach the male TNC RF connector (supplied with antenna) to the mobile-end of the antenna cable. Attach this connector to the cable in accordance with instructions supplied with antenna and/or TNC connector. **As noted in the previously presented WARNING, do not cut the cable to a shorter length!**



A unity-gain antenna is tuned for maximum performance (i.e., minimum reflection) per the test procedures presented in Section 13. Other antennas used with the M5300 are factory-tuned and therefore do not require tuning in the field.

4. 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.

6.2.2 Install and Connect the GPS Antenna (Required Only if Radio has GPS Receiver Option)

If the M5300 radio is equipped with the GPS receiver option, 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:



An SMR/GPS combination ("combo") antenna kit includes a GPS antenna built into the base of the mobile antenna. Refer to Table 4-2 (page 18) and/or Figure 6-1 (page 24) for available combo antennas.

1. Once the mounting location is selected, refer to the antenna manufacturer's mounting and testing instructions for installation guidance. Install the antenna in accordance with these instructions. If necessary, contact M/A-COM's Technical Assistance Center. See page 16 for TAC contact information. **Do not attempt to 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 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 REMOTE-MOUNT RADIO INSTALLATION

7.1 MOUNTING THE RADIO

This section provides details on mounting the mobile radio in the vehicle. See Figure 5-2 and refer to the respective wiring diagram at the end of this manual as necessary. Control head installation procedures are included in Section 7.3 which begins on page 33.

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



NOTE

Mobile Radio Installation Kit MAHK-NZN7R (contents listed in Table 4-1 on page 17) contains the most complete set of materials for installing the radio. Therefore, the following instructions make repeated reference to this kit. Item numbers given in parenthesis refer to items in the kit.



NOTE

Prior to beginning the installation, verify the radio has the proper version of software and verify it has been configured properly for customer usage.



CAUTION

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



WARNING

At a minimum, the mounting surface should be 16-gauge (approximately 1/16-inch thick) steel sheet metal. Mounting to plastic or other material with low tensile and shear strength could lead to an unsafe and/or failed mounting condition, turning the radio and its 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.



CAUTION

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.

7.1.1 Mounting Bracket Installation

Typically, the radio's mounting bracket (a part of Item 1 in Table 4-1) is mounted in the vehicle's trunk, on the top surface of the trunk tray or the trunk floor. However, it can be suspended from the trunk's rear deck if the surface is completely flat and the gauge of deck's sheet metal is high (16-gauge minimum).

When selecting a mounting location for the radio, verify sufficient clearance can be maintained around the radio for installation and service access. A minimum distance of four (4) inches is recommended at

the rear, left and right sides of the radio, and at least (2) inches of clearance is recommended at the front of the radio.

As illustrated in Figure 7-1, the bracket is left-to-right symmetrical and the shortest portion of its side rails are at the rear.

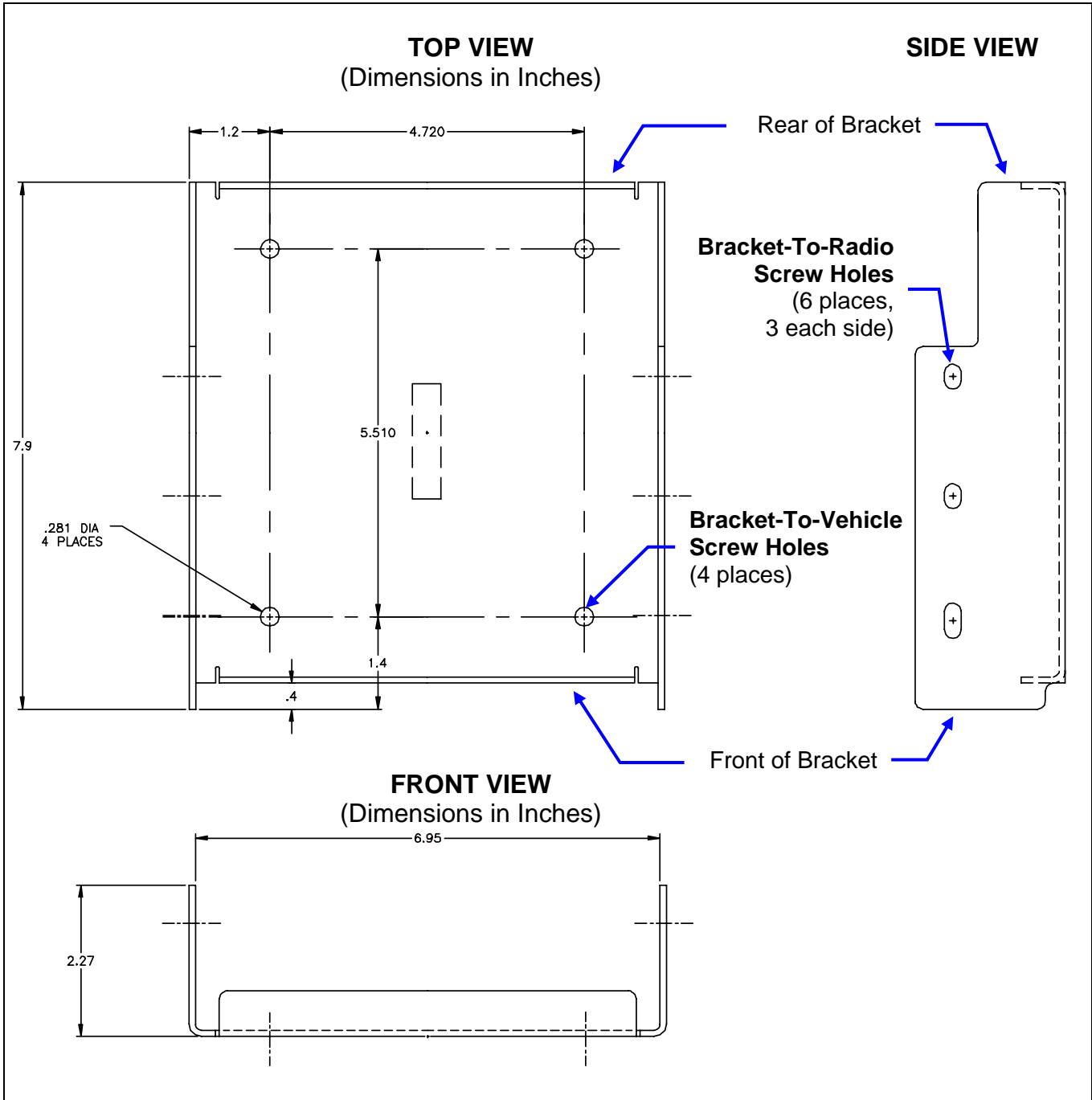


Figure 7-1: Mounting Bracket with Dimensions (Radio Not Shown)

As all installations differ, bracket-to-vehicle mounting screws are not included. Utilization of either 1/4-inch stainless-steel self-threading screws or 1/4-inch 28-tpi (1/4-28) stainless-steel shelf-locking hardware

is recommended. Sheet metal screws should never be used. The bracket has four (4) available mounting holes, and all four must be used to secure the bracket to its mounting surface.

The following mounting procedure is recommended:

1. Using the mounting bracket (part of item 1 in Table 4-1 on page 17) as a template, and/or the dimensional information shown in Figure 7-1, 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 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-back 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.

