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IDs: BV8M7200VTAC/3670A-M72VTAC  
Report #: 2007101-001

## **Appendix I: Manuals**

Please refer to the following pages for the operator and installation manuals.

*future*  
**The Future of Mobile Radio**

**Preliminary**



**M7200 Series**  
**Digital Mobile Radio**  
with Vehicular Tactical Network (V-TAC)

### MANUAL REVISION HISTORY

REV	DATE	REASON FOR CHANGE
-	Feb/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:

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### CREDITS

This device is made under license under one or more of the following US patents: 4,590,473; 4,636,791; 5,148,482; 5,185,796; 5,271,017; 5,377,229; 4,716,407; 4,972,460; 5,502,767; 5,146,497; 5,164,986; 5,185,795.

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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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## TABLE OF CONTENTS

	<i>Page</i>
<b>1 SAFETY SYMBOL CONVENTION.....</b>	<b>6</b>
<b>2 RF ENERGY EXPOSURE INFORMATION .....</b>	<b>7</b>
2.1 RF ENERGY EXPOSURE AWARENESS, CONTROL INFORMATION, AND OPERATION INSTRUCTIONS FOR FCC OCCUPATIONAL USE REQUIREMENTS .....	7
2.1.1 Federal Communications Commission Regulations.....	7
2.2 COMPLIANCE WITH RF EXPOSURE STANDARDS .....	8
2.2.1 Mobile Antennas.....	9
2.2.2 Approved Accessories .....	9
2.2.3 Contact Information.....	9
<b>3 OPERATION SAFETY RECOMMENDATIONS.....</b>	<b>10</b>
3.1 TRANSMITTER HAZARDS .....	10
3.2 SAFE DRIVING RECOMMENDATIONS.....	10
<b>4 OPERATING RULES AND REGULATIONS.....</b>	<b>11</b>
4.1 OPERATING TIPS .....	11
<b>5 PRODUCT DESCRIPTION.....</b>	<b>12</b>
5.1 REMOTE CONTROL HEAD OPERATION .....	12
5.2 INTERCOM OPERATION .....	13
5.3 V-TAC OPERATION .....	13
<b>6 OPENSky OPERATION.....</b>	<b>14</b>
6.1 CH721 FRONT PANEL COMPONENTS .....	14
6.2 POWER UP AND VOLUME CONTROL .....	16
6.2.1 Power Up .....	16
6.2.2 Volume Control .....	16
6.3 SELF-TEST.....	16
6.4 LOGIN TO THE NETWORK .....	16
6.5 LOG OFF THE NETWORK.....	17
6.6 TURNING THE RADIO OFF .....	17
6.7 MENU DISPLAY AND CONTROL AREA .....	17
6.8 RADIO STATUS ICONS .....	18
6.9 DWELL DISPLAY .....	18
6.10 PERSONALITY .....	18
6.10.1 Profiles.....	18
6.10.2 Talk Groups .....	19
6.11 ALERT TONES .....	19
6.12 BASIC MENU STRUCTURE .....	20
6.13 DUAL-TONE MULTI-FREQUENCY .....	23
6.14 KEYPAD COMMANDS (SYSTEM MODEL CONTROL HEAD).....	23
6.14.1 Password Entry .....	24
6.14.2 DTMF Overdial .....	24
6.15 CHANGING THE ACTIVE PROFILE.....	24
6.16 CHECKING OR CHANGING THE SELECTED TALK GROUP.....	24
6.17 ADJUSTING DISPLAY & BUTTON BACKLIGHT BRIGHTNESS .....	25
6.18 STEALTH MODE .....	25

## TABLE OF CONTENTS

	<u>Page</u>
6.18.1 Enabling Stealth Mode .....	25
6.18.2 Disabling Stealth Mode .....	25
6.19 ADJUSTING SIDE TONE AUDIO LEVEL .....	25
6.20 CHANGE OPERATING MODE .....	26
6.21 RECEIVING AND TRANSMITTING VOICE CALLS .....	26
6.21.1 Receiving a Voice Call .....	26
6.21.2 Transmitting a Voice Call .....	26
6.22 ADJUSTING AUDIO TREBLE LEVEL .....	27
6.23 INTERCOM MODE .....	27
6.24 TALK GROUP LOCK OUT .....	27
6.24.1 Lock Out a Talk Group .....	28
6.24.2 Unlock a Talk Group .....	28
6.25 SCANNING .....	29
6.25.1 Checking or Changing Active Scan Mode .....	29
6.25.2 Scanning Priority .....	29
6.26 MAKING SELECTIVE CALLS .....	30
6.26.1 Manually Dialing a Selective Call (System Model Control Head) .....	30
6.26.2 Speed Dialing a Selective Call .....	30
6.26.3 Receiving a Selective Call .....	31
6.27 SELECTIVE ALERT .....	31
6.27.1 Sending Selective Alert Messages .....	31
6.27.2 Receiving Messages .....	32
6.27.3 Defining Pre-Programmed Messages .....	33
6.28 TELEPHONE INTERCONNECT CALLS (SYSTEM MODEL CONTROL HEAD) .....	33
6.29 EMERGENCY COMMUNICATIONS .....	33
6.29.1 Declaring an Emergency Call or Alert .....	33
6.29.2 Silent Emergency .....	34
6.29.3 Clearing an Emergency Call or Alert .....	35
6.29.4 Receiving an Emergency Call .....	35
6.29.5 Dismissing an Emergency Call .....	36
6.30 ENCRYPTION .....	36
6.30.1 Automatic Encryption .....	36
6.30.2 Manual Encryption (System Model) .....	36
6.31 PRESET BUTTONS .....	37
6.32 DYNAMIC REGROUPING .....	38
6.33 GPS COORDINATES .....	38
6.34 V-TAC FUNCTIONS .....	38
6.34.1 Extended Coverage Modes (“XCOV” & “XCOV-TG”) .....	38
6.34.2 V-TAC GPS Interlock .....	40
6.34.3 Scene-Of-Incident Mode (“SOI”) .....	41
6.34.4 Mobile-Only Mode (“Mobile”) .....	42
6.34.5 Changing V-TAC Mode .....	42
6.34.6 Displaying V-TAC Information .....	42
<b>7 BASIC TROUBLESHOOTING .....</b>	<b>44</b>
<b>8 TECHNICAL ASSISTANCE .....</b>	<b>46</b>

## TABLE OF CONTENTS

		<u>Page</u>
<b>9</b>	<b>WARRANTY .....</b>	<b>47</b>

### FIGURES

	Figure 6-1: System Model .....	14
	Figure 6-2: Scan Model .....	14
	Figure 6-3: Personality Structure Example .....	19

### TABLES

	Table 2-1: Rated Power and Recommended Minimum Safe Lateral Distance .....	8
	Table 6-1: Front Panel Default Controls and Functions .....	15
	Table 6-2: ICONS and Descriptions .....	18
	Table 6-3: M7200 Alert Tones .....	19
	Table 6-4: Basic Menu Structure .....	21
	Table 6-5: Keypad Function Commands .....	23
	Table 6-6: Scan Modes .....	29
	Table 6-7: Status of Selective Alert .....	32
	Table 7-1: Basic Troubleshooting .....	44

# 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 **E**lectro-**S**tatic **D**ischarge. 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.



NOTE

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.



CAUTION

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. M7200 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. M7200 two-way radio has an RF exposure product label. Also, your M7200 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. M7200 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. M7200 mobile two-way radio complies with the following RF energy exposure standards and guidelines:

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



Table 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 (CATALOG NUMBER)	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA (Distance in Centimeters)	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-025167-001 (MAMV-AN3J)	700/800 MHz Standard Rooftop-Mount; 3 dBd Gain	20	55
AN-025167-002 (MAMV-AN3K)	700/800 MHz Elevated-Feed Rooftop- Mount; 3 dBd Gain	20	50
AN-025167-004 (MAMV-AN3V)	700/800 MHz GPS Combo Rooftop-Mount; 3 dBd Gain	21	56
AN-025167-014 (MAMV-NAN5U)	700/800 MHz Standard Rooftop-Mount; 5 dBd Gain	20	48
AN-025167-015 (MAMV-NAN5V)	700/800 MHz GPS Combo Rooftop-Mount; 5 dBd Gain	23	45

### **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 M7200 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 M7200 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**

The M7200 Vehicular Tactical Network provides public safety users extended connectivity with the most advanced digital voice and data network. Extended connectivity is through two tightly coupled digital radios that function as an in-band router between the public safety network, the mobile vehicle, and the user's portable radio. Digital voice and data are routed between the network and the user's control head and mobile data terminal within the vehicle or the user's portable radio when the portable radio cannot maintain direct network connection.

The M7200 mobile radio is a state-of-the-art radio that operates seamlessly between the 800 MHz frequency band and the 700 MHz frequency band. The M7200 is designed to meet the critical communications demands of public service users and complies with MIL-STD-810F specifications.

The M7200 is capable of supporting multiple operating modes, including OpenSky digital operation, EDACS or ProVoice trunked modes, P25 digital trunked mode, P25 digital conventional mode, and conventional analog mode.

The M7200 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 M7200 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 M7200 is constructed with an industry-standard RS-232 interface serial port for connecting an optional laptop PC.

A PC, not included with the M7200, provides network connectivity through the standard serial (DCE-type) interface.

The M7200 has an integrated Global Positioning System (GPS) receiver. This allows the M7200 to fully support the Automatic Vehicular Locator (AVL) for fleet management and dispatch applications.

The OpenSky M7200 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 M7200 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.

## **5.3 V-TAC OPERATION**

V-TAC operation requires the V-TAC hardware configuration (RF Combiner, Vehicular Repeater Base VRB, and Mobile Radio Unit MRU) and offers the user 4 different operating modes: Extended Coverage for individual users (XCOV), Extended Coverage for talk groups (XCOV-TG), Scene of Incident (SOI), and normal Mobile-Only operation. Refer to Section 6.34 for operating information on these modes.

## 6 OPENSKY 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.

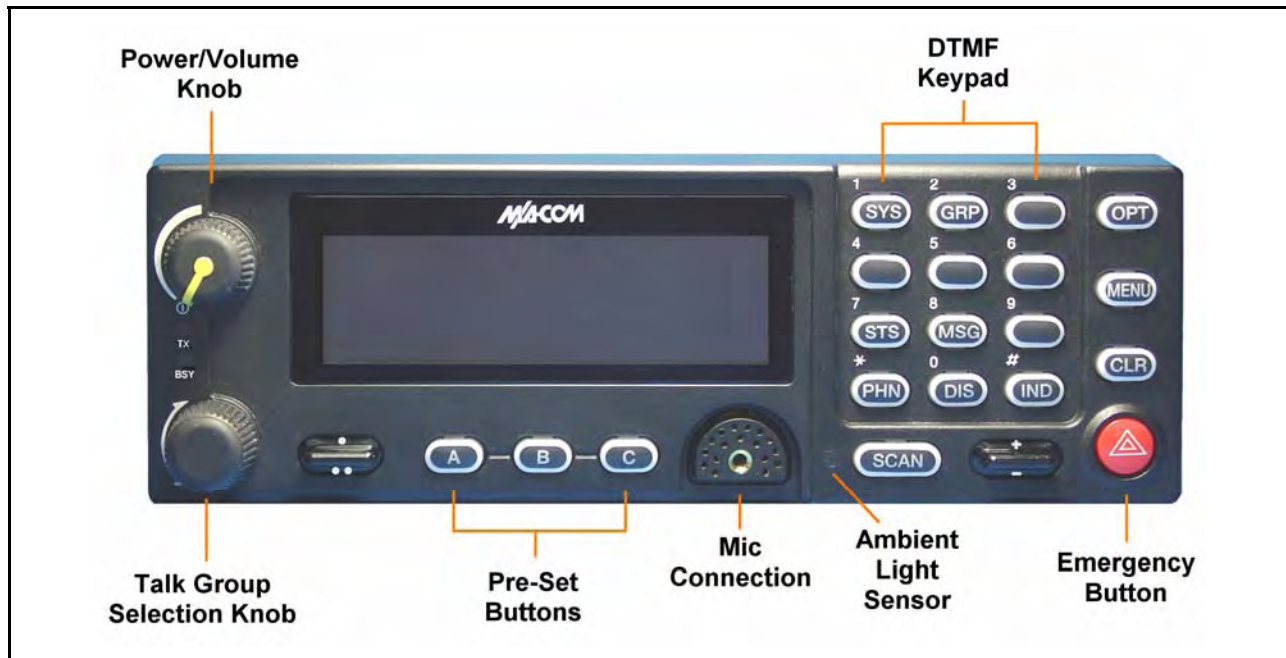


Figure 6-1: System Model



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.


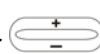

In addition, the front panel contains a light-level sensor that samples ambient light levels for automatic display and button backlight brightness adjustments. In other words, it automatically brightens the display and backlights when higher external light levels exist and it automatically dims the display 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 APPENDIX A 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.
<b>OPT/OPTION</b>	
<b>CLR/CLEAR</b>	
<b>MENU</b>	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 M7200 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

If power is abruptly disconnected from the radio prior to executing the correct turn-off procedure, user-selected radio settings and last-tuned channel information will be lost. 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. 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.


## 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/alias<sup>1</sup>, received talk group, and current channel name. V-TAC mode or V-TAC channel can be displayed as well on V-TAC installations. Press up or down with the  ramp control to scroll through and view one of these second line options.

## 6.10 PERSONALITY

As illustrated in Figure 6-3, 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.

<sup>1</sup> Alias is a logical ID name such as “J\_Smith.” The name corresponds to a user ID such as 003-542-0001.

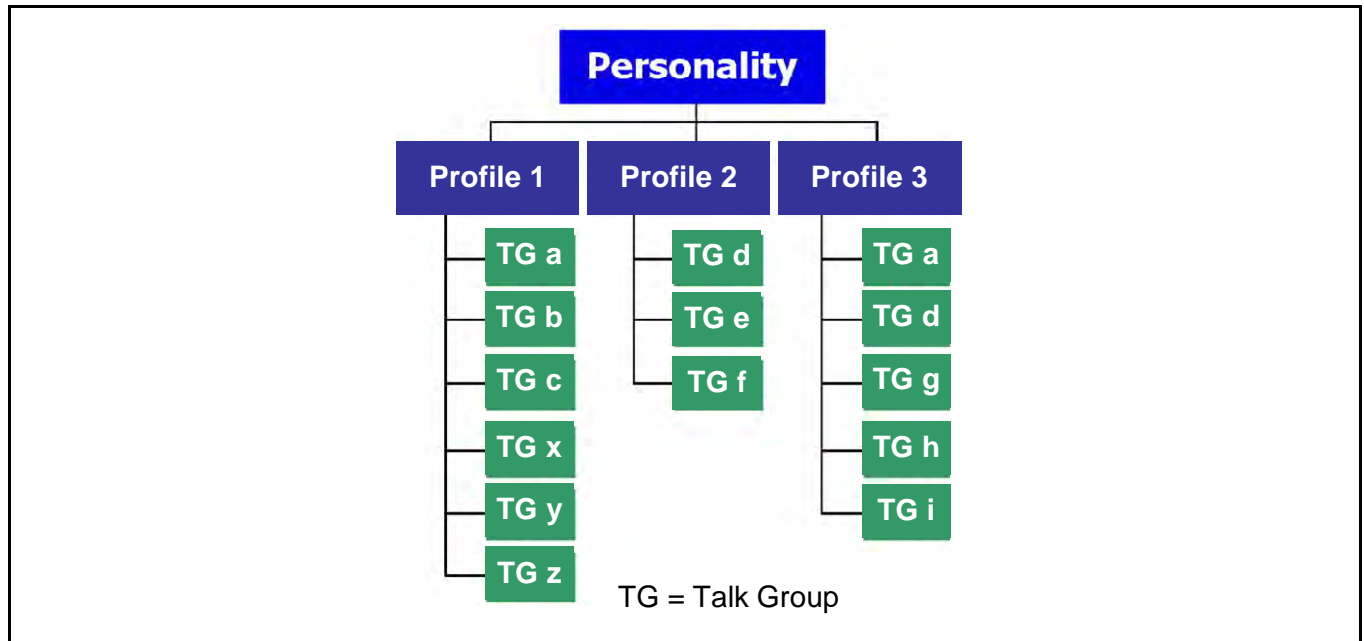


Figure 6-3: Personality Structure Example

### 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 M7200 radio also provides audible Alert Tones or “beeps” to indicate the various operating conditions (see Table 6-3).

Table 6-3: M7200 Alert Tones

























NAME	tone	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.
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).
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.




























NAME	tone	DESCRIPTION
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	Ringtone 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 tones - 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.
V-TAC On Tone	a quick high-low-high-low-pitched beep.	This tone sounds when a V-TAC automatically transitions from the mobile-only mode to one of the V-TAC XCOV modes, and from V-TAC XCOV mode to mobile radio mode. It does not sound on manual transition.
V-TAC Client Attach/Detach Tone	a quick high-pitched beep.	This tone sounds when a portable radio ("client") attaches to or detaches from the V-TAC.
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 M7200 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 <b>MENU</b> and confirm (Y/N) with  and <b>MENU</b> 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.
V-TAC Mode	V-TAC operating mode "Vmode Menu" 	Use  to choose an available V-TAC operating mode.
V-TAC Channels (Menu appears only if in SOI mode.)	V-TAC SOI channel "Vchan Menu" 	Use  to turn choose an available V-TAC channel for Scene-Of-Incident (SOI) mode communications.
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 <b>Select</b> to return to dwell display.
Display Brightness	"<< >>" "Bright Menu" 	Use  to dim or brighten backlighting. Press <b>MENU</b> to return to dwell display.
Side Tone Level	"OFF", "LOW", "MED", "HIGH" "Side Menu" 	Use  to choose side tone level. Press <b>MENU</b> to return to dwell display.
	 See Next Page	

Menu Name	Radio Displays (top and bottom lines)	Usage Notes
	See Previous Page	
Intercom	<div>“ON” or “OFF”</div> <div>“INTERCOM”</div>	Use  to turn intercom on and off. Press <b>MENU</b> to return to dwell display.
Selected Channel (Menu may not be available per radio programming)	<div></div> <div>selected channel</div> <div>“ChannelMenu”</div>	Displays the current channel. Press <b>MENU</b> to return to dwell display.
Scan Mode	<div></div> <div>current scan mode</div> <div>“ScnModeMenu”</div>	Use  to turn scan on and off. Press <b>MENU</b> to return to dwell display.
Talk group Lock Out	<div></div> <div>talk group “&lt;”</div> <div>“LockOutMenu”</div>	Use  to choose a talk group for locking/unlocking. Press <b>MENU</b> to toggle “<” on (locked out) and off.
Priority 1 Talk group	<div></div> <div>current priority talk group</div> <div>“Priority2”</div>	Use  to choose new priority talk group. Press <b>MENU</b> to return to dwell display.
Priority 2 Talk group	<div></div> <div>current priority talk group</div> <div>“Priority1”</div>	Use  to choose new priority talk group. Press <b>MENU</b> to return to dwell display.
Emergency Dismiss	<div></div> <div>alert received</div> <div>“EmgDismiss”</div>	Use  to choose emergency talk group. Press <b>MENU</b> to dismiss.
Alerts Received	<div></div> <div>time/sender's name/ alias/message text</div> <div>“AlertsRcvd” or oldest message</div>	“No alerts” or alert message text scrolls in display. Use  to view messages.
Alert Destination	<div></div> <div>current speed dial #</div> <div>“AlertDest”</div>	Use  to choose a speed-dial number. Press <b>MENU</b> to go to “AlertMsg” menu. Scroll through canned messages with  . Press <b>MENU</b> to send message and return to dwell display.
Speed Dial	<div></div> <div>current speed dial #</div> <div>“SpeedDial”</div>	Use  to choose a speed-dial number. Press <b>MENU</b> , then use  to select canned message.
Profile Selection	<div></div> <div>currently active profile</div> <div>“ProfileMenu”</div>	Use  to choose an available profile. Press <b>MENU</b> to return to dwell display.
Talk group Selection	<div></div> <div>selected talk group</div> <div>“TalkGrpMenu”</div>	Use  to choose a talk group in current profile. Press <b>MENU</b> to return to dwell display.
Dwell Display	<div></div> <div>Selected talk group (bottom line option)</div>	Use  to scroll top line through talk groups. Press <b>MENU</b> to change bottom line option.
Use  , <b>CLR</b> , or <b>OPT</b> to scroll through menus.		