7.1.2 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) Torx[®] drive M5 x 10 mm stainless-steel socket-head screws, and flat and lockwashers included with the Mounting Bracket Kit (item 1 in Table 4-1). Tighten all six 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.
3. Check the mounting area for proper clearance for cable service looping and for air circulation, plus an area to secure and rest the excess cable lengths.



NOTE

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

7.2 RADIO DC POWER INSTALLATION

Refer to the wiring diagram at the end of this manual as necessary when performing wiring procedures presented in this section. For specific information on wiring the control head's power, see Section 7.3.4 on page 39.

7.2.1 Overview of On/Off Power Wiring Configurations

Radio on/off power control is accomplished by the control head, except in the case of a data-only radio installation which has no 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 CH-721 control head's on/off/volume control must be left in the on position for automatic power-up/down to function properly.



To fuse the white wire of the control head's DC Power Cable, a waterproof (HFB type) fuse holder and a 3-amp AGC fuse are included with the cable when it ships from the factory.

- **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 CH-721 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 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 only used for the data-only radio (i.e., no control head), and it is the only means for turning its power on in the data-only radio installation.

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 (only connected in a data-only radio installation), and a 4-foot black wire (for the

ground connection). It is supplied with waterproof fuse holders, 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.



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.**

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 utilize 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.
7. Attach the ring terminal and black wire to the bare metal surface using a self-threading screw (not supplied) 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 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). Route the wire through channels in the vehicle to the location of the battery. Remove interior panels, door kick panels, etc., as necessary. Protect the wire from possible chafing where necessary, and tie and stow it as necessary.



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



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.

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

2. Obtain one of the waterproof (HFB type) fuse holders 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, 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.
7. **Do NOT install a fuse into the fuse holder at this time.**
8. Crimp a $\frac{3}{8}$ -inch ring terminal to the short red wire. The terminal is included with the DC Power Cable.
9. 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).



Most M5300 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.

7.2.2.3 White Wire Connection (for a Data-Only Radio Installations Only)

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

1. Route the 20-foot white wire of the radio's DC Power Cable to the location of the vehicle's switched power source connection point, typically identified as "Accessory" power. Route the wire through channels in the vehicle to the location of the battery. Remove interior panels, door kick panels, etc., as necessary. Protect the wire from possible chafing where necessary, and tie and stow it as necessary.
2. Connect this white wire through a fuse to the switched power source in accordance with the instructions presented within the respective subsection of Section 7.3.4.2 (page 40) for the control head's white wire. Follow Section 7.3.4.2.1 (page 40) if the vehicle's ignition switch/key must control the data-only radio's on/off power. Follow Section 7.3.4.2.2 (page 40) if a manually-controlled switch must control the data-only radio's on/off power.



NOTE

The "hot wired" wiring configuration (as depicted in Section 7.3.4.2.3) cannot be utilized for the data-only radio, since this configuration does not employ the DC Power Cable's white wire.



CAUTION

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

7.3 CONTROL HEAD INSTALLATION

7.3.1 General Information

The remote-mount M5300 mobile radio must be connected to a control head to provide the operator-to-radio interface. Two different control heads are available—the CH-721 Scan model and the CH-721 System model. See Figure 7-2 and Figure 7-3 respectively. The CH-721 Scan model control head features three (3) large menu selection buttons. The System model control head has a 12-button keypad to allow advanced operations without the need of a DTMF-capable microphone.

Figure 7-4 on page 34 illustrates the rear panel of the two control head models. Both models have identical rear panels and rear panel connectors.

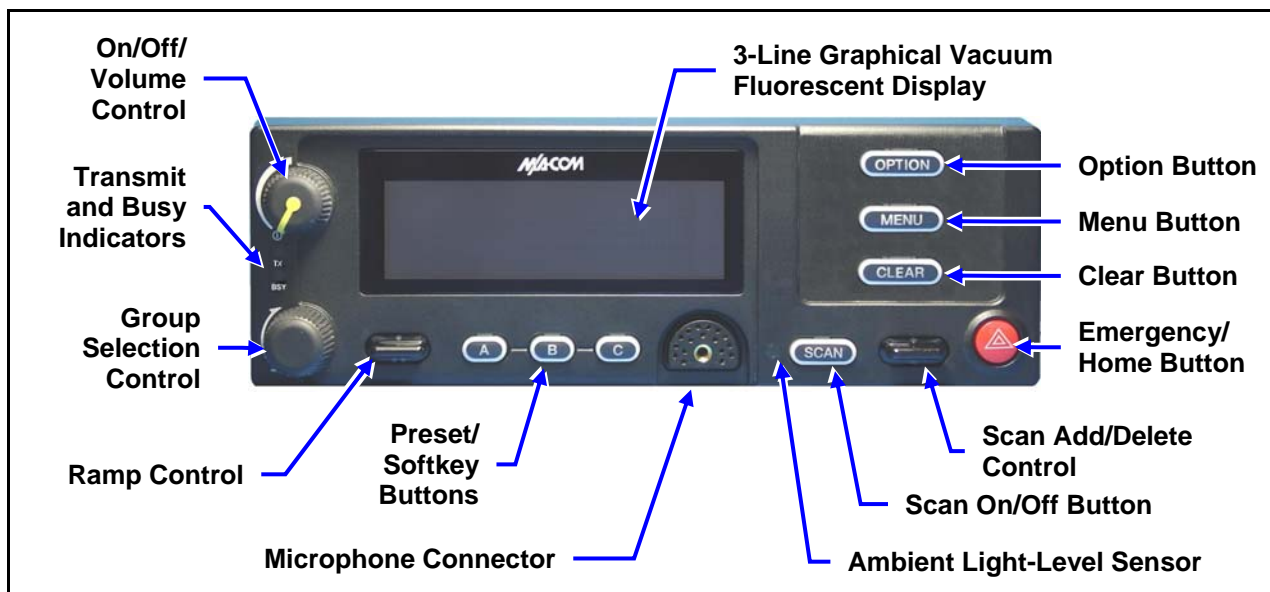


Figure 7-2: CH-721 Scan Model Control Head Front Panel



Figure 7-3: CH-721 System Model Control Head Front Panel

The CH-721 control heads feature a large easy-to-read 3-line graphical vacuum fluorescent display, an on/off/volume control knob, menu controls and buttons, trunking mode buttons, an emergency/home button, a scan on/off/volume control, and three (3) preset buttons. Other front panel components include a microphone connector and LED-type indicators. One LED indicator is the busy indicator that lights when the radio is receiving a call and one is the transmitter-enabled indicator that lights when the radio is transmitting. The front panel also has an ambient light sensor for automatic display dimming.