NOTE

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



NOTE

No V-TAC-related menus are displayed on non-V-TAC radios/control heads.

The “Vchan Menu” is only displayed if the V-TAC is in the SOI mode.

If a V-TAC is in an Extended Coverage mode (XCOV or XCOV-TG), the number of portable radios (“clients”) connected to the V-TAC is displayed in the bottom line of the dwell menu.

If a V-TAC is in the Extended Coverage for talk groups mode (XCOV-TG), the selected talk group and profile in use is displayed.

## 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**

<b>*0</b>	<b>Log-off command:</b> *0## (logs the user off the system). See page 17 for additional information.
<b>*1</b>	<b>Log-in command:</b> *1<User ID> # <Password> ## (required for encryption). See page 16 for additional information.
<b>*4</b>	<b>Enter Scene of Incident Mode (SOI) on specified channel.</b> Exit SOI Mode with *4#.
<b>*7</b>	<b>Initiate Selective Alert command:</b> *7<Target ID>#[Choose Message]#. See page 31 for additional information.
<b>*8</b>	<b>Radio-to-Radio Call command:</b> Selective call number # (PTT to dial).
<b>*9</b>	<b>Public Switched Telephone Network (PSTN) Call command:</b> See page 33 for additional information.
<b>*32</b>	<b>Begin Manual Encryption command:</b> *32<Pre-Determined Encryption Key of Up To 16 Digits># See page 36 for additional information.
<b>*33</b>	<b>End Manual Encryption command.</b>
<b>*61</b>	<b>Initiate XCOV Mode:</b> Extended coverage for individual users.
<b>*62</b>	<b>Initiate XCOV-TG Mode:</b> Extended coverage for talk groups.
<b>*60</b>	<b>Exit XCOV or XCOV-TG Mode:</b> Returns to the normal mode.



### 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 16 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.



NOTE

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.





NOTE

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
<b>No Scan</b>	<p><b>Eliminates distractions.</b></p> <p>Full communications (transmit and receive) on selected talk group.</p> <p>No calls received from other talk groups.</p>
<b>Normal (Default)</b>	<p>Full communications (transmit and receive) on the selected talk group.</p> <p>Scans all talk groups in the active profile that are not locked out.</p> <p>Receive calls from more than one talk group, if available from the current site.</p> <p>Allows dragging of the selected, default emergency, P1, and P2 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>An emergency-enabled talk group is only dragged if it is in emergency mode.</p>
<b>Fixed</b>	<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>

### 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 in it until read 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**

<b>STATUS MESSAGE</b>	<b>DEFINITION</b>
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 M7200 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 M7200 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 14. 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.



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 29 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., M7200 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. It can be between one and sixteen (1 - 16) digits and it is entered into the radio using the keypad.

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 (up to 16 digits).
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.



NOTE

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]

## 6.34 V-TAC FUNCTIONS

When a mobile radio detects that it is part of a V-TAC configuration, two additional menu items become available: "Vmode Menu" and "Vchan Menu." The "Vchan Menu" is available only when a V-TAC is operating in the special mode referred to as the Scene-of-Incident mode (SOI).

The "Vmode Menu" permits user selection and control of one of four (4) different V-TAC operating modes:

- Extended Coverage for Individual Users (display reads "XCOV")
- Extended Coverage for Talk groups (display reads "XCOV-TG")
- Scene-of-Incident (display reads: "SOI")
- Mobile-Only (display reads: "Mobile")

These modes are described in detail in the following subsections.

### 6.34.1 Extended Coverage Modes ("XCOV" & "XCOV-TG")

#### General Information

In addition to all standard mobile radio operating capabilities, Extended Coverage adds the V-TAC's bridging (vehicular repeat) functionality for accessing the OpenSky radio network using connected portable radios. Each portable radio connected to the V-TAC using Extended Coverage is considered a "client" on the V-TAC. Extended Coverage benefits (permitted) portable radios since it allows them to get network connectivity using the V-TAC's higher transmit output power and better antenna system. In

addition, dispatchers can communicate with the portable radios (the clients) connected to the V-TAC and logging recorders can record their tactical communications.

The V-TAC supports two Extended Coverage modes: Extended Coverage for individual users (XCOV) and Extended Coverage for talk groups (XCOV-TG). Up to eight (8) client radios can connect to the V-TAC via the XCOV mode, having fully radio functionality including selective calling and mobile data. Using the XCOV-TG mode, up to thirty (30) client radios can connect to the V-TAC. XCOV-TG is designed to support a large number of client radios in a tactical scenario. However, unlike XCOV, radios connected to using XCOV-TG are limited to communicating only on the XCOV-TG talk group and emergency communications. Advanced features such as selective calling and mobile data operations are not available to the XCOV-TG connected clients.



**NOTE**

Extended Coverage for Talk Groups (XCOV-TG) is only available in OpenSky radio firmware versions 9.0 and later.

When operating in an Extended Coverage mode, the V-TAC acts both as a local base station by operating on a base station frequency plan to communicate with the attached client radios and as a mobile radio by operating on a mobile frequency plan to connect to the OpenSky radio network. The V-TAC rebroadcasts voice traffic received from connected client radios, routes the received audio to its speaker, and relays this voice traffic to the network for distribution to other users. It also routes received audio network traffic to its speaker and forwards this audio to the connected client radios. However, filtering of some network traffic can occur.

Extended Coverage mode can be enabled automatically or manually (via the menu). For example, an automatic mode transition may occur after the vehicle's operator has removed the portable radio from its charger within the vehicle. When the V-TAC transitions between the Mobile-Only mode and an Extended Coverage mode, or between an Extended Coverage mode Mobile-Only mode and a four-beep high-medium-high-medium tone sequence sounds in the speaker (this tone does NOT play during a manual mode transition). Also, for ten (10) seconds, the V-TAC's control head flashes "XCOV" if it transitions to the Extended Coverage for individual users mode, or "XCOV-TG" if it transitions to the Extended Coverage for talk groups mode, or "Mobile" if it transitions to the Mobile-Only mode (the display does NOT flash these messages during a manual mode transition). When in the Mobile-Only operating mode, neither of these mode identifiers appears in the display. XCOV vs. XCOV-TG mode determination methods are described later. When the V-TAC goes from XCOV mode to Mobile-Only mode, it the tone sounds and "Mobile" flashes in the display for ten (10) seconds.

In most cases, the V-TAC's Mobile-Only mode is desired when the vehicle is in motion and an Extended Coverage mode is desired when the vehicle is stationary (a configurable parameter). The exact method used for mode selection depends upon the specific radio installation. For example, one

V-TAC radio installation could have a 2-position toggle switch mounted on the vehicle's dash panel for manual mode selection, while another could automatically enable an Extended Coverage mode when the portable radio is removed from its cradle/charger within the vehicle.



**CAUTION**

Operating the V-TAC in an Extended Coverage mode when the vehicle is in motion can have serious consequences to system operation and performance and is therefore not recommended. This condition is sometimes referred to as a "rolling V-TAC."

If necessary, contact the local administrator and/or radio installation personnel for mode selection information for a particular installation.

The V-TAC operator has control of the following functions affecting call processing:



- Talk group selection
- Talk group scanning
- Call preemption of the portable and mobile radio clients (e.g., by the Scene Commander)

The V-TAC takes advantage of OpenSky's TDMA capability to minimize interference between its local and network radio links when operating in an Extended Coverage mode (XCOV or XCOV-TG), an undesirable characteristic of many traditional vehicular repeater systems. However, unlike OpenSky network radio channels, Extended Coverage supports only one active voice call at a time.

Frequency selection is automatic from a predetermined list of channels. This list is defined as part of the configuration being available for V-TAC operation. The process is supported by GPS location information that allows the V-TAC to be aware of its location and choose accordingly from its channel list. If no Extended Coverage channels have been configured, the V-TAC will remain in Extended Coverage mode and it will continue to search its V-TAC channel list.

### **Changing Between Extended Coverage Modes**

By default, the specific Extended Coverage mode utilized, either XCOV or XCOV-TG, is determined by commands sent to the V-TAC and portable radios from the system administrator or radio installation personnel. In other words, these commands determine which Extended Coverage mode the V-TAC and radios normally utilize when transitioning from the Mobile-Only mode. Therefore, they also determine the access method that must be employed at a portable radio to connect to the V-TAC. After commands of this type are sent to the V-TAC and portable radios, each must be rebooted (powered off and then back on) before the change will take effect.

However, both the V-TAC and the portable radios can manually override this command-determined default mode. At the V-TAC, this is accomplished by a selection from the "Vmode Menu". Manual override at a portable radio is accomplished by pressing a pre-defined key sequence; refer to the respective portable radio's operator manual for exact key sequences required.

### **Additional XCOV-TG Mode Information**

The talk group used for Extended Coverage for talk groups (XCOV-TG) communications is the talk group that was selected at the V-TAC when it entered XCOV-TG mode.

However, at the V-TAC, the selected talk group and/or profile can be changed to another talk group and/or profile when XCOV-TG is in use. The selected talk group and profile in effect when the V-TAC transitioned to XCOV-TG mode will continue to be used to validate portable radio connections and filter the network voice traffic sent to the portable radios.

The selected talk group and profile in use when the V-TAC transitioned to XCOV-TG mode is displayed on the bottom line of the dwell menu preceded by an "X-".

## **6.34.2 V-TAC GPS Interlock**

The V-TAC GPS Interlock feature is enabled or disabled through programming by the system administrator. If enabled, the V-TAC can transition from XCOV or XCOV-TG to the Mobile Radio mode of operation based on the location and velocity of the VTAC (provided by GPS) in order to prevent a rolling VTAC. This capability applies only to XCOV and XCOV-TG mode of operation and does not apply to Mobile Radio mode or Scene of Incident (SOI) mode.



**NOTE**

The distance and velocity required for transition are programmed by the system administrator.

The VTAC will transition from XCOV(-TG) operation to the Mobile Radio mode of operation if:

- The distance traveled by the VTAC exceeds a maximum permissible distance from a reference point. The maximum distance is configured via programming.



**NOTE**

The reference point is the location of the V-TAC based on latitude/longitude provided by the GPS when the V-TAC first transitions into XCOV(-TG), either directly at power-up, from V-TAC Mobile Radio mode, or from VTAC SOI mode.

Distance traveled is the current location of the VTAC, based on the latitude/longitude provided by the GPS, from the reference point.

- The velocity of the VTAC exceeds a maximum velocity threshold in miles/hour. The maximum velocity threshold is configured through programming.

Velocity is based on the velocity information provided by the GPS.

If location and velocity information is not provided by the GPS and the VTAC is in XCOV(-TG) mode, VTAC GPS Interlock processing is suspended. When location and velocity information is provided by the GPS, VTAC GPS Interlock processing is resumed, taking the first valid GPS position coordinates as the location reference point and acting immediately on GPS provided velocity.

This is intended to cover the situation where the GPS is not operational. If the GPS is out of coverage, the last location and velocity information provided by the GPS and will be deemed useable.

When the VTAC transitions from XCOV(-TG) mode to Mobile Radio mode the VTAC will disconnect all connected clients.

When the VTAC transitions from XCOV(-TG) mode to Mobile Radio mode, an audio and visual indication is provided to the operator. This indication is identical to the indication of the mode transition based on the external event switch.

When the VTAC is in Mobile Radio mode, the VTAC can return to XCOV(-TG) mode only by the external event switch or manually via the control head menu.

If the VTAC is in XCOV(-TG) mode and the VTAC transitions to Mobile Radio due to exceeding the distance and velocity thresholds, the VTAC will not transition back into XCOV(-TG) mode when it falls back within the distance or velocity thresholds.

### 6.34.3 Scene-Of-Incident Mode (“SOI”)

SOI mode is user-selectable using the V-TAC’s the “Vmode Menu.” SOI mode provides a local repeater function with no network connection. It supports two concurrent voice calls, and it supports communication between other mobiles and portables.



**WARNING**

**When using the SOI mode, both the V-TAC and any connected portable or mobile radios (the clients) are off the OpenSky network. Therefore, communications with radios and dispatch personnel on the network is not possible.**

Frequency selection is performed manually from a list of pre-defined channels using the V-TAC’s “Vchan Menu.” The radio indicates the FCC channel number for each in addition to its alpha-numeric identifier.

In SOI mode, the V-TAC supports the following features:

- Talk group selection

- Talk group scanning
- Call preemption of the client radios (i.e., Scene Commander can preempt a call from a portable or mobile radio)



NOTE

In SOI, an emergency initiated at the V-TAC will preempt a client voice call.

#### 6.34.4 **Mobile-Only Mode (“Mobile”)**

The Mobile-Only mode is user-selectable from the “Vmode Menu” or the radio can be configured to enter this mode automatically. When utilized, portable radios (clients) cannot connect to the V-TAC. In this mode, the V-TAC provides two-way communications and it acts like a standard M7200 mobile radio. Refer to the following section for instructions on choosing this mode.

#### 6.34.5 **Changing V-TAC Mode**

Use the following procedure to change between the Mobile-Only mode and one of the three (3) V-TAC-related modes:

1. Press the ▲ or ▼ button until “Vmode Menu” appears in the bottom line of the display. The current mode appears in the top line (Mobile, XCOV, XCOV-TG or SOI).
2. Press the ◀ or ▶ button to select another mode.
3. Press the **Select** button. A yes/no confirmation prompt appears.
4. To confirm the new selection, press ▶ to toggle to “Y” (yes).
5. Press the **Select** button.
6. If the SOI mode was selected, the “Vchan Menu” automatically appears; choose a radio frequency channel using the ◀ and ▶ buttons, and confirm by pressing the **Select** button. If selecting the SOI mode, observe the **WARNING** in Section 6.34.3.



NOTE

Instead of using the “Vmode Menu,” some radio installations may be configured to automatically enter a V-TAC mode when a dash-mounted switch is flipped or some other action is performed. For example, the V-TAC can be wired and configured to automatically enter the XCOV mode when the vehicle’s portable radio is removed from its vehicular charger. See Changing Between Extended Coverage Modes in Section 6.34.1 for additional information.

#### 6.34.6 **Displaying V-TAC Information**

When using a V-TAC mode, repeated depressions of the **Select** button causes the following information to appear in the bottom line of the dwell display:

- XCOV and XCOV-TG modes only: Total number of portable radios (clients) currently connected to the V-TAC.
- XCOV-TG mode only: Talk group currently used for XCOV-TG communications.
- XCOV-TG mode only: Profile currently used for XCOV-TG communications.
- All V-TAC modes: Current V-TAC channel. (Does not apply to the Mobile-Only mode.)

- All V-TAC modes: Currently utilized V-TAC mode (XCOV, XCOV-TG, SOI, or Mobile-Only mode).

## 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.
V-TAC will not transmit.	V-TAC channels and/or geographic coverage zones are not defined or base stations are not configured with geographic coordinates provisioned to V-TAC radios.	Contact system administrator.
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 M7200 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 M7200 automatically powers down when voltage drops below +5.0 volts. Have the battery checked by an authorized technician.

SYMPTOM	CAUSE	SOLUTION
“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.
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		
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.
Encrypted calls cannot be made.	User not logged in.	Log in (refer to Section 6.14.1).
V-TAC Menu does not display.	Unit not set up as a V-TAC.  VRB is not responding.	None  Check power connection. Ensure front panel (VRB-VRM) data cable is connected. Report the problem to a technician.

## **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](mailto:tac@tycoelectronics.com)

## 9 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



## APPENDIX A      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		#	

*This page intentionally left blank.*

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**M7200 Vehicular Tactical Network (V-TAC)**  
Full-Duplex 700 & 800 MHz Trunk-Mount Mobile Radio  
with CH-721 Scan and System Control Heads

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## TABLE OF CONTENTS

	<i>Page</i>
<b>1 REGULATORY AND SAFETY INFORMATION.....</b>	<b>6</b>
1.1 SAFETY SYMBOL CONVENTIONS .....	6
1.2 RF ENERGY EXPOSURE AWARENESS AND CONTROL INFORMATION FOR FCC OCCUPATIONAL USE REQUIREMENTS .....	6
1.2.1 Federal Communications Commission Regulations .....	7
1.3 COMPLIANCE WITH RF EXPOSURE STANDARDS .....	7
1.3.1 Mobile Antennas .....	8
1.3.2 Approved Accessories.....	8
1.3.3 Contact Information .....	8
1.4 OCCUPATIONAL SAFETY GUIDELINES AND SAFETY TRAINING INFORMATION.....	8
1.5 COMMON HAZARDS .....	9
1.6 SAFE DRIVING RECOMMENDATIONS .....	10
1.7 OPERATING RULES REGULATIONS .....	10
1.8 OPERATING TIPS .....	11
<b>2 SPECIFICATIONS .....</b>	<b>12</b>
2.1 GENERAL.....	12
2.2 TRANSCEIVER .....	12
2.3 REGULATORY .....	13
<b>3 INTRODUCTION .....</b>	<b>14</b>
3.1 V-TAC OPERATING MODES .....	14
3.1.1 Extended Coverage Modes (XCOV and XCOV-TG) .....	14
3.1.2 Scene-Of-Incident Mode (SOI).....	15
3.2 GENERAL INFORMATION .....	15
3.2.1 Equipment Mounting and Control Heads.....	15
3.2.2 Operating Power .....	16
3.2.3 Half- and Full-Duplex Communications.....	16
3.2.4 Serial Port for Connecting Optional Equipment .....	16
3.2.5 RF Operating Bands.....	16
3.2.6 Built-In GPS Tracking Receiver .....	16
3.2.7 Modulation and Speech/Data Compression Technologies .....	17
3.3 RELATED DOCUMENTS.....	17
3.4 CONTACTING M/A-COM FOR TECHNICAL ASSISTANCE .....	18
<b>4 UNPACKING AND CHECKING THE EQUIPMENT.....</b>	<b>19</b>
4.1 MATERIALS.....	19
4.2 MATERIAL INSPECTION.....	21
<b>5 PLANNING THE INSTALLATION.....</b>	<b>22</b>
5.1 GENERAL INFORMATION .....	22
5.2 TOOLS REQUIRED.....	22
5.3 LOCATING COMPONENTS .....	25
<b>6 MOUNTING THE V-TAC .....</b>	<b>26</b>
6.1 BRACKET INSTALLATION .....	26
6.2 MOUNT THE V-TAC INTO THE BRACKET .....	28
<b>7 ANTENNA INSTALLATION.....</b>	<b>29</b>
7.1 ANTENNA MOUNTING LOCATIONS .....	29
7.1.1 Direct Center or Center-Rear of Rooftop .....	30
7.1.2 Center of Trunk Lid .....	30
7.2 ANTENNA INSTALLATION PROCEDURE .....	30
7.2.1 Install and Connect Mobile Antenna.....	30