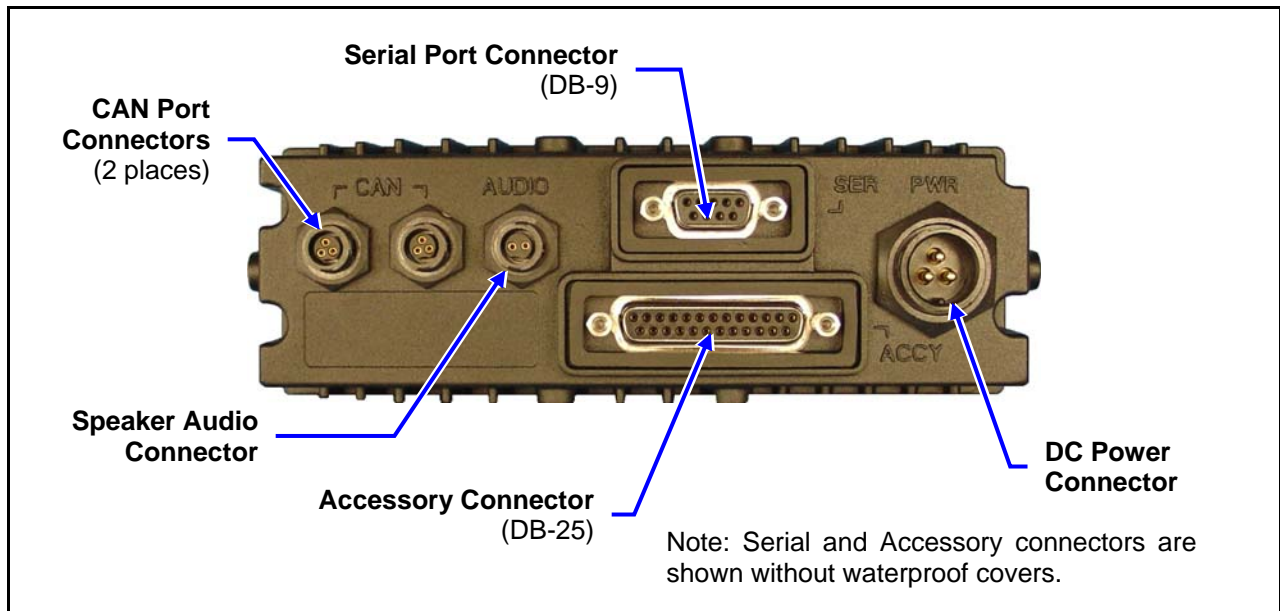


Figure 7-4: CH-721 Rear Panel (both control head models)



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



Because Installation Kit MAHK-NZN7R contains the most complete set of materials for installing the radio and control head, the following instructions make repeated reference to items within this kit. Item numbers given in parenthesis refer to items in the kit as listed in Table 4-1 on page 17.

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

7.3.2 **Control Head Mechanical Installation**

7.3.2.1 **Selecting the Mounting Location**

When selecting a location for the CH-721 control head, first observe the safety and operator-convenience related information presented in Section 5.1 on page 20. Also always consider and include clearance for the microphone's connector that must mate to the mic connector on the front panel of the head, and clearance for the connectors/cables that must mate to the connectors on the rear panel of the head. The CH-721 control head can be mounted under or on top of a mounting surface (typically the vehicle's dash) as space permits using either the standard U-shaped mounting bracket or the optional mounting pedestal.

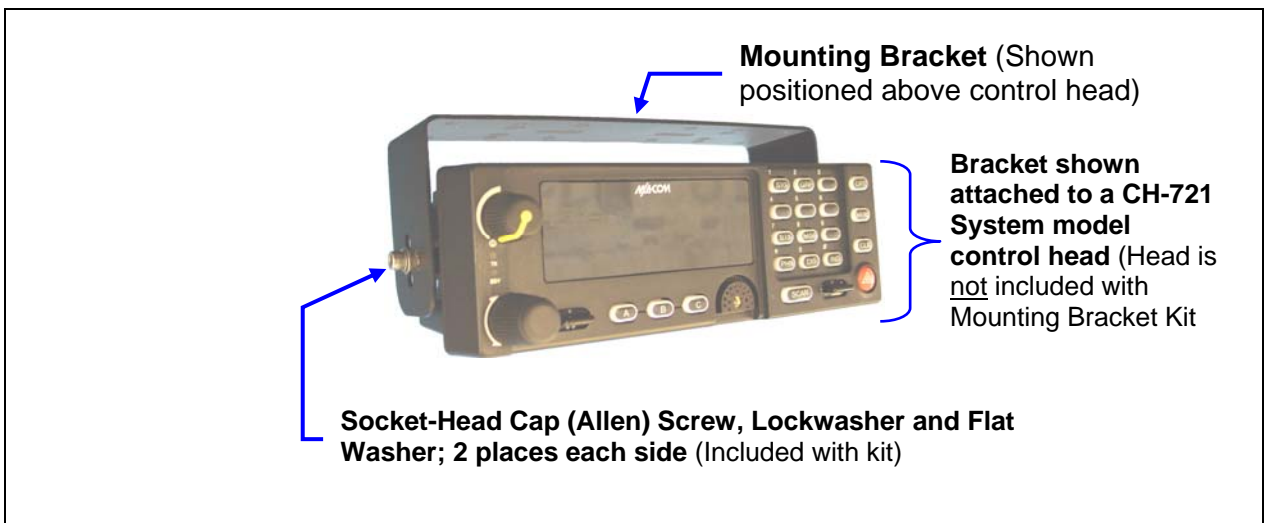


Figure 7-5: Standard U-Shaped Control Head Mounting Bracket (Kit Part Number KT-008608)

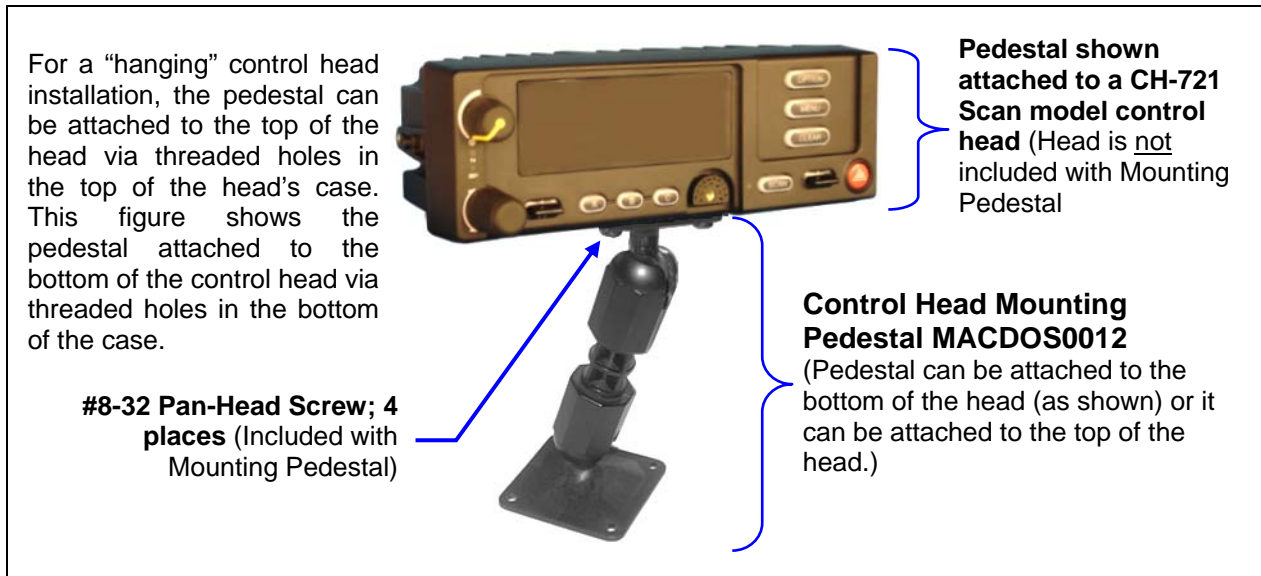


Figure 7-6: Optional Control Head Mounting Pedestal (Part Number MACDOS0012)

7.3.2.2 Using the Standard U-Shaped Mounting Bracket

If the standard U-shaped mounting bracket will be used to mount the control head, the following mounting procedure is recommended. As listed in Table 4-1 on page 17, this bracket is item 2 in the Installation Kit.