## TABLE OF CONTENTS (Continued)

	<i>Page</i>
7.2.2 Install and Connect GPS Antenna .....	31
<b>8 V-TAC DC POWER INSTALLATION .....</b>	<b>32</b>
8.1 ON/OFF POWER WIRING CONFIGURATIONS.....	32
8.2 POWER INSTALLATION PROCEDURE.....	32
8.2.1 Install Main Fuse Holder and 10-AWG Red Wire .....	32
8.2.2 Assemble and Install Fuse Distribution Rail Assembly .....	33
<b>9 CONTROL HEAD INSTALLATION .....</b>	<b>39</b>
9.1 GENERAL INFORMATION .....	39
9.2 CONTROL HEAD MECHANICAL INSTALLATION .....	41
9.2.1 Selecting the Mounting Location .....	41
9.2.2 Using the Standard U-Shaped Mounting Bracket .....	42
9.2.3 Using the Mounting Pedestal (Optional).....	42
9.3 CAN CONNECTIONS .....	43
9.3.1 General Information .....	43
9.3.2 Make CAN Link Terminations and Cable Connection .....	44
9.4 CONTROL HEAD POWER CABLE INSTALLATION.....	44
9.4.1 Install DC Power Cable and Make Power and Ground Connections .....	44
9.4.2 Connect DC Power Cable's White Wire.....	45
<b>10 MICROPHONE ATTACHMENT .....</b>	<b>49</b>
<b>11 SPEAKER INSTALLATION.....</b>	<b>50</b>
<b>12 V-TAC EXTENDED COVERAGE INSTALLATION .....</b>	<b>51</b>
12.1 GENERAL INFORMATION .....	51
12.2 SOFTWARE CONFIGURATION AND WIRING.....	51
12.2.1 Inverting Interpretation of V-TAC's Motion Sense Input Logic State with "XEVENT" Command.....	51
12.2.2 Setting Default Extended Coverage Mode with "CMODE" Command.....	53
<b>13 OPTIONAL CABLES .....</b>	<b>54</b>
13.1 FULL-DATA I/O OPTION CABLE .....	54
13.2 PROGRAMMING OPTION CABLE .....	56
<b>14 GPS NMEA-FORMATTED SERIAL DATA CONNECTION.....</b>	<b>57</b>
<b>15 INITIAL POWER-UP TEST.....</b>	<b>58</b>
<b>16 PERFORMANCE TESTS .....</b>	<b>59</b>
16.1 CHANGING OPERATING MODE FOR TESTS.....	59
16.1.1 Switching to OTP Mode.....	59
16.2 REQUIRED TEST EQUIPMENT .....	60
16.3 TRANSMITTING INTO A DUMMY LOAD.....	60
16.4 TRANSMITTING INTO THE MOBILE ANTENNA .....	62
16.5 TEST PERFORMANCE DATA FORM .....	64
<b>17 COMPLETE THE INSTALLATION.....</b>	<b>65</b>
<b>18 WARRANTY .....</b>	<b>66</b>
<b>19 WIRING DIAGRAM: M7200 V-TAC MOBILE RADIO WITH CH-721 CONTROL HEAD ...</b>	<b>67</b>

## FIGURES

	<u>Page</u>
Figure 5-1: Typical Installation in a Standard Passenger Vehicle.....	23
Figure 5-2: M7200 V-TAC Mobile Radio — Front and Rear Views .....	24
Figure 6-1: Base Bracket (V-TAC Mobile Radio Not Shown) .....	27
Figure 7-1: Recommended Antenna Mounting Locations With Antenna Part Numbers.....	29
Figure 8-1: Contents of Fuse Distribution Rail Kit FS23057.....	34
Figure 8-2: Contents of Fuse Distribution Accessory Kit FS23058.....	35
Figure 9-1: CH-721 Scan Model Control Head Front Panel .....	39
Figure 9-2: CH-721 System Model Control Head Front Panel .....	39
Figure 9-3: CH-721 Rear Panel (both control head models).....	40
Figure 9-4: Standard U-Shaped Control Head Mounting Bracket (Kit Part Number KT-008608).....	41
Figure 9-5: Optional Control Head Mounting Pedestal (Part Number MACDOS0012) .....	41
Figure 9-6: CAN Link Connections for a Single Control Head Installation .....	43
Figure 9-7: Typical CAN Link Connections for a Multi-Control Head Installation .....	43
Figure 9-8: Connection of White Ignition Sense Wire Using Vehicle Fuse and T-Tap Kit.....	46
Figure 9-9: Attaching T-Tap Quick-Disconnect Terminals .....	47
Figure 10-1: Attaching the Microphone to the CH-721 Control Head.....	49
Figure 13-1: Full-Data I/O Option Cable 1000022242-0001 and Programming Option Cable 1000022242-0002 .....	54
Figure 16-1: Wattmeter Connections for Antenna System Tests .....	61

## TABLES

	<u>Page</u>
Table 1-1: Recommended Minimum Safe Lateral Distance from Transmitting Antenna .....	8
Table 4-1: V-TAC Installation Kit MAMV-NZN8B .....	19
Table 4-2: Additional Options and Accessories .....	20
Table 4-3: Control Head Installation Kit MAMV-ZN7N.....	20
Table 4-4: Additional Accessories for CH-721Control Heads.....	21
Table 12-1: V-TAC Mobile-Only Vs. Extended Coverage Operating Mode Selection Logic .....	52
Table 12-2: Test Equipment Required to Send Commands to the V-TAC via its Serial Port.....	53
Table 13-1: Full-Data I/O Option Cable 1000022242-0001 Wire Interconnections.....	55
Table 13-2: Programming Option Cable 1000022242-0002 Wire Interconnections .....	56
Table 16-1: Test Equipment Required to Complete Performance Test Procedures .....	60



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

The M7200 V-TAC 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.



**CAUTION**

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

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

ANTENNA PART NUMBER (CATALOG NUMBER)	ANTENNA DESCRIPTION	RECOMMENDED MINIMUM LATERAL HUMAN BODY DISTANCE FROM TRANSMITTING ANTENNA (Distance in Centimeters)	
		CONTROLLED ENVIRONMENT	UNCONTROLLED ENVIRONMENT
AN-025167-001 (MAMV-AN3J)	700/800 MHz Standard Rooftop-Mount; 3 dBd Gain	20	55
AN-025167-002 (MAMV-AN3K)	700/800 MHz Elevated-Feed Rooftop-Mount; 3 dBd Gain	20	50
AN-025167-004 (MAMV-AN3V)	700/800 MHz GPS Combo Rooftop-Mount; 3 dBd Gain	21	56
AN-025167-014 (MAMV-NAN5U)	700/800 MHz Standard Rooftop-Mount; 5 dBd Gain	20	48
AN-025167-015 (MAMV-NAN5V)	700/800 MHz GPS Combo Rooftop-Mount; 5 dBd Gain	23	45

### 1.3.1 Mobile Antennas

The antenna(s) for the radio must be installed in accordance with Section 7 in this manual. Refer to Figure 7-1 on page 29 for applicable antenna part numbers. Installation guidelines presented in Section 7 are limited to metal-body motor vehicles or vehicles with appropriate ground planes.

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

### 1.3.2 Approved Accessories

The radio has been tested and meets FCC RF guidelines when used with M/A-COM accessories supplied or designated for use with it. Use of other accessories may not ensure compliance with the FCC's RF exposure guidelines, and may violate FCC regulations. For a list of approved accessories refer to Section 4 in this manual (begins on page 19) 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 18.

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

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

- It is a violation of FCC rules to interrupt any distress or emergency message. The radio operates in much the same way as a telephone “party line.” Therefore, always listen to make sure the channel is clear before transmitting. Emergency calls have priority over all other messages. If someone is sending an emergency message – such as reporting a fire or asking for help in an accident, do not transmit unless assistance can be offered.
- The use of profane or obscene language is prohibited by Federal law.
- It is against the law to send false call letters or false distress or emergency messages. The FCC requires keeping conversations brief and confine them to business. To save time, use coded messages whenever possible.
- Using the radio to send personal messages (except in an emergency) is a violation of FCC rules. Send only essential messages.
- It is against Federal law to repeat or otherwise make known anything overheard on the radio. Conversations between others sharing the channel must be regarded as confidential.
- The FCC requires self-identification at certain specific times by means of call letters. Refer to the rules that apply to the particular type of operation for the proper procedure.

- No changes or adjustments shall be made to the equipment except by an authorized or certified electronics technician.



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

## 1.8 OPERATING TIPS

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

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



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

## 2 SPECIFICATIONS<sup>1</sup>

### 2.1 GENERAL

<b>Dimensions, Mobile Radio:</b> (Height x Width x Depth)	7.3 x 8.8 x 9.3 inches (18.5 x 22.4 x 23.6 centimeters) (Includes bracket but <u>not</u> space required for cables)
<b>Dimensions, Control Head:</b> (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)
<b>Weight, Mobile Radio:</b>	13.5 pounds (6.12 kilograms)
<b>Weight, Control Head:</b>	1.7 pounds (0.8 kilograms)
<b>Operating Ambient Temperature Range:</b>	-22 to +140° Fahrenheit (-30 to +60° Celsius)
<b>Storage Temperature Range:</b>	-40 to +185° Fahrenheit (-40 to +85° Celsius)
<b>Altitude</b>	
Operating:	15,000 feet (4572 meters) maximum
Storage/Shipment:	50,000 feet (15,240 meters) maximum
<b>DC Supply Voltage Operating Range:</b>	+13.6 Vdc $\pm$ 10% (Normal range per TIA-603)
<b>DC Supply Current Requirements</b>	
Receive:	2 amps maximum at 0.5-watt speaker audio output power (includes control head)
Transmit:	14 amps maximum, 12 amps typical at 10 watts VRM transmit RF output power and 3 watts VRB transmit RF output power (includes control head)
<b>Quiescent/Off Current</b>	
Mobile Radio:	2 milliamps maximum
Control Head:	100 microamps maximum

### 2.2 TRANSCEIVER

#### Frequency Ranges

VRM Receive/VRB Transmit	
700 MHz Narrow Bands:	764 to 767 MHz and 773 to 776 MHz
800 MHz Band:	851 to 869 MHz
VRM Transmit/VRB Receive	
700 MHz Narrow Bands:	794 to 797 MHz and 803 to 806 MHz
800 MHz Band:	806 to 824 MHz
VRM Talk-Around (Transmit & Receive)	
700 MHz Narrow Bands:	764 to 767 MHz and 773 to 776 MHz
800 MHz Band:	851 to 869 MHz

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

**VRM Transmit Output Power** (See footnote <sup>2</sup>)

700 MHz SMR Channels:	1 to 10 watts (programmable range)
700 MHz Interoperability Channels:	300 milliwatts maximum
800 MHz SMR/NPSPAC Channels:	1 to 10 watts (programmable range)

**VRB Transmit Output Power** (See footnote <sup>2</sup>)

700 MHz SMR Channels:	0.25 to 3 watts (programmable range)
800 MHz SMR/NPSPAC Channels:	0.25 to 3 watts (programmable range)

**Channel Spacing:** 12.5 kHz or 25 kHz (mode dependent)

**Data Communications Mode:** Full-Duplex

**Voice Communications Mode:** Half-Duplex

**Frequency Stability:**

700 MHz Bands	
12.5 kHz Channel Operations:	±1.5 ppm with AFC disabled; ±0.4 ppm with AFC enabled
25 kHz Channel Operations:	±2.5 ppm with AFC disabled; ±0.4 ppm with AFC enabled
800 MHz Bands:	±1.5 ppm

**Receiver Sensitivity**

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

**ACPR Mask**

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

**Audio Frequency Response:** 300 to 3000 Hz (with <3% audio distortion)

**Audio Output Power (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™)
P25 Phase 1 Mode:	Improved Multi-Band Excitation (IMBE™)

**OpenSky Data Rate:** 19.2 kbps

## 2.3 REGULATORY

**FCC Identification Number:** BV8M7200VTAC

**Applicable FCC Rules:** Part 90 and Part 15

**Industry Canada Certification:** 3670A-M72VTAC

**Applicable Industry Canada Rules:** RSS-119

<sup>2</sup> Transmit output power at V-TAC's antenna port.



## **3 INTRODUCTION**

The M7200 Vehicular Tactical Network (V-TAC) mobile radio is a high-performance full-duplex dual-band digital mobile radio. The M7200 V-TAC provides standard and advanced mobile radio communication functions, along with three (3) distinct V-TAC-related operating modes. The V-TAC operates on the following radio systems/standards:

- 700 MHz and 800 MHz OpenSky trunked radio networks using the OpenSky Trunking Protocol (OTP)
- 800 MHz APCO Project 25 phase I compliant Common Air Interface (P25 CAI) trunked radio networks
- 700 MHz talk-around communications in accordance with the APCO Project 25 phase I standard
- Conventional FM repeater-based and FM talk-around voice communications in 700 and 800 MHz bands

The M7200 V-TAC consists of two similar-type mobile radios coupled together via a special RF combiner. The main radio is called the Vehicular Repeater Mobile. The VRM provides connectivity to the trunked radio network. The other radio is called the Vehicular Repeater Base. The VRB is the “base station” part of the V-TAC. It provides connectivity for portable radios operating near the V-TAC. The radio is shown in Figure 5-2 on page 24.

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

This manual contains product safety-related and installation procedures for the M7200 V-TAC mobile radio with the CH-721 control head. Installation 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. Product safety-related information is included in Section 1.

### **3.1 V-TAC OPERATING MODES**

The M7200 V-TAC is based on the M7200 mobile radio platform. It can perform all M7200 full-duplex radio functions, while at the same time providing an in-band network extension to portable radios that cannot directly connect to the radio network. Three (3) V-TAC operating modes are available. Two of the three modes are considered extended coverage modes for the portable radios, and one is a scene-of-incident type mode where the V-TAC operates as a local repeater without network connectivity.

#### **3.1.1 Extended Coverage Modes (XCOV and XCOV-TG)**

The two (2) V-TAC extended coverage operating modes include a mode called “Extended Coverage for individual users” (typically abbreviated “XCOV”), and a mode called Extended Coverage for talk groups (typically abbreviated “XCOV-TG”). Each portable radio connected to a V-TAC using one of these extended coverage modes is considered a “client” on the V-TAC. With an extended coverage mode, the V-TAC functions as a router between the trunked radio network and the portable radios connected to it.

When the V-TAC is operating in the Extended Coverage for individual users mode, up to eight (8) portable radios (8 clients) can connect to it. These portable radios can operate with all standard radio functions, including selective calling and mobile data.

When the V-TAC is operating in the Extended Coverage for talk groups mode, up to thirty (30) portable radios (30 clients) can connect to it. This mode is designed to support a large number of radios in a

tactical scenario. However, unlike XCOV, radios connected to using XCOV-TG are limited to communicating only on the XCOV-TG talk group and emergency communications. Advanced features such as selective calling and mobile data operations are not available to the XCOV-TG connected clients. For additional information on the XCOV and XCOV-TG modes, refer to Section 12.1 on page 51 of this manual and/or the radio's operator's manual (publication number listed in Section 3.3).

### **3.1.2 Scene-Of-Incident Mode (SOI)**

The V-TAC can also function as a local base station at the scene of an incident. Communications of this type are supported by a V-TAC operating mode called the Scene-Of-Incident (SOI) mode. Typically, this mode is used when the V-TAC and the nearby portable radios are outside of the trunked radio network's normal coverage area. In SOI mode, the V-TAC operates as a local repeater without network connectivity. For additional information, refer to the radio's operator's manual (publication number listed in Section 3.3).

## **3.2 GENERAL INFORMATION**

The M7200 V-TAC 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 mode, the radio's SMR/NPSPAC channel RF transmit output power is 10 watts maximum. However, the power limit for 700 MHz interoperability channel operations is 300 milliwatts maximum. This interoperability channel transmit power limit guarantees the 2-watt ERP (effective radiated power) limit of the 700 MHz interoperability narrowband channels is not exceeded when the radio is connected to a 5 dBd gain antenna. Several different types of external-mount antennas are approved and available for use with the radio, as listed in Table 1-1 and Table 4-2. For additional specifications, refer to Section 2 on page 12 of this manual.

### **3.2.1 Equipment Mounting and Control Heads**

The M7200 V-TAC 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. Typically, only one control head is connected to the V-TAC. However, up to five (5) heads can be connected to it in a multiple control head installation. A 3-wire Controller Area Network (CAN) cable provides radio-to-control head(s) interconnection. 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 a multiple control head installation, two or more control heads are interconnected to the mobile radio in a series (daisy-chain) fashion via CAN link cables.

Control heads used with the M7200 V-TAC radio include the CH-721 Scan and the CH-721 System model control heads. See Figure 9-1 (page 39) through Figure 9-3 (page 40). 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) keypad functionality and easier operator system/group selection control at the control head's front panel.

As shown in Figure 9-3 on page 40, the CH-721 Scan and System model control heads have several connectors located on the rear panel. These connectors include a DC power connector, two (2) CAN port connectors used for CAN link interconnections, an external speaker connector, a 9-pin serial port connector for connecting optional equipment such as a mobile data terminal, and a 25-pin multi-function connector.

### **3.2.2     Operating Power**

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

### **3.2.3     Half- and Full-Duplex Communications**

The radio provides half-duplex voice communications, and both half- and full-duplex data communications. Voice communications are accomplished via a "push-to-talk" (PTT) type microphone and a speaker connected to the control head.

### **3.2.4     Serial Port for Connecting Optional Equipment**

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.

### **3.2.5     RF Operating Bands**

#### **3.2.5.1   Vehicular Tactical Mobile (VRM)**

700 MHz operating bands of the V-TAC's VRM radio (normally used for network connectivity) include the two 3 MHz wide repeater output bands from 764 to 767 MHz and 773 to 776 MHz, and the two 3 MHz wide repeater input bands from 794 to 797 MHz and 803 to 806 MHz. The mobile can operate only on the narrowband channels within these bands and, as previously stated, transmit output power is limited to 300 milliwatts on interoperability channels. Talk-around operation is supported between 764 to 767 MHz and 773 to 776 MHz.

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

#### **3.2.5.2   Vehicular Repeater Base (VRB)**

RF operating bands of the V-TAC's VRB radio are identical to the VRM operating bands. However, the RF input (VRB receive) bands are reversed with the RF output (VRB transmit) bands. In addition, VRB does not operate (transmit or receive) on the 700 MHz interoperability channels.

### **3.2.6     Built-In GPS Tracking Receiver**

The M7200 V-TAC has a built-in Global Positioning System (GPS) tracking receiver. GPS provides quick and accurate unit location information to dispatchers via the radio network. The GPS receiver determines the V-TAC's location and the V-TAC transmits it to the radio network. The GPS antenna may

be integrated into the mobile transmit/receive antenna (a “combination” antenna) or it may be separate from the mobile transmit/receive antenna.

### 3.2.7 **Modulation and Speech/Data Compression Technologies**

An M7200 V-TAC mobile 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 M7200 V-TAC 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.

APCO Project 25 phase I standard P25 radio systems utilize Improved Multi-Band Excitation (IMBE™) speech/data compression technology, also developed by Digital Voice Systems, Inc. Like AMBE technology, IMBE technology allows the M7200 V-TAC to deliver exceptional voice quality, even in areas where the received RF signal strength is weak. IMBE replicates human speech better than other voice compression technologies, resulting in better voice quality and better speaker recognition. The Telecommunications Industry Association (TIA) funded an independent study to evaluate compression technologies. The findings showed that when compared with other industry-recognized compression technologies, IMBE provided the highest voice quality. In the study, radio users were asked to listen to coded speech produced by four different compression technologies operating under a variety of conditions. The users rated the speech on a scale of one to five, with five being the best quality. Under each operating conditions, IMBE was rated the best.

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



**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.

## 3.3 **RELATED DOCUMENTS**

The following documents contain additional information:

- OpenSky Operator’s Manual: MM-011553-001 (available at [www.macom-wireless.com](http://www.macom-wireless.com))
- Maintenance Manual: MM-TBD-001

### **3.4 CONTACTING M/A-COM FOR TECHNICAL ASSISTANCE**

Should the V-TAC 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](mailto:tac@tycoelectronics.com)

## 4 UNPACKING AND CHECKING THE EQUIPMENT

### 4.1 MATERIALS

A typical set of M7200 V-TAC mobile radio installation materials includes:

- **M7200 V-TAC Full-Duplex 700/800 MHz Trunk-Mount Mobile Radio, part number RU-008736-001** (Catalog numbers MAMV-VDLXA, -VDLXE, and -VDLXX). Includes:
  - M7200 V-TAC 700/800 MHz VRM Mobile Radio, part number RU-008732-001
  - M7200 V-TAC 700/800 MHz VRB Mobile Radio, part number RU-008733-001
  - M7200 V-TAC 700/800 MHz RF Combiner, part number RF-008734-001
- **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)
- **V-TAC Installation Kit MAMV- NZN8B**
- **Control Head Installation Kit MAMV-ZN7N** (includes external speaker)

V-TAC Installation Kit MAMV-NZN8B can be used to install the V-TAC mobile radio, or individual components may be purchased separately as needed. Table 4-1 lists the parts included in the kit. Table 4-2 lists part numbers for radio options and accessories. Table 4-3 lists the parts included in Control Head Installation Kit MAMV-ZN7N. Table 4-4 includes optional parts available for the CH-721 Scan and System model control heads.