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



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

- 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).
- 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. Sheet metal screws should not be used.
- 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.
- 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.”
- 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.

7. The control head can be positioned at various angles for best display viewing at the normal position of the operator. As necessary, turn it on the pegs to a good position and tighten both screws using an 1/8-inch hex key (Allen) wrench until the control head is held firmly in place. Do not over-tighten.

7.3.2.3 Using the Mounting Pedestal (Optional)

An optional Mounting Pedestal, part number MACDOS0012, may be purchased separately to replace the standard U-shaped mounting bracket. This pedestal can be attached to the bottom of the control head as shown in Figure 7-6, and then mounted to a mounting surface below the two. It can also be attached to the top of the head and then mounted to a mounting surface above the two.

7.3.3 Control Head-to-Radio CAN Cable Connections

7.3.3.1 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 M5300 mobile radio is considered a CAN device, and each CH-721 control head in the installation is also considered a CAN device. Figure 7-7 illustrates CAN cable and CAN terminator connections for a single control head installation. Figure 7-8 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.

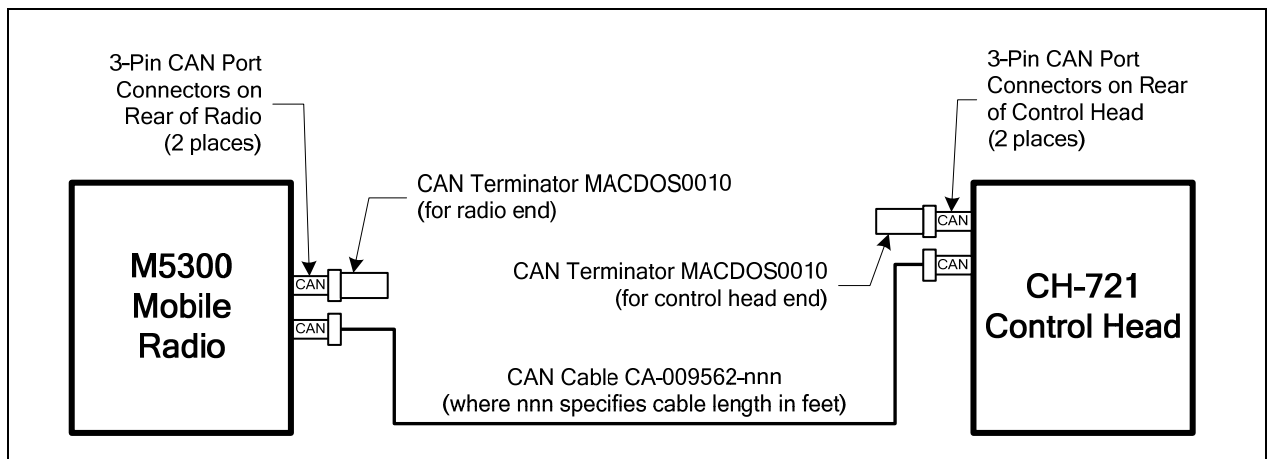


Figure 7-7: CAN Link Connections for a Single Control Head Installation

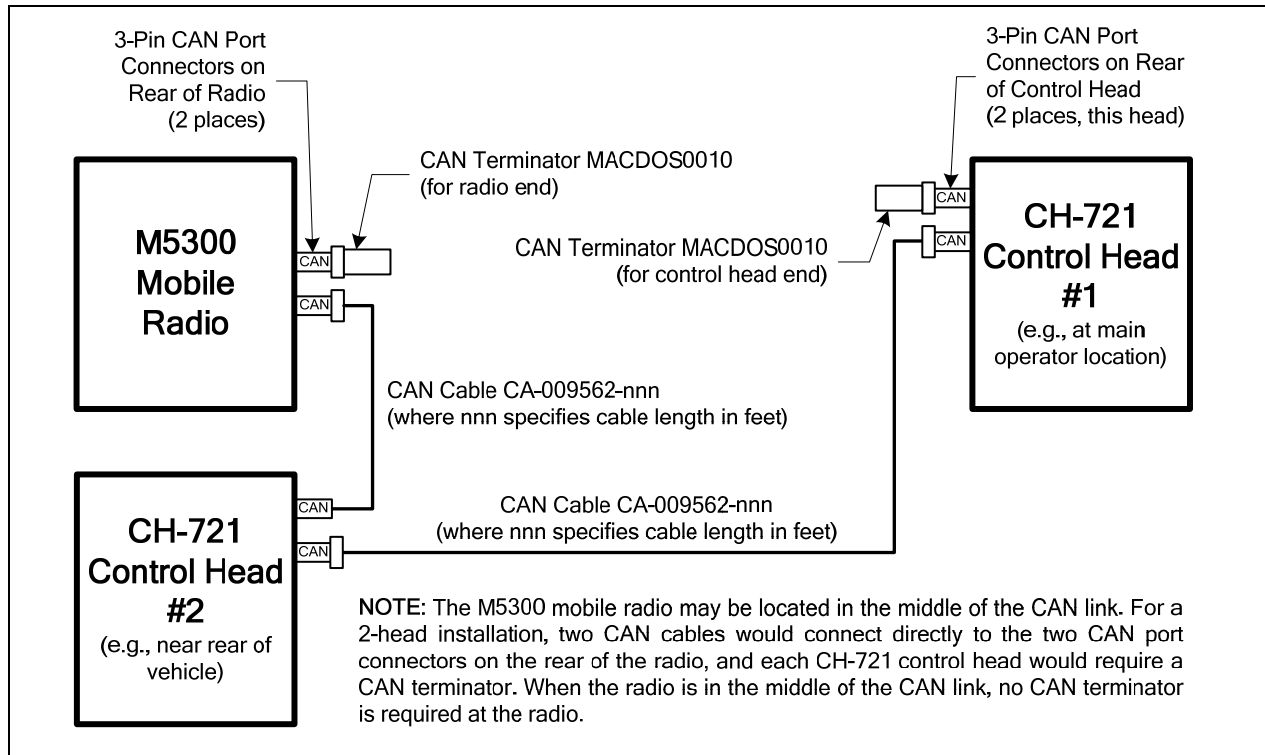


Figure 7-8: Typical CAN Link Connections for a Multi-Control Head Installation

Both the radio and the control head have two CAN ports to support “daisy-chaining” of multiple control heads or other CAN devices. Figure 5-2 on page 22 shows the radio’s two CAN port connectors, which are located near the center of the radio’s rear panel. Figure 7-4 on page 34 shows the two CAN port connectors on the control head’s rear panel.

7.3.3.2 Make CAN Link Terminations and Cable Connection

Follow this procedure for an installation which has only one control head. For a multi-control head installation, refer to Figure 7-8 as necessary.

1. Mate a CAN Terminator (item 6 in Table 4-1 on page 17) onto either one of the two smaller 3-pin CAN port connectors on the rear panel of the CH-721. 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.