**Table 4-1: V-TAC Installation Kit MAMV-NZN8B**

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	1000003678	Bracket, Base
2	1	FS23057	Kit, Fuse Distribution Rail. Includes (1) Fuse Distribution Rail Assembly, (1) In-Line ATC Fuse Holder, (1) 30-Amp ATC Fuse, 20 Feet of 10-AWG Red Wire, 1 Foot of 10-AWG Black Wire, (1) Moisture-Resistant Butt Splice, and (2) 3/8-Inch Ring Terminals. (Kit contents shown in Figure 8-1 on page 34.)
3	1	MAMROS0075-N1210	Cable, DC Power: 12-AWG, 10-Foot, Straight Connector
4	1	MACDOS0010	Terminator, CAN; 3-pin
5	2	AD00006	Screws: #8-32 Pan-Head (Package of 4)
6	1	FS-011855-020	Fuse, 20-Amp ATC (Color = Yellow)

Table 4-2: Additional Options and Accessories

PART/MODEL NUMBER	DESCRIPTION
MAMROS0044	Kit, Trunk Mounting. Includes base bracket, screws.
MACDOS0010	Terminator, CAN; 3-pin
MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10 Feet, Straight Connector
MAMROS0075-N1220	Cable, DC Power; 12-AWG, 20 Feet, Straight Connector
MAMROS0075-R1210	Cable, DC Power; 12-AWG, 10 Feet, Right-Angle Connector
MAMROS0075-R1220	Cable, DC Power; 12-AWG, 20 Feet, Right-Angle Connector
1000022242-0001	Cable, Full-Data I/O Option
1000022242-0002	Cable, Programming Option
AN-025167-001 (Catalog No. MAMV-AN3J)	Antenna, 700/800 MHz; 3 dBd Gain, Rooftop-Mount
AN-025167-014 (Catalog No. MAMV-NAN5U)	Antenna, 700/800 MHz; 5 dBd Gain, Rooftop-Mount
AN-025167-002 (Catalog No. MAMV-AN3K)	Antenna, 700/800 MHz; 3 dBd Gain, Elevated-Feed, Rooftop-Mount
AN-025167-004 (Catalog No. MAMV-AN3V)	Antenna, Combo GPS/700/800 MHz; 3 dBd Gain, Rooftop-Mount
AN-025167-015 (Catalog No. MAMV-NAN5V)	Antenna, Combo GPS/700/800 MHz; 5 dBd Gain, Rooftop-Mount
AN-025187-001 (Catalog No. MAMV-NAN5F)	Antenna, GPS; Roof-Mount
MAMROS0055	TIA/EIA-232 Serial Computer Cable (6 feet)

Table 4-3: Control Head Installation Kit MAMV-ZN7N

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	KT-008608	Kit, Mounting Bracket. Includes (1) U-Shaped Mounting Bracket, (2) ¼-Inch #8-32 stainless-steel screws, (2) stainless-steel flat washers and (2) stainless-steel lockwashers.
3	1	MACDOS0010	Terminator, CAN; 3-Pin
4	1	CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors
5	1	MAMROS0075-N1210	Cable, DC Power; 12-AWG, 10 feet, Straight Connector
6	1	FS23058	Kit, Fuse Distribution Accessory. Includes (1) Fuse Block, (1) Protective Marker, (1) Fuse Block Jumper, (1) 5-Amp ATC Fuse, (1) 15-Amp ATC Fuse. (Kit contents shown in Figure 8-2 on page 35)
7	1	FS24473	Kit, Vehicle Fuse and T-Tap. Includes (1) ATM Fuse Holder, (1) 2-Amp ATM Fuse, (2) T-Tap Disconnects and (1) ¼-Inch Crimp Tab.
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 4-4: Additional Accessories for CH-721 Control Heads

PART/MODEL NUMBER	DESCRIPTION
CA-009562-006	Cable, CAN; 6 feet, Right-Angle-to-Straight Connectors
CA-009562-030	Cable, CAN; 30 feet, Right-Angle-to-Straight Connectors
CA-009562-090	Cable, CAN; 90 feet, Right-Angle-to-Straight Connectors
CA-009562-250	Cable, CAN; 250 feet, Right-Angle-to-Straight Connectors
MACDOS0010	Terminator, CAN; 3-Pin
MACDOS0012	Kit, Control Head Pedestal Mounting. Includes Pedestal Mount and Mounting Screws.
MACDOS0013-CN004	Kit, Speaker; 20-Watt, Straight Connector
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 number 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
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 V-TAC, 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 18) 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 V-TAC, control head, and/or antenna in ways other than those described in this manual may adversely affect performance, violate FCC rules on RF exposure, and even damage the unit, posing a potential safety hazard.



## 5 PLANNING THE INSTALLATION

### 5.1 GENERAL INFORMATION

Figure 5-1 provides an example of a typical trunk-mounted M7200 V-TAC mobile radio installation. Before starting, plan the installation carefully so it will meet the following requirements:

- The installation is safe for the operator and passengers within the vehicle.
- The equipment is installed away from the airbag deployment areas.
- The installation allows for convenient access by the operator, as applicable (i.e., the control head).
- The equipment is protected from water damage.
- The installation is neat and allows easy service access.
- The 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!

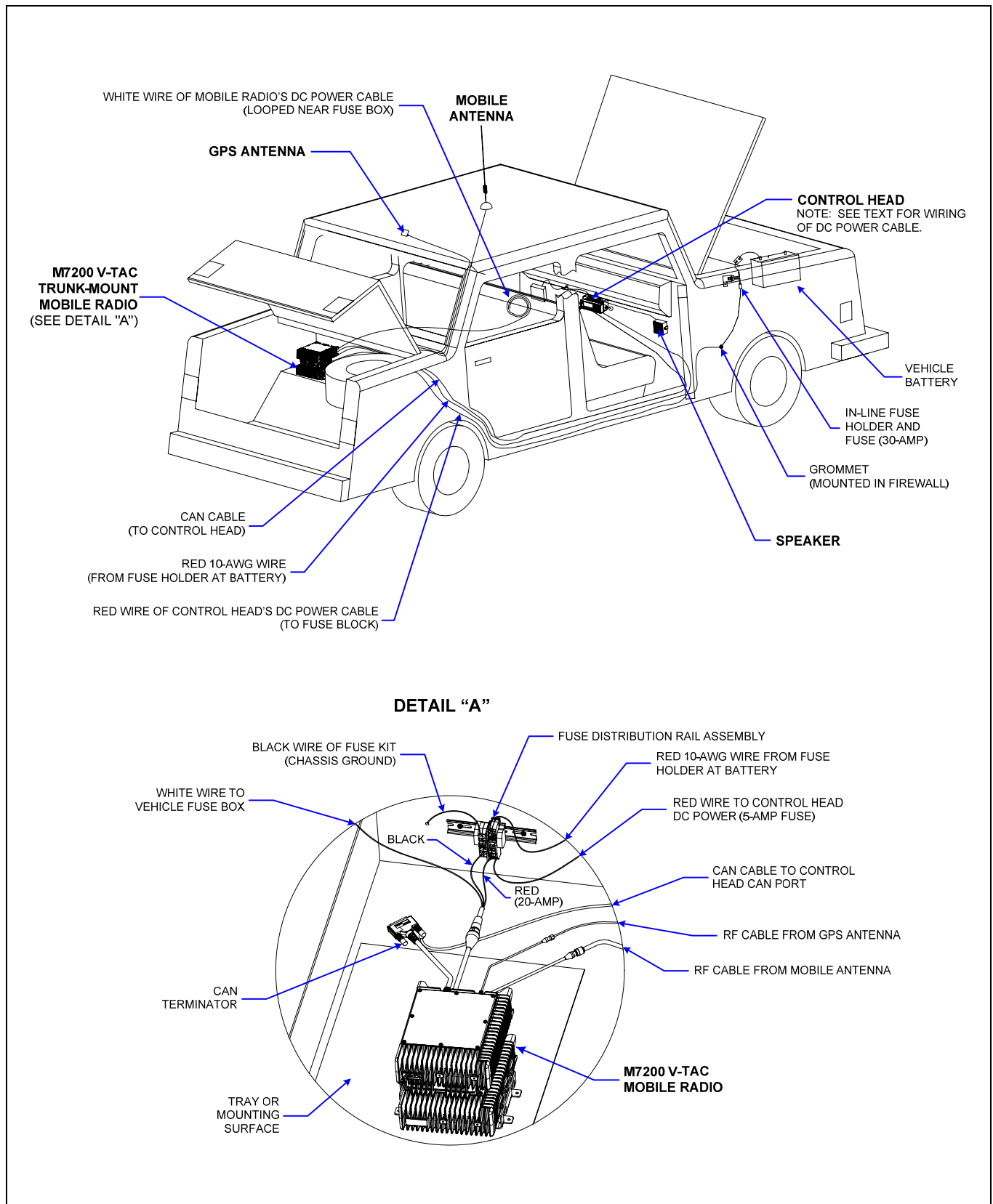
### 5.2 TOOLS REQUIRED

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



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

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



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

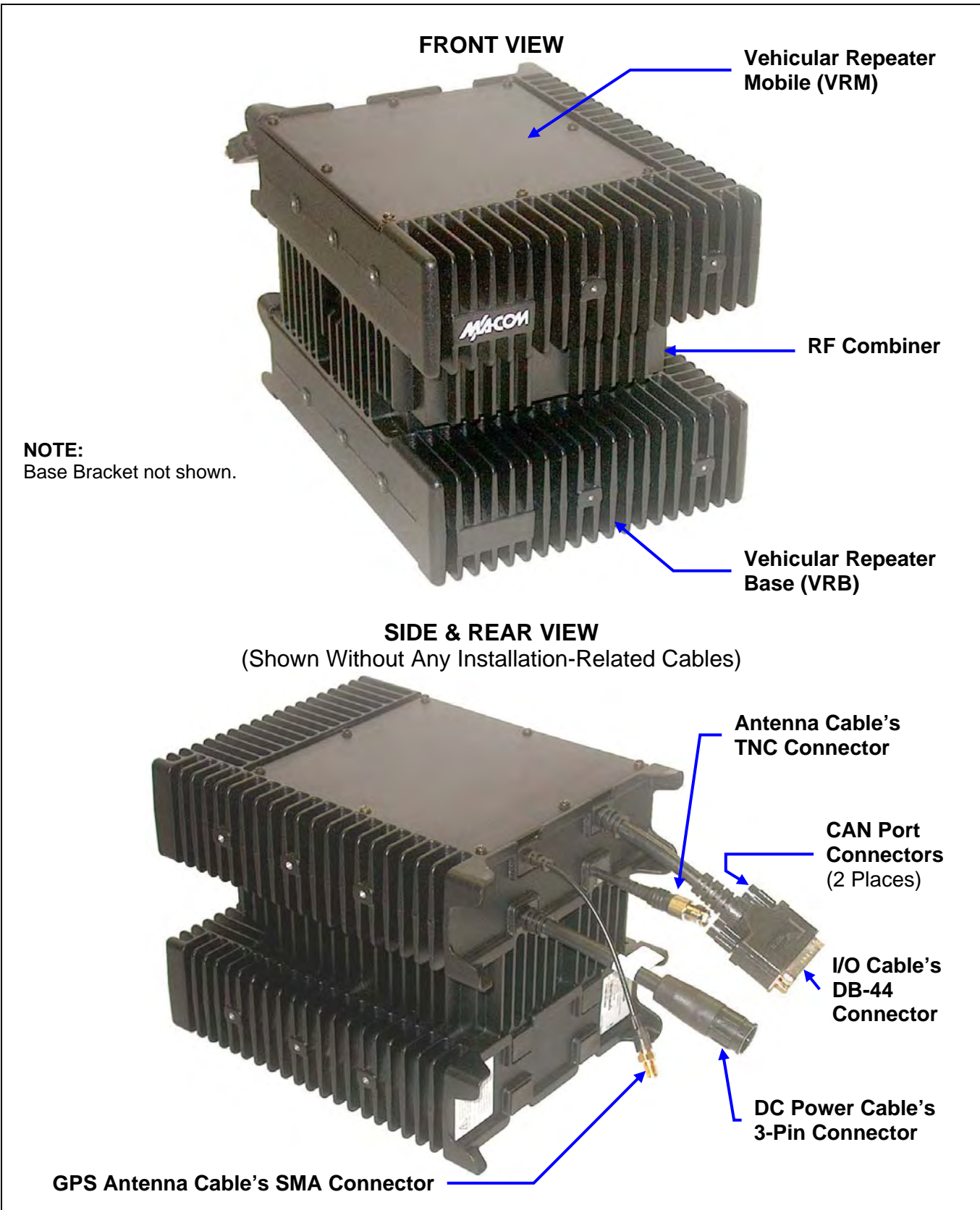


Figure 5-2: M7200 V-TAC Mobile Radio — Front and Rear Views

## 5.3 LOCATING COMPONENTS

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

- Determine the customer's preferences, if any, for location of components. Comply with these preferences as long as they are consistent with safety recommendations and guidelines presented in this manual, and other generally accepted professional radio installation practices.
- Nominal dimensions for the V-TAC radio are 7.3 x 8.8 x 9.3 inches (18.5 x 22.4 x 23.6 centimeters); height x width x depth). This includes the base bracket and its mounting tabs, but it does not include any clearance space required for cabling, air circulation, access to mounting hardware, etc.
- Verify sufficient clearance behind the units is provided so cables will not be stressed, crushed, twisted, or bent at severe angles. Also, the front and sides must have clearance for air circulation, access to mounting hardware, etc.
- Connections at the V-TAC radio are made through "pigtail" type cables exiting the rear of the radio. This design minimizes the stresses associated with mating connections and it allows for easy connector mating. However, stresses can still be induced if adequate service looping is not employed. Connections to the control heads are made with connectors mounted on the rear panel of each head instead of "pigtail" type cables.



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

## 6 MOUNTING THE V-TAC

This section provides details on mounting the V-TAC mobile radio. See Figure 5-2 and refer to the respective wiring diagram at the end of this manual as necessary. Control head installation procedures are included in Section 9 (page 39) of this manual.

The preferred mounting is on top of a firm, flat surface. The V-TAC is a relatively heavy radio, at approximately 14 pounds. Consider this weight when selecting a mounting surface. Refer to the specifications listed in Section 2.1 (page 12) of this manual for radio and control head weight specifications.



NOTE

V-TAC Installation Kit MAMV-NZN8B (contents listed in Table 4-1 on page 19) contains the most complete set of materials for installing the V-TAC. 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 V-TAC has the proper version of software installed and it has been configured for customer usage.



CAUTION

Though generally mounted in a trunk or remote location, the V-TAC 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 V-TAC 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 V-TAC and its base bracket into a projectile during a high-shock incident such as a motor vehicle accident. If the selected mounting surface does not meet the minimum 16-gauge steel sheet metal requirement, the surface should be reinforced with a metal backing plate (not supplied) or it should be reinforced using some other approved mounting method.**



CAUTION

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

### 6.1 BRACKET INSTALLATION

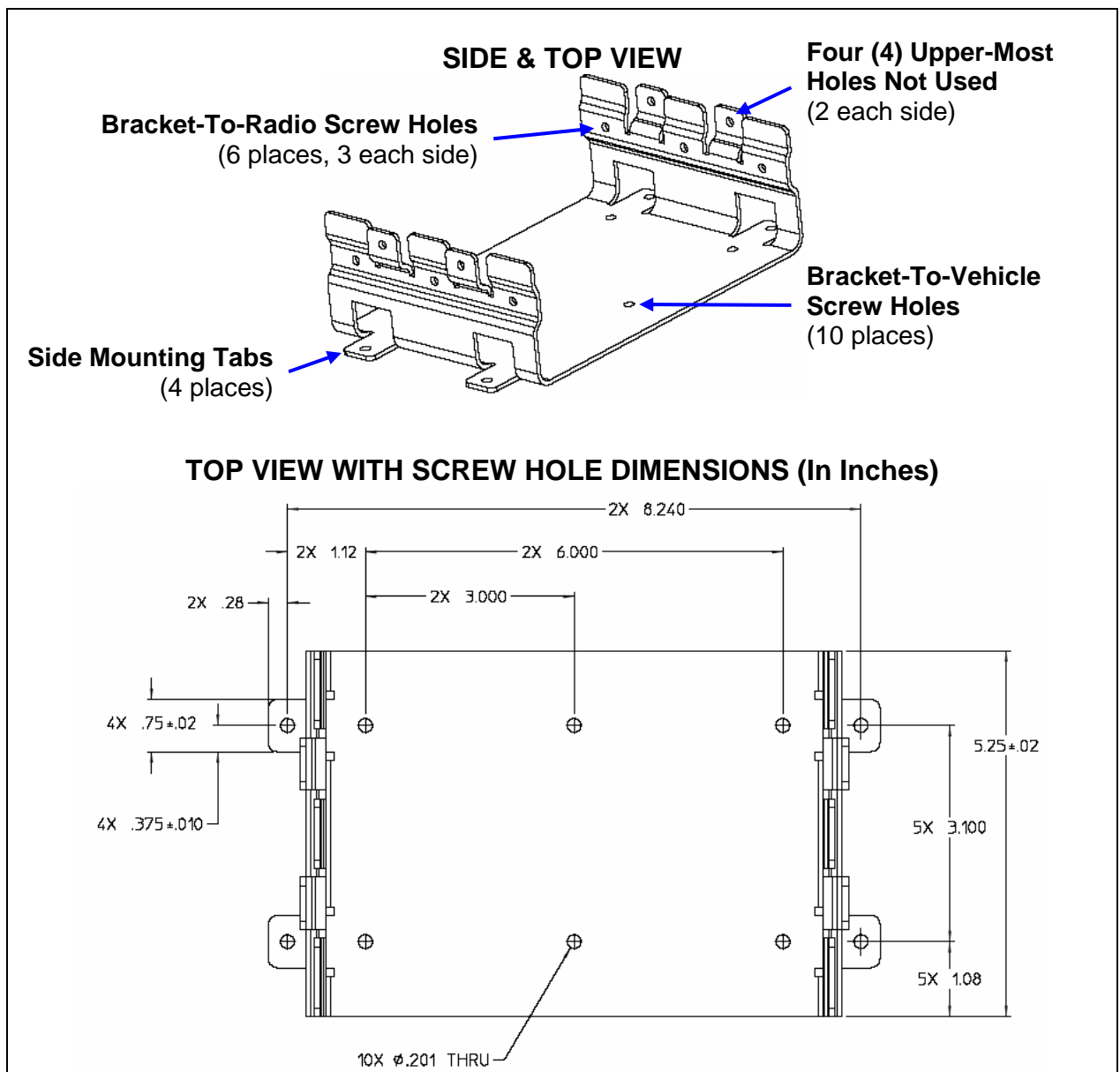
Typically, the V-TAC's Base Bracket (Item 1 in Table 4-1) is mounted in the vehicle's trunk, on the top surface of the trunk tray or the trunk floor. However, it can be suspended from the trunk's rear deck if the surface is completely flat, does not require any shimming and the gauge of deck's sheet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

Since the V-TAC protrudes several inches from the bracket's front and back edges, maintain sufficient distance at the front and back for this and additional clearance. A minimum distance of three (3) inches is

required from the rear edge of the bracket; however four (4) inches or more is recommended to improve V-TAC installation and removal ease. A minimum distance of two (2) inches is recommended from the front edge of the bracket. The bracket is front/back symmetrical, and left/right symmetrical.

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

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



**Figure 6-1: Base Bracket (V-TAC Mobile Radio Not Shown)**

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

## **6.2 MOUNT THE V-TAC INTO THE BRACKET**

The V-TAC should now be mounted into the bracket according to this procedure:

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



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

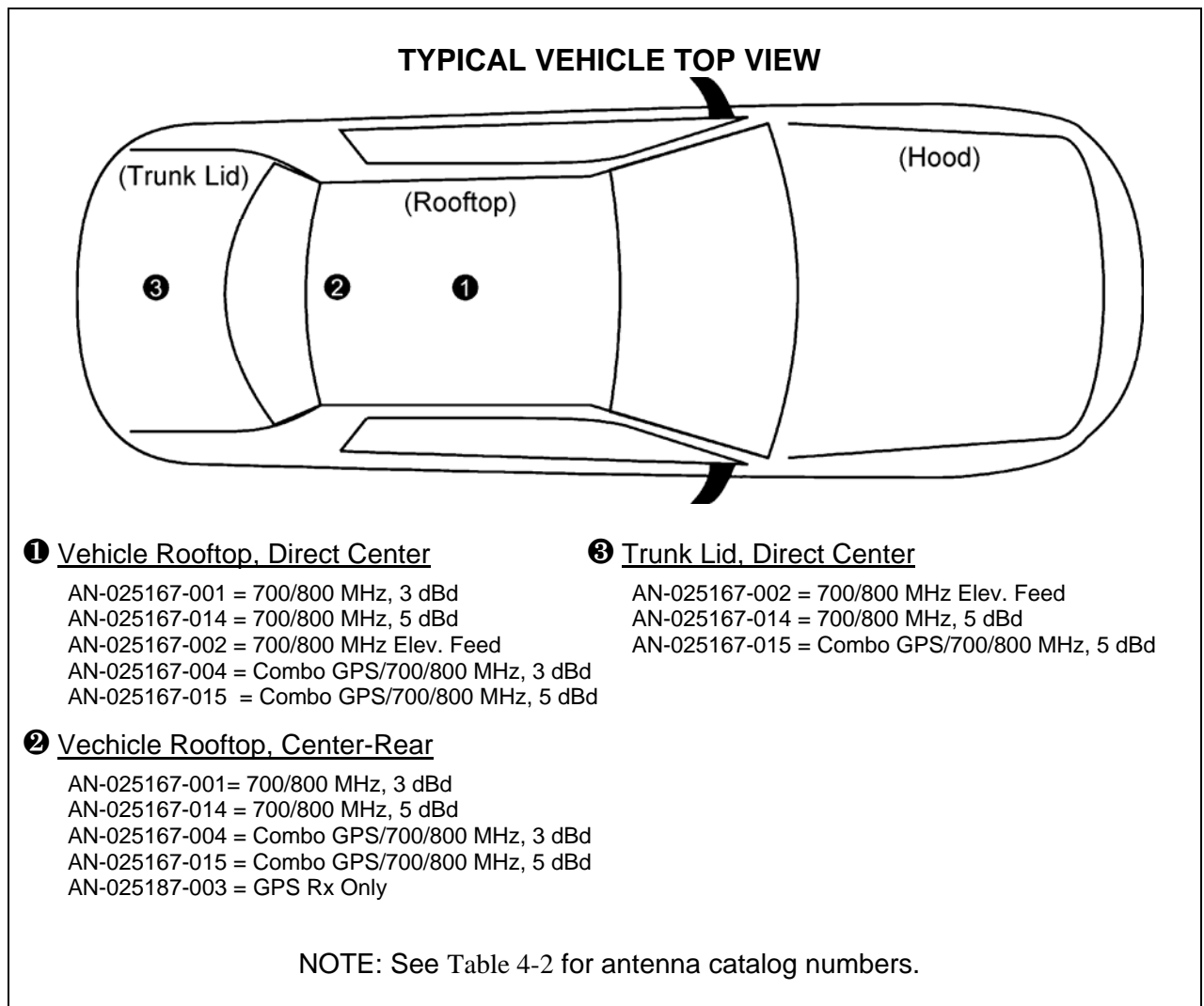
## 7 ANTENNA INSTALLATION

### 7.1 ANTENNA MOUNTING LOCATIONS



At this time, review all information presented in the **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 7-1 below as a guide for determining the best possible mounting configuration/location in order to reduce human exposure to radio frequency (RF) electromagnetic energy during transmit mode.

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



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



### 7.1.1 Direct Center or Center-Rear of Rooftop

The center of the vehicle's roof is the best location for the rooftop antenna (❶ in Figure 7-1). For optimal performance, the mounting area under the antenna must be a flat with a minimum radius of six (6) inches of 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 (❷ in Figure 7-1).

### 7.1.2 Center of Trunk Lid

Certain vehicles do not allow for the antenna to be placed in the center or center-rear of the roof. In this case, the next best location for the antenna is in the direct center of the trunk lid (❸ in Figure 7-1). In this case, an elevated-feed-point antenna is recommended. Although this type of antenna does not require a 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 to be treated as custom and separately specified.

## 7.2 ANTENNA INSTALLATION PROCEDURE



NOTE

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

### 7.2.1 Install and Connect Mobile Antenna

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

1. Once the mounting location is selected, refer to the antenna manufacturer's assembly, mounting and testing instructions included with the antenna kit for installation guidance. If necessary, contact M/A-COM's Technical Assistance Center (see page 18 for contact information).
2. Route the cable from the antenna to the rear of the V-TAC. The cable should be kept out of casual contact from persons within the vehicle. Tie and stow as necessary.



WARNING

Use the full length of coaxial cable included with the antenna. Never cut the cable to a shorter length, but rather coil any excess. Reducing the length of cable increases the output power radiated by the antenna, thereby exceeding the Maximum Permissible Exposure (MPE) allowance regulated by the FCC.

3. Connect the antenna cable's TNC plug-type (male) connector to the V-TAC's TNC receptacle-type (female) "pigtail" type RF connector at the rear of the V-TAC. Mate the two connectors and turn the plug clockwise until finger-tight.

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

### **7.2.2 Install and Connect GPS Antenna**

The V-TAC is equipped with a GPS receiver which requires connection to an externally-mounted GPS antenna if the GPS functions will be utilized. Some installations may use a magnetic-mount stand-alone GPS antenna installed separately from the SMR mobile antenna.

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

The following antenna installation procedure is recommended:

1. Once the mounting location is selected, refer to the antenna manufacturer's mounting and testing instructions for installation guidance. If necessary, contact M/A-COM's Technical Assistance Center (see page 18 for contact information).
2. Route the cable from the GPS antenna to the rear of the V-TAC. The cable should be kept out of casual contact from persons within the vehicle.
3. Connect the GPS antenna cable's SMA plug-type (male) connector to the V-TAC's SMA receptacle-type (female) "pigtail" type RF connector at the rear of the V-TAC. Mate the two connectors and turn the plug clockwise. Tighten with a pair of slip-jaw pliers.



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

## 8 V-TAC DC POWER INSTALLATION

Refer to the wiring diagram at the end of this manual as necessary when performing wiring procedures presented in this section. With regards to control head installation, power connections for the CH-721 Scan and CH-721 System control heads are exactly the same.

### 8.1 ON/OFF POWER WIRING CONFIGURATIONS

The M7200 V-TAC mobile radio can be wired in a motor vehicle in various ways to accommodate the user's preferences. In all cases, its red power wire must be connected through an in-line fuse to raw battery power (positive battery terminal). An in-line switch for switched battery power to the V-TAC must not be considered unless the user has the discipline to turn off the V-TAC through the control head's on/off/volume control or through a separate switch wired to the ignition sense wire. Failure to wait for the V-TAC to completely power down before disconnecting battery power will not damage the V-TAC; however, it may result in the loss of settings that have changed (e.g., volume setting, etc.) during the operating session.

On/Off power functions for the V-TAC are controlled by the control head. The following power wiring configurations are supported:

- **V-TAC turns on/off automatically with vehicle's ignition switch/key** — The white sense wire of the control head's DC Power Cable is connected to a fused switched power source, typically identified as "Accessory" power. This source must switch on (up to positive (+) battery voltage potential) when the vehicle's ignition switch/key turns on, and it must switch off (to near zero volts) when the ignition switch/key turns off. The required fuse rating is 2 amperes. An ATM fuse holder and fuse are included with the applicable fuse kit. 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.
- **V-TAC turns on with a manual switch** — The white sense wire of the control head's DC Power Cable is connected to one side of a manual toggle switch and the other side of this switch is connected to a fused vehicle power source. This configuration is used when, for example, the V-TAC must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. The required fuse rating is 2 amperes if no other devices share the switch. If other devices share the switch, the 2-ampere ATM fuse must be spliced in the white wire on the load/switched power side of the switch. 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.
- **V-TAC turns on with control head's on/off/volume control ("hot wired")** — This configuration allows radio power on/off control only via the control head's on/off/volume control. It may be desired if, for example, the V-TAC must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is not desired. In this case, the white sense wire of the control head's DC Power Cable must be connected to unswitched and fused vehicle power. The required fuse rating is 2 amperes.

### 8.2 POWER INSTALLATION PROCEDURE

#### 8.2.1 Install Main Fuse Holder and 10-AWG Red Wire

The main power fuse (30-amp), its holder, and related items are included in Fuse Distribution Rail Kit FS23057 illustrated in Figure 8-1 on page 34. Follow the procedure in this section to wire fused main power from the vehicle's battery to the location of the V-TAC and the Fuse Distribution Rail Assembly in

the vehicle's trunk. The Fuse Distribution Rail Assembly is installed during the subsequent procedure (Section 8.2.2). Also refer to the respective wiring diagram at the end of this manual as necessary.



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



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

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

1. Strip one of the ATC Fuse Holder's wires and crimp a 3/8-inch ring terminal to it. Both items are included in the Fuse Distribution Rail Kit.
2. **Verify the fuse is NOT in the Fuse Holder.**
3. Connect the ring terminal directly to the battery's positive post (or if present, to a stud on the battery's main/non-switched power distribution terminal block).
4. Strip the Fuse Holder's other wire, strip one end of the 20-foot long 10-AWG red wire, and then connect these two wires together using a 10-AWG moisture-resistant butt splice. The red wire and the butt splice for this connection is included in the Fuse Distribution Rail Kit.



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.**

5. Route the other (load) end of the 20-foot long red wire through a wire-loom then through the grommet in the firewall. This load end of the red wire will later be connected to a Fuse Block clipped on the Fuse Distribution Rail Assembly (both parts of the Fuse Distribution Rail Kit). The Fuse Distribution Rail Assembly will be located near the V-TAC in the trunk.
6. Continue routing the 20-foot red wire through channels in the vehicle to the location of the V-TAC. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing where necessary.

## 8.2.2 Assemble and Install Fuse Distribution Rail Assembly

The Fuse Distribution Rail Assembly must be completely assembled and installed in the vicinity near the V-TAC mobile radio. This rail assembly, included in Fuse Distribution Rail Kit FS23057, comes preassembled with only one (1) Fuse Block on the rail. However, the installation requires two blocks—

one to fuse the V-TAC and one to fuse the control head. Therefore, the assembly must be partially disassembled so the Fuse Block and the Fuse Block Jumper from kit FS23058 can be added to the rail assembly. As shown in Figure 8-1 and Figure 8-2, one Fuse Block is included in kit FS23057 (preassembled to the rail) and one is included in kit FS23058. The completed assembly is shown in the photo on page 38.



**Note:** This kit is a part of V-TAC Installation Kit MAMV-NZN8B. See Table 4-1 on page 19 for descriptions of the kit's contents (item 2 in the table).

**Figure 8-1: Contents of Fuse Distribution Rail Kit FS23057**



**Note:** This kit is a part of Control Head Installation Kit MAMV-ZN7N. See Table 4-3 on page 20 for descriptions of the kit's contents (item 6 in the table).

**Figure 8-2: Contents of Fuse Distribution Accessory Kit FS23058**

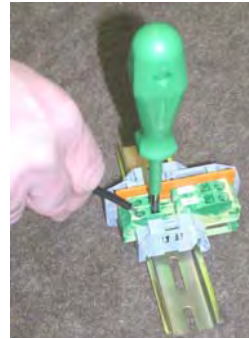
The Fuse Distribution Rail Assembly has a DIN-type rail allowing additional Fuse Blocks to be added to it if fuse expansion is necessary in the future, such as for multiple control head installations. The rail may be cut to decrease its length if necessary, but enough room for at least one control head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

1. Mount the Fuse Distribution Rail Assembly in the vicinity of the V-TAC's mounting location, but where casual contact is not likely. Use self-threading screws (not supplied) and any available mounting slots in the DIN rail to mount the block.
2. Strip one end of the 10-AWG black wire (included with the Fuse Distribution Rail Kit) and crimp a 3/8-inch ring terminal to it.
3. Near the Fuse Distribution Rail Assembly, locate an area of vehicle chassis ground within approximately six (6) inches of the assembly and strip the area of any paint or dirt to expose a bare metal surface.
4. Drill a hole as necessary and connect the ring terminal to chassis ground. Use a self-threading screw or other appropriate hardware to ensure a reliable metal-to-metal contact. Tighten securely.
5. Cut the black wire to a length long enough to reach a green-yellow Grounding Block on the Fuse Distribution Rail Assembly, plus length for a service loop. Strip the end to prepare it to connect to a Grounding Block.
6. The Fuse Distribution Rail Assembly has two green-yellow Grounding Blocks. Each Grounding Block has two wire-clamps with associated wire-clamp release slots. As shown in the photo at the right, insert a #1 or #2 flat-blade screwdriver completely into one of the wire-clamp release slots. Insert the screwdriver until it is captured in a vertical position as shown in the photo in the next step.



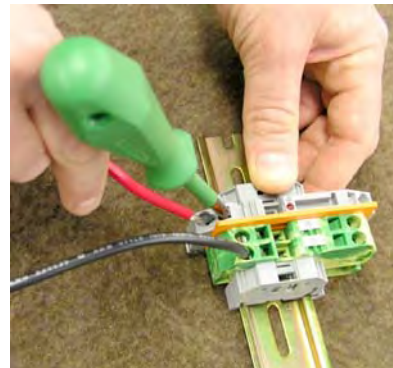


7. Insert the stripped end of the black wire fully into the wire-clamp beside the screwdriver, and then remove the screwdriver to lock the wire in the clamp. The adjacent Grounding Block is electrically connected together, so this black wire grounds both blocks.



8. Prepare to connect the 10-AWG red wire from the Fuse Holder at the vehicle battery to the Fuse Block of the DIN rail assembly by cutting excess length and stripping the end. Leave enough wire length for a service loop.

9. As shown in the photo at the right, connect the 10-AWG red wire to the **Fuse Block's supply-side wire-clamp**.

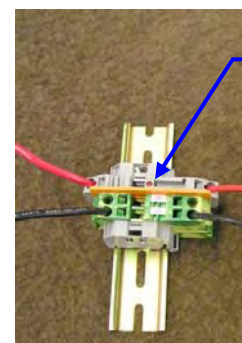


10. Obtain the V-TAC's DC Power Cable (Item 3 in Table 4-1).

11. Mate the cable's connector to the V-TAC's 3-pin power connector as follows: Visually align the key and firmly push and turn the outer locking ring clockwise until it stops. A click will be sensed to confirm proper mating.

12. Prepare to connect the cable's black (negative) and red (positive) wires to a Grounding Block and to the Fuse Block by cutting excess length from both wires and stripping the ends. Leave enough wire length for service loops.

13. Connect the cable's red wire to the wire-clamp on the **Fuse Block's load-side wire-clamp** and connect the cable's black wire to any one of the wire-clamps on a Grounding Block.



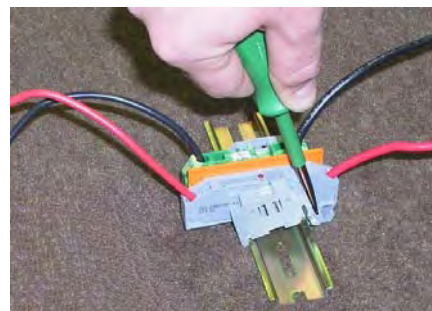
Fuse Blown Indicator Light (on **input** side of ATC Fuse)

DC Power Cable's red power wire (to radio/load)

DC Power Cable's black ground wire (to radio/load)

14. A second Fuse Block must be installed onto the Fuse Distribution Rail Assembly to supply power to the control head. Therefore, obtain the second Fuse Block from Fuse Distribution Accessory Kit FS23058.

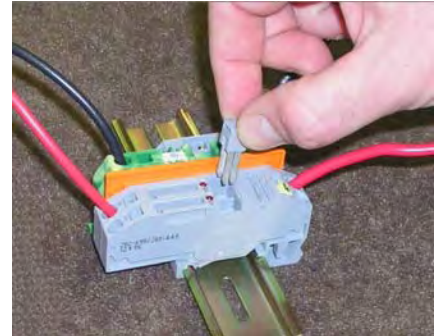
15. As shown in the photo at the right, remove the End Stop next to the original Fuse Block on the DIN rail by prying at its side release with the screwdriver.



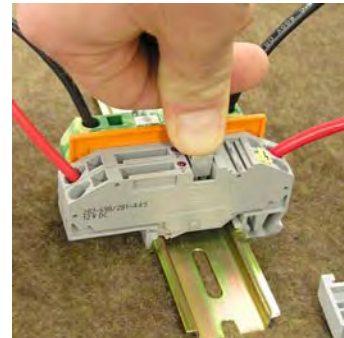
16. Hook the second Fuse Block's rail clip onto the DIN rail next to the original Fuse Block and snap it in place. When installed correctly, the Fuse Blocks will snap themselves together as well.



17. As shown in the photo at the right, install the Fuse Block Jumper into adjacent slots of the two Fuse Blocks. DC power distribution occurs through the jumper; therefore, daisy-chaining of the supply-side wire-clamps is not required. The Fuse Block from the Fuse Distribution Accessory Kit has a protection marker installed on the supply-side of the block to warn of inappropriate wire installation in its supply-side wire-clamp.



18. Press the Fuse Block Jumper firmly in place as shown in the photo at the right.



19. Reinstall the End Stop by hooking its rail clip onto the DIN rail and snapping in the other side. Make sure it is firmly against the second Fuse Block.

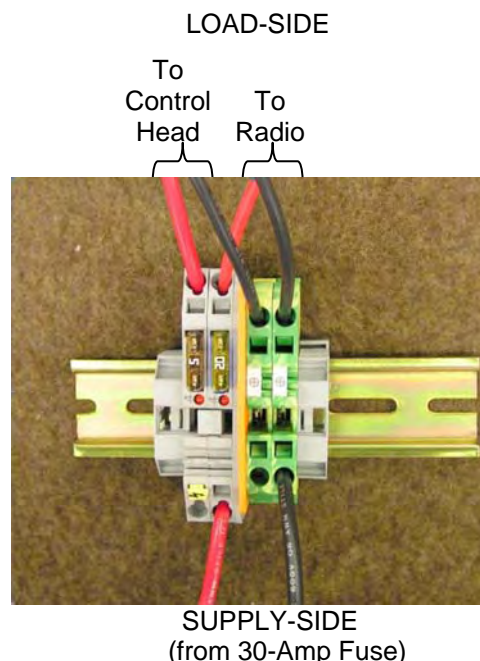




20. Install two ATC-type fuses into the Fuse Blocks. **The V-TAC mobile radio requires a 20-amp fuse (fuse color = yellow) and the control head requires a 5-amp fuse (fuse color = tan). Install the correct fuse into the correct Fuse Block based upon the wire connection at the load side of each block!**

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

The photo at the right also includes red and black wires for control head power. These wires are connected during a later procedure in this manual.



22. Apply the sticker included in the Fuse Distribution Rail Kit in the vicinity of the Fuse Block as future reference for service personnel.
23. Route the V-TAC DC Power Cable's white wire to the vehicle's fuse box and label it accordingly. Tie and stow the wire as necessary so it remains out of the way of casual contact and wire chafe is avoided.



NOTE

The control head wakes up the V-TAC via the CAN port when power is applied. However, connection of the V-TAC DC Power Cable's white sense wire may be needed in future configurations that do not use the control head. Therefore, it is recommended that the white wire be labeled, routed up to the vehicle's fuse box, coiled, and stowed for possible future use rather than be cut from the DC Power Cable.



CAUTION

Installing a fuse with the wrong amperage rating could cause an unsafe condition and/or a prematurely blown fuse. Verify the correct fuse value for the V-TAC is installed. The color of the 20-amp fuse is yellow.