2. Obtain a CAN Cable and mate it to the other CAN port connector on the rear panel of the CH-721. Typically item 7 in Table 4-1 is utilized, a 30-foot CAN cable.
3. Route the 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.

4. Mate this other end of the cable to one of the two CAN port connectors on the rear panel of the radio.
5. Mate another 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.
6. 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.

7.3.4 Control Head Power Cable Installation

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

7.3.4.1 Install DC Power Cable and Make Power and Ground Connections

1. Connect the control head's DC Power Cable (item 4 in Table 4-1 on page 17) to the large 3-pin connector at the rear of the head. Visually align the key and gently push and turn the outer locking ring clockwise until it stops. A click will be sensed to confirm proper mating.
2. At the back of the control head, locate a nearby section of vehicle chassis ground and strip this area of any paint or dirt to expose a bare metal surface.
3. Cut the black wire of the control head's DC Power Cable to the required length, plus a service loop of at least six (6) inches, then strip it and crimp a 3/8-inch ring terminal to it. Two ring terminals of this type are included with the cable when it ships from the factory.
4. Drill a hole as necessary and attach this ring terminal to chassis ground. Use a self-threading screw or other appropriate hardware to ensure a reliable metal-to-metal contact.
5. At the back of the control head, form a cable service loop, and tie and stow the cable as necessary.
6. For the positive 12-volt DC power source connection, route the cable's red wire to the location of an **unswitched** 12-volt DC power source. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing as necessary. This is the control head's main DC power source.
7. Obtain one of the waterproof (HFB-type) fuse holders included with the control head's DC Power Cable.
8. Cut excess length from the red wire and splice the fuse holder into it, near the location of the unswitched 12-volt DC power source connection point.
9. 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.
10. 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.

7.3.4.2 Connect DC Power Cable's White Wire

A review of the information presented in Section 7.2.1 (page 30) 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.

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

With this wiring configuration, the control head and radio automatically turn on and off with the vehicle's ignition switch/key. The white wire of the control head's DC Power Cable is sometimes referred to as the "white ignition switch wire" or the "ignition sense input wire." In this configuration, the white wire connects to a switched power source, typically identified as "Accessory" power, that switches on and off with the vehicle's ignition switch/key. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly.



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

1. Locate the vehicle's switched ignition or "Accessory" power connection point that will be used for the switched ignition 12-volt DC power source. This point is typically located at or near the vehicle's fuse panel. It may be necessary to consult the vehicle manufacturer's wiring diagram.
2. Route the white wire of the control head's DC Power Cable from the back of the head to the area near this connection point. Protect the wire from possible chafing as necessary.
3. Obtain one of the waterproof (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.

7.3.4.2.2 Control Head and Radio Turn On with a Manual Switch

With this wiring configuration, the control head and radio are manually turned on and off via an on/off switch mounted separately from the control head and radio, not through the vehicle's ignition switch/key. This configuration is used when, for example, the radio must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable and/or required. In this configuration, the white wire connects to a fused switched power source such as that provided by a toggle switch mounted on the vehicle's dash panel. When using this configuration, the CH-721 control head's on/off/volume control must be left in the **on** position for automatic power-up/down to function properly.

1. Route the white wire of the control head's DC Power Cable from the back of the head to an area near the location of the panel-mounted on/off switch. Protect the wire from possible chafing as necessary.

2. Cut a short section (6 to 8 inches) off the end of the white wire and strip the ends.
3. Obtain one of the waterproof (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, with a length at least 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. Obtain the 3-amp AGC-type fuse included with the cable, and install it into the fuse holder.
10. If not already, mount the switch to the vehicle's dash panel, or other customer-selected location.
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.**"

7.3.4.2.3 Control Head and Radio Are "Hot Wired"

In the "hot-wired" configuration, the control head and radio are turned on and off only by the control head's on/off/volume control located on the front panel of the control head. In this configuration, the control head's white wire must be connected to **unswitched and fused 12-volt** vehicle power. Follow the procedure presented in Section 7.3.4.2.1, **except connect the white wire to unswitched** battery power instead of switched ("Accessory") power.

8 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 8-1, grasp the mic's connector with a thumb and index finger on the sides of the connector just adjacent to the thumbscrew.
2. Position the connector in front of the control head's mic connector so the mic cable's strain relief is hanging down and out at an approximate 45 degree angle.
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. Attach the microphone clip to the mounting surface using self-threading screws. Select a location that has clearance for the mic when it is clipped to the clip.
7. The microphone clip must be grounded to the vehicle's chassis. If not mounted to a grounded metal surface, complete this requirement by adding a jumper wire attached from chassis ground to the clip.
8. Clip the microphone to the clip.

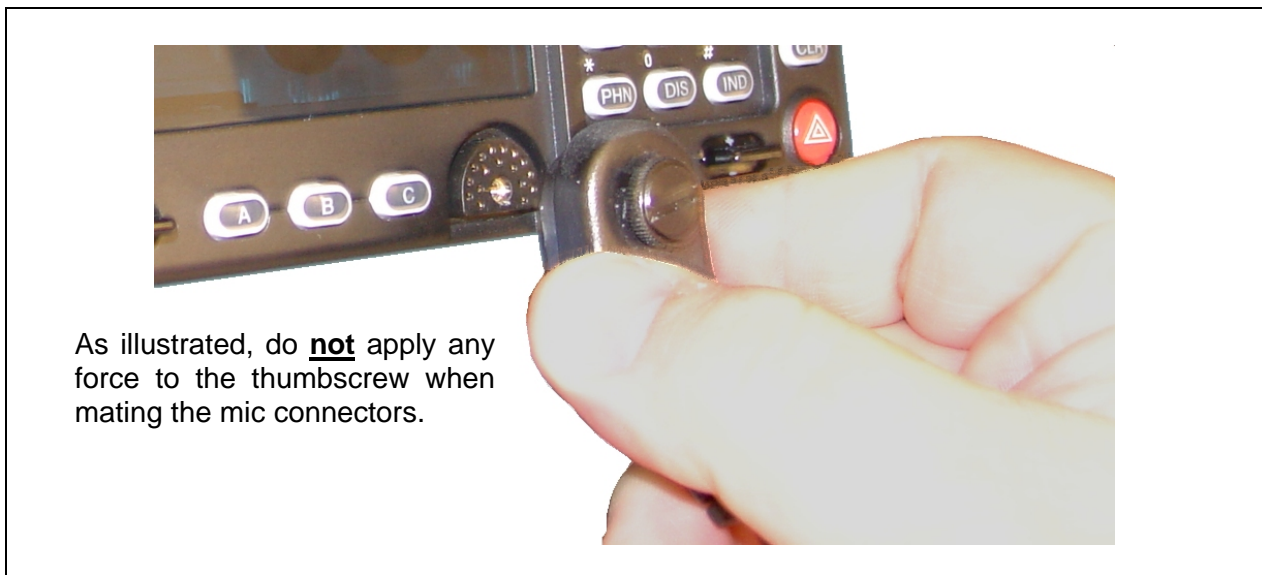


Figure 8-1: Attaching the Microphone to the CH-721 Control Head

9 SPEAKER INSTALLATION

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

1. Install the speaker (item 8 in Table 4-1 on page 17) using the hardware and mounting bracket supplied with it.
2. Route the speaker's cable to the rear of the control head.
3. Mate the Speaker Cable (item 9 in Table 4-1) 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.
4. Connect the speaker's 2-pin plastic connector to the respective mating connector on the Speaker Cable.
5. Route the cables out of the way of casual contact, and tie and stow as necessary.

10 M5300/M7300 OPTION CABLE

The M5300/M7300 Option Cable CA-012349-001 connects to the radio's 44-pin I/O cable connector. It breaks out into several smaller standardized connectors. This allows straightforward access to all external I/O interfaces provided by the radio. It also helps speed radio removal and re-installation time when required. The cable is shown in Figure 10-1.

The cable's 2-pin connector, identified P2, provides connections for an external speaker output in a front-mount radio installation. As of the publication of this manual, the M5300 is not available in a front-mount radio configuration. P2 is not used in a remote-mount radio configuration.

The cable's 6-pin connector, identified P3, provides connections for siren/PA functions. As of the publication of this manual, this feature is not available.

The cable's D-subminiature 9-pin connector, identified P5, 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 11 on page 47 for additional information.

The cable's D-subminiature 25-pin connector, identified P4, provides audio and data interfaces for connections to non-CAN-based radios. As of the publication of this manual, this feature is not available.

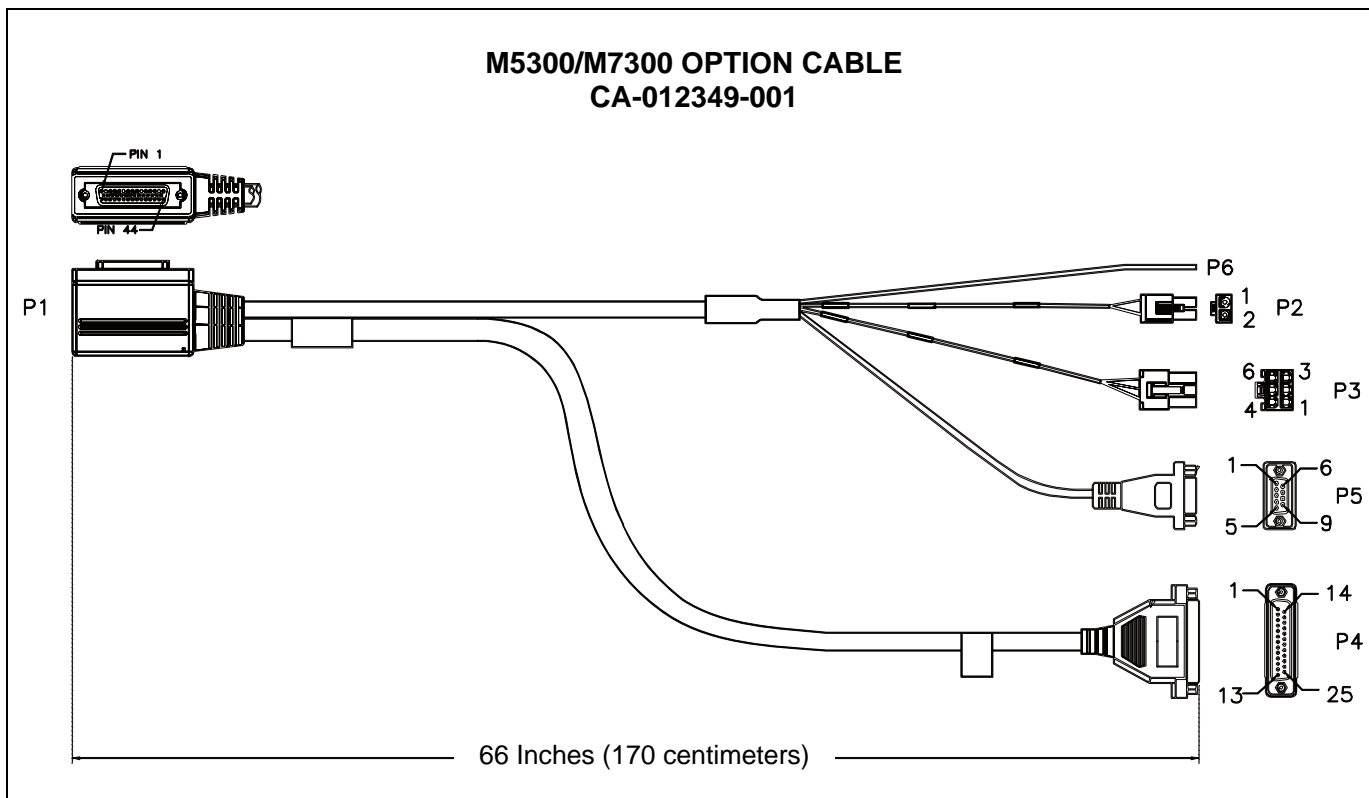


Figure 10-1: M5300/M7300 Option Cable CA-012349-001

Table 10-1: M5300/M7300 Option Cable CA-012349-001 Interconnections

44-PIN I/O CABLE CONNECTOR PIN	SIGNAL NAME	TO/FROM	DESCRIPTION
19	SPKR1	P2 pin 1	Speaker Audio Output 1 (Not used in a remote-mount radio installation)
20	SPKR1	P2 pin 1	
21	SPKR2	P2 pin 2	Speaker Audio Output 2 (Not used in a remote-mount radio installation)
22	SPKR2	P2 pin 2	
10	OUT2	P3 pin 1	Digital Output 2 (open-collector)
7	GND	P3 pins 2 & 4	Chassis ground (fused on PK Board at 3-amps)
26	HKSW	P3 pin 3	Hookswitch Digital Input
25	INP2	P3 pin 5	Digital Input 2
28	SWA+	P3 pin 6	Switched A+ (DC Power) Output
8	GND	P4 pin 1	Chassis ground (fused on PK Board at 3-amps)
30	DGPS_DATA	P4 pin 4	GPS Serial Data
4	EXTRX	P4 pin 5	External Rx Audio Output (for non-CAN based radio)
9	EXTMOD	P4 pin 7	External Tx Audio Input (for non-CAN based radio)
3	SDATA	P4 pin 8	Serial Data (for non-CAN based radio)
5	FDISC	P4 pin 9	Buffered Discriminator Audio (for non-CAN based radio)
13	ALO	P4 pin 10	Audio Ground/Reference (for non-CAN based radio)
12	MICHI	P4 pin 11	Microphone Audio Input (for non-CAN based radio)
1	EXTALO	P4 pin 12	External Audio Output (Balanced, Low)
14	VOLHI	P4 pin 13	Volume High (for non-CAN based radio)
15	CTLON	P4 pin 14	Control On Digital Output (for non-CAN based radio)
16	XTONEENC	P4 pin 15	External Tone Encode Audio (for non-CAN based radio)
17	XTONEDEC	P4 pin 16	External Tone Decode Audio (for non-CAN based radio)
6	EXTALO	P4 pin 17	External Audio Output (Balanced, Low; for non-CAN based radio)
24	HORNRING	P4 pin 18	Horn/Ring Output (for non-CAN based radio)
23	SONOFF	P4 pin 19	Siren On/Off Digital Output (for non-CAN based radio)
18	INP1	P4 pin 21	Digital Input 1 (for non-CAN based radio)
2	OUT1	P4 pin 22	Digital Output 1 (open-collector; for non-CAN based radio)
29	TXENB+	P4 pin 23	Transmit Enable B+ (for non-CAN based radio)
27	EXTMIC	P4 pin 24	External Mic Audio Input (for non-CAN based radio)
28	SWA+	P4 pin 25	Switched A+ DC Power Output (for non-CAN based radio)
32	GPS_NMEA_RX	P5 pin 2	Serial Rx Input for GPS NMEA-Formatted Serial Data
31	GPS_NMEA_TX	P5 pin 3	Serial Tx Output for GPS NMEA-Formatted Serial Data
7	GND	P5 pin 5	Ground for GPS Serial Data Signals