CAUTION

The fuse for the control head is rated at 5 amperes. Installing the wrong fuse value could lead to damage. Verify the control head is wired to the 5-amp (tan color) ATC fuse!



CAUTION

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

## 9 CONTROL HEAD INSTALLATION

### 9.1 GENERAL INFORMATION

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

Figure 9-3 on page 40 illustrates the rear panel of the two control head models. Both models have identical rear panels and rear panel connectors.

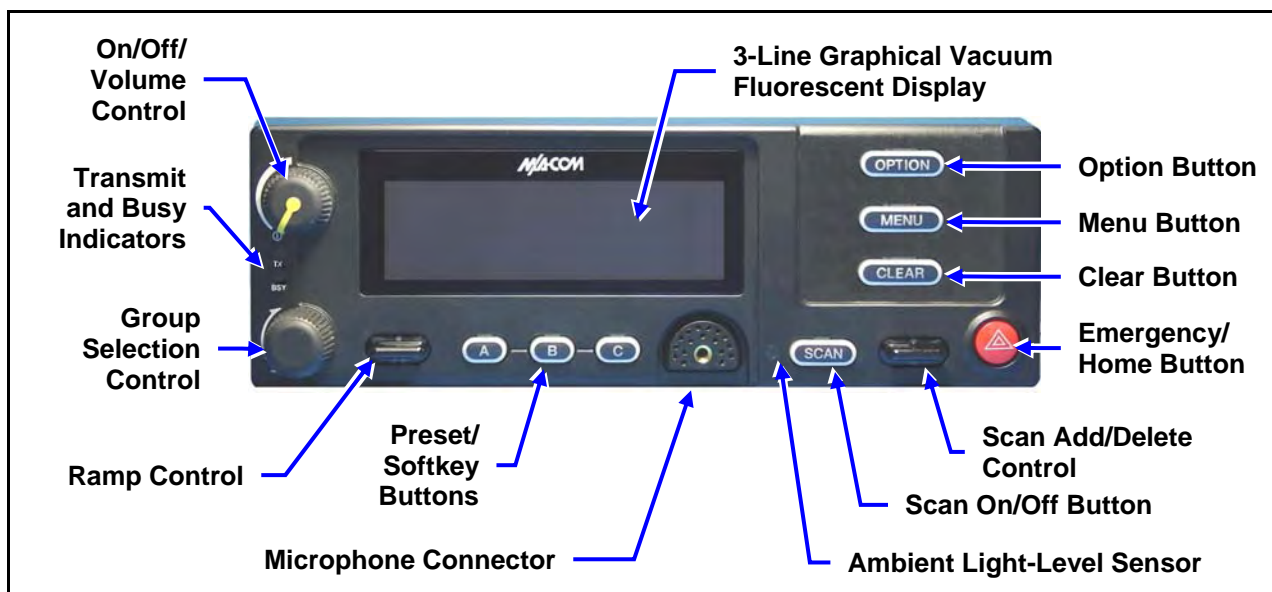


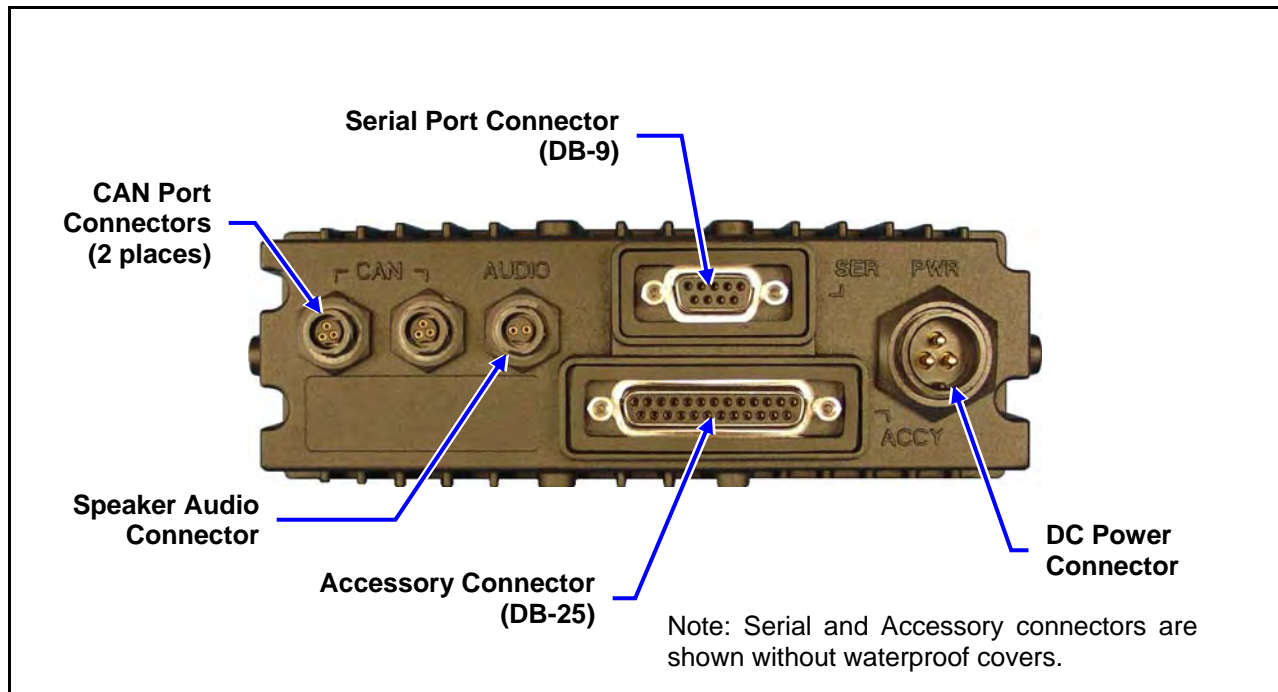
Figure 9-1: CH-721 Scan Model Control Head Front Panel



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

The CH-721 control heads feature a large easy-to-read 3-line graphical vacuum fluorescent display, an on/off/volume control knob, menu controls and buttons, trunking mode buttons, an emergency/home button, a scan on/off/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 V-TAC is receiving a call and one is the transmitter-enabled indicator that lights when the V-TAC is transmitting. The front panel also has an ambient light sensor for automatic display dimming.



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



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



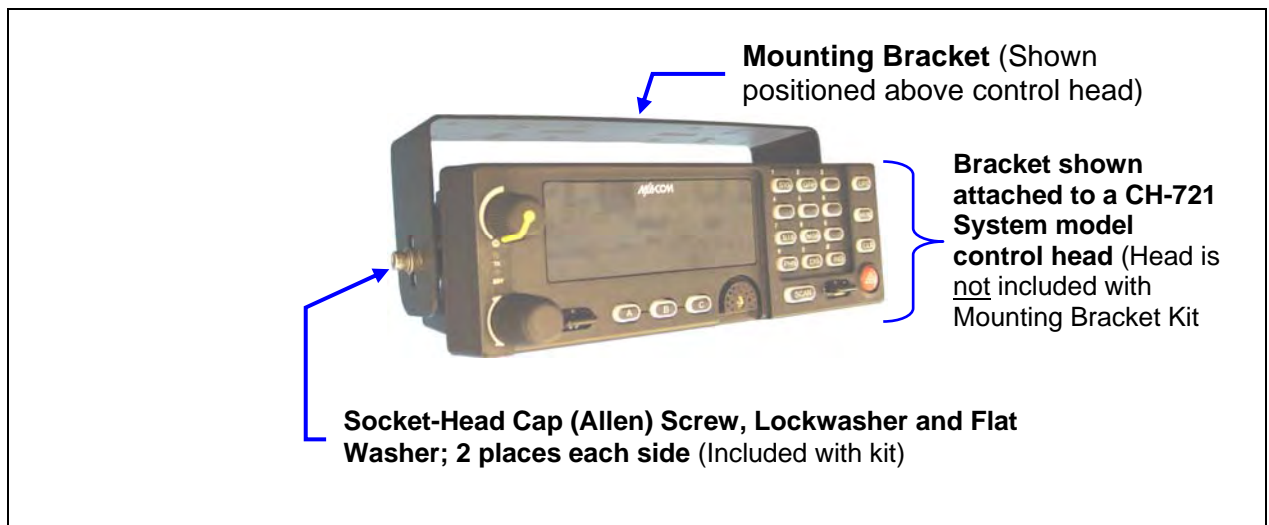
Because the Control Head Installation Kit MAMV-ZN7N contains the most complete set of materials for installing the control head, the following instructions make repeated reference to this kit. Item numbers given in parenthesis below refer to items in the kit. See Table 4-3 on page 20 for a complete listing of kit contents.

In a mobile installation, more than one control head can be connected to a V-TAC 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 V-TAC. Multi-head installations also provide other benefits such as intercom functionality.

## 9.2 CONTROL HEAD MECHANICAL INSTALLATION

### 9.2.1 Selecting the Mounting Location

When selecting a location for the CH-721 control head, first observe the safety and operator-convenience related information presented in Section 5.1 on page 22. Also always consider and include clearance for the microphone's connector that must mate to the mic connector on the front panel of the head, and clearance for the connectors/cables that must mate to the connectors on the rear panel of the head. The CH-721 control head can be mounted under or on top of a mounting surface (typically the vehicle's dash) as space permits using either the standard U-shaped mounting bracket or the optional mounting pedestal.



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



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

### 9.2.2 Using the Standard U-Shaped Mounting Bracket

If the standard U-shaped Mounting Bracket will be used to mount the control head, the following mounting procedure is recommended. This bracket is included with the Mounting Bracket Kit listed in Table 4-3 (page 20).

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



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

2. 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).
3. Install and tighten the mounting screws. Screws for mounting the bracket to the mounting vehicle's surface are not included, as all installations differ. Self-threading screws are recommended. Sheet metal screws should not be used.
4. Verify the bracket is held firmly to the mounting surface. Firm mounting prevents unreasonable vibration, which could damage the control head and/or cause its cable connections to loosen.
5. Slide the control head into the bracket, placing the two pegs protruding from its left and right sides into the respective round holes in the bracket's two side "ears."
6. In each side "ear" of the mounting bracket, start a #8-32 socket-head cap (Allen) head screw with a lockwasher and a flat washer by inserting the screw through the slotted hole in the bracket and then into the threaded hole in the side of the control head. This hardware is included with Mounting Bracket Kit. The lockwasher should be adjacent to the screw head and the flat washer should be adjacent to the bracket. Turn each screw clockwise as observed from the head of the screw.
7. The control head can be positioned at various angles for best display viewing at the normal position of the operator. As necessary, turn it on the pegs to a good position and tighten both screws using an 1/8-inch hex key (Allen) wrench until the control head is held firmly in place. Do not over-tighten.

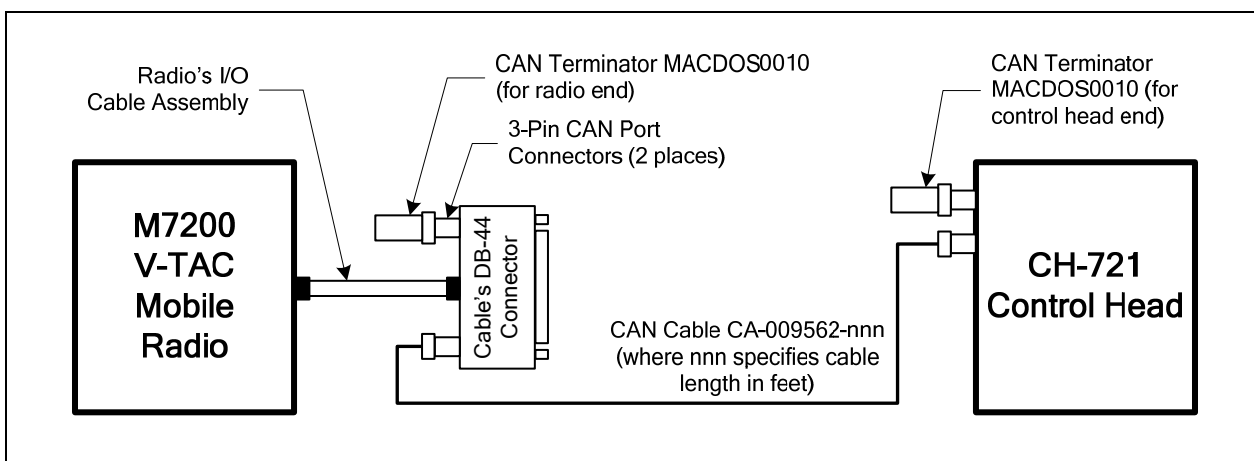
### 9.2.3 Using the Mounting Pedestal (Optional)

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

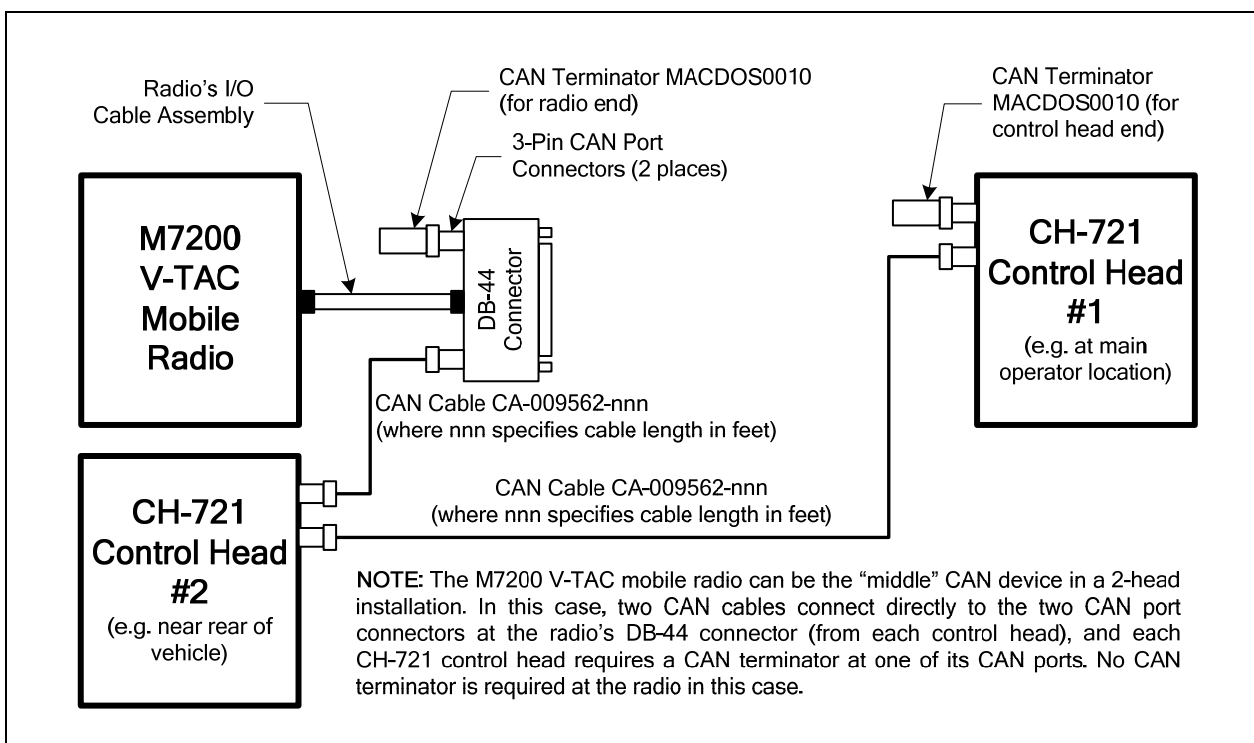
## 9.3 CAN CONNECTIONS

### 9.3.1 General Information

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



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



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



Both the V-TAC 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 24 shows the V-TAC’s two CAN port connectors, which are located on cable side of the I/O cable’s DB-44 connector. Figure 9-3 on page 40 shows the two ports on the control head’s rear panel.

### **9.3.2     Make CAN Link Terminations and Cable Connection**

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

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



When mating any CAN connection (terminators and cables), visually align the ¾-moon-shaped keys of the connectors, and then gently push and turn the outer locking ring of the plug (male) connector clockwise until it stops. A mild click will be sensed to confirm proper mating. Without visual alignment as a guide, it is possible with excessive force to mate the CAN connectors improperly. Damage to the connector(s) may result. Therefore, visual alignment is recommended when mating CAN connectors.

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

## **9.4     CONTROL HEAD POWER CABLE INSTALLATION**

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

### **9.4.1     Install DC Power Cable and Make Power and Ground Connections**

1. Connect the control head’s DC Power Cable (Item 5 in Table 4-3) to the large 3-pin connector at the rear of the control head. Visually align the key and gently push and turn the outer locking ring clockwise until it stops. A click will be sensed to confirm proper mating.
2. At the back of the control head, form a cable service loop of at least six (6) inches, and tie and stow the cable as necessary.
3. Route the cable’s red (positive power) wire through channels in the vehicle to the location of the Fuse Distribution Rail Assembly near the V-TAC mobile radio. Remove interior panels, door kick panels, etc. Protect the wire from possible chafing as necessary.



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.

4. At the Fuse Distribution Rail Assembly near the V-TAC, cut the red wire to the required length, strip it, and connect it to the load-side of the Fuse Block that has the 5-amp ATC fuse. (This fuse was installed during the rail assembly installation procedure presented in Section 8.2.2.) See the illustration on page 38 and the following CAUTION.



The fuse for the control head is rated at 5 amperes. Installing the wrong fuse value could lead to damage. Verify the control head is wired to the 5-amp (tan color) ATC fuse!

5. 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.
6. Cut the black wire of the control head's DC Power Cable as short as possible, but long enough for a service loop, then strip it and crimp a 3/8-inch ring terminal to it.
7. Drill a hole as necessary and screw this ring terminal to chassis ground. Use a self-threading screw or other appropriate hardware to ensure a reliable metal-to-metal contact.

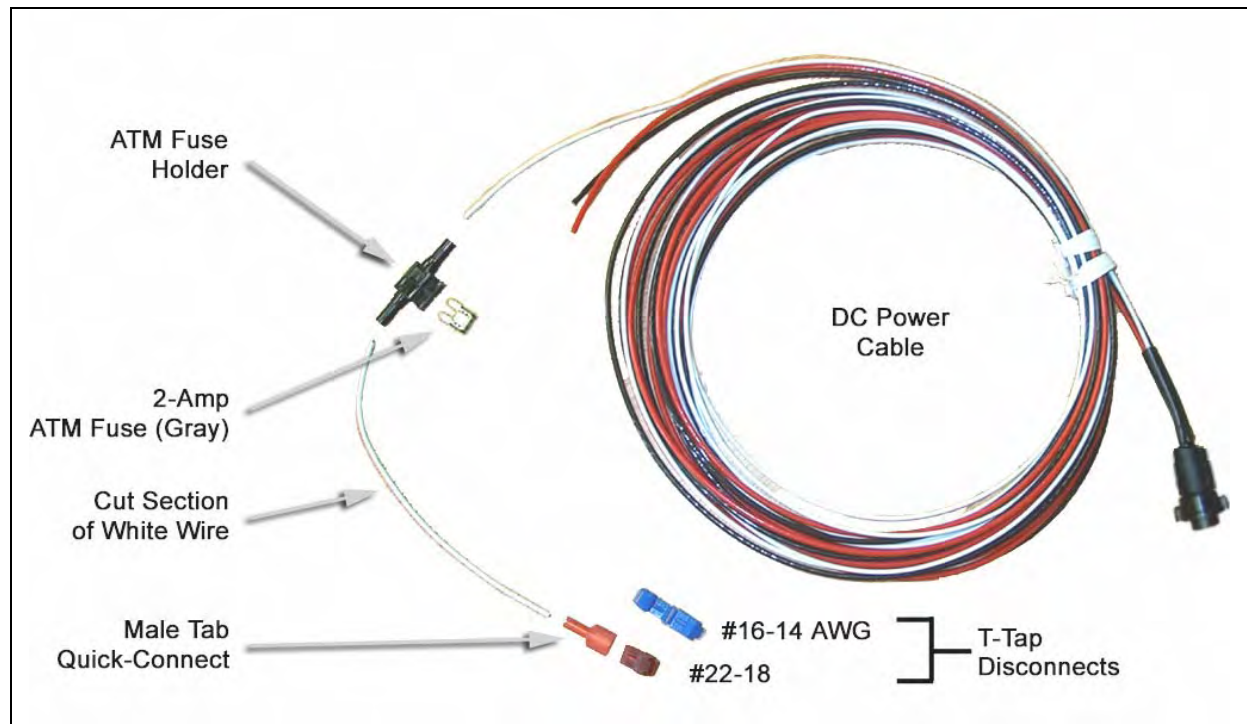
#### 9.4.2 Connect DC Power Cable's White Wire

A review of the information presented in Section 8.1 (page 32) 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. The control head's DC Power Cable and associated fuse and wire terminal devices are shown in Figure 9-8.



Only the control head's white wire must be connected to the ignition or switched power sense. When this vehicle line is asserted (i.e., power switched on), the control head automatically powers-up the V-TAC via the CAN connection.





**Figure 9-8: Connection of White Ignition Sense Wire Using Vehicle Fuse and T-Tap Kit**

#### 9.4.2.1 Control Head and V-TAC Turn on with Vehicle's Ignition Switch/Key

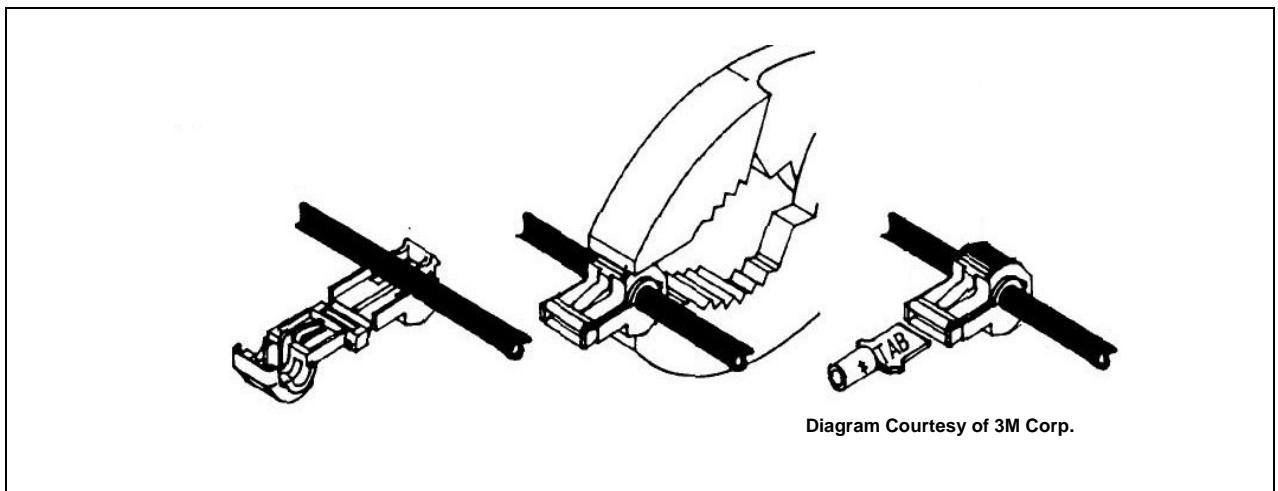
With this wiring configuration, the control head and V-TAC automatically turn on and off with the vehicle's ignition switch/key. The white wire of the control head's DC Power Cable is typically identified as the "white ignition switch wire" or the "ignition sense wire." In this configuration, the white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

1. Locate the switched ignition or "Accessory" power wire (typically at or near the vehicle's fuse block or in a vehicle wiring harness) that will be used for the switched ignition power source. It may be necessary to consult the vehicle manufacturer's wiring diagram.
2. Route the white wire of the control head's DC Power Cable from the back of the head to an area near the switched ignition power source. At the back of the head, be sure to maintain a cable service loop of at least six (6) inches.
3. Cut a short section (6 to 8 inches) off the end of the white wire and strip each end of this short wire.

4. From the Vehicle Fuse and T-Tap Kit (Item 7 in Table 4-3), locate the male-tab quick-connect terminal and crimp it to one end the short wire. Refer to the respective wiring diagram at the end of this manual.
5. From the same kit, locate the ATM fuse holder and crimp it to the other end of the short wire. The holder has built-in crimpable joints.
6. Cut the excess length from the white wire of the control head's power cable, strip it, and crimp it to the other side of the ATM fuse holder.
7. Pull enough of the switched ignition source wire out of the vehicle's wiring harness so one of the T-tap quick-disconnect terminals may be attached to it.
8. Two T-tap quick-disconnect terminals are included in the kit. Based on the gauge of wire, select the proper terminal size: Red is for 22 to 18-AWG wire and blue is for 18 to 14-AWG wire.
9. Attach the selected T-tap quick-disconnect terminal by fitting the wire into its wire groove and snapping the two halves together with a pair of pliers as shown in Figure 9-9.



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

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

### **9.4.2.2 Control Head and V-TAC Turn On with a Manual Switch**

With this wiring configuration, the control head and V-TAC are manually turned on and off via an on/off switch mounted separately from the control head and V-TAC, not through the vehicle's ignition switch/key. This configuration is used when, for example, the V-TAC must remain on even when the ignition key must be removed from the vehicle and a separate on/off switch is acceptable. In this configuration, the white wire connects to a switched power source such as a toggle switch mounted on the vehicle's dash. 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 unit to an area near the on/off switch's location. At the back of the control head, be sure to maintain a cable service loop of at least six (6) inches.
2. Cut a short section (6 to 8 inches) off the end of the white wire and strip the ends.
3. For a new on/off switch (not supplied):
  - (a) Tap a wire off non-switched battery power from the vehicle's fuse box with an 18-AWG wire. (Use wire remaining from the power cable, if available.) Keep wiring as short as possible and use approved wiring methods. Use techniques presented in Section 9.4.2.1 as a reference.
  - (b) Strip and crimp this wire tap to one side of the ATM fuse holder. This holder is included with Vehicle Fuse and T-Tap Kit, item 7 in Table 4-3. It has built-in crimpable joints.
  - (c) Crimp the short wire to the other side of the ATM fuse holder and connect the other end of this wire to the common terminal of the manual switch.
  - (d) Connect the white wire of the power cable to the load (switched) side of the manual switch.

For an existing switch:

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

### **9.4.2.3 Control Head and V-TAC Are "Hot Wired"**

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

## 10 MICROPHONE ATTACHMENT

There are several versions of microphones available for use with the M7200 V-TAC mobile 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 V-TAC can be configured to provide a monitor function when the microphone is cradled in the clip. Connect the mic to the control head and install the clip as follows:

1. As illustrated in Figure 10-1, grasp the mic's connector with a thumb and index finger on the sides of the connector just adjacent to the thumbscrew.
2. Position 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 10-1: Attaching the Microphone to the CH-721 Control Head**

## **11 SPEAKER INSTALLATION**

Select a location for the speaker that will allow for proper listening range with a moderate volume setting. Total speaker cable length (of both cables) is approximately five (5) feet. Therefore, to include service 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 4-3) using the hardware and mounting bracket supplied with it. Also refer to the instructions included in the speaker for additional mechanical installation information.
2. Route the speaker's cable to the rear of the control head.
3. Mate the Speaker Cable (Item 9 in Table 4-3) 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.

## 12 V-TAC EXTENDED COVERAGE INSTALLATION

### 12.1 GENERAL INFORMATION

The V-TAC supports two Extended Coverage modes: Extended Coverage for individual users (display reads “XCOV”) and Extended Coverage for talk groups (display reads “XCOV-TG”). Extended Coverage adds the V-TAC’s “bridging” (vehicular repeat) functionality for accessing the OpenSky radio network using connected portable radios. Each portable radio connected to the V-TAC using Extended Coverage is considered a “client” on the V-TAC. Extended Coverage benefits (permitted) portable radio users since it allows them to get network connectivity using the V-TAC’s higher transmit output power and better antenna system. In addition, dispatchers can communicate with portable radio users (the clients) connected to the V-TAC, and logging recorders can record their tactical communications.

With the XCOV mode, up to eight (8) client radios can connect to the V-TAC. These radios can operate with all standard radio functions, including selective calling and mobile data.

Using the XCOV-TG mode, up to thirty (30) client radios can connect to the V-TAC. XCOV-TG is designed to support a large number of client radios in a tactical scenario. However, unlike XCOV, radios connected to using XCOV-TG are limited to communicating only on the XCOV-TG talk group and emergency communications. Advanced features such as selective calling and mobile data operations are not available to the XCOV-TG connected clients.



NOTE

For complete details on the V-TAC’s various operating modes, refer to the Operator’s Manual (publication number listed in Section 3.3).

In most cases, the Mobile-Only operating mode of the V-TAC (control head displays “Mobile”) is desired when the vehicle is in motion. However, an Extended Coverage operating mode is desired when the vehicle is stationary and the tactical situation warrants a V-TAC operating mode. Typically, an Extended Coverage mode is utilized after the vehicle’s operator has exited the vehicle with a portable radio unit and the portable unit requires the V-TAC’s “bridging” functionality to access the OpenSky radio network.

A four-beep high-medium-high-medium tone sequence sounds when the V-TAC enters an Extended Coverage mode. Also, for ten (10) seconds, the Control Head’s display flashes “XCOV” for the Extended Coverage for individual users mode, and “XCOV-TG” for the Extended Coverage for talk groups mode. When in the Mobile-Only operating mode, neither indication is displayed.

Operating the V-TAC in an Extended Coverage mode when the vehicle is in motion can have serious consequences to system operation and performance and is therefore not desired. This undesirable condition is sometimes referred to as a “rolling V-TAC.” Proper connection to the V-TAC’s motion sense input and appropriate radio software configurations can prevent the “rolling V-TAC” condition. M/A-COM recommends connecting the V-TAC’s motion sense input to an automatic motion sensor switch or a dash-mounted toggle switch, neither of which are supplied. An operating mode can also be manually selected via the V-TAC’s “Vmode Menu” (V-TAC mode menu).

### 12.2 SOFTWARE CONFIGURATION AND WIRING

#### 12.2.1 Inverting Interpretation of V-TAC’s Motion Sense Input Logic State with “XEVENT” Command

As shown in Table 12-1, the “XEVENT” command allows inversion of how the V-TAC interprets the condition of the V-TAC’s motion sense input. This allows inversion of the sense signal via software, thus

preventing the need of an external inverter circuit for the V-TAC's motion sense input. This command can be entered manually via the V-TAC's serial port or the over-the-air interface using the following syntax:

**at@vtac-xevent N** (where N = 0 or 1; see Table 12-1)

For information on entering commands via the V-TAC's serial port, refer to Table 12-2 on page 53. Also see Figure 16-1 on page 61 for required cable connections between a Personal Computer (PC) and the V-TAC's serial port.

**Table 12-1: V-TAC Mobile-Only Vs. Extended Coverage Operating Mode Selection Logic**

"XEVENT" COMMAND SETTING	V-TAC'S MOTION SENSE INPUT VOLTAGE	SELECTED V-TAC OPERATING MODE
0	+12 Vdc	Extended Coverage (Either XCOV or XCOV-TG per "CMODE" command)
0	0 Vdc (Grounded) or Floating/Not Connected	Mobile-Only
1	+12 Vdc	Mobile-Only
1	0 Vdc (Grounded) or Floating/Not Connected	Extended Coverage (Either XCOV or XCOV-TG per "CMODE" command)



NOTE

There is no factory default "XEVENT" command setting. The value of "XEVENT" must be defined as part of the personality profile loaded prior to installation. Not setting a defined value will result in an arbitrary (random) setting. However, especially whereas details of the installation may not be known until the installation has commenced, the setting of "XEVENT" can occur locally through the V-TAC's serial port at any time. The best time for doing so is during the antenna PERFORMANCE TESTS procedures presented later in this manual (subsections 16.3 and/or 16.4). It can also be done remotely over-the-air after the antenna test procedures are completed.

Connecting the V-TAC's motion sense input to a dash-mounted, manually controlled, 2-position switch is highly recommended. Although manual intervention is required for turning XCOV mode on and off, manually switching the mode prevents the V-TAC from entering XCOV mode unnecessarily.

For manual switching, use a single-pole double-throw (SPDT) type. This switch is not supplied with the V-TAC. It should be wired so the V-TAC's motion sense input switches between +12 Vdc and vehicle ground (0 Vdc). Attach the V-TAC's motion sense input to the switch's pole/common terminal (usually the center-most terminal), connect one of the poles to +12 Vdc raw battery voltage, and connect the other pole to vehicle ground. For the +12 Vdc connection, fuse it using the ATM fuse holder and fuse supplied in the Fuse Kit. Use excess wire from the DC power cable or use #18-AWG wire (not supplied) to make the connections. Keep wiring as short as possible and use approved wiring methods. Place a placard or label by the switch accordingly. For example: **"V-TAC Extended Coverage ON/OFF."**

If the V-TAC's motion sense input will be connected to a new (not supplied) or an existing automatic motion sensor switch within the vehicle, refer to the installation instructions provided with the switch or the vehicle manufacturer's wiring diagram for specific wiring information. In this case, placing a placard/label on the vehicle's dash near the Control Head is recommended. For example: **"V-TAC Extended Coverage Operating Mode is DISABLED when vehicle is in motion."**



Connecting the V-TAC's motion sense input to a vehicle switching signal such as one from a parking brake or gear indication sensor switch or to another vehicle signal not specifically designed for motion sensing may degrade the reliability of the vehicle's wiring system or even lead to a failure of a vehicle safety system such as anti-lock brakes. Therefore, a connection of this type is not recommended.

### 12.2.2 Setting Default Extended Coverage Mode with "CMODE" Command

The "CMODE" command can be utilized to set the V-TAC's default Extended Coverage mode. Like the XEVENT command described in the previous section, this command can be entered manually via the V-TAC's serial port or via the over-the-air interface as follows:

**at@vtac-cmode N** (where N = 0 for XCOV mode, or 1 for XCOV-TG mode)

Refer to the PERFORMANCE TESTS subsections 16.3 and/or 16.4 for more information on entering commands via the V-TAC's serial port.

**Table 12-2: Test Equipment Required to Send Commands to the V-TAC via its Serial Port**

TEST EQUIPMENT	NOTES																				
Desktop or Laptop Personal Computer (PC)	<ul style="list-style-type: none"> <li>With Microsoft Windows® 95 (or greater) operating system and a terminal application to issue commands through the COM1 serial port (such as HyperTerminal).</li> </ul> <p><u>Recommended HyperTerminal Settings:</u></p> <table> <tr> <td><u>General (tab):</u></td><td><u>Settings (tab):</u></td></tr> <tr> <td>Connect Using: COM1</td><td>Terminal Keys (selected)</td></tr> <tr> <td>Configure (button)</td><td>Emulation = VT100</td></tr> <tr> <td>Bits Per Second = 19200</td><td>Backscroll Buffer Line = 500</td></tr> <tr> <td>Data Bits = 8</td><td>ASCII Setup (button)</td></tr> <tr> <td>Parity = None</td><td>Everything unchecked</td></tr> <tr> <td>Stop Bits = 1</td><td>Line Delay &amp; Character = 0</td></tr> <tr> <td>Flow Control = None</td><td>Terminal Settings (button)</td></tr> <tr> <td></td><td>132 Column Mode = unchecked</td></tr> <tr> <td></td><td>Character Set = ASCII</td></tr> </table>	<u>General (tab):</u>	<u>Settings (tab):</u>	Connect Using: COM1	Terminal Keys (selected)	Configure (button)	Emulation = VT100	Bits Per Second = 19200	Backscroll Buffer Line = 500	Data Bits = 8	ASCII Setup (button)	Parity = None	Everything unchecked	Stop Bits = 1	Line Delay & Character = 0	Flow Control = None	Terminal Settings (button)		132 Column Mode = unchecked		Character Set = ASCII
<u>General (tab):</u>	<u>Settings (tab):</u>																				
Connect Using: COM1	Terminal Keys (selected)																				
Configure (button)	Emulation = VT100																				
Bits Per Second = 19200	Backscroll Buffer Line = 500																				
Data Bits = 8	ASCII Setup (button)																				
Parity = None	Everything unchecked																				
Stop Bits = 1	Line Delay & Character = 0																				
Flow Control = None	Terminal Settings (button)																				
	132 Column Mode = unchecked																				
	Character Set = ASCII																				
Serial Cable	<ul style="list-style-type: none"> <li>With 9-pin D-Subminiature Male-Female Connectors, 1:1, shielded (Option MAMROS0055 or equivalent)</li> </ul>																				



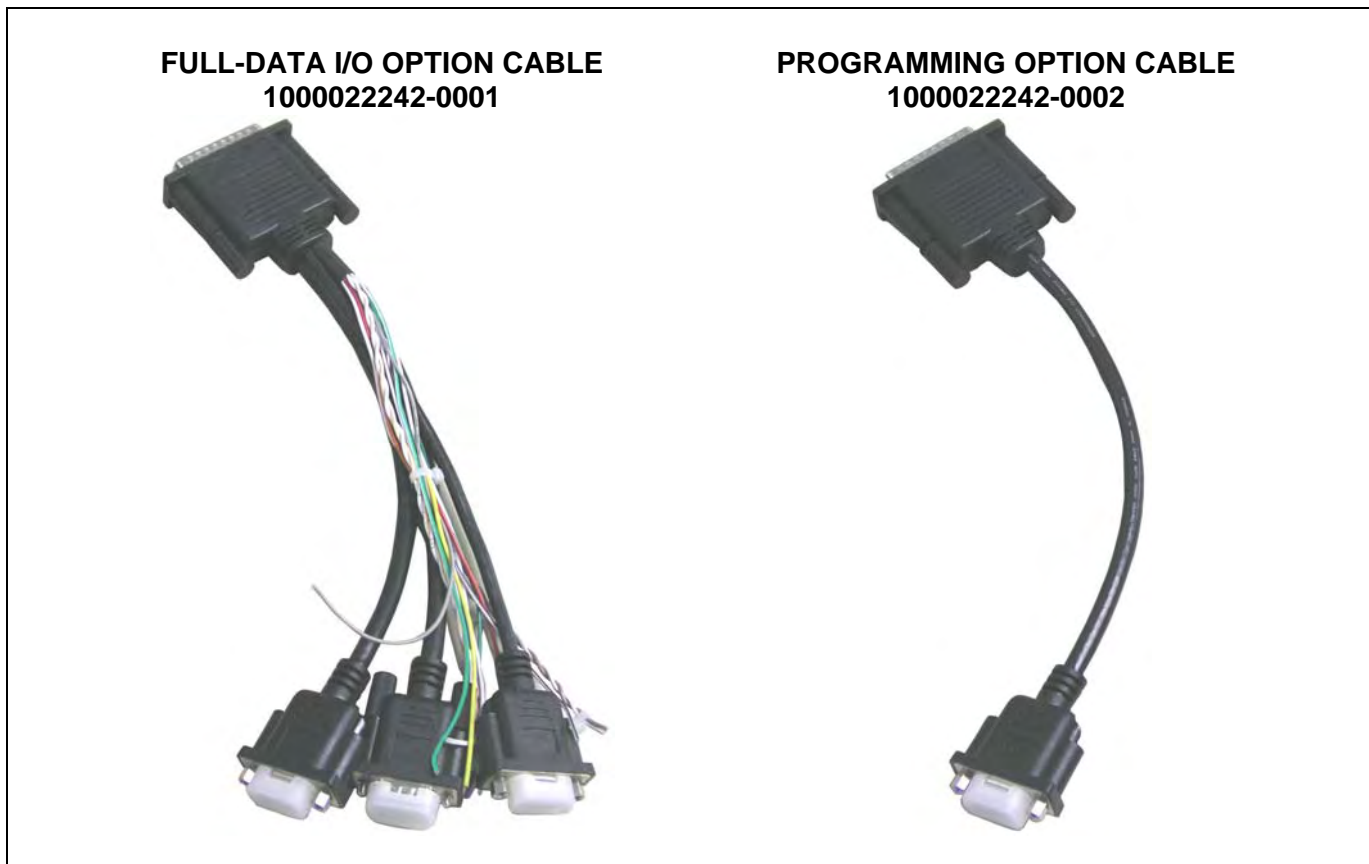
## 13 OPTIONAL CABLES

### 13.1 FULL-DATA I/O OPTION CABLE

The Full-Data I/O Option Cable 1000022242-0001 connects to the V-TAC's 44-pin I/O cable connector. It breaks out into three (3) separate D-subminiature 9-pin (DB-9) type connectors. It also has blunt-end wires (i.e., not stripped or terminated with a connector) for optional/miscellaneous connections. This combination allows straightforward access to all external I/O connections provided by the V-TAC. It also helps speed V-TAC removal and re-installation time when required. This cable is shown in Figure 13-1.