Table 10-1: M5300/M7300 Option Cable CA-012349-001 Interconnections

44-PIN I/O CABLE CONNECTOR PIN	SIGNAL NAME	TO/FROM	DESCRIPTION
11	IGNITION	(no connection)	Unused/Spare ignition sense input.
33	—	(no connection)	This pin of P1 is not used/not connected.
34	—	(no connection)	This pin of P1 is not used/not connected.
35	—	(no connection)	This pin of P1 is not used/not connected.
36	—	(no connection)	This pin of P1 is not used/not connected.
37	—	(no connection)	This pin of P1 is not used/not connected.
38	—	(no connection)	This pin of P1 is not used/not connected.
39	—	(no connection)	This pin of P1 is not used/not connected.
40	—	(no connection)	This pin of P1 is not used/not connected.
41	—	(no connection)	This pin of P1 is not used/not connected.
42	—	(no connection)	This pin of P1 is not used/not connected.
43	—	(no connection)	This pin of P1 is not used/not connected.
44	—	(no connection)	This pin of P1 is not used/not connected.

11 GPS NMEA-FORMATTED SERIAL DATA CONNECTION

To obtain GPS NMEA-formatted serial data from the radio, use of the M5300/M7300 Option Cable CA-012349-001 is required. Follow this procedure to complete the GPS NMEA-formatted serial data connections:

1. Obtain M5300/M7300 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 with an optional MAMROS0055 serial cable — and tighten the screws until firm. Route the cabling as required.
4. Follow the manufacturer’s instructions on processing the NMEA-formatted GPS data from the radio.



NOTE

If the M5300/M7300 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 10-1 for additional information.



NOTE

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

12 INITIAL POWER-UP TEST

1. At the radio's main waterproof (HFB-type) fuse holder installed near the vehicle battery, insert the 15-amp AGC-type fuse that was included with the radio's DC Power Cable.
2. Tie and stow the fuse holder as necessary to prevent excess vibration/movement.
3. Carefully reconnect the vehicle's battery ground cable.
4. If the control head is not already powered up, do so by rotating its on/off/volume control clockwise out of the detent position.
5. If the installation is wired so the vehicle's ignition key/switch turns the radio on and off, turn the switch to the Accessory or Run position.
6. Verify the control head has powered-up by observing its display. If the display is not lit, refer to Section 7.2.1 as necessary.



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

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

- After a short boot-up sequence, the control head displays login information and/or a talk group.
- If no errors are displayed, the installation is most-likely properly wired.
- If an error is displayed, recheck all cable connections, verify all fuses are properly installed, and verify battery power on the load side of the fuses, etc. If problems persist, contact M/A-COM's Technical Assistance Center (see page 16).
- Consult the Operator's Manual for operational information.

Refer to the following section for performance test information.

13 PERFORMANCE TESTS

This section includes procedures to verify the performance of the radio installation's mobile antenna system. The tests require a peak-power reading wattmeter to measure RF power. There are three procedures in this section:

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



CAUTION

The accuracy of test results depends upon a DC power source in the range of 13.8 to 16 volts DC, with a current capacity of greater than 8 amps. Make sure the vehicle's battery is fully charged by running the engine for a few minutes before the test, and keep the engine running during the test procedures. **Abide by the following WARNING!** Alternatively, instead of running the vehicle's engine for an extended period of time, a 12-volt vehicle battery charger with a current capacity of at least 15 amps can be connected to the vehicle's battery. If using a battery charger, **observe polarity** when making the connections to the battery.



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!



CAUTION

If a vehicle equipped with this radio requires jump-starting, the radio installation's main AGC fuse (15-amp) should be removed from the holder prior to jump-starting. Doing so will prevent damage to the radio system.



NOTE

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.

13.1 CHANGING OPERATING MODE FOR TESTS

The radio must be operating in the OpenSky Trunking Protocol (OTP) mode during the performance test procedures presented in this section:

13.1.1 Switching to OTP Mode

1. If necessary, apply power to the radio and turn it on.
2. Rotate the **Group Selection Control** until **Mode Menu** appears in the middle line of the display. Refer to Figure 7-2 on page 33 and/or Figure 7-3 on page 34 as necessary.

3. Toggle the **Ramp Control** until **OTP** (or **M: NM** for mode = normal) appears in the top line of the display.
4. Confirm the OTP selection by pressing the **MENU** button, then toggling the **Ramp Control** once (to select **Y** for Yes), followed by pressing the **MENU** button again. The radio will reboot and enter OTP mode as indicated by the display.

13.2 REQUIRED TEST EQUIPMENT

Table 13-1: Required Test Equipment

TEST EQUIPMENT	MODEL / PART NUMBER & DESCRIPTION
Peak Power Wattmeter	<ul style="list-style-type: none"> • Bird Electronic Corp. Model 4314B (or equivalent) with N-type female connectors at input and output ports.
Wattmeter Slug	<ul style="list-style-type: none"> • Bird Electronic Corp. Element 25E, 25 watts, 400 - 1000 MHz (or equivalent).
RF Coaxial Jumper Cable	<ul style="list-style-type: none"> • Pasternack Enterprises PE3661-36 (or equivalent) 50-Ohm Coaxial Cable with TNC-type male connector and N-type male connector, approximately three (3) feet in length. <p>The utilized cable must have VSWR below 1.5:1 within the RF passband.</p>
N-Type to TNC RF Adapter	<ul style="list-style-type: none"> • Pasternack Enterprises PE9090 (or equivalent) N-type male to TNC-type female adapter. Required to connect the cable of the vehicle-mounted 900 MHz antenna to the wattmeter.
50-Ohm RF Terminator (“Dummy Load”)	<ul style="list-style-type: none"> • Pasternack Enterprises PE6106 (or equivalent) 50-ohm RF terminator rated at greater than 50 watts power, with N-type male connector.
Vehicle-Mounted Antenna	Tests are performed with the vehicle-mounted 900 MHz antenna per the installation described in Section 6 of this manual.

13.3 TRANSMITTING INTO A DUMMY LOAD

1. Using the N-type male to TNC-type male RF coaxial jumper cable, connect the radio’s antenna connector to the wattmeter’s input connector. Refer to Figure 13-1 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 900 MHz antenna.



A peak-power reading RF wattmeter equivalent to the wattmeter specified in Table 13-1 must be used. Do **not** use an average or RMS-responding wattmeter.

3. If not already, turn the radio on and set it to the OTP mode. Refer to Section 13.1 as necessary.
4. Set the radio to a test talk group, if available.



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

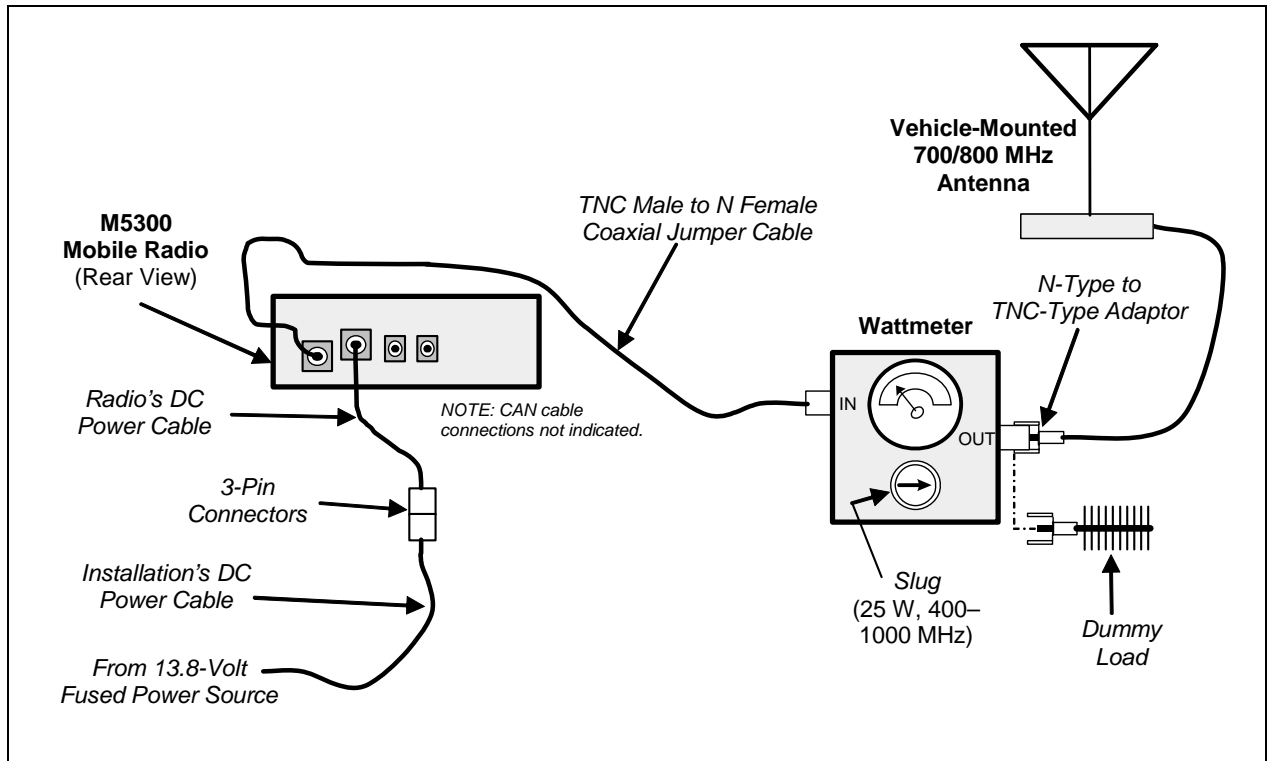


Figure 13-1: Wattmeter Connections for Antenna System Tests

5. Position the wattmeter's slug to measure forward RF output power. Rotate it if necessary. The arrow on the face of the slug must point away from the radio and towards the dummy load for forward power measurements.
6. Set the wattmeter to measure peak RF power.
7. Key the radio's transmitter via the microphone's PTT button.
8. Compare the wattmeter's reading with the target RF output power range of **10 – 20 watts**.



NOTE

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

9. **If the wattmeter reading is within the range**, record the measured value in the appropriate space on the data collection form near the end of this manual.

If the wattmeter reading is outside the range, verify the radio's power supply voltage (i.e., battery voltage) is within the specified range, recheck all connections and measure the RF output power again. If this fails to produce a reading within the range, replace it and repeat this procedure. If problems persist, contact M/A-COM's Technical Assistance Center (see page 16).

13.4 TRANSMITTING INTO THE MOBILE ANTENNA

1. Connect the antenna cable from the vehicle-mounted 900 MHz antenna to the wattmeter as shown in Figure 13-1.
2. If not already, turn the radio on and set it to OTP mode. Refer to Section 13.1 as necessary.
3. Set the radio to a test talk group, if available.



NOTE

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



NOTE

A peak-power reading RF wattmeter equivalent to the wattmeter specified in Table 13-1 must be used. Do **not** use an average or RMS-responding wattmeter.

4. Position the wattmeter's slug to measure forward RF output power. Rotate it if necessary. The arrow on the face of the slug must point away from the radio and towards the antenna for forward power measurements.
5. Set the wattmeter to measure peak RF power.
6. Key the radio's transmitter via the microphone's PTT button.
7. Compare the wattmeter reading with the target RF output power range of **10 – 20 watts**.



NOTE

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

8. **If the wattmeter reading is within the range**, record the value in the appropriate space on the data collection form near the end of this manual.

If the wattmeter reading is outside the range, verify the radio's power supply voltage (i.e., battery voltage) is within the specified range, recheck all connections, and measure the forward power again. If this fails to produce a reading within the range, check all cabling and connections, and repeat the testing procedure to this point. In the event the wattmeter reading still falls outside the range, replace the antenna, make sure all connections are seated firmly, and repeat the testing procedure. If problems persist, contact M/A-COM's Technical Assistance Center (see page 16).

9. Position the wattmeter's slug to measure reverse (reflected) RF power from the antenna. The arrow on the face of the slug must point away from the antenna and to the radio to measure reverse power.
10. Verify the wattmeter is still set to measure peak RF power.
11. Key the radio's transmitter via the microphone's PTT button.
12. Compare the wattmeter reading with the RF power output range of **2 watts or less**.



NOTE

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

13. **If the wattmeter reading is within the range**, record the value in the appropriate space on the data collection form near the end of this manual.

If the wattmeter reading is outside the range, make sure the antenna is consistent with the specified frequency range of the radio. Recheck all antenna connections, and measure the reverse power again. If this fails to produce a reading within the range, replace the antenna and repeat the entire antenna test procedure. Any value exceeding the maximum allowable reflected power value will result in a diminished RF output signal. If problems persist, contact M/A-COM's Technical Assistance Center (see page 16).

14. Disconnect the coaxial cable jumper and wattmeter.
15. Permanently connect the cable from the vehicle-mounted 900 MHz antenna to the radio's antenna cable by mating the two TNC connectors together. Use two pairs of slip-jaw pliers to gently tighten this connection. Do not over tighten and do not twist either cable.



NOTE

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



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.

13.5 TEST PERFORMANCE DATA FORM

Clip  Here

Enter the information requested on this data collection form. Clip this form and file it as a permanent record of the tested performance of the M5300 mobile radio installation.

Mobile Radio Serial Number

Antenna Make and Model Numbers

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

Company Performing Installation

Technician Performing Test



Watts
<i>Power Into a Dummy Load</i>

Watts
<i>Forward Power With Antenna</i>

Watts
<i>Reflected Power With Antenna</i>

14 COMPLETE THE INSTALLATION

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

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

15 WARRANTY

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

This warranty applies only within the United States.

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ECR-7047C

16 INSTALLATION WRING DIAGRAM: M5300 MOBILE RADIO WITH CH-721 CONTROL HEAD

DRAWING NOT AVAILABLE.

WIRING DIAGRAM
M5300 Mobile Radio with
CH-721 Control Head

(AA-TBD Rev. -)

Installation Wiring Diagram Inside