When connected, each DB-9 connector of the Full-Data I/O Option Cable is a TIA/EIA-232 serial data interface port for the V-TAC. The connector labeled "SERIAL" is the V-TAC's serial programming port. The connector labeled "MODEM" supports the RF modem function that the V-TAC can provide. The connector labeled "GPS" provides NMEA-formatted GPS serial data connections for the external computer processing the NMEA-formatted GPS data received by the V-TAC's internal GPS receiver. This optional cable adapts the V-TAC's 44-pin I/O cable connector to standard 9-pin serial computer cables, or alternatively, it can be plugged directly to a computer's (or mobile data terminal's) serial port connector.

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



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

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

44-PIN I/O CABLE CONNECTOR PIN	DB-9 CONNECTOR NAME & PIN <sup>3</sup>	SIGNAL NAME	DESCRIPTION
1	SERIAL pin 7	CTS_A	TIA/EIA-232 Signal, Radio Serial Port
2	SERIAL pin 8	RTS_A	TIA/EIA-232 Signal, Radio Serial Port
3	SERIAL pin 1	DCD_A	TIA/EIA-232 Signal, Radio Serial Port
4	GPS pin 3	GPS_NMEA_RD	TIA/EIA-232 Signal, GPS Output Data
5	(N/C)		(Pin 5 of 44-pin connector not used.)
6	MODEM pin 6	DSR_B	TIA/EIA-232 Signal, Modem Input
7	MODEM pin 4	DTR_B	TIA/EIA-232 Signal, Modem Input
8	MODEM pin 2	RD_B	TIA/EIA-232 Signal, Modem Input
9	MODEM pin 9	RI_B	TIA/EIA-232 Signal, Modem Input
10	(White/Black)	AUD_IN_PTT*	Push-to-Talk for Audio Input (active low)
11	(Orange)	TTL_IN1	TTL Digital Input #1
12	(Blue)	TTL_IN2	TTL Digital Input #2
13	(Gray)	OC_OUT2	Open-Collector Digital Output #2
14	(White/Blue)	IN_SHLD	Baseband Audio Input Shield
15	(Tan)	AUD_IN_L	Differential Audio Input Low (1/2 of twisted pair)
16	SERIAL pin 2	TD_A	TIA/EIA-232 Signal, Radio Serial Port
17	SERIAL pin 5, shell	GND_A	TIA/EIA-232 Ground, Radio Serial Port
18	SERIAL pin 4	DSR_A	TIA/EIA-232 Signal, Radio Serial Port
19	(N/C)		(Pin 19 of 44-pin connector not used.)
20	GPS pin 5, shell	GPS_GND	TIA/EIA-232 Ground, GPS Output Data
21	(N/C)		(Pin 21 of 44-pin connector not used.)
22	MODEM pin 5, shell	GND_B	TIA/EIA-232 Ground, Modem Input
23	MODEM pin 3	TD_B	TIA/EIA-232 Signal, Modem Input
24	(N/C)		(Pin 24 of 44-pin connector not used.)
25	I/O-shell	GND_SHLD	Overall Cable Shield/Radio Ground
26	(N/C)		(Pin 26 of 44-pin connector not used.)
27	(N/C)		(Pin 27 of 44-pin connector not used.)
28	(Red)	OC_OUT1	Open-Collector Digital Output #1
29	(White/Green)	AUD_OUT_ACT	Audio Output Activate
30	(White/Gray)	AUD_IN_H	Differential Audio Input High (½ of twisted pair)
31	SERIAL pin 3	RD_A	TIA/EIA-232 Signal, Radio Serial Port
32	SERIAL pin 6	DTR_A	TIA/EIA-232 Signal, Radio Serial Port
33	SERIAL pin 9	RI_A	TIA/EIA-232 Signal, Radio Serial Port

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

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

44-PIN I/O CABLE CONNECTOR PIN	DB-9 CONNECTOR NAME & PIN <sup>3</sup>	SIGNAL NAME	DESCRIPTION
34	GPS pin 2	GPS_NMEA_TD	TIA/EIA-232 Signal, GPS Output Data
35	(White/Violet)	SGND1	Signal Ground Reference
36	MODEM pin 7	RTS_B	TIA/EIA-232 Signal, Modem Input
37	MODEM pin 8	CTS_B	TIA/EIA-232 Signal, Modem Input
38	MODEM pin 1	DCD_B	TIA/EIA-232 Signal, Modem Input
39	(N/C)		(Pin 39 of 44-pin connector not used.)
40	(Yellow)	VEHICLE_IN2	+12V Control Input #2 from Vehicle
41	(Green)	VEHICLE_IN1	+12V Control Input #1 from Vehicle
42	(N/C)		(Pin 42 of 44-pin connector not used.)
43	(White/Orange)	AUD_OUT_H	Differential Audio Output High (½ of twisted pair)
44	(White/Brown)	AUD_OUT_L	Differential Audio Output Low (½ of twisted pair)

## 13.2 PROGRAMMING OPTION CABLE

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

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

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

## 14 GPS NMEA-FORMATTED SERIAL DATA CONNECTION

To obtain GPS NMEA-formatted serial data from the M7200 V-TAC mobile radio, use of the Full-Data I/O Option Cable 1000022242-0001 is recommended. Follow this procedure to complete the GPS NMEA-formatted serial data connections when using this recommended cable:

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

**NOTE**

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

**NOTE**

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

## 15 INITIAL POWER-UP TEST

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

**CAUTION**

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

3. Carefully reconnect the vehicle's battery ground cable.
4. 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. Verify the control head has powered-up by observing its display. If the display is not lit, refer to Section 8.1 as necessary.

**NOTE**

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

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

- After a short boot-up sequence, the control head displays login information and/or a talk group.
- If no errors are displayed, the installation is most-likely properly wired.
- If an error is displayed, recheck all cable connections, verify all fuses are properly installed, and verify battery power is getting to the two Fuse Blocks. If problems persist, contact M/A-COM's Technical Assistance Center (see page 18).
- Consult the Operator's Manual for operational information. Refer to Section 3.3 on page 17 as necessary.

Refer to the following section for performance test information.

## 16 PERFORMANCE TESTS

This section includes procedures to verify the performance of the installation's mobile antenna system. 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 (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 V-TAC mobile radio requires jump-starting, the radio installation's main ATC fuse should be removed from the holder prior to jump-starting. Doing so will prevent damage to the V-TAC.



NOTE

Prior to installation, the V-TAC's VRM and VRB transmit RF output power levels 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 outputs from the V-TAC, as values are set and more accurately measured in the factory. The values obtained in these test procedures determine a successful installation only.

### 16.1 CHANGING OPERATING MODE FOR TESTS

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

#### 16.1.1 Switching to OTP Mode

1. If necessary, apply power to the V-TAC and turn it on.
2. Rotate the **Group Selection Control** until **Mode Menu** appears in the middle line of the display. Refer to Figure 9-1 and/or Figure 9-2 on page 39 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 V-TAC will reboot and enter OTP mode as indicated by the display.

## 16.2 REQUIRED TEST EQUIPMENT

Table 16-1: Test Equipment Required to Complete Performance Test Procedures

TEST EQUIPMENT	MODEL / PART NUMBER & DESCRIPTION
Peak-Reading RF Power Wattmeter	<ul style="list-style-type: none"> <li>Bird Electronic Corp. Model 4314B (or equivalent) with N-type female connectors at input and output ports.</li> </ul>
RF Wattmeter Slug	<ul style="list-style-type: none"> <li>Bird Electronic Corp. Element 25E, 25 watts, 400 - 1000 MHz (or equivalent).</li> </ul>
RF Coaxial Jumper Cable	<ul style="list-style-type: none"> <li>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.</li> </ul> <p>The utilized cable <b>must</b> have VSWR below 1.5:1 within the RF passband.</p>
N-Type to TNC RF Adapter	<ul style="list-style-type: none"> <li>Pasternack Enterprises PE9090 (or equivalent) N-type male to TNC-type female adapter. Required to connect the cable of the vehicle-mounted 700/800 MHz antenna to the wattmeter.</li> </ul>
50-Ohm RF Terminator ("Dummy Load")	<ul style="list-style-type: none"> <li>Pasternack Enterprises PE6106 (or equivalent) 50-ohm RF terminator rated at greater than 50 watts power, with N-type male connector.</li> </ul>
Vehicle-Mounted Antenna	Tests are performed with the vehicle-mounted 700/800 MHz antenna per the installation described in Section 7 of this manual.

## 16.3 TRANSMITTING INTO A DUMMY LOAD

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



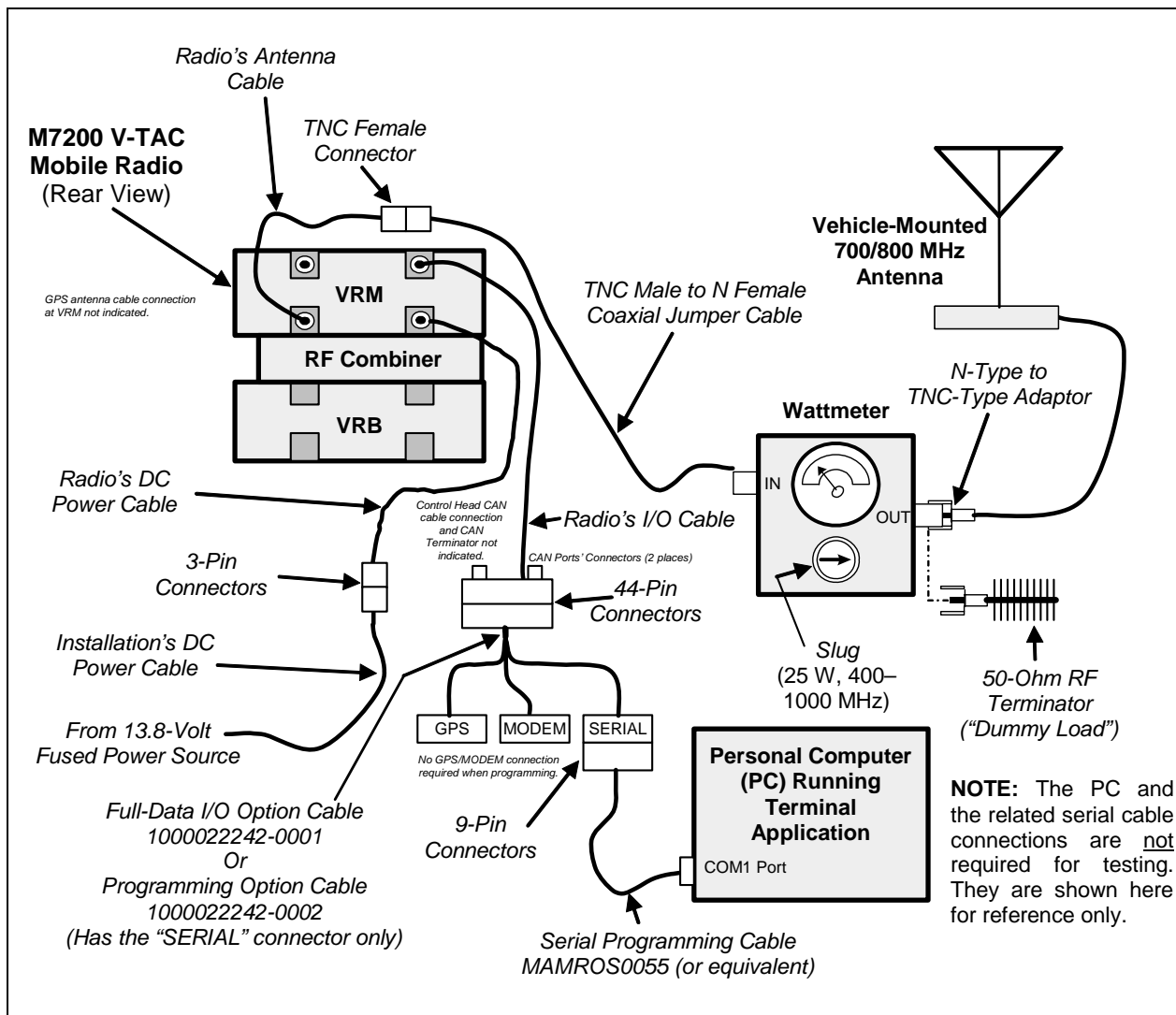
A peak-power reading RF wattmeter equivalent to the wattmeter specified in Table 16-1 must be used. Do **not** use an average or RMS-responding wattmeter.

3. If not already, turn the V-TAC on and set it to the OTP mode. Refer to Section 16.1 as necessary.
4. Set the V-TAC to a test talk group, if available.



NOTE

It is recommended that a test talk group be allocated for the test procedures presented in this manual. This same group should be used when performing the antenna test procedure presented in the subsequent section.



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

5. Position the wattmeter's slug to measure forward RF output power. Rotate it as necessary. The arrow on the face of the slug must point away from the V-TAC and towards the dummy load for forward power measurements.
6. Set the wattmeter to measure peak RF power.
7. Key the V-TAC transmitter via the microphone's PTT button.
8. Compare the wattmeter's reading with the target RF output power range of **8 – 15 watts**. As stated in the last NOTE on page 59, this wide power level range takes into account errors caused by cable loss, voltage variations, etc.





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 (page 64).

**If the wattmeter reading is outside the range**, verify the V-TAC'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 18).

## 16.4 TRANSMITTING INTO THE MOBILE ANTENNA

1. Connect the antenna cable from the vehicle-mounted 700/800 MHz antenna to the wattmeter as shown in Figure 16-1.
2. If not already, turn the V-TAC on and set it to OTP mode. Refer to Section 16.1 as necessary.
3. Set the V-TAC to a test talk group, if available.



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 of this manual (begins on page 6).**



A peak-power reading RF wattmeter equivalent to the wattmeter specified in Table 16-1 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 as necessary. The arrow on the face of the slug must point away from the V-TAC and towards the antenna for forward power measurements.
5. Set the wattmeter to measure peak RF power.
6. Key the V-TAC transmitter via the microphone's PTT button.
7. Compare the wattmeter reading with the target RF output power range of **8 – 15 watts**.



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 (page 64).

**If the wattmeter reading is outside the range**, verify the V-TAC'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 18).

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 towards the V-TAC to measure reverse power.
10. Verify the wattmeter is still set to measure peak RF power.
11. Key the V-TAC'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 (page 64).

**If the wattmeter reading is outside the range**, make sure the antenna is consistent with the specified frequency range of the V-TAC. 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 18).

14. Disconnect the coaxial cable jumper and wattmeter.
15. Permanently connect the cable from the vehicle-mounted 700/800 MHz antenna to the V-TAC'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 V-TAC performance but also to harmful exposure to RF electromagnetic energy.**

Testing is complete. The V-TAC is now ready for normal communications.

## 16.5 TEST PERFORMANCE DATA FORM

Clip  Here

Enter the information requested on this data collection form. Clip this form and file it as a permanent record of the tested performance of the installed M7200 V-TAC mobile radio.

*V-TAC Mobile Radio  
Serial Number*

*Antenna  
Make and Model Numbers*

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

*Company Performing Installation*

*Technician Performing Test*

**tyco** / Electronics

**MACOM**

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

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

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

## 17 COMPLETE THE INSTALLATION

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

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

## **18 WARRANTY**

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

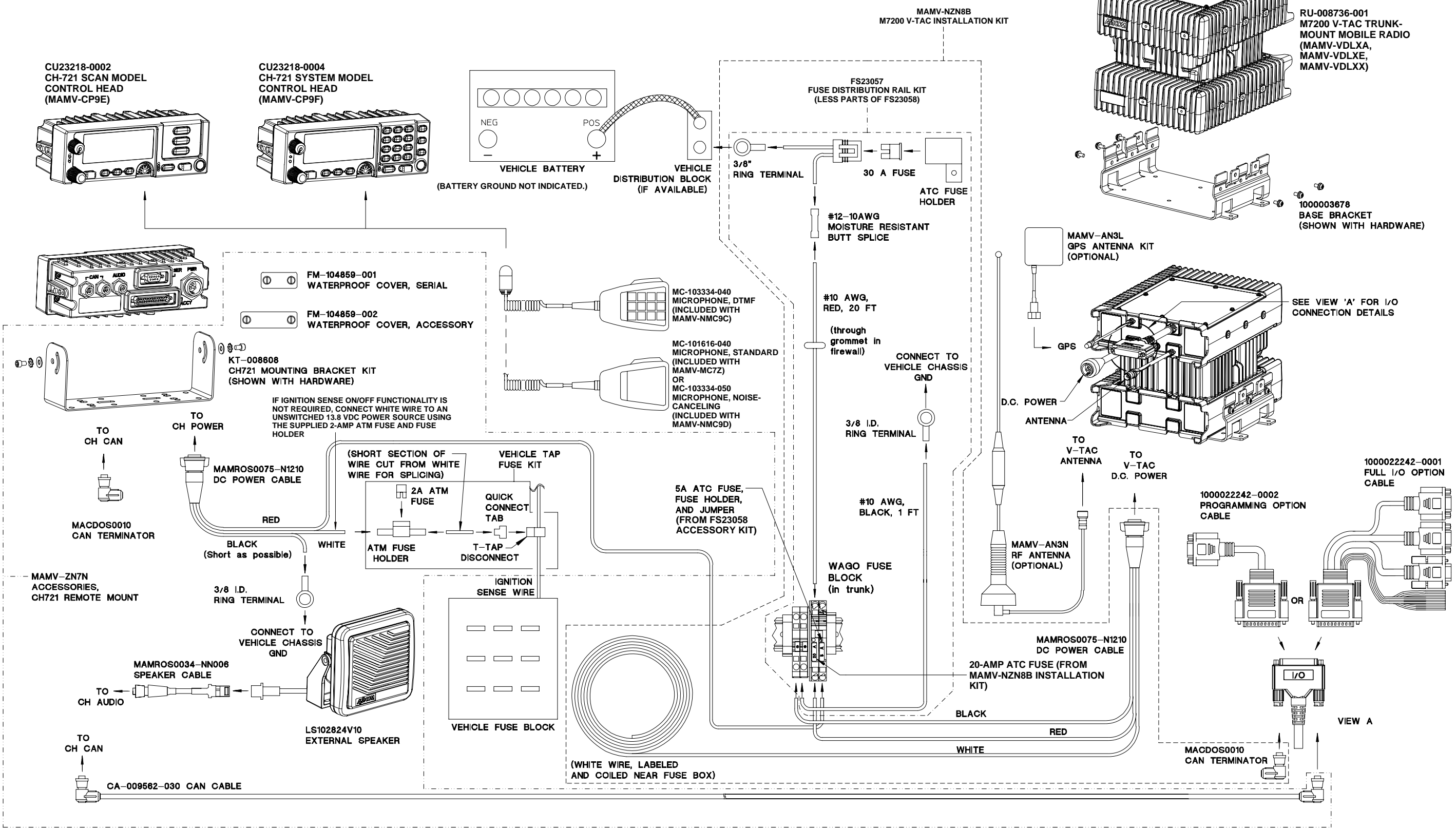
This warranty applies only within the United States.

**M/A-COM, Inc.**  
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1-877-OPENSKY

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

ECR-7047C

19 WIRING DIAGRAM: M7200 V-TAC MOBILE RADIO WITH CH-721 CONTROL HEAD



**Wiring Diagram Inside**